ACCOUNTS AND PAPERS:

THIRTY VOLUMES.

—(11.)—

EAST INDIA.

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ACCOUNTS AND PAPERS:

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THIRTY VOLUMES:—CONTENTS OF THE

ELEVENTH VOLUME.

N. B.—*THE* Figures *at the* beginning of the line, *correspond with the* N° *at the foot of each* Paper; *and the* Figures *at the* end of the line, *refer to the* MS. Paging *of the Volumes arranged for The House of Commons.*

EAST INDIA:

East India Company (Home Accounts):

East India Company (Territorial Revenues and Disbursements):

Revenues and Charges of India:

Acts passed:

Cadetships:

Customs and Post Office Duties (India):

TRIGONOMETRICAL SURVEY (INDIA).

RETURN to an Order of the Honourable The House of Commons, dated 12 February 1850;—*for*,

RETURNS "of Full and Detailed REPORTS of the Extent and Nature of the Operations and of the EXPENDITURE connected with the GRAND TRIGONOMETRICAL SURVEY of *India*, and of the Grand Triangulation thereof, for the Measurements of the Arcs of the Meridian, from the Year the first Base was measured to the latest Date:"

"Also, REPORTS of the SURVEYS, whether General, Revenue, or Military, which have hitherto been Carried on, Completed, or are in Progress, specifying the Divisions or Portions of India; also, the Number and what Sheets of the GRAND ATLAS have been Completed and Engraved, with the Cost thereof to the Government, and the Selling Price per Sheet to the Public, and what Progress the remaining Portions of the ATLAS are in:"

"Of the Nature of the Information collected in connection with the GRAND SURVEY, and with the Detailed Surveys of India, and a List of all the Memoirs, and their Contents, sent in:"

"And, STATEMENTS to illustrate the nature of the different Great Divisions, and the Smaller Districts or Departments thereof, into which India within the line of the Indus is divided, for Political, Civil, Revenue, Judicial, and Military purposes, exhibiting the Areas, Population, and nature of Productions thereof; and showing the relation and the authority under which they stand in to the East India Company, whether immediately subordinate to and under the direct Rule, or are Tributary, Protected, Subsidiary, or Independent."

East India House,
14 April 1851.

JAMES C. MELVILL.

(Mr. Hume.)

Ordered, by The House of Commons, *to be Printed,*
15 *April* 1851.

REPORT on the Progress and Expense of the GREAT TRIGONOMETRICAL SURVEY of *India*, and a SKETCH MAP of *India*,* showing the Extent of the Great Trigonometrical Survey up to the Year 1849–50.

Great Trigonometrical Survey of India.

THIS magnificent geodetic undertaking, which at the present time extends from Cape Comorin to Thibet, and from the meridian of Calcutta to that of Cashmere, was commenced at the beginning of the present century by the celebrated Colonel Lambton.

Col. Lambton's Superintendence.

2. That officer, who had previously served as a surveyor in America, joined Her Majesty's 33d regiment, at Calcutta, in the year 1797. The regiment was then under the command of the Hon. Colonel Wellesley, now the great Duke of Wellington, whose good opinion Colonel Lambton possessed. The regiment being ordered to join the army proceeding to Mysore, Colonel Lambton, then Brigade-major of his Majesty's troops, accompanied the head quarters of the 33d in the "Fitzwilliam" East Indiaman, which was nearly wrecked on Saugor Sand during a storm. When the army under Lord Harris, destined for the siege of Tippoo Sultan's capital, was organized, Brigade-major Lambton was attached to the 1st brigade, 2d division, under Sir David Baird. During the siege he lost no opportunity of making himself useful, and particularly during the storm, when he rallied the left column. The particulars of this service are to be found in Major Beatson's account of the Mysore campaign, and justify the opinion that, if circumstances had permitted Colonel Lambton to turn his attention exclusively to military subjects, he would have become no less distinguished as a warrior than he afterwards became as a man of science.

3. Immediately after the fall of Seringapatam, Brigade-major Lambton drew up his project for a trigonometrical survey across the Peninsula. This plan was submitted to Government with the recommendation of the Duke of Wellington, to whose cordial support the trigonometrical survey of India owes its origin. Lord Clive was at that time Governor of Madras, and warmly approved of the undertaking, which was accordingly sanctioned by Government.

4. The instruments used in Colonel Lambton's operations were a 36-inch theodolite, by Cary; an 18-inch repeating theodolite, by the same maker; a five feet zenith sector, by Ramsden; two steel chains, by the same maker; a standard brass scale, by Cary; and several small theodolites by different makers, for minor purposes. These instruments were the finest that the state of art at the commencement of this century could produce; but the great theodolite received an injury in the year 1808, while it was being hoisted to the summit of a lofty pagoda in Tanjore. This injury was repaired by Colonel Lambton himself, who, to the duties of astronomer and surveyor, had, throughout his operations, to combine those of a mathematical instrument maker. In Europe great facilities exist for repairing and preserving instruments, but in judging of geodetical operations in India, more particularly in Colonel Lambton's time, allowances must be made for want of aid in every part of the work.

5. In his early operations Colonel Lambton was assisted by Lieutenant Warren, of his Majesty's 33d, and Captain Kater, of his Majesty's 12th Foot. The first named officer belonged to the ancient noblesse of France, to which country he returned after the peace. His stay with Colonel Lambton was of short duration, as he was, at a very early period of the work, appointed to the charge of the Madras Observatory. Captain Kater's health having failed, obliged him to quit the department. This officer afterwards acquired an European reputation as a scientific man, having become a member of almost every academy in Europe, been employed on every business of national research, appointed a member of the Board of Longitude, and finally elected vice-president of the Royal Society. Thus it appears that, during the greater portion of his career, Colonel Lambton worked nearly single-handed in the extensive and arduous operations which he carried on, amidst the formidable trials and obstacles that the baneful nature of the climate and the want of resources in the country everywhere presented.

6. It

* This map is deposited in the library of the House of Commons, and can be there inspected.

Col. Lambton's Superintendence.

6. It must also be borne in mind, that for a long period these operations were frequently interrupted by the disturbed political condition of the country, which was often the scene of warlike operations; for it was not until the Marquis of Hastings destroyed the Pindara confederacies in 1818, that the Peninsula and Dekhan settled down into repose. The mysterious character of the instruments and operations, as well as the planting of flags and signals, have always more or less awakened the apprehensions or excited the jealousy of the native princes; it requires, therefore, no ordinary tact, firmness, patience, and good nature on the part of the head of the department to conciliate good will.

7. Shortly after the commencement of his labours, Colonel Lambton was called on to demonstrate the utility of his work. It was asserted that surveys on an astronomical basis would be equally accurate, and more economical than geodetical operations. The futility of these views was ably exposed by the Colonel, and being supported by the Astronomer Royal of the day, the Rev. N. Maskelyne, all open opposition was withdrawn, and Major Rennell, who was the chief advocate of the astronomical basis, afterwards concurred in the trigonometrical system.* As this view of the subject has been confirmed by the practical testimony of every nation in Europe, and the importance of trigonometrical operations is now universally admitted by all practical scientific men as the only trustworthy basis for extensive national surveys, it is unnecessary to discuss the first principles any further in this place, and they are only adverted to in illustration of the formidable prejudices the trigonometrical survey in India has all along had to contend with. The honourable the Court of Directors, however, when once convinced of the important practical utility of the work, have ever since continued its firm and powerful supporters, and in the words of the Edinburgh Review, "their liberal and enlarged views cannot be too highly commended."

8. With reference to the length of time occupied by Colonel Lambton's operations, it may be proper to remark that, in addition to the interruptions caused by the disturbed state of India, that officer's establishment was on the most circumscribed scale, and his arrangements were often thwarted by the Finance Committee at Madras. It required, indeed, all the powerful support of the Honourable Court of Directors and of influential men in office in India to keep the operations on foot, even on this limited scale. Amongst those most instrumental in furthering the great objects he had in view were the Duke of Wellington, at that time Colonel Wellesley; Lord Clive, Mr. Josiah Webb, Chief Secretary; Lord William Bentinck, Mr. W. Petrie, Member of Council; Mr. Andrew Scott, First Judge of Appeal; Colonel Munro, Quartermaster-general; Sir Thomas Munro, Lords Minto and Hastings, and Mr. H. Russel, Resident of Hyderabad; from all of whom he received cordial support and sympathy in his arduous and useful undertaking.

9. Colonel Lambton remained at his post till his death, which occurred on the 20th January 1823, at the age of 70, at Hingham Ghat, about 50 miles from the city of Nagpore, in the Dekhan.

10. The professional account of Colonel Lambton's labours is given in the first five volumes of the General Report, which are deposited at the India House in manuscript. Condensed accounts of the more scientific part of his operations have been from time to time published as follows:

1st. An account of the method for extending a geographical survey across the peninsula of India. *Vide* Transactions Asiatic Society, vol. 7, pp. 312–337.

2nd. An account of the measurement of an arc on the meridian on the coast of Coromandel, and the length of a degree deduced therefrom in latitude 12° 32′. *Vide* Transactions Asiatic Society, vol. 8, pp. 137–193.

3d. An

* Colonel Lambton's operations detected an error of no less a quantity than 40 miles in the breadth of the Peninsula, as previously laid down astronomically in the way Major Rennell proposed. All the principal places on the old maps, which had been fixed astronomically, were found considerably out of position. For example, Arcot was out 10 miles, and Hyderabad no less than 11′ in latitude and 32′ in longitude.—*Vide* Colonel Lambton's Official Correspondence. In fact, for the survey of an enormous empire, the trigonometrical system is not only the most rigorous, but the cheapest in the end, as will be shown in the sequel of this Report.

Col. Lambton's Superintendence.

3d. An account of the trigonometrical operations in crossing the Peninsula of India, and connecting Fort St. George with Mangalore. *Vide* Transactions Asiatic Society, vol. 10, pp. 291–384.

4th. An account of the measurement of an arc on the meridian, comprehended between the latitudes 8° 9′ 38·39″ and 10° 59′ 48·93″ north, being a continuation of the grand meridional arc commenced in 1804, and extending to 14° 6′ 19″ north. *Vide* Transactions Asiatic Society, vol. 12, pp. 1–101.

5th. An account of the measurement of an arc on the meridian, extending from latitude 10° 59′ 49″ to latitude 15° 6′ 0·65″ north. *Vide* Transactions Asiatic Society, vol. 12, pp. 286–356.

6th. An account of the measurement of an arc of the meridian, extending from latitude 15° 6′ 0·2″ to latitude 18° 3′ 45″, being a further continuation of the former arc commencing in latitude 8° 9′ 38″. *Vide* Transactions Asiatic Society, vol. 13, pp. 1–127.

7th. An abstract, containing the result of Colonel Lambton's measurements from Punnæ to Damargida. *Vide* Philosophical Transactions Royal Society for 1818.

11. The early portions of his works were very ably reviewed by the late Professor Playfair, in the year 1813, in the 21st vol. of the Edinburgh Review, and they have been pronounced by competent judges to be equal to the best geodetic operations of those days.

12. It would be impracticable to discuss the professional merits of those operations in a more succinct form than Colonel Lambton himself has done in his published statements, to which reference can be made by those desirous of possessing complete information regarding the character of his work. It only remains to notice the financial part of the question, viz., the extent of area triangulated, and its cost, which come more especially within the scope of this report.

13. Colonel Lambton, between the years 1802 and 1815, covered the whole country as high as 18° latitude with a net work of triangles, whereby the Peninsula was completed from Goa on the west to Masulipatam on the east, with all the interior country from Cape Comorin to the southern boundaries of the Nizam's and Mahratta territories. Subsequent to this achievement, the Great Arc triangulation was extended nearly to Takal Khera, in latitude 21° 6′. The greater part of the Nizam's eastern territories were triangulated by meridional series between the Kistnah and Godavery, and considerable progress was made in the longitudinal series from the Beder base towards Bombay. All these operations are described in minute detail in the volumes of the General Report, at the India House.

14. The area comprised by the whole of the operations prosecuted during the time Colonel Lambton was superintendent, aggregates 165,342 square miles, as shown in the accompanying statement, marked (C). The expense incurred amounted to 8,35,377 Company's rupees. Consequently, the rate at which the triangulations have been executed averages Company's rupees 5. 0. 10. or less than 10 *s.* per square mile; which cannot but be considered remarkably cheap, more especially as this calculation includes the expense of Dr. Voysey's geological researches.

15. From the circumstance of Colonel Lambton's operations having commenced in Southern India arises the great superiority of the maps of the Madras Presidency; the atlas sheets whereof, published by order of the Honourable East India Company, are nearly complete. This part of India was surveyed in detail upon the basis of Colonel Lambton's operations, and on a scale of one mile per inch, by the officers and sub-assistants trained at the military surveying schools. No complete record exists in this office of the cost of most of these surveys, but judging from analogous operations of the Hyderabad survey, the expense appears to have averaged about Company's rupees 6, or less than 12 *s.* per square mile.

16. In October 1817, the most noble the Marquis of Hastings, impressed with a well-founded conviction of the important utility of the trigonometrical survey, resolved to transfer the control over its operations to the Supreme Government of India; and further, in consideration of Colonel Lambton's increasing age and

and infirmities, which were little fitted to encounter the laborious exertions, corporeal and mental, which such a task demands, selected Captain (now Colonel) Everest, as eminently fitted by mathematical attainments and practical skill to assist the superintendent, and eventually become his successor. This resolution of the Governor-general having exercised so important an influence on the subsequent prosperity of the survey, it appears desirable that it should be appended to this report. It will accordingly be found marked (A.) in Appendix; and it is only just to add, that the Marquis, so deservedly celebrated for his happy selections of able men for public business, never made a more fortunate choice; for to Colonel Everest's mathematical acquirements, practical genius, and undaunted resolution in contending with difficulties, is to be ascribed the high state of efficiency afterwards attained, and now existing undiminished in this hard-working establishment.

Col. Lambton's Superintendence.

Capt. Everest's Superintendence.

17. Captain Everest joined the Colonel as chief assistant in the latter end of 1818, and was employed, in the first instance, in the triangulation of the eastern parts of the Nizam's dominions; where, in consequence of the extremely unhealthy character of the country, together with great exposure induced by indefatigable labour in the duties of the survey, he twice fell a victim to jungle fever, and eventually was ordered to the Cape of Good Hope for the recovery of his health. While at the Cape, Captain Everest employed his leisure in investigating the circumstances appertaining to the Abbé de la Caillé's arc, which formed the subject of a valuable paper, published in the first volume of the Astronomical Society's Transactions.

18. On his return to duty Captain Everest was deputed on a longitudinal series of the great triangles emanating from the Beder base line, and intended to connect Bombay. He was engaged on this important work at the time of Colonel Lambton's death, by which event he succeeded to the office of superintendent, and immediately proceeded to concentrate the resources at his disposal for the extension of the Great Arc series. It would unduly lengthen this report to recount all the formidable difficulties that were encountered, but notwithstanding the state of his health, which suffered severely from the insalubrity of the climate, and the unremitting labour of his professional duties, the measurement was at length carried to the latitude of 24°, when it was terminated by the Sironj base line.

Great Arc of India.

19. An account of these operations is given in detail in the fifth and sixth volumes of the General Report, deposited at the India House. All the scientific portion relating to the fifth section of the great Indian arc was further published by order of the Honourable East India Company, in the year 1830.

20. After the termination of the Sironj base line Captain Everest proceeded to England for the recovery of his health; and as there was no person in India competent to succeed him, the Supreme Government resolved to retain the situation of superintendent open until his return.

21. About this time the Honourable Court of Directors having called for a report on the progress and probable duration of the trigonometrical survey, a very masterly discussion of the subject was prepared by the late Colonel Valentine Blacker, at that time Surveyor-general of British India, who, with the exception of Colonel Everest, was the ablest and most scientific man that ever presided over this extensive department. His report so fully represents the state of affairs in those days, that it appears desirable to submit an abstract thereof, which will accordingly be found in Appendix, marked (B.)

22. During Captain Everest's absence the establishment was usefully employed under the principal sub-assistant, Mr. Joseph Olliver, in extending a longitudinal series from the Sironj base line to connect Calcutta, for which work written instructions were given by Captain Everest. This series traverses, throughout the greater part of its extent, a wild, desolate, and unhealthy tract of hill country, which presented formidable difficulties. Notwithstanding the frequent ravages of jungle fever, which has all along been the most baneful enemy of the trigonometrical survey, as well as one of the chief retarding causes, this party, composed entirely of East Indians, successfully overcame all obstacles, and the work was eventually brought to a close in the year 1832, at the Calcutta base line, having occupied a period of six years in accomplishing a direct

Operations conducted by Mr. Joseph Olliver.

Calcutta longitudinal series.

Operations conducted by Mr. Joseph Olliver.

a direct distance of 671 miles. The progress, therefore, was at the rate of 112 miles per annum, including branching series of secondary triangles. Too much credit cannot be bestowed on Mr. Olliver for his indefatigable exertions under difficult circumstances, but, on account of the defective state of the instrumental equipments, the professional value of the work is only of a secondary or tertiary order. The area comprised in these operations is 33,442 square miles, and the charges amount to Company's rupees 1,30,740, giving an average rate of expenditure amounting to *Rs.* 3. 14. 6. per square mile, including cost of measuring the Calcutta base line with Colonel Colby's apparatus. This amounts to little more than 6 *s.* per square mile, a result which cannot but be considered wonderfully cheap.

Superintendence resumed by Capt. now Col. Everest.

23. Colonel Everest returned to India in 1830, liberally provided by the munificence of the Honourable Court of Directors with geodetical instruments and apparatus of every description, in the construction of which the most skilful artists of the day, Messrs. Troughton & Simms, exhausted every resource of modern invention. The equipments consisted of a complete base line apparatus, the invention of Colonel Colby, precisely similar to that employed on the Ordnance survey; a great theodolite, 36 inches in diameter, designed by Troughton, which even at the present day is supposed to stand unrivalled by any other instrument of the kind in the whole world, and which most probably will never be surpassed; two 18-inch theodolites, and a variety of smaller instruments, from 12 inches diameter downwards, all by the same celebrated maker. The signals, all of the most efficient kind, and recently invented, consisted of heliotropes, reverberatory lamps, and Drummond's lights, of which the two former have been exclusively used; and here it may be remarked, that the substitution of luminous signals for opaque ones has contributed vastly to the improvement of the observations. These modern inventions, together with the extreme precision of Troughton's graduation, as well as the high optical power employed, and the rigorous system of changing zero, introduced by Colonel Everest, has brought the terrestrial operations to a refinement of accuracy which may almost be pronounced unsurpassable.

24. During his absence from India, Colonel Everest had made himself acquainted with the English Ordnance survey system, and with every modern improvement in geodetical matters that had taken place in Europe. The apparatus supplied by order of his honourable masters was superior to any in the world. A London artist, Mr. Henry Barrow, was sent out to maintain the apparatus in order. Thus splendidly equipped, Colonel Everest returned to India in the prime of life, the full vigour of his faculties, and with an undaunted determination of character that never quailed before any difficulties, nor yielded to any opposition. The task before him required indeed the full display of all the vigour he possessed. In addition to the duties of superintendent of the trigonometrical survey, he had now to perform those of Surveyor-general of India, to which office he had recently been appointed by the Honourable Court of Directors. This union of offices, though it served to facilitate arrangements, nevertheless vastly increased his labours at the outset; for the apparatus being new to India, and the establishment untrained, the whole task of teaching devolved on him unaided. In 1833, moreover, the offices of Deputy Surveyor-general at Madras and Bombay were abolished, which further increased the duties of the Surveyor-general of India, so that Colonel Everest had, in fact, to perform the work which had hitherto occupied the undivided attention of four officers. In the sequel these reductions have been found to operate conveniently enough, and so far have justified the expectations of the Honourable Court by whom they were ordered, but the additional labour thrown on the Surveyor-general is still immense; and occurring as these events did, at the time that the trigonometrical survey was about to recommence on a new organization, the task Colonel Everest had to achieve was of the most arduous kind.

Calcutta base line.

Great Arc.

25. He was detained by all these arrangements, by official delays, and by the measurement of the Calcutta base line, until the end of 1832, from which time the great arc may be considered to have actually recommenced, after a cessation of seven years. The work was carried on unremittingly till December 1841, when it closed with the measurement of the Beder base line; and the whole Indian arc from Cape Comorin to the Himalaya Mountains, forming the main axis of Indian geography, was thus completed.

26. These

Col. Everest's Superintendence. Great Arc.

26. These operations are fully detailed in Colonel Everest's book, published in 1847, by order of his firm and constant patrons the Honourable the Court of Directors. The work has been most favourably noticed in the 87th volume of the Edinburgh Review, April 1848, to which reference can be made. The area comprised by the Great Arc operations, principal and secondary, aggregates 56,997 square miles, including the revision of the section Beder to Kalianpur, and the measurement of three base lines, each from 7½ to 8 miles in length. The average progress, therefore, was about 5,700 square miles per annum, and the total cost being 8,98,326 Company's rupees, the rate per square mile averages *Rs.* 15. 12. 2., or say 29*s.*

27. This rate considered *per se* is very moderate, but contrasted with Colonel Lambton's it exhibits a ratio of three to one. This is easily accounted for by the great superiority of the work, which is perhaps unsurpassed by any similar undertaking in the world. The instruments were much heavier, and more numerous, requiring a larger establishment of porters. The signals being all luminous, necessitated an increased number of attendants; the base line apparatus infinitely more complicated and ponderous than Colonel Lambton's steel chains, demanded an additional number of observers, as well as greater cost of transport. A considerable part of the triangulation likewise passes through the plains of the Ganges, which is the garden of India. In this part of the country compensation had to be paid wherever private property was interfered with, and costly masonry towers were erected for stations. These are the reasons which enhanced the charges; but if the work be considered in relation to its superior merits, as well as to the peculiarity of the circumstances, the rate of 29*s.* per square mile must be reckoned moderate.

28. It has been already explained that an account of the Great Arc was published in 1847, and favourably reported on in the Edinburgh Review of 1848. In addition to the publications above cited, Colonel Everest made periodical reports of progress to the Government of India, in which are contained many interesting particulars. These reports bear the dates noted below.* In the year 1839 Colonel Everest also published a pamphlet† on the subject, being a series of letters addressed to his Royal Highness the late Duke of Sussex, at that time President of the Royal Society.

Bombay longitudinal series.

29. In the year 1829 a trigonometrical survey in the Bombay Presidency was commenced by Lieut. Shortrede, on an independent base and point of departure. These desultory principles were objected to by General Hodgson, at that time surveyor-general of India, who recommended that the work should emanate from the Great Arc, and proceed to Bombay precisely according to Colonel Lambton's original design. This injunction, however, remained unheeded; and notwithstanding the respect due to Colonel Lambton's judgment, and General Hodgson's authority, the survey proceeded in an unsystematic manner until it was brought under Colonel Everest's control in 1831. Finding that no use could be made of this confused net of triangulation, the Colonel directed that the longitudinal series should be taken up where he left off in 1823, at the time of Colonel Lambton's death. Lieut. Shortrede resigned in 1836, and was succeeded by Lieut. Jacob, of the Bombay engineers, by whom the Bombay longitudinal series was brought to a conclusion in the year 1841, and the whole work now rests on his observations alone. This officer united to considerable mathematical attainments, great practical skill as an observer and mechanic; and although the instrument employed, a 15-inch theodolite, by Dollond, was small for such extended operations, no man could have turned it to better account, and the work accordingly bears a superior character for accuracy. Its history and details are given by Colonel Everest in the eighth volume of the General Report, Part 2, which has been transmitted to the India House. The series extends 315 miles in length, and having occupied 12 years, progressed at an apparent rate of only 26 miles per season; but in fact the only efficient part of the work, viz. that executed by Lieut. Jacob, was performed

* First, 30th August 1836. Second, 3d August 1839. Third, 13th August 1842.

† Published by W. Pickering.

Col. Everest's Superintendence.

performed in three seasons. There is no official record of the expenses incurred prior to the party being placed under the control of the Surveyor-general of India. Since that date the charges amount to 1,37,427 Company's rupees, and the area comprised being 15,198 square miles, the average rate of cost is *Rs.* 8. 5. 3. per square mile, or 16*s.* nearly.

Bombay longitudinal series.

Parasnath series.

30. Immediately after the measurement of the Calcutta base, Colonel Everest fitted out a party under Lieut. James Western, of engineers, for the purpose of carrying a triangulation along the meridian of Parasnath, dependent on one of the sides of the Calcutta longitudinal series. This work commenced in February 1832, Lieut. Western continuing in charge till September 1834, when he was relieved by Lieut. Bridgman, of artillery, who shortly afterwards was compelled to relinquish the duty from ill health, induced by exposure and fatigue, which obliged him to proceed to Europe on medical certificate, and soon after this promising young officer died on the voyage. No final work that could be made use of was executed up to this period, and the cost incurred, 35,224 rupees, was in fact fruitless. Lieut. (now Lieut.-colonel) A. H. E. Boileau assumed charge in 1835–36, and commenced the work *de novo*. Excepting an absence of six months on medical certificate, he continued to conduct the triangulation till December 1838, when he resigned his appointment in the great trigonometrical survey for one of superior emolument and less exposure. The small portion remaining to connect the series with Lieut. Buxton's triangulation in Cuttack, was executed by Mr. Sub-assistant Kallonas, since which no further operations have been undertaken on the Parasnath meridian; but a party will proceed in the season 1850–51, to extend it northerly to the Himalaya Mountains. The area comprised in Colonel A. H. E. Boileau's triangulation, principal and secondary, amounts to 4,914 square miles, and the charges to 54,760 Company's rupees, showing an average rate of *Rs.* 11. 2. 4. per square mile, or say 21*s.* On account of defective instrumental power, this work is only of a second-rate order. The detailed account was brought up by me in 1845, and forms Volume 13, Part 1, of the General Report of the Great Trigonometrical Survey transmitted to the India House.

Budhon series.

31. Colonel Everest at the end of 1832 fitted out another party, under Lieutenant Roderick Macdonald, of the Bengal Native Infantry, to carry on the Budhon meridional series, dependent on a side of the Calcutta longitudinal series. Lieutenant Macdonald broke ground on the 2d February 1833, and was obliged to relinquish the work in September 1835, on account of ill-health, produced by exposure. In a short time afterwards the melancholy intelligence was received of this amiable and accomplished officer's death. Consequent on the departure of Lieutenant Macdonald, Lieutenant Ommanney, of engineers, was placed in charge, and he remained in that post till April 1837, when he resigned his appointment, and was succeeded by Mr. Olliver. In the early part of 1838 operations were suspended on account of Mr. Olliver's services being required with Lieutenant Waugh on the Great Arc. Up to this time the progress of the Budhon series had been satisfactory as far as the hilly country extended, and ceased to be so as soon as the operations entered the flat lands in the valley of the Ganges. Until November 1839, no officer or sub-assistant of experience being available, the work remained suspended, but on the conclusion of the Amua series, the party under command of Lieutenant Renny (now Captain Renny Tailyour) was transferred to this series, and placed under Mr. Sub-assistant Murphy. After the termination of the Great Arc, on which Captain Renny Tailyour had been employed, he proceeded to take personal charge of the Budhon series, and the work was at length brought to a successful conclusion by that able and energetic officer in one season, having occupied in all no less than eleven years from the commencement. The reasons for this slow progress may be inferred from this narrative. A full and complete account of this work has been given by Colonel Everest, in Volume 9, Part 1, of the General Report of the Great Trigonometrical Survey. The area covered amounts to 12,468 square miles, and the charges to 1,72,510 Company's rupees, giving a mean cost of *Rs.* 13. 13. 5. per square mile, or say 25 shillings.

Topographical and geological survey by Lieuts. Waugh and Renny.

32. On the 2d July 1832, I was nominated to the department, on the recommendation of the Colonel; and on the 23d of the same month, Lieutenant Renny, of Engineers (now Captain Renny Tailyour), was also appointed, on the selection of

of the superintendent. We were immediately employed in exploring the wild and jungly country between Chunar and the sources of the Son and Narbada Rivers, and up to the city of Jubbulpore. This extensive survey was completed in the season 1832 and 1833, and formed the subject of a topographical and geological report submitted in 1834. After closing the work at Jubbulpore in March 1833, we proceeded to join the approximate operations of the Great Arc series in the Gwalior country, with which we remained till August of the same year, when we were ordered to organize two parties, one for the Ranghir meridional series under myself, the other for the Amua meridional series under Lieutenant Renny, both series being dependent on sides of the Calcutta longitudinal series.

Col. Everest's Superintendence.

Ranghir series.

33. I broke ground on the Ranghir series in January 1834, and finished 120 miles along the meridian by August of the same year, the operations closing merely on account of the termination of the hilly country. With a new organization adapted for the plains, work was resumed early in October, and considerable advance made during that month, whereby the establishment was fully instructed in the nature of the work, the continuance of which devolved on the head Sub-assistant Mr. Armstrong during my absence on duty at the Dehra Doon Base, in which operation I was ordered to take a part. After the completion of the Base, I returned to the Ranghir series, the approximate operations of which had been carried rapidly forward by Mr. Armstrong during my absence. I resumed work in October, and resigned charge to Mr. Armstrong in December, when I proceeded to join the Great Arc as astronomical assistant, in which capacity I remained till the Honourable the Court of Directors did me the honour to select me to succeed Colonel Everest on his retirement from the service in December 1843.

34. The Ranghir series was ably completed by Mr. Armstrong as far as the mountains, into which it was carried by Mr. Lane, and the work closed in 1841, having occupied nine years. The meridional distance comprised is about 400 miles, showing an average progress of 44 miles per annum. The area covered amounts to 16,088 square miles, the charges to 1,18,378 rupees, showing an average cost of *Rs.* 7. 5. 9. per square mile, or say 14 shillings, which cannot but be considered remarkably cheap, considering the very large proportion of flat country traversed, as well as the difficulties of the mountain work. Great credit is therefore due to Mr. Armstrong for his share in the operations, which it may be remarked proceeded uninterruptedly from its commencement to its conclusion. An account of this series is given in detail by Colonel Everest in Volume 9, Part 2, of the General Report.

Amua series.

35. Captain Renny Tailyour commenced the Amua series in January 1834, and carried forward the work to the plains by June of the same year. In October he resumed operations in the plains, and in November proceeded to take a part in the measurement of the Dehra Doon Base, leaving Mr. Tulloh in charge. The series was brought to a conclusion in June 1839, having been entirely completed by Captain Tailyour personally, except during a short interval in 1837-38, when he was detached on duty at the Sironj Base measurement, and afterwards at the end of 1838, when the Captain was transferred to the Great Arc. During these intervals the work was conducted by Sub-assistant Murphy, under the Captain's orders. A full and complete account of this series has been given by Colonel Everest in Volume 9, Part 3, General Report. The instrument used was a good 18-inch theodolite, by Troughton & Simms, the powers of which were done ample justice to by Captain Renny Tailyour, who is a first-rate observer. The work therefore possesses superior merit, and is creditable to that officer and his assistants. The area comprised is 5,565 square miles, and the charges amount to 1,04,958 Company's rupees, giving an average cost of *Rs.* 18. 13. 9. per square mile, or say 35 shillings. This rate has been enhanced by the great extent of flat country traversed, by forests in the Terai near the terminus of the series, through which rays had to be cut, and by the several periods of Captain Tailyour's absence on duty with the Great Arc, during which his salary continued to be borne on the accounts of this series.

Karara series.

36. Lieutenant W. Jones, of Engineers, was appointed to the trigonometrical survey in the year 1835, and remained till 1838 attached to the Great Arc. After the measurement of the base near Sironj, in which operation he took a

Col. Everest's Superintendence. Karara series.

part, Lieutenant Jones was deputed to conduct a series on the meridian of Karara, dependent on a side of the Calcutta longitudinal series. The work was commenced with the ability and zeal which might have been expected from a gentleman of Lieutenant Jones' talents and skill as an observer, but towards the close of 1838 the whole party was attacked by jungle fever, from the effects of which one sub-assistant, Mr. Scully, died, and Lieutenant Jones himself was obliged to seek for restoration to health in the hills. In consequence of this disaster, a fatal stop was put to the progress of the work. The Lieutenant made another attempt to take the field in 1839, which produced a recurrence of his illness. Shortly afterwards he considered it his duty to resign his appointment in the survey, and is now usefully employed in the superintendence of the Rohilcund canals. The establishment was broken up, and the work remained in abeyance till 1841, when Captain R. Shortrede, of the Bombay army, was appointed to conduct it. Little progress, however, being made, Captain Shortrede was placed at the disposal of his own Government in March 1845. Anxious to expedite the completion of a work which had languished for so many years, I selected Mr. Armstrong to take charge of it, on account of his having distinguished himself by the energy of his operations on the Ranghir series. By his exertions, aided by another party working from the north, the series was brought to a close that season. I have given a full and complete account of the work in volume 10, part 1st, General Report of the Trigonometrical Survey of India. The instruments employed were of an inferior order, and this series cannot, therefore, be considered a first-class performance. It embraces an area of 5,819 square miles, and cost no less that 134,908 Company's rupees, giving an average rate of rupees 23. 2. 11. per square mile, or say 43*s*. The charges were enhanced by the several disasters which occurred, and but for the arrangements I made for closing it rapidly the cost would have been greater.

Himalaya longitudinal series.

37. Brevet Captain Du Vernet, of the Madras army, was appointed to the trigonometrical survey in the year 1840, and in the year 1841 proceeded to prosecute the triangulation of the Himalaya longitudinal series, extending from the Great Arc along the southern face of the sub-Himalayan range, so as to connect the northern limits of all the meridional series. This officer had previously acquired a favourable reputation as a surveyor by his able management of the Hyderabad Topographical Survey, in which his artistical powers as a draughtsman had ample scope. He had no experience, however, of geodetical operations on a great scale, and the field of employment being difficult for a first trial, little progress was made during the first season, but the next year he closed on the Ranghir series. This work, together with the Pilibit series, conducted by myself, forms a portion only of the "North Longitudinal Series," under which head it will be discussed.

North longitudinal or connecting series.

38. Previous to Colonel Everest's departure, Captain Du Vernet was ordered to continue the north longitudinal series, between the meridians of Amua and Karara, which he successfully accomplished in one season. During the year 1844–45 he was employed in prosecuting the triangulation from the north along the meridian of Karara to form a junction with Captain Shortrede, who was working from the south, as already explained under the head of Karara series.

Col. Waugh's Superintendence. Gurwani series.

39. On the termination of this duty, Captain Du Vernet was directed to take up the Gurwani meridional series, depending on a side of the Calcutta longitudinal series. This work commenced in 1845–46, and was accomplished in a very able manner in two years, showing the great effect of the experience he had acquired. The area embraced is 6,298 square miles, and the charges amount to 53,020 rupees, giving an average rate per square mile of *Rs.* 8. 6. 8., or say 16 *s.*, which is very creditable considering the large extent of flat country traversed. In this series was employed for the first time a 24-inch theodolite made up by myself from various materials belonging to Government, and lying useless in store, the fundamental part being a 24-inch circle hand, divided by Mr. Simms, formerly appertaining to the astronomical circles. It was fitted up with five micrometers, and the results have been most excellent, showing that it is capable in good hands of measuring angles to half a second of the truth. I have rendered a full and ample account of this work, in the volume of the General Report of the Trigonometrical Survey, now on the eve of transmission to the India House.

40. On

Col. Waugh's Superintendence.

North-west Himalaya series.

40. On the completion of the Gurwani meridional series, Captain Du Vernet with his establishment was transferred to the North-west Himalaya series, proceeding from the Great Arc to Peshawar. This work was intended to form the foundation of the triangulation of the newly conquered provinces of the Punjab, agreeably to a design sanctioned by the Right honourable Lord Hardinge, to whom I am greatly indebted for prompt and powerful support.

41. On the termination of the Great Arc, the two parties which had been engaged on that work were reduced, and placed respectively under the charge of Mr. George Logan, a civil engineer of experience and ability, and of Mr. James, principal sub-assistant. These parties were deputed by Colonel Everest before his departure to take up the Chendwar meridional series, and the Gora meridional series, dependent on sides of the longitudinal series.

Chendwar series.

42. Mr. Logan, as might have been expected, finished the Chendwar series in first-rate style in two seasons, since which period he has been employed on the north longitudinal series, of which mention will be made hereafter. An account of the Chendwar series has been prepared for the General Report, and will in a short time be transmitted to the India House. It comprises an area of 3,565 square miles, and cost 64,504 rupees, giving a rate of *Rs.* 18. 1. 6. per square mile, or say 33 *s.*, the cost being enhanced by the nature of the country traversed, the greater portion being the rich alluvial lands of Behar and Tirhoot, in which the work was impeded by trees, for which heavy compensation was paid.

Gora series.

43. Mr. James at the same time commenced the Gora meridional series, in which he had made little progress up to the time of his death, which occurred in June 1844. On my appointment to the situation of surveyor-general, Lieutenant Peter Garforth was nominated to the vacancy, and in consequence of my being ordered to Calcutta by Government, I directed that officer to join Mr. Logan's party, in order to gain an insight into the work. On Mr. James's death, the Lieutenant was directed to assume charge of the Gora series, but in consequence of the unhealthy character of the country, as well as inexperience, he did little work the first year; thus two years were fruitlessly expended. During the next two seasons, Lieutenant Garforth completed the work from beginning to end in a very able manner, after which he resigned his situation. An account of this work is now ready for incorporation with the General Report of the Trigonometrical Survey of India, and will shortly be transmitted to the India House. It embraces an area of 4,417 square miles, and cost 76,948 rupees, giving an average rate of *Rs.* 17. 6. 8. per square mile, or say 32 *s.*; but the expense was nearly doubled, as already explained, by the abortive proceedings of the first two seasons.

Maluncha series.

44. On the conclusion of the Budhon series, Captain Renny Tailyour was ordered by my predecessor to take up the Maluncha meridional series, dependent on a side of the longitudinal series. Shortly after, the Captain was directed in general orders to join the army proceeding against Gwalior, and being appointed Brigade-major of Engineers, was present in that capacity at the battle of Maharajpore, his services in which action were acknowledged in the despatches. During Captain Tailyour's absence, the work was commenced by the senior sub-assistant, Mr. Clarkson, but the Captain rejoined the party in the spring, and carried the operations to the Ganges, after which he proceeded to England on furlough. On his departure, Lieutenant Reginald Walker, of Engineers, was nominated to the vacancy, and placed with Mr. Logan for instruction. In the meantime Mr. Clarkson continued to prosecute the Maluncha series during the next season, in which the party suffered much from the unhealthiness of the country. Lieutenant Walker assumed charge in 1845, and being an officer of very superior talents and energy, carried the work to completion in the ensuing season. The detailed account of this work is now under preparation for the General Report, and will be transmitted in due course to the India House. It comprises an area of 4,765 square miles, and cost 52,878 rupees, showing an average rate of *Rs.* 11. 1. 6. per square mile, or say 20 *s.*, which, considering the large proportion of flat country and extreme unhealthiness of climate, may be deemed moderate.

Col. Waugh's Superintendence.

Calcutta series.

45. The Calcutta meridional series was commenced at the base line in 184 4 by Mr. Sub-assistant Lane, but his proceedings being slow, I directed M r I. Peyton to assume charge, by whom the final work was entirely executed, and brought to a conclusion in 1848. The series in its whole extent traverses the alluvial plains of the Ganges, in which great difficulties had to be surmounted. The instrument employed was an 18-inch theodolite, by Troughton & Simms, to which ample justice was done by Mr. Peyton. On closing at Sonakoda base the linear error amounted to 0·64 feet in seven miles, from which is inferred an average error of 0·09 foot per mile; which, considering the size of this engine-divided instrument, and the extent of triangulation, 260 miles, entirely in a flat marshy country, may be considered creditable to Mr. Peyton. This party suffered greatly from the unhealthy climate. An account of the work in detail is now preparing for the General Report, and will be transmitted in due course to the India House. The area comprised amounts to 4,136 square miles, and the cost to 1,10,302 rupees, giving an average rate of *Rs.* 26. 10. 9. per square mile, or say 49 *s.*, the price being enhanced by the flatness of the country, and its unhealthiness.

Coast series.

46. In the year 1845 Captain Thorold Hill, of the Madras army, who had formerly been employed in the Madras Topographical Survey, was nominated by Government to succeed Captain Shortrede. He was deputed to the charge of the Coast series, intended to extend from the Calcutta base line to the Madras Observatory, according to Colonel Lambton's original design. Considering the importance of this series, and its extent, it was desirable that it should be executed in superior style, with a first-rate instrument. I therefore determined to await the arrival of four new 24-inch theodolites, which my honourable masters had been graciously pleased, at my earnest solicitation, to order to be constructed by the best London artists. In the meantime, that Captain Hill might gain experience, he took up the South Maluncha series, on which he was employed during two seasons, from 1845 to 1847. On the arrival of the new theodolites, Captain Hill was supplied with one of those constructed by Mr. Simms, a beautiful instrument, graduated by his new self-acting apparatus. With this theodolite, the Coast series commenced at the Calcutta base, and being still in progress, no complete report can be rendered. Colonel Lambton, in his project for this series, contemplated that great difficulty would be experienced in carrying it over the flat lands between Balasore and Calcutta. The obstacles have proved as great as that celebrated geodist anticipated, but they are not insuperable, and I expect the part which lies in the low country will be completed this year; after which, with the aid of a hilly country, the progress will be rapid, and the cost diminished. The low lands are covered with water, and very unhealthy till December. During the cold season fogs are prevalent, and at the vernal equinox, as well as during the hot season, tornados, or circular hurricanes, are of frequent occurrence, producing the most devastating effects. During the past season the whole tent equipage of the party was utterly destroyed. The country is not only flat and covered with groves, but intersected with creeks and marshes, which render triangulation both slow and expensive. On the other hand, the unhealthiness of the climate is such that every season the party has been driven away by sickness, and Captain Hill's health suffered so much that he has been compelled to proceed to sea for two years. From all these causes combined, progress has been very slow. The area comprised by the operations on this series from 1845 to 1849 amounts only to 2,427 square miles, and the cost has been 91,534 rupees, giving an average rate of *Rs.* 37. 12. 4., or say 70 *s.* per square mile. The difficulties, however, may be expected to be entirely surmounted in 1851; after which, the country being easy, the cost will most probably fall to about five or six rupees per square mile.

Col. Everest's and Col. Waugh's Superintendence.

North longitudinal or connecting series.

47. The north longitudinal series extends from the Dehra Doon base to the Sonakoda base, a distance of 690 miles along the frontier. This work has been executed by various parties at different times. The first part, from the Great Arc series to the Ranghir series, was executed by Captain Du Vernet, as already stated. The next portion, between the Ranghir and Amua series, was completed by myself, prior to my succeeding to Colonel Everest. The part between Amua and Karara was executed by Captain Du Vernet, but on account of some defect in the instrument was not considered satisfactory, and has been revised by Mr. Logan, who completed the whole extent as far as the Chendwar series, under great

great difficulties as regards climate and forest, from which his party suffered greatly. The whole of this portion is excellent, having been executed with Barrow's great theodolite, by Mr. Logan himself, who is second to none as an observer. From Chendwar to Maluncha series the work rests on Mr. Peyton's and Mr. Nicolson's observations, with a 24-inch theodolite by Barrow. The remaining portion from Maluncha series to Sonakoda base depends on Lieut. Walker and Mr. Lane's observations, with Troughton's great theodolite.

Col. Everest's and Col. Waugh's Superintendence.

North longitudinal or connecting series.

48. In the year 1846–47 I joined Lieut. Walker, for the purpose of inspecting his work and assisting in the selection of the base line. While I was so engaged this talented young officer died of jungle fever, by which event the department lost one of its most able members. After his death I remained with the party, and during the summer carried on the operations for fixing the positions and elevations of the great snowy peaks and other mountains in Sikim, an account of which will be given in a forthcoming volume of the General Report.

Col. Waugh's Superintendence.

Snowy Peak triangulation.

49. In the year 1847–48 I measured the Sonakoda base line, for the verification of the north longitudinal and the Calcutta meridional series, as well as to furnish a new basis for the extension of operations into Assam, and up to the extreme frontier of British India on the east. This base line was very satisfactorily measured with Colby's compensation apparatus, and being proved by minor triangulation, in four sections, exhibits the following results :—

Sonakoda.

Sonakoda or West End.

Ramgaiy or East End.

Scale 2 Miles to an Inch.

Sonakoda base.

Each Section of the Base compared with the whole Base.

	West End to A.	A to B.	B to C.	C to East End.
Measured length - - inches	109625·15	110381·17	116428·94	103794·45
Computed from the whole base - „	109625·00	110381·17	116429·03	103794·51
Error, Inches - -	+ 0·15	0·00	−0·09	−0·06

Each Section compared with the other Sections.

Measured length - - - inches	109625·15	110381·17	116428·94	103794·45
Computed from 1st section - „	- - -	110381·32	116429·20	103794·65
„ 2d „ - „	- - -	- - -	116429·03	103794·51
„ 3d „ - „	- - -	- - -	- - -	103794·43

50. The area comprehended by the north longitudinal series amounts to 15,826 square miles, exclusive of the mountain operations in Sikim and along the frontier, which cover a further area of 73,920 square miles, giving a total of 89,746 square miles. The cost, including the expense of the Sonakoda base, amounts to 214,257 Company's rupees, which, divided by the former, gives an average of *Rs.* 13. 8. 7., or say 25*s.* per square mile for the plain work, or, including the snowy peaks, an average of only *Rs.* 2. 6. 2., or say 4*s.* a mile.

North longitudinal or connecting series.

51. Captain Renny Tailyour, while in England, made himself acquainted with the progress of the Ordnance survey, and returning to India in 1847, gave his valuable assistance at the base line, after which he was deputed to proceed to Sironj,

Great longitudinal series.

Col. Waugh's Superintendence.

Sironj, with Troughton's great theodolite, for the purpose of extending the great longitudinal series from Sironj base to Karachi in Scind. This work having commenced in 1848-49, and being still in progress, is not included in this report.

Col. Everest's and Col. Waugh's Superintendence.

Bombay trigonometrical survey: South Konkan series.

52. After the conclusion of the Bombay longitudinal series, Captain Jacob proceeded to England on sick certificate, and being an officer of great experience and talent, his loss to the department was severely felt. He was succeeded by Lieut. Harry Rivers, of the Bombay engineers, by whom the trigonometrical operations in that presidency have been conducted to the present time. These consist of the South Konkan series, dependent on a side of the Bombay longitudinal series. This work was completed by Lieut. Rivers between the years 1842 and 1844, and I have rendered a full account thereof in Volume 14, Part 1, General Report. It is a scanty and second-rate performance. After the conclusion of this work Lieut. R. took up the North Konkan series, in the prosecution of which the health of his party suffered so much that it became necessary to withdraw from it when it had attained the parallel of 21° 45′. He next took up the Khanpisura series on the meridian of 75°, which he has continued in a masterly manner up to Ajmere. The area comprised in these several operations conducted by Lieut. Rivers amounts to 45,854 square miles, and the cost to Company's rupees 1,26,734, giving an average rate of only *Rs.* 2. 12. 2. per square mile, or say, nearly 5*s.* The expense has been much reduced by the facility of the country, and Lieut. Rivers' rapid style of work. That officer is now about to undertake a new series on the meridian of Aboo, dependent on a side of the great longitudinal series, and it is intended that the triangulation shall be extended over Guzerat.

Col. Waugh's Superintendence.

Bombay Trigonometrical Survey: North Konkan series, and Khanpisura series.

53. Of all these latter operations detailed reports of progress have been submitted by me from time to time to the Government of India, under dates as follows:—22d August 1845.—19th August 1846.—15th January 1849.—20th August 1850.

54. The accuracy attained by the modern operations may be thus briefly stated. In the large triangulation, where of course the greatest refinement and most scrupulous care is observed, an error of one inch per mile, or $\frac{1}{63360}$ part, amounts to 500 inches or 42 feet, or nearly half a second in arc of latitude or longitude in 500 miles, which distance is even exceeded between some of the bases. The work is reckoned liable to half this error when executed with the great theodolite, on the principle of double series. The results attained by the new 24-inch theodolites are but little inferior to this degree of accuracy; when the series are single, the liability to error is reckoned to approach nearer to one inch per mile; when performed with good 18-inch theodolites, the error will exceed one inch per mile, according to the character of the graduation. With inferior instruments, or a less careful system, the accumulation of error would approach a foot per mile, which is equal to a ratio of $\frac{1}{5280}$ in linear dimension, or $\frac{1}{26\,40}$ in area, or $\frac{1}{20}$ per cent, or six seconds of arc in the above distance.

Recapitulation.

55. In reviewing the whole progress of the trigonometrical survey of India from its commencement by Colonel Lambton to the year 1848, it will be seen that the grand total of area triangulated amounts to 477,044 square miles, and the grand total of cost to Company's rupees 34,12,787, or say 312,389*l.*, showing an average cost of *Rs.* 7. 2. 5. per square mile, or about 13*s.* 1*d.*, which cannot but be considered remarkably moderate, especially when the nature of the country and climate, as well as the absence of all the usual resources to be found in Europe, are taken into account. The hardships and exposure of surveyors working in the field for the greater part of the year, in such a climate as India, and living under canvas, whilst all other servants of Government seek the protection of cool houses, are either little known or little appreciated. We have on several occasions kept the field throughout the year. The duties of the trigonometrical survey likewise are often unremitting day and night, because the best observations are obtained during the nocturnal hours, when the dust raised by hot winds subsides, and the atmosphere becomes clear and calm. The fatigue and exposure are trying to the most hardy constitutions, and this history will show how few officers have been able to withstand their effects. The loss of trained officers entails a considerable increase of expense, for their places

places cannot be efficiently taken by newly-appointed officers, until they have been thoroughly trained, while the cost of training is always an unproductive item in the account.

Accounts of the Military Auditor-General.

56. My calculation of expenses will be found to differ in some respects from those given by the Military Auditor-general, in whose statement is included a charge of 96,372. 7. 3. Company's rupees, for the cost of feeding government cattle. Now it may be remarked that the cattle lent to this department in times of peace, and always withdrawn during war, have added no extra charge to the public service, and the survey cannot fairly be debited therewith; if it be included, however, the rate per square mile would only be enhanced by three annas and two pice, or less than five pence. Two other items charged by the Military Auditor-general are, *Rs.* 53,300. 9. 2. for miscellaneous charges, and *Rs.* 69,929. 8. 4. for articles furnished by magazines and arsenals. These charges not being stated in detail, cannot be checked in this office; I surmise, however, that they include cost of instruments and equipments which are all still in existence, and most of them likely to outlive the duration of the survey; the department should therefore receive credit for their present value per contra.

57. The Auditor-general further charges to the survey the military pay of officers, and the Surveyor-general's pay and allowances. With reference to the first, it may be remarked, that these charges are not controllable by this department, and that no extra officers are maintained specially on its account; on the contrary, officers doing duty with the survey have always been withdrawn for war service when required; therefore the employment of these officers involves no additional cost whatever to the State, beyond their staff allowances, with which I have debited the department. The Surveyor-general's office does not pertain to the trigonometrical survey alone, but to all the surveys of India. I have, therefore, in drawing up the accounts, adhered strictly to the system laid down by my predecessor; the difference, however, upon the rate per square mile made by these doubtful charges, is not by any means considerable, amounting in fact only to a few pence.

Duration of the trigonometrical survey considered.

58. With regard to the duration of the survey, it has been already remarked by the late Colonel Blacker, that the question depends on the strength of the establishment employed, which statement is true within certain limits defined by the power of supervision and training. The chief point is the rate per square mile, which I have shown to be on an average 15*s.* 4*d.* The survey has been about 48 years in operation, chiefly on a small scale. Now as the area of India exceeds Great Britain and Ireland some 12 times, we have, comparatively speaking, been only four years at work. Since the commencement the object in view has perpetually extended. Successive wars have added continual accessions of territory to be surveyed. The late wars alone have given new kingdoms with no less additional surface than 169,827 square miles, as will be apparent from the following statement:

Scinde - - - - - -	60,240	square miles.
Jalander, Doab, and Kohistan - -	16,400	,,
Protected Sikh and Hill States - -	15,187	,,
The Punjab Proper - - - -	78,000	,,
TOTAL - - -	169,827	square miles.

59. The limits of our empire, however, appear to have been at length reached. The total area of British India as it now stands, including Scinde, Punjab, Jalandar, Doab, and Tenasserim, has been carefully estimated at 800,758 square miles, and the native states at 508,442 square miles, making a grand total of 1,309,200 square miles as the area of survey under my charge. A complete delineation of this vast superficial extent, amounting to 1 ½ million of square miles, confined within an external boundary of 11,260 miles in length, including every variety of configuration and climate, is an undertaking of unprecedented magnitude, demanding considerable time to accomplish with any pretensions to mathematical accuracy. The exertions hitherto made have been unremitting, and it is but justice to say that the progress has been, generally speaking, as honourable to the officers employed as the results have been useful to the country.

60. The

The extent surveyed, and remaining for survey.

60. The accompanying chart * shows at a glance the extent of country which has been triangulated †, as well as surveyed in detail, up to the present time. The blank spaces have all been more or less explored, but require to be filled up successively as survey parties become disposable.

Present state of establishment.

61. The present state of the Trigonometrical Survey consists of seven parties, employed as follows:

Two parties in the Punjab - - - - - - - -	2
One party in extending the Great Longitudinal Series from Calcutta to Karachi, in Scinde - - - - - -	1
The operations have reached Mount Aboo, and there only remains to complete the hiatus through the desert.	
One party on the Coast Series from Calcutta to Madras; the results of which will be most important to maritime geography - - - - - - - - - -	1
One party employed on the Hurelaong Series in Behar. If possible, to be extended into Nipal - - - - -	1
One party employed in Bengal on the Parasnath Series -	1
One party employed in the Bombay Presidency - - -	1
TOTAL number of Parties - - -	7

Project for geodetical operations in progress.

62. The programme of future operations which have been sanctioned is as follows:—According to Colonel Everest's design, an ellipsoidal space is included between the great arc on the west, the Calcutta meridional series on the east, the great longitudinal series on the south, and the north longitudinal series along the frontier; which are verified by four base lines at their origin and termination; all measured with Colby's apparatus. This immense ellipsoidal area is filled up by subordinate meridional series nearly one degree of longitude apart, which series depend on the great longitudinal series for origin, and on the north longitudinal for verification. This has been denominated the gridiron system, and obviously possesses superior facilities for rapidity and accuracy. This design of Colonel Everest's has been nearly completed, for there remains only a small portion of the Hurilong meridian, and the northern part of the Parasnath meridian, which will be finished in two years. The country to the west of the Great Arc is intended to be triangulated on precisely the same principles. 1st. The north-west Himalaya series will extend from the Dehra Doon base line to Peshawar, where it will be verified by a measured base. This series has reached the meridian of Cashmere, and may be expected to be completed in two or three years. 2dly. The great longitudinal series will be extended from the Sironj base to Karachi, where it will be verified by a measured base. It has been carried as far as the borders of the desert, across which its further progress is uncertain, because no analogous operations have ever been attempted. 3dly. Between the Peshawar and Karachi bases will extend a great meridional series, between which and those before described will be included an immense ellipsoidal area, averaging 9° of latitude by 10° of longitude. As all the bounding series will be executed with superior instruments, and duly verified by base lines, whereby limits will be placed to the intrusion of error, those series will be fit to verify the subordinate meridional series by means of which the intermediate space is intended to be rapidly filled up at every degree of longitude apart, according to Colonel Everest's system.

63. To the east of the Calcutta meridian it is proposed to extend the north longitudinal series, from Sonakoda base into Assam. From this series will depend other meridional triangulations at one degree apart, upon which the accurate geographical delineation of eastern Bengal will be based.

64. The

* This chart is deposited in the library of the House of Commons, and can be there inspected.

† The principal triangulation is chiefly shown, on account of the smallness of the scale, which precludes the representation of secondary operations.

64. The Bombay party will complete the remaining triangulation of that presidency in a few years. There only remains, therefore, to be considered the vacant space to the south of the Calcutta longitudinal series, in which is embraced the hill country of Gondwana and tributary mahals, between the sources of the Son and Narbada, the Godaveri river, and the sea. This region, inhabited by aboriginal tribes, is unhealthy in the extreme, and of no value; but from its rugged configuration, any survey not based on triangulation would accumulate vast errors. It is proposed to triangulate this region by meridional series at every two degrees apart, filling up the interstices with secondary triangulation. In this way that space can be most rapidly surveyed. The accomplishment of these several plans will complete the trigonometrical survey of all British India; and in six or seven years such progress will have been made as will bring the termination in view; before which time no satisfactory opinion can be given.

Conclusion of the survey may be calculated in six or seven years.

65. The instrumental equipments are admirably adapted for the work in hand, and consist of the following apparatus, most liberally supplied by the munificence of the honourable Court for whose undeviating support I feel deeply grateful.

Present equipment adapted to vigorous operations.

1 Colby's compensation apparatus for measuring base lines.

2 Great theodolites, 36 inches diameter, by Troughton & Simms, and Barrow, respectively.

4 24-inch theodolites, by Simms & Barrow.

2 18-inch theodolites, by Troughton & Simms.

6 14-inch Vernier theodolites, by Simms.

6 12-inch theodolites, by Troughton & Simms.

20 7-inch theodolites, by Troughton & Simms.

2 Astronomical circles of 3-feet diameter, by Troughton & Simms.

5 Astronomical clocks.

14 Chronometers.

The signals consist of Argand lamps and heliotropes.

66. With regard to the probable rate of progress, much depends on the efficiency of the officers, and on the accidents of climate to which the parties are so much exposed. In a hilly country, the average advance made per season by each party is now about 120 miles in length by 30 in breadth, or say 3,600 square miles. In a flat country the average is 80 miles in length by 12 in breadth, or about 1,000 square miles. The average for both kinds of ground may be taken at the mean, or 2,300 square miles, which, multiplied by seven, gives 16,100 square miles per annum of probable progress. The cost is not likely to exceed the general average hitherto attained, of 10 *s.* or 12 *s.* per square mile of hilly country, and from 20 *s.* to 30 *s.* in flat land, or a general average of 15 *s.* to 16 *s.* over all. This rate might be expected to diminish, if the department were made more efficient in officers. It has been shown in the foregoing narrative that few succeed in these arduous undertakings. A rigorous training is indispensable at the outset, without which success cannot be certain, nor any adherence expected to system. Widely dispersed as the surveys are, and remote from constant supervision, little by little innovations would creep in, and the character of the work become compromised. To prevent evils so calculated to retard the completion of the survey of India, due provision should be made for contingent vacancies, instead of waiting till they occur. A newly appointed officer is not effective for two years, and when more than one vacancy occurs at a time, the task of training is inconvenient. The department is now so under-officered that a few casualties occurring together would leave it unofficered; an anticipation which would give me more anxiety than it does, were it not for the great ability of a few of the subordinates, who are themselves competent practically to conduct series. It is evident that at the present stage of the business, when so large an area remains for survey, effective establishments are most important. In fact, an augmentation of two or three officers now would be more useful than filling up vacancies towards the close of the work. Such an augmentation would most likely provide for every contingency, without any further addition hereafter, as vacancies occur.

Probable rate of progress estimated.

No adequate provision made for filling vacancies. Risk of leaving the department unofficered.

67. Before

Testimony to the high character of the sub-assistants.

67. Before concluding these remarks, it is but just towards an industrious and useful class of subordinates, chiefly born and bred in India, to bear testimony to their meritorious services in this department. A more loyal, zealous, and energetic body of men than the sub-assistants forming the civil establishment of the survey department is no where to be found, and their attainments are highly creditable to the state of education in India. Among these may be mentioned, as most conspicuous for ability, Babu Radanath Sikhdar, a native of India, of Brahminical extraction, whose mathematical acquirements are of a high order; and Messrs. Peyton, Armstrong, Clarkson, and Mulheran, who have all distinguished themselves practically in the field, and also as computers. The merits of Messrs. De Penning, Olliver, and Rossenrode have been handsomely acknowledged by Colonel Everest, in his published works, in connexion with the older operations.

Interior filling in surveys. Madras system.

68. Having discussed the trigonometrical part of the subject, it remains to report on the land surveys by which the interior is filled up. These are enumerated in a tabular statement, marked (D.) in the Appendix. The greater part of the Madras peninsula has been taken up on the basis of the great triangulation, by means of minor triangles, and military plane table surveys, executed on a scale of one inch per mile. This style of work is remarkably cheap, the cost per square mile not exceeding six rupees or less than 12 *s.*; and in favourable localities, free from jungle fever, which is the dire enemy of all survey operations in India, the expense becomes much lower. This kind of survey being based on triangulation cannot accumulate error, and gives an admirable representation of the land, but it requires good draughtsmen, who are difficult to be obtained in India. The system is peculiarly adapted to mountainous countries, where the value of the land being small, an expensive system is inapplicable. It has already been extensively carried out in the native states, and it is proposed to extend the same principles to the remainder. Of the native states, the following are most conspicuous, and the total area included therein amounts to 508,442 square miles, of which 200,000 square miles have been already surveyed, leaving about 308,442 square miles, almost all wild hilly jungle, and of little value to be taken up:—

	Square Miles.		Square Miles.		Square Miles.
Oude (Lucknow)	23,738	Bikanere	17,676	Oudeypore	11,614
Mysore	30,886	Jeysulmere	12,252	Satara	9,061
Hyderabad (Nizam's)	95,337	Baroda and Kattyawar	24,249	Kolapore	3,445
Jodhpore	35,672	Jhansi	15,570	Cutch	6,764
Gwalior	33,119	Bhopal	6,764	Kotah	4,339
Bhawulpore	20,003	Rewah	9,827	Indore	4,467
Golab Sing's Territory	25,123	Protected Sikh and Hill States	15,188	Travancore	4,722
Berar (Nagpore)	76,432			Alwar	3,573
Jeypore, &c.	12,521			Bhurtpore	1,978

The revenue survey system of Bengal.

69. The revenue survey of Bengal commenced in the year 1822, and consists of the measurement of the boundaries of estates, which are executed by theodolite and chain, upon the traverse system. Up to the year 1830, the rate of progress at which the operations proceeded was extremely limited, only 3,020 square miles or little more than half a square degree had then been performed in seven years, with ten officers employed in the department, the annual rate of progress of each surveyor ranging from 50 square miles to 338 as a maximum; and at this rate it was estimated that the area of Bengal, and of the north western provinces, being about 310,000 square miles, or 77 square degrees, would require 481 years to accomplish. The officers employed in those days, however, had little or no assistance, and the duties performed then by the revenue surveyor himself are now entrusted to competent assistants and sub-assistants, with large native establishments under them, whilst the surveyor acts as a superintendent over the whole; the result of which has been, that during the last 20 years, or since 1830, the whole of the north-western province districts, all Behar and Orissa, and a considerable portion of Bengal proper, have been completed as detailed below. No less than 46 districts of unsettled estates, amounting to 101,519 square miles, and 13 districts of Bengal and Bahar perpetually settled estates, yielding an area of 53,295 square miles, have thus been surveyed in detail and mapped, leaving 20 districts of Bengal, comprising 57,990 square miles, to be taken up, five of which are now in hand.

Unsettled Districts Surveyed:

1. Paneeput.
2. Hurrianah.
3. Dehli.
4. Rhotuck.
5. Goorgaon.
6. Saharunpore.
7. Muzuffurnuggur.
8. Meerut.
9. Boolundshuhur.
10. Allygurh.
11. Bijnour.
12. Moradabad.
13. Budaon.
14. Bareilly.
15. Phillibeet.
16. Shajehanpore.
17. Muttra.
18. Agra.
19. Furruckabad.
20. Mynpoorie.
21. Etawah.
22. Cawnpore.
23. Futtehpore.
24. Humeerpore.
25. Banda.
26. Allahabad.
27. Goruckpore.
28. Azimgurh.
29. Jounpore.
30. Mirzapore.
31. Benares.
32. Gazeepore.
33. Jaloun.
34. Dehra Doon.
35. Bhuttianah.
36. Sohagpore.
37. Ramgurh.
38. Ajmere.
39. Mairwhara.
40. Pooree.
41. Cuttack.
42. Balasore.
43. Cachar.
44. Jynteah.
45. Chittagong.
46. Assam.

Settled Districts surveyed:

1. Midnapore.
2. Hidgellee.
3. Hoogley.
4. Shahabad.
5. Sarun.
6. Patna.
7. Monghyr.
8. Behar.
9. Purneah.
10. Tirhoot.
11. Malda.
12. Bhaugulpore.
13. 24 Pergunnahs.

13
46 Unsettled Districts.

TOTAL - - - 59 Districts surveyed.

Districts under Survey:

1. Rajshye.
2. Beerbhoom.
3. Baraset.
4. Mymensing.
5. Goalpara.

5 TOTAL.

Districts for Survey:

1. Nuddea.
2. Jessore.
3. Burdwan.
4. Bancoorah
5. Dinajepore.
6. Moorshedabad.
7. Bogra.
8. Rungpore.
9. Pubna.
10. Dacca.
11. Dacca Jelalpore.
12. Bakergunje.
13. Sylhet.
14. Tipperah.
15. Bulloah.

15 TOTAL.

70. In addition to this, the newly acquired territory of the Punjab, and Cis and Trans Sutlej States, have come under the revenue operations, and afford a large field of employment for the department.

Accuracy attainable by revenue survey.

71. As respects the accuracy attainable by the measurement of the revenue survey, it may be stated generally that the maximum error allowed in linear dimension, according to the test it is submitted to by traverse proof, is 10 links in 100 chains, equal to 5·28 feet per mile; but in the actual prosecution of the extensive surveys of the season 1847–48, covering an area of about 16,000 square miles, the average ratio of correction employed for the closing of the traverses is found to be only two feet per mile, or rather more than one-third of the allowed correction: $\frac{1}{10}$ per cent. therefore, for the pergunnah or main circuit measurement is fully within practicability; $\frac{1}{10}$ per cent. also may be allowed for the area of the district; $\frac{1}{2}$ per cent. for the village survey area, and one per cent. for the interior detail measurement of cultivation and waste. But the most severe test to which a revenue survey can be subjected is the comparison of its results with those of the trigonometrical survey; and that this comparison may be performed as readily as possible, a due and proper connexion between the two surveys is essential, and now scrupulously maintained.

Test by trigonometrical survey.

72. The following comparative tabular statement of the numerical values of surveys, conducted both in the North Western Provinces, as well as in Bengal, and performed at an interval of 17 years, will best illustrate the preceding remarks.

REVENUE Survey of 1832 compared with the Trigonometrical Survey.

DISTANCES.	From Revenue Survey.	From Trigonometrical Survey.	Error.	Error upon 1 Mile.
	Feet.	*Feet.*	*Feet.*	*Feet.*
Saini to Saroli - - - - - - - -	96,989	97,017	28	1·63
Saini to Sirdana - - - - - - - -	67,571	67,639	68	5·16
Saini to Dholri - - - - - - - -	107,906	108,018	112	5·58
Saroli to Dholri - - - - - - - -	89,681	90,249	568	33·50
Saroli to Sirdana - - - - - - - -	31,170	31,194	24	4·07
Godhna to Saini - - - - - - - -	214,296	214,886	590	14·54
Bahin to Chapra - - - - - - - -	116,637	116,046	591	26·66

REVENUE Survey of 1849 compared with the Trigonometrical Survey.

DISTANCES.	From Revenue Survey.	From Trigonometrical Survey.	Error.	Error upon 1 Mile.
	Feet.	*Feet.*	*Feet.*	*Feet.*
Calcutta Base (north end) to Barrackpore Flagstaff -	19,850	19,869	19	4·89
Calcutta Base (north end) to Armenian Church, Chinsura - - - - - - - - - - -	66,636	66,721	85	6·72
Calcutta Base (north end) to Fort William Flagstaff -	55,987	56,051	64	6·03
Samalia to Sarisa - - - - - - - -	70,196	70,326	130	9·77
Sarisa to Diamond Harbour Semaphore - - -	22,097	22,147	50	12·02

73. From an inspection of this table, it will be seen that the errors committed on the two revenue surveys range from ·162 to 33·50 per mile on the former, and from 4·8 to 12 feet per mile on the latter; and they all lie in the same direction, the revenue measurement being in defect of the trigonometrical survey. Taking the smaller of these discrepancies as the error of the revenue survey unit, it will be seen that the greatest error actually committed in the more recent operations is only seven feet per mile.

74. The azimuth of any side of the large triangles likewise proves a check on the deduced azimuth of the revenue survey, as conveyed from one main circuit to another, and this comparison is carefully carried out when opportunity is afforded for so doing.

Progress and cost of revenue surveys.

75. As a sample of the progress now made by the combined efforts of the officers employed on this side of India, and the cost at which the work is performed, the following analysis of the general average rates per square mile, with the total area completed, is given for the North Western Provinces from the year 1833, and for Bengal from the year 1838, the first commencement of operations down to the present time. The average for the North Western Provinces in the twelve seasons' work amounts to *Rs.* 16. 8. 8. per square mile, and for Bengal it is in a similar period, *Rs.* 20 14. 10. per square mile, whilst the general average on the whole area executed is only *Rs.* 18 6. 8. per square mile. In the two seasons of 1847–48, and 1848–49, upwards of 16,000 square miles of country appear to have been surveyed by the united exertions of eight different parties in the two provinces.

NORTH WESTERN PROVINCES.			BENGAL PROVINCES.		
Season of Survey.	Area Completed.	General Average Rate per Square Mile.	Season of Survey.	Area Completed.	General Average Rate per Square Mile.
	Square Miles.	Rs. a. p.		Square Miles.	Rs. a. p.
1833–34	3,747	29 4 1	1838–39	1,901	60 – 1
1834–35	5,282	24 7 5	1839–40	2,450	49 9 4
1835–36	5,391	27 5 11	1840–41	5,145	23 3 4
1836–37	7,455	23 15 –	1841–42	9,132	22 5 7
1837–38	12,400	13 7 –	1842–43	6,035	22 13 –
1838–39	10,974	13 15 8	1843–44	7,079	18 4 4
1839–40	12,698	11 12 5	1844–45	7,043	16 10 2
1840–41	12,698	11 12 5	1845–46	8,967	12 10 8
1846–47	3,583	20 1 7	1846–47	7,429	14 9 5
1847–48	8,997	14 4 5	1847–48	7,097	18 2 5
1848–49	9,858	12 5 –	1848–49	6,243	21 – 4
1849–50	5,552	22 12 –	1849–50	5,162	24 14 10
Total - - 12	98,636	16 8 8	Total - - 12	73,684	20 14 10

	Area in Square Miles.	Cost in Rupees.	Rate.
Total of the Two Provinces - - -	172,321 - - -	31,74,101 - -	18r. 6a. 8p.

Cost of all surveys tend to diminish, if a proper system be adhered to, and innovation guarded against.

76. It appears that as the surveys advance, it tends to diminish the cost per mile in each succeeding year, caused by the facility acquired by well-trained establishments, and the very efficient mode of working exercised by the superintending officers. The expense of a revenue survey, however, is much influenced by local peculiarities, and even allowing for the difference amongst surveyors, some being more skilful, active, and capable than others under precisely the same circumstances of doing more work, it often happens that the utmost endeavours of the most energetic officers will not produce so low a mileage cost as others who have more favoured ground to go over. In the circuit system work of the revenue surveys, the size of the villages is the grand secret; if the average size is large, above a square mile, as in the North Western Provinces, a good out-turn may be expected, and consequently a reduced cost; but in Bengal, where the villages do not average above half a square mile, it is impossible to compete with the extraordinary cheapness which some of the old surveyors attained. Neither, indeed, is such a thing desirable, with reference to the accuracy demanded in the present day. If 3,000 square miles and upwards are given in by a single surveyor, the results must partake of that haste with which the country is got over, and eventually prove of an inferior order.

77. A survey establishment is always proportionally more expensive the less complete it is, the chief expense being the salary of the surveyor and the European assistants. It should therefore be kept up in as effective a state as possible with a view of turning it to the best account, and by a proper division of labour as economical a survey may be obtained as local circumstances will permit. At the average rate of progress already made in the Bengal provinces, it may fairly be anticipated that what remains to be done will not occupy a longer period than 10 years more, when, in addition to a good topographical survey, we shall have a complete and detail record of every estate paying revenue to Government; and at the present average rates the cost may be calculated at about 11½ lacs of rupees, which, added to 15½ lacs already expended, will make 27 lacs as the entire expense for Bengal, Behar, and Orissa.

Advantages to be expected from a more careful selection of officers.

78. It would tend greatly to expedite these useful surveys, and diminish their cost, if the professional qualifications of the officers selected for these duties were tested, previous to their appointment, by an examination conducted by the Surveyor-general or his deputy. There is no lack of well-educated gentlemen in the service, but without previous examination by competent persons the highest talent cannot be secured, nor without previous training can failure be guarded against.

General principles.

79. It will be apparent, from the foregoing statements, that the revenue surveys supply the interior filling up of the triangles in the British revenue districts, which are chiefly flat lands, to which that system is most applicable. In native states and wild hilly countries, the topographical surveys before described are admirably adapted to the object in view, which is a complete and inexpensive first survey of all India. Considered in this point of view, the work may challenge comparison with any in the world. The triangulation supplies a permanent and accurate basis for the present, as well as for future internal surveys; for it must be borne in mind that, as the resources of this country become developed under the fostering protection of British rule, the topographical aspect of many districts must, in a moderate number of years, be completely changed. Tracts now covered with jungle will be reclaimed, canals will be dug, marshes drained, and roads established. New towns and villages will arise, and fresh groves be planted, and rivers will change their course. That these views are not chimerical may be attested by my own experience, during 22 years of wandering throughout the length and breadth of the land; for places where, in my early days, I hunted the tiger, the bear, and the boar, are now covered with smiling fields, yielding a plentiful harvest to the cultivator. The greatest difference is also perceptible in the extension of towns and villages, showing the increase of productive wealth which is taking place on all sides. On the other hand, in many native states the jungle is advancing on cultivation, and the people thus become the alternate prey of man and wild beast. These alterations cannot but produce, in the course of time, considerable changes in the topographical features of the country, for which reason revised surveys will be required, and these, like the present ones, will be based on the operations of the Great Trigonometrical survey of India, which are intended to form a lasting monument for future generations, and an imperishable record of the landmarks of the present time.

Desultory surveys frequently carried on without the cognizance of the Surveyor-general of India.

80. In addition to the surveys I have described, others have, I believe, been set agoing from time to time by local authority, without reference to this office, or any adequate control. Of these operations, having no official cognizance, it is beyond my province to speak, but it is supposed that in general they are conducted with defective instruments on desultory principles, with no known unit of measure, nor any settled point of departure.

List of distinguished officers in connexion with the accurate survey of India.

81. Before concluding these memoirs, it may be considered a just tribute to those officers who have been most conspicuous for meritorious service in connexion with the accurate geography of India, to place their names on record. Colonel Lambton and Colonel Everest stand pre-eminently above all others for scientific services, and their names are held in affectionate remembrance in this department. To these may be added, Captain Renny Tailyour, of engineers, astronomical assistant, Captain Jacob, of the Bombay engineers, late 1st assistant, and Mr. G. Logan, 1st assistant, all of the Trigonometrical Survey, whose services have been as valuable as of long duration; and Colonel Wilcox, afterwards astronomer to the king of Lucknow; the late General Hodgson, Colonel T. Oliver, Major Herbert, and Major W. Brown, of the old revenue survey; together with Captain Thuillier, the present Deputy Surveyor-general, whose abilities are of a high order, and Captain R. Smyth, of the Bengal artillery, both of whom are ardent admirers of accuracy. In the Madras Presidency, Captain Du Vernet, the late Captain Garling, Major Ward, and Captain Snell.

Printed catalogue of maps appertaining to India.

82. A printed catalogue in three volumes, containing a list of all maps and plans appertaining to the surveys of the three Presidencies, corrected and revised to the present time, accompanies this Report.*

Surveyor-general's Office,
Dehra Dun,
20 October 1850.

A. S. Waugh, Lieut.-colonel Engineers,
Surveyor-general of India, and
Superintendent of the Great Trigonometrical
Survey.

* *N. B.* The three volumes here referred to are deposited in the Library of the House of Commons, and can be there inspected.

APPENDIX.

(A.)

Appendix (A).

EXTRACT of LETTER, No. 111, dated 25 October 1817, from Lieut.-Colonel *J. Young*, Secretary to the Governor-General, Military Department, to Major *John Craigie*, Officiating Secretary to Government in the Military Department.

IT is well known to Government that since the year 1801-2, Lieut.-colonel Lambton, of His Majesty's 33d Regiment, has been employed under the presidency of Fort St. George, in a series of trigonometrical operations, instituted originally for the purposes of establishing with perfect accuracy certain important points in the geography of the Peninsula, and of ascertaining the length of a degree of the meridian in those latitudes. The success with which that learned person's labours have been conducted, naturally led his employers to extend their views, and to desire that the lieut.-colonel's operations should gradually be expanded, so as to embrace nearly the whole south of India, and then be pushed progressively towards the north.

Those employers, it is needless to mention, are the Hon. Court of Directors. This magnificent work was projected and is carried on under their particular auspices and munificent patronage, in a manner befitting that dignified body: their perseverance in this grand enterprise is worthy of the splendid original design, and this single public act has raised the name of the English East India Company in the eyes of the scientific world to a level with those of the great sovereigns of Europe, who have been their only rivals in similar undertakings.

Independently of the benefits reaped by mathematical science from labours like Lieut.-colonel Lambton's, in regard to the more accurate knowledge of the figure of the earth, as deduced from his measurements of an arc of the meridian; the most important practical advantages must obviously accrue from the prosecution of this trigonometrical survey on its present plan. There is no other solid basis on which accurate geography can so well be founded. The primary triangles thus spread over this vast country establish almost beyond error a multitude of points, and the spaces comprehended within these, when filled up by the details of subordinate surveyors, will afford the lieutenant-colonel's employers, and through their liberal communication, to the world, a map without a parallel, whether in relation to its accuracy, to its extensiveness, or to the unity of the effort by which it will have been achieved. The importance attached to such works by the economists and statesmen, as well as by the learned of Europe, is proved by the perseverance for so many years of England and France in similar undertakings. The Governor-general ventures to speak to this point with no ordinary confidence, because it came under his personal knowledge when he had the honour of presiding over the Royal Ordnance department. Under the superintendence of that Board, and the patronage of His present Majesty, the great trigonometrical survey of Britain commenced above 30 years ago, under General Roy, of the Royal engineers, and it is continued unremittingly at the present day by Colonel Mudge, of the Royal artillery. His Royal Highness the Commander-in-chief, actuated by consideration for the magnitude and interesting nature of Lieut.-colonel Lambton's parallel operations in India, has acceded to the wishes of the Hon. Company, by granting the lieutenant-colonel unlimited leave of absence, although his regiment has long since returned to England.

Such is the scale and character of this splendid undertaking. The great extent to which the trigonometrical survey has now reached, appears to the Governor-general to indicate the time as having arrived when expediency requires that it be taken under the direct and immediate control of the Supreme Government. His Lordship is persuaded that its operations will henceforward be greatly facilitated by this measure, for they have already passed the British boundary into the territories of his highness the Nizam, and the Governor-general trusts will now progressively advance into Hindoostan and the east, until the net of triangles shall be woven over the whole continent of India. In the meantime, all those public British authorities with whom, for obvious purposes, Lieut.-colonel Lambton must now hold correspondence and intercourse, are under the sole orders of the Governor-general in Council, and they will be enabled to give immediate attention to his wants and wishes in cases where otherwise a reference to the Governor in Council of Fort St. George (his immediate superior) must be followed by a further reference to Bengal. But besides these considerations of convenience and facilitation, the Governor-general is of opinion that others of a higher nature lead to the same inference. His Lordship has no scruple in avowing his sentiments, that an undertaking of such national importance and general interest is only in its appropriate place when drawn under the direct orders and countenance of the supreme authority in British India.

The Governor-general is not unaware that with minds of a certain order such a step as his Lordship purposes may be open to the idle imputation of vainly seeking to partake the gale of public favour and applause which the labours of Lieutenant-colonel Lambton have recently attracted. To some it may possibly seem to savour of ostentation, that the direct countenance of the Supreme Government has been withheld until the moment when the learned societies of England and France, the first in the world, have borne illustrious testimony to the character of this survey, and the merits of its conductor, by enrolling his name in the distinguished lists of their members. But the discerning candour of the superior

Appendix (A).

authorities who sit in judgment on the acts of the Governments in India, will lead them to a juster interpretation of the conduct of their servants. The analogy of the Governor-general's procedure to their own resolution in the parallel case of the General Survey Department will not escape the notice of the honourable Court; they will mark the striking practical facilitation afforded to Colonel Lambton's operations by their transfer, at this period of progress, to the only authority politically connected with those countries within which the survey has arrived; and if it should appear that from more immediate contact with the Supreme Government even the smallest portion of additional encouragement, or of respectability in the eyes of the world, can be conferred on Lieutenant-colonel Lambton, or his labours, the Governor-general is well assured that the transfer will be approved and applauded even on that single ground.

I am now therefore formally to communicate to the Honourable the Vice-President in Council the resolution of the Governor-general (in his absence from the seat of his government), for effecting the transfer of the trigonometrical survey of India from under the presidency at Fort St. George, to the immediate direction and control of the Governor-general in Council of Fort William: the transfer to take effect from the 1st January 1818. The Governor-general in furtherance of the determination has been pleased to direct, 1st. That from that date Lieutenant-colonel Lambton, and all persons connected with the establishment of the survey, shall be considered as under the sole control of the Supreme Government, and as belonging to the Bengal Establishment. 2d. That the survey be denominated the Great Trigonometrical Survey of India, and Lieutenant-colonel Lambton the superintendent thereof. 3d. That all the salaries, allowances, gratuities, reversionary claims to recompense or pensionary support, and generally, all right or reasonable privileges which any of the persons now attached to the survey possess from the Government of Fort St. George, shall be admitted in the fullest manner as binding on the Government of Bengal. 4th. That a duly qualified officer be appointed chief assistant to the superintendent, on a salary (besides the pay, full batta, gratuity and tent allowance of his regimental rank) of 600 sicca rupees, which is not to be subjected to deduction for any broken periods that the survey may not actually be employed in the field. 5th. That a person skilled in natural science, and capable of affording medical and surgical aid to the survey establishment, be permanently attached to it as geologist and surgeon, on a salary of 600 sicca rupees. 6th. That the trigonometrical survey be considered wholly distinct from, and independent of, the Surveyor-general of India; but as this measure is adopted out of respect to the rank, talents and eminent services of the present superintendent, in the event of that officer ceasing to hold the direction of the trigonometrical survey, the Governor-general will consider this regulation as open to revision. 7th. That the whole expense of this survey be considered a civil charge. 8th. That the trigonometrical survey be placed immediately under the public department, and that all reports, instructions or other correspondence regarding it be conducted through the secretary to Government in that department. 9th. That all records, documents, plans, &c. connected with the surveys which may now be deposited at Fort St. George be removed to Bengal as soon as possible, when arrangements will be made for their reception and custody in the public department.

On these several provisions the Governor-general does not conceive that it is necessary for him to make any particular remarks, except as to the 4th and 5th articles. His Lordship desires to observe on the 4th, that the intense mental and bodily labour of conducting the trigonometrical survey has been performed heretofore by Colonel Lambton alone, and that the rank and the advancing age of that zealous and distinguished person now demand some relief from such severe fatigue. But independently of the consideration so eminently due to the individual, the Governor-general is decidedly of opinion that the strongest reasons of public expediency exist for associating an assistant in this great employment. The mathematical qualifications for conducting such labours are of a very high order, and possessed by few in India; they require to have been kept up by habitual exercise, and moreover the extreme accuracy indispensable in trigonometrical calculations on the scale of Colonel Lambton's undertaking demands a dexterity in the use of the instruments, and a scrupulous degree of attention in what may be termed the practical part of the labour, which can scarcely be conceived by persons unaccustomed to it, and which is to be learnt only by a rigorous apprenticeship. The regretted time must one day arrive when Lieutenant-colonel Lambton's task is to devolve on a successor. It would not be wise to trust to chance for producing one fully equal to the duty at the moment when he is wanted; neither is it right that this important survey should thus hang on the life of a single individual. Lieutenant-colonel Lambton himself has urged this point to the Governor-general, and has pressed on his Lordship the propriety of giving him an associate. The Governor-general therefore has selected for this office, Captain Everest, of the artillery, of whose eminent degree of science as a mathematician he is assured, and whose talents are known to the Vice-president in Council, both by his surveys in Java, under the quartermaster-general's department, and by his successful exertions as an engineer, in recently clearing the navigation of the Matabanga and other rivers. His Lordship purposes to grant Captain Everest a salary nearly similar to that of an ordinary land surveyor, or 600/. rupees, besides regimental allowances, to be considered, like all the other expenses of the survey, a civil charge.

(True extract.)

A. S. Waugh, Lieutenant-Colonel, Engineers.
Surveyor-General of India, and
Superintendent Great Trigonometrical Survey.

(B.)

ABSTRACT of a LETTER from the late Colonel *V. Blacker*, Surveyor-General of India, to the Secretary to Government of India, Military Department, Fort William; dated 11 August 1824.

I SHALL assume for granted that a great trigonometrical triangulation, corrected for spherical excess and the spheroidal figure of the earth, is the only accurate basis for the geography of any country; because this point is acknowledged by all the first mathematicians in Europe, and because as well in England as on the Continent the same has been made, with more or less zeal and effect, the object of expensive operations by almost every government in Christendom. In some States they have been completed, and in others partially accomplished, or only attempted, according to the exigencies of war or peace, or the characters of individuals in the several governments. But their importance has been questioned by none, and it therefore remains for decision with the ruling authorities of India, whether they will prosecute to accomplishment a princely undertaking hitherto conducted with success, restrict its course to a less complete result, or discontinue it immediately.

Considerable time elapsed at its origin in procuring the instruments, and some effect was lost in the gradual training of sub-assistants and followers attached, to comprehend and perform all those parts of the work which did not belong to the immediate province of the superintendent himself. The commencement, therefore, including cost of instruments, was the most expensive part of the proceeding in proportion to the effect produced; and as that loss and inconvenience has been incurred, it appears impolitic to sacrifice a subsequent advantage derived from it, by an immediate or premature termination of the survey.

It is extremely difficult to recommend any restriction of the great triangulation, short of that imposed by the features of the country and the limits of British control, so long as its operations are conducted with zeal and intelligence; but if such a suggestion were exacted, I should propose for limit the termination of the Doddagoontah meridional series of triangles in the Thibet Mountains, the continuation of the western series along the coast from Goa to Cambay, and the prolongation of that on the eastern coast from Masulipatam to the nearest practical point to Fort William. From four to five years with the present establishment would be the probable time necessary for the completion of the meridional arc, which may justly be denominated the great axis of Indian geography, and would connect the minor surveys of the Duckhin with those of Hindoostan, which are at present but vaguely related; for the accomplishment of the other two, which would nearly complete a correct outline of India to the sea, and show the extent in longitude of the British possessions, about four years each would be required.

I cannot

Note.—I take leave to subjoin the translate of a letter from Mr. De Lambre, perpetual secretary of the French Institute, to Lieutenant-colonel Lambton, as a proof of the importance attached by that scientific body to his labours:—

Paris, 30 May 1818.

I first of all received your letter, and shortly after the extract of your new memoir, which was sent me from London. I have seen with admiration the zeal and constancy with which you pursue your great undertaking. If the author of all the Siddantas could re-appear on the earth, and see their country covered with triangles which fix the position of so many places, so many distances, the shape of their coasts, longitudes and latitudes, by modes and with a precision of which they could not have the smallest idea, what would they think of their astronomy when compared with ours, and of the praises which their extravagant admirers have thought fit to heap on them? I have translated your last letter, and I flatter myself that you will not blame my haste in spreading it through Europe by means of the "Connaissance des Tems," which however will not be done until after its publication in the Philosophical Transactions. Your new measurements and new calculations will be seen with great interest. I had already in the "Connaissance des Tems" given your former results, and your comparison of the different degrees. I had noticed what I had discovered by our formulas, with the assistance of your data; the former being a little simplified to bring them nearer to your suppositions, where you pass over the superior powers of the compression.

Everywhere I have had the satisfaction to find our agreement with you. Our metre calculated from your operations differed only 0·015, which you make so much smaller. You now reduce this difference to one-third. I now permit myself to conclude that it is determined with all the exactness that can be desired; but as we have never reckoned on attaining a chimerical precision, and as we know what difficulties accompany the measurement of the earth on a grand scale, we have united the metre to the pendulum, the observations of which, more easy and more proportioned to the pecuniary means of astronomers, are repeating at this moment in London with an astonishing agreement, and will be multiplied in the different countries in the globe by the aid of Monsieur Gautchin, officer of the Marine, who is well skilled in observing, and communicates his observations with rare fidelity. We may now flatter ourselves that we know the general figure of the earth. All the great operations of India, of England, of Sweden, of France and of Germany, lead to the same results. When they are considered "*en masse*" it is not necessary to pay attention to the trifling irregularities of parallels and contiguous arcs. There is no absolute demonstration that the meridians are perfectly regular ellipses and all equal one to the other; that the strata of the earth are exactly symmetrical, or that the best instruments have not some errors. Let us not, however, too much regret that which is still wanting; but let us rather congratulate ourselves on the astonishing precision to which we have arrived. Let us redouble our efforts to diminish the slight anomalies by new researches, and let us multiply as much as possible our observations, and those scientific enterprises which like yours will confirm the glory of the philosophers of the 19th century.

Appendix (B).

I cannot, however, too forcibly, as Surveyor-general of India, deprecate the adoption of a restriction so inconsistent with the liberal views under which this survey has been hitherto conducted; so unworthy of the fame* which the rulers of India have already acquired among scientific societies for their promotion of geodesy, and so completely destructive of all hopes of an accurate knowledge of the geography of the greater part of Central India and all its extremities, excepting the Presidency of Madras and part of the Duckhin and Konkan. Rather, on the contrary, let there be employed more hands and more instruments to give fresh vigour to the undertaking, and to reduce the period of its accomplishment within a calculable time, by the protection and facilities afforded to it.

I feel a difficulty in adding more in reply to the demand for precise information in regard to the objects embraced in the survey, and the particular purposes to which it is to be applied, as it may respect the geography of the country. Without this basis, which is itself independent, all detailed surveys must not only be wrong, but extremely tedious in producing even erroneous results; no single point can be accurately placed, nor can the extent of India, particularly in longitude, be known without it. Such is the proneness of maps to exceed in that direction, that an error of 500 leagues was discovered by Gassendi in the length of the Mediterranean Sea, and De Lisle shortened Asia from east to west more than 24 degrees. The King of France complained that Cassini's great triangulation had deprived him of a large portion of his dominions, and the late Lieutenant-colonel Lambton found the breadth of the Peninsula in the parallel of Madras some miles overrated by all the maps existing previously to his survey, notwithstanding the able and zealous labours of Messrs. Topping and Goldingham to establish the longitudes of several points on both coasts by astronomical observations.

One of the great questions of general service, whose determination depends on the highest geodetic operations, is the ascertainment of the magnitude and figure† of the earth, through various measurements on different meridians, and under different parallels. The scientific world agree nearly among themselves now, although from different grounds, on the comparative lengths of the earth's axis and equatorial diameter, notwithstanding that no two meridians may be similar; and the latest observations in various latitudes on the lengths of the seconds pendulum (an expedient which has been adopted as a substitute for geodetic operations, where the latter from sundry reasons are impracticable), have generally corroborated the conclusion deduced without its assistance. Lieutenant-colonel Lambton's operations have had their full share in the ascertainment of the earth's figure, and the prolongation of the Doddagoonta meridian to the Thibet Mountains, at about the latitude of 31° 30′ will be of equal importance in clearing away remaining doubts, or throwing light on new phenomena; but in fact there is no branch of physical science specially affected by the three co-ordinates of latitude, longitude, and elevation, to which the great trigonometrical operations are not of primary importance; whilst the determination of the changes of gravity in different latitudes, the laws of terrestrial and celestial refraction, the attraction of mountains, the phenomena of magnetism and temperature, with several important branches of geology, should properly accompany or follow them.

I have now placed the question of the continuation of the Great Trigonometrical Survey in the most conspicuous light which the limits I have assumed will permit. In pointing out the expedient for a complete accomplishment of this great desideratum, I have rejected the method hitherto followed of an uninterrupted triangulation, for that of several meridional series, which appears to me, if less satisfactory, to be a saving in time of 20 years; and should the resumption of the former system be ever desired hereafter, its execution will be advanced by the previous work exactly in proportion to the ground covered. The next alternative comprises the completion of the Doddagoonta meridian, and continuation of the series on each coast; and if that be considered too extensive, the meridian may stand alone, whilst the survey of the coasts shall be abandoned.

From para. 50 to 54 relates to the memorandum received from Major Rennell, regarding "the best mode of obtaining a complete map of India within a reasonable time." The character of that distinguished geographer for talent, industry, and literature is so well established, that his opinions on the subject to which so much of his attention has been successfully directed claim immediate respect. But there is a distinction between geography and geodesy; and the latter is the object of the present inquiry. Notwithstanding, Major Rennell's celebrity chiefly rests on the ingenious use and sagacious reasoning with which he has turned to account a variety of uncertain authorities, and that his Bengal atlas, although said to be founded on actual survey, depends neither on measured base or triangulation,

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* I beg leave to quote here an extract from the Edinburgh Review or Critical Journal:—

Note.—They have sent out parties in all directions for the purpose of ascertaining the bearings and distances of the places which compose or limit their extensive dominions. A late volume of the Asiatic Researches contains an account of the march of an officer at the head of a detachment into one of the most remote and unknown districts of India, for no other purpose but to decide a question interesting only to philosophers, viz. Whether the Ganges rises within or without, that is, on the south or the north side of the great chain of Himaleh, the Snowy Mountains, or the Immaus of the ancients? There are but few of the most enlightened cabinets in Europe which can boast of an expedition equally disinterested and meritorious.—Ed. Rev. Vol. XXI. Page 313.

† It may not be amiss here to notice that the figure of the earth is so far from being an object of mere curiosity, that it affects a large portion of the tables used by navigators, especially all those of which the moon's parallax is an element. No power has more reason therefore to be interested in this investigation, than the East India Company.

triangulation, as far as I have been able to ascertain, he is evidently aware that transcendent geodetic methods are now employed in Europe, however he may have overlooked their latter progress in this country.

The mode at present suggested of insulated astronomical observations, and estimation of distance by time, was applicable to the limited influence of the British power half a century ago, and has since been occasionally practised by solitary and adventurous European travellers in the wilds of America. Not only have the grounds of accurate knowledge been extended over Southern India, but accurate surveys in detail have been erected on them. How irreconcilable, then, will be the inconsistencies of the proposed loose method with the results of science already accomplished, and how unworthy of the character, power, interests, and opportunities enjoyed by the honourable Company, to return to such a rude expedient, after having originated and promoted, during more than 20 years, an operation approved by science, and received for their conduct the applause of the scientific of Europe? Were this all, perhaps these arguments, powerful as they deserve to be considered, might fail of carrying conviction to every mind; but in fact the proposed experiment would be entirely nugatory. Incorrect throughout itself, it could form no correct ground for minor surveys; so that it must be either useless or baneful. Its erroneousness would be inconsistent with the scale of four miles to an inch, which always supposes, in a general map, accurate data; and if ever it were engraven in the proposed form, it could have no other fate than that of being thrown aside in vexation for the expense incurred and the misconceptions it produced, to make way for a new and accurate survey.

These observations apply to the proposal for substituting astronomical observations for high geodetic operations and estimation of distance by time for actual measurement. If, on the other hand, the celestial observer be confined to those tracts whose nature forbid the approach of the Great Trigonometrical Survey, much advantage may be derived from his labours. This benefit, however, must depend on a different principle of calculation from that to be inferred from Major Rennell's memorandum. No astronomical result is of value unless it be more accurate than that which it proposes to correct; and the propriety of its adoption or rejection depends therefore on the local surveys supposed to follow or accompany it. An itinerary corrected for the true azimuth will not in general, if conducted with moderate skill and attention, be in error more than two miles in 100, which is near the average distance proposed to separate any two points astronomically determined. The memorandum estimates at 2½ to 3 years the period requisite for the astronomer to merely travel over his ground; but no estimate is made of the time necessary for making observations and calculations. This omission is the more to be regretted, as on the number of observations, as well as on the skill of the observer and excellence of his instruments, depends the value of the results. In a subsequent paragraph it is added, that with five surveyors three or four years would suffice to fill up all the localities; and that period therefore is probably considered at least sufficient, both for travelling and the determination of the 85 primary points, as they are intended to precede the operation in detail.

It would require more attention than possibly I may be entitled to expect, to follow the reasoning necessary to show the fruitlessness of the proposed hurried observations. The distances in latitude of the local survey may be checked at considerable intervals by a good sextant in the hand, and many seasons of the year are favourable to observations of the sun or stars. But I should apprehend that no professed astronomer would be satisfied to hang his character on such a procedure, which is properly restricted to the purposes of navigation. No instrument but such as is too large for the hand, and must be adjusted by the plummet or spirit level, is capable of giving the latitude with sufficient accuracy to render the result worthy of a professional astronomer and assistant, or adequate to the expense of his establishment; and this instrument, whether a zenith sector, or an altitude circle, requires time and patience for its adjustment, previous to any observation. This delay, added to the occasional want of proper stars sufficiently high during all hours of the night, will render evident the necessity of continuing much longer at one station for latitude alone, than could have possibly been anticipated by the memorandum, which avoids any explanation on this subject.* Mr. Biot did not think 1,400 observations for latitude unnecessarily numerous, when ascertaining the length of the seconds pendulum at Unst, a few years ago; which I hope will be sufficient to show the opinion of the scientific, respecting the difficulty of escertaining that element with the precision suitable to professional observations on shore.†

But

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* Colonel Lambton declares, in one of his papers, that in the climate of India he has never been able to observe a star during the day.

† Within the last half century almost all the observatories in Europe, with all their facilities, have corrected their latitudes, and in some instances considerably. That of the Cracow Observatory has been altered 15″ or a quarter of a geographic mile; that of Gottingen, 19″; the Berlin Observatory 1 geographic mile, and that of Manheim has been augmented even 1′ 23″! But without depending on instances in the west, reference may be made to the practice of Colonel Lambton, who invariably devoted several weeks to observations, for the latitudes of his principal stations.

	No. of Days.	No. of Observations.
At Doddagoonta	59	98
At Putchapolliam	26	173
At Punuae	28	236
At Namthabad	28	120
At Daumergidda	34	205

Appendix (B).

But if the determination of the latitude requires so much time and care, what shall be said regarding the still more important element of longitude, which involves the errors of tables, the rarity of phenomena, the inaccuracies of the timekeeper, the uncertainty of the method, the delay and mistakes in operose calculations? The rate of the timekeeper requires the most attentive vigilance; so much so, that the French astronomer, on the occasion above-mentioned, thought it necessary in two months to observe 1,200 absolute altitudes of the sun and stars, to regulate his clock. If the eclipses of Jupiter's satellites be used as the most simple expedient for determining the longitude, there are parts of the year in which they are either below the horizon, or so little elevated as to be invisible or indistinct. The tables of these eclipses are not to be depended on where great accuracy is proposed, being more an approximation to direct the observer when to look out, than a final result for comparison with the observation; add to which, that the gradual disappearance and re-appearance of the satellites, the unequal powers of the telescopes used, the various state of the atmosphere, and visual power of the observer, give rise to no inconsiderable differences in the times observed. The eclipses of the moon furnish another method of equal simplicity; but they are of rare occurrence, and so inexact, from the uncertainty of the edge of the shadow, that the use of them for determining the longitude has been generally abandoned. The remaining means, such as lunar distances, eclipses of the sun, and occultations of the stars and planets by the moon, the passages of the inferior planets over the sun's disk, the right ascensions of the moon with its horary angles, and the differences of declination, are all attended with operose calculations, on account of the element of parallax, which affects them all. These methods have different degrees of certainty, but the occurrence of the phenomena on which they depend are too rare to admit of any choice in a very limited time, and hence arises the great uncertainty of conclusions for longitude. Even the arc of the meridian measured in Peru by two French and two Spanish astronomers, is found to have been placed too much to the east, 50′ in arc; and the longitude of the Madras Observatory, which has existed 30 years, was not long since discovered to be in excess 1′ 8″. Nothing less than an average residence of two lunar months at one place, exclusive of the rainy season, can be considered sufficient for a result in longitude worthy of any consideration.

The errors of astronomical tables have been already adverted to as a source of error when unlimited reliance is placed on them; but those deductions of longitude which depend on instantaneous phenomena, such as eclipses, transits and occultations, may be rendered more or less independent of those inaccuracies by corresponding observations at a place whose longitude has been already satisfactorily determined. Many of the phenomena observable in India are invisible under the meridian of Greenwich; and some even of those which may be visible in parts of India influenced by the south-west monsoon, are not observable at the Madras observatory on the coast of Coromandel. A considerable portion of the observations which may be made in various parts of India will therefore be without correspondents; and it was a consideration of this circumstance which in part induced me to suggest in my letter under date the 4th February last, the establishment of a limited observatory at the Surveyor-general's office, for the purpose of supplying the above-mentioned deficiency.

To avoid trespassing any longer on the attention of superior authority, I shall hasten to a conclusion of this most important subject, by remarking that no future survey should deserve to be considered final, unless it shall have been conducted on the most approved principles, with appropriate instruments, and by skilful hands; that the accomplishment of such a work, which is alone worthy of the expense it costs, demands time and encouragement. Since the discovery of high scientific principles, all the advantage derived from the application of them to practical purposes, has depended on the accuracy of minute corrections in the execution, which never can be hurried without loss of effect; nor should the principles themselves be any more abandoned, as on them depends the calculus, which "should ever" (to use the words of the late Professor Playfair) "be so instituted as to preserve to the conclusions all the accuracy possessed by the data themselves." These, from the great perfection of modern art, may be rendered by skilful hands extremely correct; and the great desideratum therefore is reduced to the employment of good surveyors, with suitable instruments. Let these arguments, which challenge contradiction, stand in favour of the continuance of the great trigonometrical survey on an enlarged establishment, commensurate with the extent of country still open to its operations; or if arguments without example be insufficient, let the want be supplied by a reference to the extension of the great Ordnance Survey of Great Britain, after mature experience, to the shores of the sister kingdom.

(True abstract.)

A. S. Waugh, Lieutenant-Colonel,
Surveyor-General of India,
and Superintendent Great Trigonometrical Survey.

(C.)

STATEMENT of EXPENSES incurred on Account of the GREAT TRIGONOMETRICAL SURVEY of *India*.

Number.	Nature and Description of Survey.	Duration.	Area in Square Miles.	Total Cost.	Cost per Square Mile.	REMARKS.
				Co. Rs. a. p.	*Co. Rs. a. p.*	
1	Colonel Lambton's triangulation of the southern peninsula of India, between the parallels of 8° and 19° of N. latitude, Great Arc series included - - - - - -	1800 to 1822	146,014·42			
2	Colonel Lambton's Great Arc series, between the parallels of 19° and 21° 15′ of N. latitude, and along the meridian of 77° 41′ of E. longitude - - - - - - -		4,055·04			
				8,35,377 7 3	5 - 10	
3	Captain Everest's triangulation to the eastward of Nirmal and Karnool, in the Nizam's dominions, between 17° and 19° of N. latitude, and between 79° and 80° 30′ of E. longitude - - - - - - -	1819 to 1822	13,108·78			
4	Captain Everest's western or Bombay longitudinal series, between 16° and 18° 30′ of N. latitude, and between 76° and 77° 30′ of E. longitude - - - - - - -		2,163·95			
			165,342·19			
5	Colonel Everest's Great Arc series, from Beder to the Himalaya Mountains, between 18° and 31° of N. latitude, and along the meridian of 77° 41′ of E. longitude, including revision of Arc 18° 3′ to 24° 7′ of N. latitude - - - - - - -	1822 to 1825	19,775·28	1,23,618 15 1	- - -	- - Arc Beder to Kalianpur.
		and 1832 to 1842	37,222·20	7,74,707 2 4	- - -	- - Arc Beder to Himalaya Mountains.
			56,997·48	8,98,326 1 5	15 12 2	
6	Calcutta longitudinal series, commencing from the base line near Sironj, and terminating at the base line near Calcutta, between 77° 41′ and 88° 23′ of E. longitude, and between the parallels of 22° 30′ and 24° 7′ of N. latitude - - - - - - -	1826 to 1832	33,442·19	1,30,740 9 11	3 14 6	- - Measurement of Calcutta base included.
7	Bombay longitudinal series, being a revision and continuation of Captain Everest's western longitudinal series, commencing from the Great Arc series, near Beder, and terminating at Bombay, between 72° 52′ and 77° 25′ of E. longitude, and between 18° and 19° of N. latitude - - -	1831 to 1842	15,198·10	1,37,427 2 9	8 5 3	
8	North Parasnath meridional series - -	1832 to 1835	- - -	35,224 7 5	- - -	- - This work was rejected, as explained in paragraph 30 of Report.
9	South Parasnath meridional series, commencing from the Calcutta longitudinal series, and extending south to Balasore, between 21° 20′ and 23° 30′ of N. latitude, and between 85° 53′ and 86° 48′ of E. longitude - - - - - - - -	1835 to 1840	4,914·00	54,759 10 3	11 2 4	
10	Budhon meridional series, emanating from the Calcutta longitudinal series, extending north, and connecting with the north longitudinal series, between 24° and 30° of N. latitude, and along the meridian of 78° 33′ of E. longitude - - - - - - -	1833 to 1843	12,468·48	1,72,509 13 -	13 13 5	
11	Ranghir meridional series, emanating from the Calcutta longitudinal series, and connecting with the north longitudinal series, between 24° and 29° of N. latitude, and along the meridian of 79° 28′ of E. longitude - - - - - - - -	1834 to 1842	16,087·74	1,18,377 14 10	7 5 9	
12	Amua meridional series, emanating from the Calcutta longitudinal series, extending north, and connecting with north longitudinal series, between 24° and 28° 15′ of N. latitude, and along the meridian of 80° 32′ of E. longitude - - - - - - -	1834 to 1839	5,565·36	1,04,958 5 -	18 13 9	
13	Karara meridional series, commencing from the Calcutta longitudinal series and extending north, and joining with the north longitudinal series between 24° and 27° 42′ of N. lat., and along the meridian of 81° 18′ of E. longitude - - - - - - -	1838 to 1845	5,818·99	1,34,908 2 2	23 2 11	

(*continued*)

Number.	Nature and Description of Survey.	Duration.	Area in Square Miles.	Total Cost.	Cost per Square Mile.	REMARKS.
				Co. Rs. a. p.	Co. Rs. a. p.	
14	Gurwani meridional series, commencing from the Calcutta longitudinal series, extending north, and connecting with the north longitudinal series, between 24° and 27° 25′ of N. lat., and along the meridian of 82° 20′ of E. longitude - - - - - -	1845 to 1847	6,298·00	53,019 15 3	8 6 8	
15	Chendwar meridional series, commencing from the Calcutta longitudinal series, extending north, and connecting with the north longitudinal series, between 24° and 26° 30′ of N. lat., and along the meridian of 85° 28′ of E. longitude - - - - - - -	1844 to 1846	3,565·37	64,504 2 1	18 1 6	
16	Gora meridional series, commencing from the Calcutta longitudinal series, extending north, and connecting with the north longitudinal series, between 24° and 27° 12′ of N. lat., and along the meridian of 83° 17′ of E. longitude - - - - - -	1843 to 1847	4,416·64	76,948 4 -	17 6 8	
17	Maluncha meridional series, commencing from the Calcutta longitudinal series, extending north, and connecting with the north longitudinal series, between 23° 50′ and 26° 5′ of N. lat., and between the meridians of 86° 30′ and 87° 30′ of E. longitude - -	1844 to 1846	4,765·43	52,878 - 3	11 1 6	
18	Calcutta meridional series, commencing from the Calcutta longitudinal series, from the base line measured near Calcutta, extending north, and connecting with the north longitudinal series, between 22° 39′ and 26° 16′ of N. lat., and along the meridian of 88° 25′ of E. longitude; including survey of the Hoogly River, from Calcutta to the Sand Heads - - - - - - - -	1844 to 1848	4,135·86	1,10,302 3 -	26 10 9	
19	South Maluncha series, commencing from the Calcutta longitudinal series, and extending south to Midnapore - - - - - -	1845 to 1847	1,624·33			
20	Coast series, commencing from the Calcutta longitudinal series near Calcutta, and extending along the coast, being still in progress -	1847 to 1849	803·14			
			2,427·47	91,533 14 11	37 12 4	
21	North longitudinal series, commencing from the Great Arc series termination in the Dehra Doon, and extending east, along the southern skirt of the Himalaya Mountains to the Sonakoda base of verification in the Purnea district, between 78° 3′ and 88° 30′ of E. longitude, and between 30° 28′ and 26° 10′ of N. lat.; consisting of the following portions, viz.:					
	Between Great Arc and Rhangir series -	1841 to 1844	8,031·28	29,473 12 -	3 10 9	
	„ Ranghir and Amua series - -	1842 to 1843	608·55	26,207 2 7	43 1 -	Includes one season in measuring Sonakoda base, by which the rate is enhanced one third.
	„ Amua and Karara series - -	1843 to 1844	716·57	19,697 - 9	27 7 10	
	„ Karara and Chendwar series -	1846 to 1847	3,422·09	53,927 15 1	15 12 1	
	„ Chendwar and Maluncha series -	1848 to 1849	1,243·80	25,591 14 6	20 9 3	
	„ Maluncha and Calcutta series -	1847 to 1848	1,803·48	59,358 15 8	32 14 7	Includes one season employed at Sonakoda, by which the rate is enhanced one half.
			15,825·77	2,14,256 12 7	13 8 7	
22	Operations for fixing the Snowy Mountains, carried on simultaneously with the north longitudinal connecting series, between the parallels of 27° 40′ and 29° 26′ of N. lat., and along 10° of longitude - - -	1841 to 1849	73,920·64			
			89,746·41	- - - -	2 6 2	
23	South Konkan series, commencing from the Bombay longitudinal series, and extending south, along the coast to Goa - - -	1842 to 1844	11,071·54			
24	North Konkan series, commencing from the Bombay longitudinal series, and extending north, along the coast, to 21° 45′ of N. lat. -	1844 to 1846	18,160·00			
25	Khanpisura meridional series, commencing from the Bombay longitudinal series, and extending north, up to Indore, between 18° 45′ and 22° 45′ of N. lat., and along the meridian of 75° of E. longitude; being still in progress - - - - - -	1846 to 1848	16,622·66			
			45,854·20	1,26,733 15 1	2 12 2	
	GRAND TOTAL - - -		477,043·91	34,12,786 13 2	7 2 8	

Surveyor-General's Field Office, Dehra Doon, 20 October 1850.

A. S. Waugh, Lieutenant-Colonel, Surveyor-General, and Superintendent Great Trigonometrical Survey of India.

(D.)

TABULAR GEOGRAPHICAL STATEMENT of SURVEYS in *India*.

PROVINCE OR DISTRICT.	TITLE OF SURVEY.	AUTHOR'S NAME.	DATE.	REMARKS BY THE SURVEYOR-GENERAL.
Sirmoor, Gurhwal - -	- - Map of the mountain provinces comprehended between the Rivers Sutluj and Ganges, bounded on the north by Chinese Tartary.	- - Captain J. A. Hodgson and Lieut. J. D. Herbert, surveyors.	1817-18-19-20-21	- - This survey of the mountain provinces between the Sutlej and Ganges river, depends on a measured base and triangulation, the point of departure being astronomically determined, and the fundamental level above the sea by barometrical observations. An interesting account of these operations is given in the Asiatic Researches, Vol. 14.
	Continuation of the Gurhwal survey, extending from Subhattoo northward to the Sutluj river.	- - Captain Thomas Oliver, assistant, Gurhwal Survey.	1822	- - The basis of the survey is highly creditable to the scientific ability of the officers employed, and having subsequently been connected by the great trigonometrical survey, the results have proved satisfactory. But the interior filling up is scanty and incomplete, and the drawing of the ground inaccurate and inartistical. It is to be regretted that a work so well commenced was so hastily concluded. Considering the time and means employed, no greater completeness could be expected, but it can only be termed a first survey, requiring to be taken up again on rigorous principles. None but first-rate draughtsmen can be expected to succeed in a mountainous country so difficult of delineation.
	Triangulation of the Sirmoor and Gurhwal survey.	- - Captain J. A. Hodgson and Lieut. J. D. Herbert.	1819-21	
Kumaon - - - -	Map of the province of Kumaon - -	- - Captain W. S. Webb, surveyor.	1821	- - The remarks on the survey of Sirmoor and Gurhwal are equally applicable to this work. For particulars of the basis of this survey, *vide* an interesting paper by Captain Webb, in the Asiatic Researches, Vol. 13, p. 297.
Trans-Sutluj - - -	- - Jalindhur Doab revenue survey (unfinished).	Lieut. T. C. Blagrave - -	1846-47-48	- - This is a revenue survey of the newly-acquired territory of the Jalindhur Dooab. It is yet unfinished: the north-eastern portion, forming the hilly parts of the Dooab, is now under survey. It is conducted on the same principles as the revenue survey of the British territory in the north-west provinces, and rigorously connected throughout with the North Himalaya longitudinal series, great trigonometrical survey, now in progress. The details of this survey are complete in every respect. The Kohistan, or hilly portion of the Dooab, is on a trigonometrical basis, the triangles of which bear excellent comparison with the secondary triangles of the great trigonometrical survey, and the maps which have as yet been furnished by this surveyor are of a very high order.

(*continued*)

TABULAR GEOGRAPHICAL STATEMENT of SURVEYS in *India*—continued.

PROVINCE OR DISTRICT.	TITLE OF SURVEY.	AUTHOR'S NAME.	DATE.	REMARKS BY THE SURVEYOR-GENERAL.
	Revenue survey map of the district of—			
Rohilkund - - -	Bijnour - - - - - - -	Captain Birnie Brown - -	1833-34-35-36-37-39-40-41.	- - From an inspection of the Bijnour district map, the north-western parts, particularly in the Purgannah of Mundwar, along the Ganges River, appear to be unfinished or unsurveyed.
	Moradabad - - - - -	Ditto - - - - -	1834-35-36-37-38-39-40-41.	The general principles of the survey of these districts are the same as above noticed. The first two seasons' work of the southern division of the Moradabad district (now subdivided into and denominated the Budaoon district) differed in one respect, however: in the protraction of the map and the calculation of the area, Gale's universal theorem was not used. This method of plotting was originally employed in the revenue survey of the Dihlee district, by Captain Thos. Oliver, and having been highly approved of by the then Surveyor-general, Major Hodgson, its introduction into all the revenue surveys, subsequently to the year 1823, was immediately ordered by circular.
	Budaoon - - - - - -	- - Captains J. Bedford and R. Wroughton.	1822-23-28 and 34.	
	Barelly - - - - - -	- - Lieutenants G. J. Fraser and J. Abbott.	1833-34-35-36 and 37.	
	Pillibheet - - - - - -	Captain B. Browne - - -	1838-39-40.	
	Shahjuhanpoor - - - - -	- - Captain J. Abbott and Lieut. G. J. Fraser.	1838-39.	
Cis-Sutluj - - -	- - Revenue survey of the protected Sikh states.	Captain H. V. Stephen - -	1846-47 1847-48 1848-49.	- - Rough sketches of two seasons' work have been received in this office, but no complete maps or computations have as yet been received from this surveyor. The remarks respecting the old surveys west of the Jumna are equally applicable to this.
Bhutteeana - - -	Revenue survey of the Bhuttee country	Captain W. Brown - - -	1840-42.	- - The revenue surveys west of Jumna, in the Dehli district, commenced in 1822. From that period to about 1834, when the surveyors' conference was held at Allahabad, by order of Lord W. Bentinck, then Governor-general, the topographical details were well executed, but a system of economy and rapidity was then introduced, which sacrificed the quality of the work for the sake of quantity. The maps thenceforward to be furnished by surveyors were required to delineate accurately only the boundary line of each village and its site, with sketches of roads, rivers, &c. On account of this retrograde resolution a remarkable difference is perceptible in the drawing of the maps here enumerated, the earlier surveys presenting good specimens of topographical surveying, and the latter only a skeleton sketch, exhibiting little else than the boundary line and site of the village, with some roads marked thereon.
Hurriana - - -	Hurriana district - - - -	- - Captains Wm. Brown and J. H. Simmonds.	1837-38.	
West of Jumna - -	Dihlee - ditto - - - -	- - Captains T. Oliver, Wm. Brown, and J. H. Simmonds.	1824-25-26-30-1-2 and 1840.	
	Paneeput ditto - - - -	Ditto - - - - -	1822-23-24-25-26-27-28-32-33.	
	Rohtuk - ditto - - - -	Captains Oliver and Simmonds -	1823-24-26-27 1831-32.	
	Goorgaon ditto - - - -	- - Captains T. Oliver, Wm. Brown, and J. H. Simmonds.	1828-29-30-31-32-38 and 40.	
	Muthra - ditto - - - -	Captain R. Wroughton - -	1835.	
	Agra - ditto - - - -	- - Captains R. Wroughton and J. Fordyce.	1837-38-39.	In consequence of the revenue preceding the great trigonometrical survey, a proper connexion unfortunately was not in the first instance established between the two operations as at present, but some of the points of the latter have been identified by means of the angle books and secondary triangulation, and inserted on the lately-published district maps, with a view to the incorporation of the materials into the Indian Atlas.

Dooab of the Ganges and Jumna Rivers.	Revenue Survey of the Districts of—		
	Dehra Doon	Capt. William Brown	1838-39
	Saharunpoor	Capt. William Brown and Lieut. G. J. Fraser.	1827 to 1836
	Moozuffurnuggar	Ditto ditto	1827 to 1836
	Meerut	Ditto ditto	1827 to 1836
	Boolundshuhur	Ditto ditto	1828 to 1840
	Allygurh	Capt. R. Wroughton	1837
	Furruckabad	Capts. H. M. Lawrence and R. Wroughton.	1833 to 1839
	Mynpoorie	Capt. R. Wroughton	1837 to 1839
	Etawah	Ditto ditto	1838-39
	Cawnpoor	Lieut. S. A. Abbott	1840
	Futtehpoor	Lieut. H. V. Stephen	1839
	Allahabad	Capt. H. M. Lawrence and Lieut. Stephen.	1838.
British Bundelkund	Revenue Survey of the Districts of—		
	Jaloun	Lieut. S. A. Abbott	1841–42
	Humeerpoor	Lieut. H. V. Stephen	1839–40
	Banda	Lieut. S. A. Abbott and H. V. Stephen.	1840–41.
	Revenue Survey Maps of the Districts of,		
Mirzapoor	Benares	Lieuts. S. A. Abbott and H. V. Stephen.	1839–40
Benares	Mirzapoor	Capt. Robert Wroughton	1840–41
Jounpoor	Jounpoor	Lieut. S. A. Abbott	1839–40
Gazeepoor	Gazeepoor	Lieut. W. Maxwell	1839–40–41
Azimgurh	Azimgurh	Capts. J. H. Simmonds and J. Fordyce, and Lieut. J. Brind, and Mr. R. Terraneau.	1835–36
Goruckpoor	Goruckpoor	Capts. J. Fordyce and H. M. Lawrence, Lieuts. J. N. Rind, James Brind, and S. A. Abbott.	1835-36-37-38.

The preceding remarks apply to these maps in an equal degree as respects the dates of the survey.

These surveys are of the same character as the preceding.

The geographical information comprised in these three district maps will require the Hon. East India Company's engraver to re-engrave the better half of sheet No. 69 of the Indian Atlas, although the materials therein used, viz. Captain Franklin's survey of Bundelkund in 1820–21, were the best then extant. But the revenue survey having been executed 28 years later, as a matter of course supply better and more accurate geographical data than a map made up of cross routes, however carefully executed. The revenue survey requires the site of every village to be laid down on the plan; not so a military or route survey. A slight comparison of these three revenue survey district maps with Captain Franklin's map of Bundelkund (the upper part) will show what changes have taken place in 20 years. Several villages noted in the one will not be found in the other. The sinuosities of the courses of rivers, and nuddees, are decidedly better depicted in the revenue survey maps than in that of Captain Franklin.

These surveys having been conducted on the same principles as the preceding, much of the former remarks apply to these also. They furnish good materials for atlas sheets, Nos. 87, 88, 89. 102, 103, and 104. All the old geographical or route surveys through these districts, viz. the surveys of the late Captain P. W. Grant, Captain Brown, Lieutenant Blake, Ensign Stephen, and Captain Lindsey, will be necessarily superseded by these later materials, which contain information in every respect more in detail.

(*continued*)

TABULAR GEOGRAPHICAL STATEMENT of SURVEYS in *India*—continued.

PROVINCE OR DISTRICT.	TITLE OF SURVEY.	AUTHOR'S NAME.	DATE.	REMARKS BY THE SURVEYOR-GENERAL.
Saugor and Nurbudda Territory.	Revenue Survey Map of the Districts of, Sohagpoor and Ramgurh, in the Saugor and Nurbudda Territory.	Capt. R. Wroughton - -	1842	- - The Sohagpoor and Ramgurh district map will furnish geographical data superior to the Hurkaru route surveys between Omurkuntuk and Jubulpoor, made under the direction of the late Captain William Lloyd. Atlas sheets 90 and part of 71 will embrace these two districts.
Behar and Bengal - -	Revenue Survey of the Districts of—			- - These surveys, of the same character as those immediately preceding, cover a space equal in area to somewhat more than ($\frac{1}{3}$) one-third of Rennell's Atlas of Bengal and Behar. It is a fortunate circumstance that the sheets of the Indian Atlas, Nos. 102, 103, 104. 111, 112, 113, 114, 115, which will comprehend in part these 12 districts, have not been as yet published; for the Honourable East India Company's engraver would have to expunge the old geographical information derived from other sources, including the surveys of Major Rennell, "the father of Indian geography," which, though sufficiently accurate for those earlier periods of our occupancy of Hindoostan, and considering that the maps drawn therefrom consisted of military route surveys (in some instances 10 to 20 miles asunder) must now give way to the more detailed geographical data these reveuue surveys supply. All these surveys are duly connected with the great trigonometrical survey operations lately carried on, and their combination in the atlas will be certain.
	Sarun - - - - - - -	- - Lieut. W. Maxwell and Mr. Alexander Wyatt.	1843 to 1848	
	Shahabad - - - - - - -	Lieut. W. S. Sherwill.		
	Behar - - - - - - -	- - Capt. H. V. Stephen and Lieut. W. S. Sherwill.	1841–42–43–44	
	Patna - - - - - - -	Lieut. William Maxwell - -	1841–42–43	
	Tirhoot - - - - - - -	Mr. Alexander Wyatt - -	1848–49	
	Monghyr - - - - - - -	- - Capts. Egerton, Ellis and Sherwill.	1837–38–39 and 1845–46–47	
	Bhagulpoor (nearly completed) - -	- - Capts. W. S. Sherwill and S. R. Tickell.	1848–49	
	Poornea - - - - - - -	- - Messrs. J. Fitzpatrick and J. J. Pemberton.	1840 to 1847	
	Hoogly - - - - - - -	Mr. W. A. Wilson - - -	1844–45–46	
	Midnapoor - - - - - - -	- - Capt. R. Mathison, Messrs. W. A. Wilson & J. Fitzpatrick.	1838 to 1843	
	Hidjlee - - - - - - -	Lieut. R. Mathison - - -	1838–39–40	
	Balasore - - - - - - -	Mr. J. Fitzpatrick - - -	1838–39–40–41	
	Malda - - - - - - -	Mr. J. J. Pemberton - -	1848–49.	
Orissa - - - - -	Revenue Survey Map of the Districts of, Central Cuttack - - - - -	Lieut. R. Smyth, Artillery -	1839–40–41–42	- - These surveys, executed on the same principles as those now in progress in Bengal, and furnishing geographical information superior to, and much more in detail than the old maps can supply, will supersede the labours of Captains Blunt and Sackville, in 1805 and 1812 respectively, and those of Lieutenant Buxton in 1818 to 1821 in Orissa. Atlas sheets Nos. 115 and 116 will embrace the tract of country delineated on these maps.
	Pooree or Southern Cuttack - -	Lieut. H. L. Thuillier, Artillery	1839–40–41.	

Chittagong - - -	- - Revenue survey of the district of Chittagong.	- - Lieutenant H. Siddons, Engineers, and Mr. E. R. Boileau.	1835-36-37-38-89-40-41.	- - This survey, from its commencement to the end of the year 1838, was conducted without any efficient check or supervision. On Major Bedford's appointment to the office of superintendent of revenue surveys in Bengal, about the latter part of 1838, this, in common with the other district surveys then in progress, was placed under his control, and made to work upon the same uniform system that obtained in the north-western provinces. Hence this survey is of two values; the portion surveyed subsequently to 1838 is superior to that which was executed antecedently to that period. The following extract from Capt. Wroughton's report, dated 31st October 1844, No. 6, to the address of the secretary to the Suddur Board of Revenue, would therefore appear to refer in an especial manner to the work performed between 1835 and 1838: "District map of Chittagong, to be lithographed on a scale of two miles to the inch. This record will, under any circumstance, be a very meagre one, because the original map has been loosely put together, and has not been compiled from accurate numerical data, being a mere projection of bearings, and measured or guessed distances. It comprehends 13 Thannah or Purgunnah divisions, but for the most part they do not show the village boundaries, and have been compiled in a rough and very unsatisfactory manner." Atlas sheets Nos. 127 and 128 will comprise this district.
Silhet, Jynteeah, Cachar -	Revenue survey of the Jynteeah district	Lieutenant H. L. Thuillier -	1837-8-9	- - The remarks respecting the character of the Cuttack and Pooree districts, apply in an equal degree to this survey also. Portions of the late Lieutenant Thomas Fisher's and the late Captain Pemberton's surveys in this part of the British territories will be superseded by the more accurate geographical details these maps furnish. Atlas sheets Nos. 125 and 131 will require to be revised.
	Revenue survey of the Cachar district -	Ditto - - - - - -	1841-42.	
E 2 Rajpootana - - -	- - Revenue survey of the districts of Ajmere and Mairwarra.	Lieutenant D. C. Vanrenen -	1847-48	- - This survey, in character and principle, is precisely similar to those now in progress. It will furnish good materials for a portion of sheet No. 34 of the Indian Atlas, superior to the surveys of the officers in the Quartermaster-general's department in this part of the country. Captain Hall's map of the Ajmere district will therefore have to be set aside.
Assam, Upper and Lower	- - Revenue survey of Kamroop, Durrung, Bootan, Dooars, and Nowgong districts, in Lower Assam; and of Luckimpoor, Muttock, Seebpoor, and Suddiya, in Upper Assam.	- - Messrs. C. K. Hudson, Morton, J. Thornton, J. Bedford, J. Swiney, and J. Kelso.	1827-28-29-30-31-32 1837-39-40 to 48.	- - Of this tract of country the revenue survey is of two kinds, and differs materially from those already noticed in the north-western and Bengal provinces. The earlier surveys undertaken for revenue purposes, appear to have been executed by magnetic bearings and chain measurements, without any numerical data being forthcoming, or the co-ordinates being worked by traverse. What amount of error may have occurred in the protraction of the circuits of each purgunnah or tangonee it is impossible to estimate. Several of these purgunnah surveys, executed entirely by native land measurers under the collector of revenue, have been put together in the form of district maps, but being unaccompanied by the traverse tables, their accuracy is questionable. The improved mode of the north-western province revenue surveys was not introduced into Assam before the year 1842, and no regular survey establishments of an effective character have been employed in Assam prior to a late period. The peculiarly wild nature of the country in some parts of Assam may have offered obstacles to the main round circuit surveys being performed with that facility that it admits of in the plains. The details these maps furnish are, however, superior to what the earlier maps of route surveys in Assam contain, viz. by Captains Bedford, Wilcox, and Jones, Lieutenants Bedingfeld and Burlton, of the artillery, and Mr. P. Mathews; and we must be content for some time longer to use them as the best materials for the construction of a map of Assam. Atlas sheets Nos. 124, 129, 130, 138, will require to be revised for the introduction of the data these geographical records will supply. (*continued*)

TABULAR GEOGRAPHICAL STATEMENT of SURVEYS in *India*—continued.

PROVINCE OR DISTRICT.	TITLE OF SURVEY.	AUTHOR'S NAME.	DATE.	REMARKS BY THE SURVEYOR-GENERAL.
Munneepoor	Map of the territory of Munneepoor, with part of the Kubo Valley, and Burmese Frontier.	Captain R. B. Pemberton	December 1834	Captain Pemberton's is the most detailed survey that we possess in this part of the country. The operations were carried on while this lamented officer was employed on diplomatic duty, under the orders of Government, in the political department. The former hasty and imperfect survey of Captain Pemberton's that has been introduced into the Atlas sheet No. 131 should be entirely expunged therefrom, and the information contained in the first mentioned of these two maps, dated 1834, should be substituted in its stead. This map was lithographed in the year 1836, under the personal superintendence of its author. A printed report and a lithographed Atlas of his routes from the British territories into Ava, and various other places on the eastern frontier, were published at the same time, and one copy of each forwarded to this office through the political department. Some copies doubtless must have been transmitted to the India House at that period. A year later, that is in 1837, Captain Pemberton deposited the original in the Surveyor-general's office, and but for the above cause it would have been forwarded to England.
	Map of the territory of Munneepoor and surrounding country, including also the Kubo Valley.	Lieutenant R. B. Pemberton	1825-30	
Bengal and Behar	Survey of the Provinces of Bengal, Behar, and Orissa.	Major James Rennell, Engineers, Surveyor-general.	1764-1780	This survey is denoted on the map by a purple wash. It comprehends an area of nearly 32 square degrees; its character is too well known, and it has been so universally appreciated for the last 80 or 85 years, that it would be a work of supererogation to dwell longer on its merits in this report. But the changes effected by time in the courses of rivers, such as the Ganges, the Burhamputur, the Son, the Bhagrutty and other minor streams, the villages that were in existence in Rennell's time, but which have since been washed away, have rendered (geographically speaking) a re-survey of these provinces a desideratum. Hence the revenue survey now progressing in this fertile tract of British India will furnish the most detailed geographical information that can be desired. By the time this report reaches the India House, the revenue survey will have embraced fully one-half ($\frac{1}{2}$) of the area of Rennell's Atlas; and probably 10 or 12 years will suffice to complete the revenue survey of the remaining portion of Bengal; that of Orissa and Behar having been already noticed as completed.
Oudh	Survey of routes in Oudh and north-west and south-east boundaries.	Lieutenant W. S. Webb, surveyor	1809-12	There exists no map in the Surveyor-general's office, containing a detailed survey of the Oudh territory. Two or three attempts were made to get up a compilation from the route surveys that were forthcoming; but the latitudes and longitudes of some of the principal places being uncertain, the former from two to three miles, and the latter between six and seven, these attempts were abandoned. The meridional series of Karara and Gurwani of the great trigonometrical survey have furnished some data. On these, as a basis, a map has been constructed on the small scale of eight British miles to an inch, from existing materials. For several years to come, perhaps, it is not likely we shall be in possession of better information; it has therefore been deemed advisable to prepare a fair copy of this document for the use of the Honourable the Court of Directors.
	Survey of the northern frontier of Oudh.	Lieutenant P. W. Grant	1818-20	
	A survey of the eastern boundary of Oudh.	Lieutenant H. C. Smith, Engineers	1802-03	
	Detached route surveys in Oudh, protracted on small sheets of paper.	Lieutenant-colonel Colebrooke, Surveyor-general.	1808	

219. Rohilkund - - -	- - Survey of the boundary of the Rohilla Jageer (Rampoor) ceded to Ahmed Ally Khan, by the treaty of 1794.	Lieutenant J. Mouat, Engineers	1796	- - This is merely an outline map, delineating the boundary of the Rampoor Jageer, situated in Rohilkund, between the towns of Mooradabad and Pillibheet. It contains no detail except two or three routes in the interior, and the villages on each side of the boundary line; and is therefore of very little value now. The revenue surveys of the surrounding districts of Moradabad, Barelly, and Pillibheet, will furnish more accurate data for the demarcation of the boundary line (as it exists at present) than this survey, executed 54 years ago.
Bundelkund and Boghelkund.	- - Map of the whole province of Bundelkund and part of Boghelkund, including all the British possessions, and all the native states, with their respective boundaries.	- - Captain James Franklin, 4th Native Cavalry, Assistant Quartermaster-general Bengal army.	1815-20-21	- - This survey has been already alluded to at page 33; *vide* remarks opposite the districts of Jaloun, Humeerpoor, and Banda, forming British Bundelkund. Where the revenue surveys end, this map will supply the best detailed geographical information of the contiguous country. Although at the period in which it was executed it was wholly unconnected with the great trigonometrical survey operations, which then had scarcely reached the 20° parallel of latitude, its errors were in some measure checked, and the necessary corrections were duly applied as deduced from astronomical observations. Therefore, next to the great trigonometrical and the revenue surveys, this is certainly one of the best and most detailed geographical documents we possess. Atlas sheets Nos. 69 and 70, published in 1827, embrace the greater portion of this survey.
E 3 (Central India), Malwa -	- - Maps of the Principality of Bhopal, and of the adjoining Purgunnah of Bairseea to the north.	- - Captain J. Johnson, surveyor in Malwa.	1822	- - These maps consist of routes, and cross routes, and are anything but well detailed, and may be classified with the commonest order of compass and perambulator surveys. Yet superior geographical information exists not in this office at present, relative to this part of the country. Atlas sheets Nos. 53 and 71, and part of 70, will embrace this survey. The Great Arc series of the great trigonometrical survey, traversing the centre of the map, will serve to supply corrections to several points that are identical. A fair copy was supplied to the India House in December 1822. The original map of Bhopal is not forthcoming in this office; a copy exists, rather rudely executed.
Berar, Nagpoor - -	- - Map of a survey of 24,000 square miles of the Nagpoor territory.	- - Messrs. Norris and Weston, late Lieutenants Nagpoor service.	1831	- - The character and value of this survey, and the general principles on which it was conducted throughout from its first commencement, are recorded in the report drawn up in 1832 by Captain R. Wilcox and Lieutenant A. S. Waugh, at the desire of Captain G. Everest, then Surveyor-general of India. This report was forwarded to the Military Department on the 24th December of that year, for transmission to the India House. Sheet No. 72 of the Indian Atlas embraces a portion equivalent to two-thirds of this survey. Whatever be its merits or demerits, it certainly contains geographical information full of detail, more so than any other document forthcoming in this office, relative to this part of the country. The remaining one-third portion of this map to the south, will serve to furnish materials for nearly one-half of Atlas sheet No. 73.

(*continued*)

TABULAR GEOGRAPHICAL STATEMENT of SURVEYS in *India*—continued.

PROVINCE OR DISTRICT.	TITLE OF SURVEY.	AUTHOR'S NAME.	DATE.	REMARKS BY THE SURVEYOR-GENERAL.
Kandeish - - -	- - 1. Map of the Province of Kandeish according to a survey completed in 1821 and 1822, under the direction and superintendence of Captain John Briggs, political agent. 2. With a trigonometrical skeleton plan of ditto. 3. A map of the northern frontiers of their Highnesses the Nizam and Peishwa's dominions. 4. A map of the province of Kandeish.	- - Surveyed by Messrs. A. White and James Evers, under the direction of Captain John Briggs, political agent. - - Captain Thomas De Haviland, engineer and surveyor, Nizam's subsidiary force. - - Compiled in the Surveyor-general's office, Calcutta, from Captain De Haviland's map and Lieutenant Shortrede's triangulation.	1821–22 January & February, 1806 1838.	- - The original maps of this survey were transmitted to the India House in September 1838, together with an office compilation of the Province of Kandeish, with corrections applied to five corresponding southerly points from Lieutenant Shortrede's triangulation of the Konkan. On the face of the original map of Kandeish the following remarks appear:—"The map was constructed on a series of positions fixed by cross bearings taken with a circumferentor on stand, made by Adams, London, with a telescope and hair-sights, from a base line of two miles in length at Dhoolia measured by a ten-feet wooden rod, on levels taken for the purpose. The intermediate parts of the map, where places could not be seen by the person carrying on the trigonometrical survey, were filled up by measured routes and bearings made with a perambulator, a brass 100-feet chain, and small circumferentors. The object has been to include every village inhabited or uninhabited, but some of the latter were not to be found." From these remarks the character and geographical value of this survey may be estimated; on a comparison being instituted with the distances of places common to the original of this plan as well as to other maps, a discrepancy (in excess by this survey) from 15 to 20 per cent. has been found. Whatever may be its faults, no better detailed survey of this part of India is forthcoming amongst the records of this office. It would supply materials for Atlas sheets Nos. 37 and 38.
Nizam's dominions, Hydrabad.	- - Surveys of the Circars in the territory of his Highness the Nizam of Hydrabad, from its commencement in 1816 to the present time.	- - Captains J. Garling, R. Young, Lieutenants S. C. Macpherson and J. S. Du Vernet, Captains H. Morland and Crisp, and Assistant-surveyors Ficker, Long, Hill, Britain, and Chamarett, and Major J. R. Brown.	1816 to 1848	- - This survey (from the commencement), having for its basis the trigonometrical operations of the late Colonel Lambton, has progressed systematically and steadily, and is as full of detail (having been conducted on the same principles) as the Madras Military Institution survey. The tract now completed, and of which the geographical features have been well ascertained, in superficial area amounts to nearly four-fifths ($\frac{4}{5}$) of the entire territory subject to the Nizam. This work has been accomplished in 32 years; supposing its progress to be uniform, it will require eight years more to bring it to a conclusion. Sheets Nos. 56, 58, 75, 76, and 94 have been already published, and the materials remaining for the other sheets will be supplied as soon as the necessary documents are received from the surveyors, and from the chief engineer at Bombay, at whose office several valuable geographical records have been detained for the last nine years, being a portion of what were taken round to Bombay by Major J. B. Jervis in October 1840.
[redacted]				

Madras Presidency:			
Carnatic	-- Surveys of the Military Institution in the Carnatic, including Pondicherry.	-- Officers of the Military Institution survey.	1805 to 1814 inclusive.
	Ditto of the Nellore district in the Carnatic.	-- Captain Snell and Lieutenant Macpherson.	1833 to 1836, & 1839 to 1840
Trichinopoly	-- Ditto of the Trichinopoly, Salem, and Barramahl districts.	-- Captains Ward, Hill, and Campbell.	1832 to 1834, & 1835 to 1838
		Captain Campbell	1828
Salem, Tanjore	Ditto of the Tanjore district	-- By assistant-surveyors Hamilton, Dunnigan, Summers, and Howell.	1809 to 1815
Ceded districts	-- Survey of the districts ceded to the East India Company in 1799 and 1800.	-- Captain C. Mackenzie, superintendent, and Assistant-surveyors John Mather and Michael Dunnigan.	1800 to 1809
Mysore	-- Surveys of the districts in the Province of Mysore.	Lieut. J. Garling, superintendent	1811 to 1813
		Ditto	1813 to 1815
Goa	Map of the Portuguese territory of Goa	-- Captain C. Mackenzie, superintendent.	1806
Soonda and Bilgy	Map of the districts of Soonda and Bilgy	Lieutenant P. E. Conner, surveyor	1815 to 1817
Canara	Map of the Province of Canara	-- Captain B. S. Ward and Lieutenant P. Conner.	1825 to 1829
Koorg	-- Map of the Principality of Koorg or Codugu.	-- Lieutenants Ward and Conner, and Messrs. Keyes and MacMahon.	1816 to 1819
Malabar	Map of the Province of Malabar	Captain Ward and Assistant-surveyors Robinson, Keyes, MacMahon, Turnbull, &c.	1813 to 1823
Cochin, Travancore	-- Survey of the province of Cochin and Travancore.	-- Messrs. Robinson, Hill, Fletcher, and Bird, assistant surveyors.	1808 to 1813
Coimbetoor, Dindigul, Madura, Ramnad	Surveys in the districts of Coimbetoor Dindigul, Madura, Ramnad	By the Assistant-surveyors Scott, Hamilton, and Summers.	1816 to 1819
Tinnevelly	Survey of the Tinnevelly province	-- Captain Snell and Assistant-surveyors Dunnigan, Anderson, and Barnett.	1821 to 1824
Northern Circars:		-- Captain Snell, Lieut. Otter, and Assistant-surveyors Dunnigan, Anderson, and Barnet.	1824 to 1825, and 1827 to 1829
Guntoor	Map of the Guntoor Circar	-- Captain Snell and Assistant-surveyors.	1829 to 1834
Condapilly	-- Map of the Condapilly and Masulipatam Circars.		
Rajahmundry	Map of the Rajahmundry Circar		
Vizagapatam	Map of the Vizagapatam Circar		
Ganjam	Map of the Ganjam Circar		

-- The surveys of the Peninsula of the Madras Presidency having had the advantage of being based on, and having proceeded simultaneously with the great trigonometrical survey of India since its institution in 1800, may be said to have been brought to a close some years back. The re-survey of several tracts of country in the districts of Nellore, Salem, Burramahl, North and South Arcot, that were but indifferently or partially surveyed, were executed within the last seven or eight years, and the originals transmitted to the India House. These have served to furnish materials to fill the blanks in the sheets of the Indian Atlas formerly published, and the Honourable Company's geographer has been enabled to send out second editions of such Atlas sheets duly corrected. Between Rajahmundry on the Godavery River to the south-west, Ganjam to the north-east (both in the Northern Circars), and the south-west frontier of the Bengal Presidency (lying northerly from Vizagapatam), there yet remains a portion of mountainous country to be surveyed, which, when concluded, will complete the admeasurements of the Madras Presidency in detail.

(continued)

TABULAR GEOGRAPHICAL STATEMENT of SURVEYS in *India*—continued.

PROVINCE OR DISTRICT.	TITLE OF SURVEY.	AUTHOR'S NAME.	DATE.	REMARKS BY THE SURVEYOR-GENERAL.
Northern Circars—*continued.*				
Goomsur, &c. - - -	- - Map of the Goomsur, Soradah, and Coraba Zemindaries.	- - Captain Snell, Lieuts. Hill, Macpherson, and Campbell; and Assistant-surveyors Barnett and Summers.	1831 to 1837	
	Map of surveys in the Goomsur country, and W. and N. W. of Ganjam.	Lieutenant Hill and Mr. Summers	1838 to 1841	
	Continuation of the Ganjam survey in the Khond and Jeypoor countries (north of Vizagapatam and west of Ganjam).	- - Messrs. Howard, Snell, and King, under the superintendence of Captain Halpin.	1845 to 1848.	
Bombay Presidency:				
Goozerat and Cutch - -	- - Map of the province of Goozerat, including Cutch.	Colonel Monier Williams - -	1813	- - This map was received from Bombay after the abolition of the Deputy Surveyor-general's office at that Presidency. It is perfectly worthless, being all rotten and in pieces.
Goozerat, Cutch, and Kattiawar.	- - Map of Cutch and the adjacent parts of Goozerat and Scind.	Colonel Monier Williams - -	1820	- - These are compass and perambulator surveys, with detail not based on triangulation of the Western Presidency. When connected with the Great Trigonometrical Survey of India, they may be turned to good account.
	A new map of Cutch, with the eastern mouth of the Indus, the Pachum Island, and Khureer.	- - Lieut. Alexander Burnes, Deputy Assistant Quartermaster-general.	1825–26, and 1827	
	Compilation map of Cutch - -	Bombay Office Compilation -	—	
	Degree maps of Cutch and part of Goozerat.	Bombay Office Compilation -	1827–28–30–32 and 1833	
	Map of the southern and western portions of the province of Kattiawar.	Captains Slight, Benbow, and Boyd; compiled by T. B. Jervis, major of engineers.	1841.	
Southern Rajpootana and Dukhin.	- - A delineation of the country (north of Cambay) in seven sheets.	Bombay Surveyor-general's department.	1809–1810	- - These being chiefly office compilations, no field-book, memoir, or journal are forthcoming. Similar to the preceding is the character of these surveys.
	Map of the northern frontiers of the Nizam's and Paishwa's dominions.	- - Captain Thomas De Haviland, engineers, and surveyor Nizam's Subsidiary Force.	1806	
	Map of the Dukhun, comprising the country between 16° and 19° N. lat., and 74° and 76½° E. long. (No. 361, or B-a-29).	Bombay Office Compilation -	1831	
	Degree maps of parts of the Dukhun and of South Konkan, between the parallels of 14° and 19° N. lat. and the meridians of 73° and 77° E. long.	Bombay Office Compilation, compiled from the surveys of the officers of the survey department.	1828–29–30–32.	

Revenue Survey (Ahmedabad, Baroch, and Soorut).	-- Revenue Survey of the tract of country to the north and east of the Gulf of Cambay.	-- Officers of the Bombay Presidency Survey Department.	Prior to 1832, August.	-- The tract of country on the map to the north and east of the Gulf of Cambay is denominated a Revenue Survey in a "Sketch Map," received from Bombay, dated September 1832, "exhibiting the countries surveyed in detail in that Presidency." But the maps of the aforesaid Revenue Survey have never been seen in my Calcutta office; nor do any documents exist to show that they were transmitted to the India House; hence the utter impossibility of pronouncing an opinion upon the value of this work as compared with that of the Bengal Presidency. The records are wanting that would indicate what maps constituted the annual despatches of the Bombay Deputy Surveyor-general. Whence it is not improbable that at the India House copies in duplicate or triplicate of the same geographical records will be found, for the reasons assigned above, as respects that Presidency.
Konkun, Sattara - -	Surveys in the Northern Konkun -	- Messrs. Aikin, Bartie, Springer, Decosta, and Fraser.	1833	-- These surveys, comprising in detail all geographical information, are based on good triangulation work.
Kolapoor, Dharwar - -	Surveys in the Southern Konkun -	Captain T. B. Jervis - -	1824 to 1829	-- The survey of the South Konkan, and that of the large tract of country denominated the "Dukhun," "Dukhin," or "Deccan," in the Bombay Presidency, has been executed in detail, but grounded on imperfect triangulation.
	Map of the Dharwar Collectorate, compiled in deputy surveyor-general's office, Bombay.	-- From the surveys of Captains Grafton Steel, Perry, and Le Messurier, Lieutenants Campbell, Cunningham, and Boyd, and Mr. Aikin.	1825.	
	Map of the territories of his Highness the Rajah of Sattara, and Jageerdars.	-- Compiled by Capt. H. Adams, revenue surveyor.	1824.	
	Compilation map of surveys in the Dukhun (west of Poonah).	Office compilation, Bombay -	1831.	
	Map of the territory of his Highness the Rajah of Kolapoor.	Ditto - - - - - -	1827.	
Marwar or Jodhpoor -	Map of the territory of Marwar or Jodhpoor.	-- Ditto ditto, Calcutta (scale 8 miles=1 inch.)	1845, April 25	-- These maps have been constructed from a variety of materials that were procurable in the various Government offices. The geographical information embodied therein consists of two or three sorts; part from good, part from indifferent survey, and part from information. The Government calls from time to time having been urgent to furnish maps of countries or districts of native states considerably beyond the limits of the British frontier, these maps have been constructed from geographical records possessing every degree and variety of character; they cannot, therefore, be classified with the compass and perambulator surveys in detail. The documents used in these compilations it would be unnecessary to detail, as all the routes, cross routes received from officers of the Quartermaster-general's department from time to time, and from other quarters, have been employed. The amateur survey of Lieut.-colonel Fielding, of part of the Gwalior territory, has also been incorporated. The originals of all these will be found at the India House. The whole tract of country to the westward of the meridian of Ulwur is unconnected with the great trigonometrical survey of India. The longitudes of the principal places, such as Jesulmeer, Balmer, Jodhpoor, Ajmere, Jypoor, and Tonk, are consequently uncertain to four or five miles in longitude. These surveys are indicated by a coat of blue interspersed with black dots.
Rajpootana, Meywar, Gwalior.	Compilation map of Rajpootana (unfinished), comprising Jodhpoor, Ajmeer, Jypoor, Ulwur, Bhurtpoor, with part of Meywar or Oodeepoor.	Ditto ditto (scale 8 miles=1 inch)	1849-50.	
	Map of the Gwalior territory, and adjoining native states in Central India.	-- Office compilation, Calcutta (scale 8 miles=1 inch).		

(*continued*)

TABULAR GEOGRAPHICAL STATEMENT OF SURVEYS in *India*—continued.

PROVINCE OR DISTRICT.	TITLE OF SURVEY.	AUTHOR'S NAME.	DATE.	REMARKS BY THE SURVEYOR-GENERAL.
Sindh	Map of Sindh, compiled in the office of the Surveyor-general of India, from various materials, March 1841.	Office compilation (scale 8 miles = 1 inch).	1841	This is a compilation from various routes, cross routes, sketches, &c., received from the Quartermaster-general's department and engineer officers attached to the Afghanistan campaign. The late Lieutenant Alexander Burnes's survey of the Indus has also been incorporated, with many corrections thereto, derived from other sources. But nothing in detail appears on the face of the map; hence this tract of country is left uncoloured on the accompanying sketch. A revenue survey thereof ordered by Government some two or three years back is in progress, combined with triangulation: this is intended to be connected with the great longitudinal series (now under charge of Captain Strange, second assistant great trigonometrical survey), which diverges from the Great Arc series, and will proceed westerly to reach the capital of Sindh. The correct latitudes and longitudes of Hyderabad, Omerkot, Tatta, Kurachee, Shikarpoor, Sukkur, Sehwan, and other remarkable places will then be ascertained with greater certainty than is now the case. A portion only of the above-mentioned revenue survey in Sindh is reported to have been completed; but the records detailing these operations have not been transmitted to the Presidency Office of this department.
Punjab				Of the Punjab no surveys in detail are forthcoming, except that of the Jullindhur Dooab, and of part of the conterminous pergunna of Kot Kangra. Of this, mention has already been made under the head of "Revenue survey of Jullindhur," *vide* p. 31. The revenue survey is advancing to the North-eastern Division of the Punjab; and measures are in progress to have the four dooabs of Sind Sagur, Jetch, Reechna and Baree (between the Indus and Beeas rivers) surveyed simultaneously if possible; otherwise, at as early a period as practicable, as the political state of the country will allow. Up to the present date scarcely any additional geographical information worth recording has been received relative to the Punjab. Sketches on uncertain scales, sketches from memory relative to the boundary line between Goolab Sing's territory, and of part of Punjab proper, have come to hand, but these can only be classified with imperfect materials. Scraps of three new routes to the north-east, and two to the south-west in the Punjab have been transmitted to this department by the Quartermaster-general and the chief engineer to the Board of Administration, but being unaccompanied with any field book, it is difficult to determine their precise value.

India - - - - -	Route Surveys - - - - - -	Various - - - - - -	various - -	- - In the Madras Presidency all the route surveys have been rendered valueless by the complete survey of the peninsula. The same remark will apply to those through the Nizam's dominions, and to the greater portion of others traversing the Bombay Presidency from Decsa and Puttun to Dharwar. In the Bengal Presidency all route surveys comprised within the coloured tracts are necessarily superseded by the revenue and other geographical surveys in detail. The tracts uncoloured indicate those parts of India of which topographical surveys are a great desideratum; our present geographical knowledge thereof mainly resting upon itineraries of travellers; European and native surveys of routes by hurkarahs, possessing every variety of character.
Bengal - - - - -	The Revenue Surveys in progress in Bengal at present, are of the following Districts, viz.:			
	Beerbhoom District - - - -	- - Under the superintendence of Capt. Sherwill, revenue surveyor.	1840-50	- - These surveys are being conducted on the same principles as these of Bengal and Behar before noticed at page 34. The map of the district of Beerbhoom will furnish materials for part of atlas sheet No. 113; that of the Rajshye district for parts of Nos. 119 and 120; that of the 24 Purgunnahs for part of No. 121. The rapid progress now likely to be made by these parties to the eastward renders it desirable that the great triangulation should be extended from its present limits, viz., the meridian of Calcutta, so as to comprehend the several remaining districts of Bengal, as far as Dacca, Silhet, and the valley of Assam.
	Raj-Shahee District - - - -	Mr. J. Pemberton, revenue surveyor.		
	Mymun Sing District - - -	Mr. A. Wyatt, revenue surveyor.		
	Kishungur District - - - -	Capt. R. Smyth, revenue surveyor.		
Trans and Cis Sutluj States	Revenue surveys of, are in progress -	- - Lieut. T. C. Blagrave and Capt. H. V. Stephen.	1849-50	- - These surveys, already alluded to at pages 31 & 32, are progressing satisfactorily under the superintendence of the officers here named.

Surveyor-general's Office, Dehra Doon,
20 October 1850.

A. S. Waugh, Lieutenant-Colonel, Engineers,
Surveyor-General of India,
and Superintendent Great Trigonometrical Survey.

RETURN of the Number and what Sheets of the GRAND ATLAS have been Completed and Engraved, with the Cost thereof to the Government, and the Selling Price per Sheet to the Public, and what progress the remaining Portions of the ATLAS are in.

Number according to Index.		
42	contains	North Canara, part of Soonda and Bilgy, and north-west part of Mysore.
43	„	South Canara, Koorg, and south-west part of Mysore.
44	„	part of Malabar.
47	„	Himalaya Mountains, Protected Hill States.
48	„	Protected Hill and Sikh States, Sirmoor, Dehra Doon, Suharanpoor, and Muzuffernuggur.
49	„	Meerut, Bulundshukur, Rohtuk, Dehli, Goorgaon, &c.
50	„	Muttra, Aga, Bhurtpoor, Marcherry, parts of Allygurh and of Jeypoor.
56	„	Oodgheer, Daroor, Kowlas, parts of Nandair, Beder, &c.
58	„	Moodgue, Raichoor, part of the Ceded Districts, &c.
59	„	parts of Mysore and the Ceded Districts.
60	„	parts of Mysore and Koorg.
61	„	parts of Malabar, Coimbatoor, Salem and Mysore.
62	„	Cochin, parts of Malabar, Travancore, Madura, Tinnevelly, &c.
63	„	parts of Travancore and Tinnevelly.
65	„	Himalaya Mountains, parts of Bussahir and Chinese Tartary.
66	„	Kumaon; part of Gurhwal, &c.
67	„	Moradabad, Pillibheet, Bareilly, parts of Shajehanpoor, Budaon, Oude, &c.
68	„	Furruckabad, Mynpoory.
69	„	parts of Cawnpoor, Futtehpoor, Jaloun, Bandah, Humeerpoor, Jansi, &c.
70	„	Saugor, and the States in South Bundelcund.
72	„	North-west part of the Rajah of Berar's dominions.
75	„	Hydrabad, Ramgur, Mungull, Daveconda. &c.
76	„	parts of Guntoor, Nelloor, Ceded Districts, &c.
77	„	parts of Ceded Districts, Nelloor and North Arcot.
78	„	Chingleput, parts of North and South Arcot.
79	„	Trichinopoly, parts of South Arcot, Salem and Tanjore.
80	„	parts of Madura, Ramnad, Tanjore, &c.
81	„	parts of Tinnevelly and Ramnad.
89	„	Rewah Territory, parts of Mirzapore, Singrowlee, &c.
94	„	Rajahmundry, Ellore, parts of Condapilly and Kummamet.
95	„	parts of Guntoor and Masulipatam.
107	„	parts of Ganjam, Goondwara, Colahandy, &c.
108	„	parts of Vizagapatam and Ganjam.
109	„	part of Vizagapatam.
124	„	Goalpara, Kamroop, part of Nowgong, &c.
125	„	Sylhet, Cachar, Cossya Hills, and part of Mymunsing.
129	„	parts of Luckimpoor, Seebpoor, &c.

130 contains

130 contains parts of Nowgong, Luckimpoor, Seebpoor, &c.

131 „ Muneepoor.

8 „ Hill Country north-east of Assam.

Index Sheet.

The above 41 sheets, including the index sheet, have been published; five of them have been re-drawn and engraved. The cost for the drawing and engraving amounts to £.5,844.

The selling price per sheet is 4*s.* coloured.

SHEETS of the INDIAN ATLAS now in course of being Engraved.

Number according to Index Map.		
24	contains	Northern Konkun.
25	„	part of Southern Konkun, including Bombay.
26	„	part of Southern Konkun.
27 } 41 }	„	parts of Southern Konkun, Southern Mahratta Country, Goa Territory, &c.
39	„	Poonah, Ahmednuggur, parts of Bheer, Purrainda, &c.
40	„	The Satara Territory, Kolapoor, Beejapoor, &c.
51	„	parts of Scindiah's Dominions, Kotah, &c.
55	„	Bassim, Maiker, parts of Jalnah, Patree, &c.
57	„	Mulkhaid, Koolburga, Suggur, and part of Sholapoor.
74	„	Eilgundel, Mullungoor, Wurungul, &c.
88	„	Allahabad, Jounpoor, parts of Bandah, Futtehpoor, Mirzapore, Benares, Azimgurh, and of the southern part of the territory of Oude.
102	„	parts of Goruckpoor, Sarun, Tirhoot and Nepal.
103	„	Ghazeepore, parts of Shahabad, Behar, Patna, Azimgurh, Sarun, Benares and Tirhoot.

East India House, 2 April 1851.

John Walker.

STATEMENTS to illustrate the nature of the different Great Divisions, and Smaller Districts or Departments thereof, into which India within the line of the Indus is divided, for Political, Civil, Revenue, Judicial, and Military purposes, exhibiting the Areas, Population, and nature of Productions thereof; and showing the relation and authority under which they stand in to the East India Company, whether immediately subordinate to and under the direct Rule, or are Tributary, Protected, Subsidiary, or Independent.

THE great divisions of India under the direct rule of the East India Company may be considered to be the Presidency of Bengal, the Lieutenant-governorship of the North Western Provinces, the Presidency of Madras, and the Presidency of Bombay. The territories included in these divisions are for the most part subject to the Regulations enacted previously to the last Charter Act, by the respective governments of Bengal, Madras, and Bombay, and subsequently by the Governor-general in Council. But there are portions exempt from the ordinary Regulations, and administered by officers appointed either by the Governor-general, the Lieutenant-governor of the North Western Provinces, or by the Governors of Madras and Bombay, and accountable immediately to the authority from which they derive their power. Within these limits are also situate the territories not under the direct rule of the East India Company, containing the states and possessions of native princes.

According to existing arrangements, the Regulation Districts of the Presidency of Bengal are distributed, for revenue purposes, primarily into "Divisions." Of these there are seven, each containing several sub-divisions, called Collectorates or Zillahs, as enumerated in the following list:

BENGAL.

REGULATION DISTRICTS.

DIVISIONS.	DISTRICTS.	AREA		POPULATION	
		Of each District.	Of Total Division.	Of each District.	Of Total Division.
		Sq. Miles.			
Jessore	Jessore	3,512		381,744	
	Twenty-four Pergunnahs	1,186		288,000	
	Burdwan	2,224		1,854,152	
	Hoogly	2,089		1,520,840	
	Nuddea	2,942		298,736	
	Bancoorah	1,476		480,000	
	Baraset	1,424		522,000	
			14,853		5,345,472
Bhaugulpore	Bhaugulpore	5,806		2,000,000	
	Dinajpore	3,820		1,200,000	
	Monghyr	2,558		800,000	
	Poorneah	5,878		1,600,000	
	Tirhoot	7,402		2,400,000	
	Maldah	1,000		431,000	
			26,464		8,431,000
Cuttack	Cuttack with Pooree:				
	Cuttack 3,061				
	Pooree 1,768				
		4,829		1,000,000	
	Balasore	1,876		556,395	
	Midnapore and Hidgellee	5,029		666,328	
	Koordah	930		571,160	
			12,664		2,793,883
Moorshedabad	Moorshedabad	1,856		1,045,000	
	Bagoorah	2,160		900,000	
	Rungpore	4,130		2,559,000	
	Rajshahye	2,084		671,000	
	Pubna	2,606		600,000	
	Beerbhoom	4,730		1,040,876	
			17,566		6,815,876
Dacca	Dacca	1,960		600,000	
	Furreedpore, Dacca Jelalpore	2,052		855,000	
	Mymensing	4,712		1,487,000	
	Sylhet, including Jyntea	8,424		380,000	
	Bakergunge, including Deccan Shabazpore.	3,794		733,800	
			20,942		4,055,800
Patna	Shahabad	3,721		1,600,000	
	Patna	1,828		1,200,000	
	Behar	5,694		2,500,000	
	Sarun, with Chumparan	2,560		1,700,000	
			13,803		7,000,000
Chittagong	Chittagong	2,560		1,000,000	
	Tipperah and Bulloah	4,850		806,950 600,000	
			7,410		2,406,950
	Carried forward		113,702		36,848,981

(continued)

BENGAL—*continued.*

The NON-REGULATION PROVINCES within the limits of the Presidency of *Bengal*, subject to the Authority of Functionaries appointed by the Governor-General or Government of Bengal, are as follows,

DIVISIONS.	DISTRICTS.	AREA		POPULATION	
		Of each District.	Of each Division.	Of each District.	Of each Division.
		Sq. Miles.			
	Brought forward - - -	- -	113,702	- - -	36,848,981
	Jaloun and the Pergunnahs ceded by Jhansie.	- -	1,873	- - -	176,297
	The Saugor and Nerbudda Territories, comprising the Districts of,—				
	Saugor - - - - -	1,857	- -	305,594	
	Jubbulpore - - - -	6,237	- -	442,771	
Saugor and Nerbudda -	Hoshungabad - - -	1,916	- -	242,641	
	Seonee - - - - -	1,459	- -	227,070	
	Dumoh - - - -	2,428	- -	363,584	
	Nursingpore - - - -	501	- -	254,486	
	Baitool - - - -	990	- -	93,441	
	British Mahairwarrah - -	282	- -	37,715	
			15,670		1,967,302
	Umballah - - - - - -	293	- -	67,134	
	Loodianah, including Wudni -	725	- -	120,898	
	Kythul and Ladwa - - -	1,538	- -	164,805	
	Ferozepore - - - - -	97	- -	16,890	
Cis-Sutlej - - -	Territory lately belonging to Seik chiefs who have been reduced to the condition of British subjects, in consequence of non-performance of feudatory obligations during Lahore war - - -	1,906	- -	- - -	249,686
			4,559		369,727
	Cossya Hills - - - - -	729	- -	10,935	
	Cachar - - - - - -	4,000	- -	60,000	
			4,729		
	Lower: Camroop - - - 2,788	- -	- -	300,000	
	Lower: Nowgong - - - 4,160	- -	- -	70,000	
North-east Frontier (Assam)	Lower: Durrung - - - 2,000	- -	- -	80,000	
		8,948			
	Upper: Joorhat (Seebpoor) - 2,965	- -	- -	200,000	
	Upper: Luckimpoor - - 2,950	- -	- -	30,000	
	Upper: Sudiya, including Mutruck 6,942	- -	- -	30,000	
		12,857			780,935
			21,805		
Goalpara - - - -	- - - - - - - - -	- -	3,506	- - -	400,000
Arracan - - - -	- - - - - - - - -	- -	15,104	- - -	321,522
Tenasserim Provinces -	- - - - - - - - -	- -	29,168	- - -	115,431
	Sumbulpore - - - - -	4,693	- -	800,000	
	Ramgurh or Hazareebah - -	8,524	- -	372,216	
South-west Frontier -	Lohurdugga {Chota Nagpore and Palamow - -}	5,308 / 3,468	- -	482,900	
	Singhbhoom - - - - -	2,944	- -	200,000	
	Maunbhoom {Pachete - - - Barabhoom - -}	4,792 / 860	- -	772,340	
			30,589		2,627,456
The Punjaub, inclusive of the Julundur Doab and Kooloo territory -	- - - - - - - - -	- -	78,447	- - -	4,100,983
	The Sunderbunds:				
	From Saugor Island on the west, to the Ramnabad Channel on east - - - - - -	- -	6,500	- - -	unknown.
	TOTAL - - -	- -	325,652	- - -	47,958,320

NORTH WESTERN PROVINCES.

THE REGULATION PROVINCES of the *Agra* Division of the *Bengal* Presidency subject to the Jurisdiction of the Lieutenant-Governor of the North Western Provinces, are divided as follows.

DIVISIONS.	DISTRICTS.	AREA		POPULATION	
		Of each District.	Of each Division.	Of each District.	Of each Division.
		Sq. Miles.			
Delhi	Paneeput	1,279	- -	283,420	
	Hurreeanah	3,300	- -	225,086	
	Delhi	602	- -	306,550	
	Rohtuck	1,340	- -	294,119	
	Goorgaon	1,942	- -	460,326	
			8,463		1,569,501
Meerut	Saharunpoor	2,165	- -	547,353	
	Mozuffernuggur	1,617	- -	537,594	
	Meerut	2,332	- -	860,736	
	Boolundshuhur	1,855	- -	699,393	
	Allygurh	2,149	- -	739,356	
			10,118		3,384,432
Rohilcund	Bijnour	1,904	- -	620,546	
	Moradabad	2,967	- -	997,362	
	Budaon	2,368	- -	825,712	
	Bareilly and Pillibheet	2,937	- -	1,143,657	
	Shajehanpore	2,483	- -	812,588	
			12,659		4,399,865
Agra	Muttra	1,607	- -	701,688	
	Agra	1,860	- -	828,220	
	Furruckabad	1,909	- -	854,799	
	Mynpoorie	2,009	- -	639,809	
	Etawah	1,674	- -	481,224	
			9,059		3,505,740
Allahabad	Cawnpore	2,337	- -	993,031	
	Futtehpore	1,583	- -	511,132	
	Humeerpore and Calpee	2,240	- -	452,091	
	Banda	2,878	- -	552,526	
	Allahabad	2,801	- -	710,263	
			11,839		3,219,043
Benares	Goruckpore	7,346	- -	2,376,533	
	Azimghur	2,520	- -	1,313,950	
	Jounpore	1,552	- -	798,503	
	Mirzapore	5,235	- -	831,388	
	Benares	994	- -	741,426	
	Ghazepore	2,187	- -	1,059,287	
			19,834		7,121,087
	Carried down	- -	71,972	- - -	23,199,668

NON-REGULATION PROVINCES.

DIVISIONS.	DISTRICTS.	AREA		POPULATION	
		Of each District.	Of each Division.	Of each District.	Of each Division.
		Sq. Miles.			
	Brought down	- -	71,972	- - -	23,199,668
	The Butty Territory, including Wuttoo	3,017	- -	112,974	
	Pergunnah of Kote Kasim	70	- -	13,767	
	Jaunsar and Bawur	579	- -	24,684	
	Deyrah Dhoon	673	- -	32,083	
	Kuman (including Ghurwal)	6,962	- -	166,755	
	Ajmeer	2,029	- -	224,891	
	British Nimaur	269	- -	25,727	
			13,599		600,881
	TOTAL	- - -	85,571	- - -	23,800,549

MADRAS.

Madras is divided for Revenue purposes into Twenty-one Divisions or Collectorates, of which the Eighteen following are under the Regulations of the Madras Government.

DIVISIONS.	DISTRICTS.	AREA		POPULATION	
		Of each District.	Of each Division.	Of each District.	Of each Division.
			Sq. Miles.		
	Rajahmundry		6,050	887,260	
	Masulipatam		5,000	544,672	
	Guntoor, including Palnaud		4,960	483,831	
	Nellore		7,930	421,822	
	Chingleput		3,020	404,368	
	Madras, included in Chingleput			462,951	
	Arcot, South Division, including Cuddalore.		7,610	873,925	
	Arcot, North Division, including Consooddy.		5,790	623,717	
	Bellary		13,056	1,200,000	
	Cuddapah		12,970	1,228,546	
	Salem, including Vomundoor and Mullapandy.		8,200	946,181	
	Coimbatore		8,280	821,986	
	Trichinopoly		3,000	634,400	
	Tanjore, including Najore		3,900	1,128,730	
	Madura, including Dindigul		10,700	570,340	
	Tinnivelly		5,700	1,065,423	
	Malabar		6,060	1,318,398	
	Canara		7,720	995,656	
	Carried down		119,946		14,612,206

The Three following are Non-Regulation Districts, and are under the control of Agent of the Governor.

DIVISIONS.	DISTRICTS.	AREA		POPULATION	
		Of each District.	Of each Division.	Of each District.	Of each Division.
			Sq. Miles.		
	Brought down		119,946		14,612,206
	Gangam	6,400		438,174	
	Vizagapatam	15,300		1,047,414	
	Kurnool	3,243			
			24,943	241,632	1,727,220
	Total		144,889		16,339,426

BOMBAY.

For Revenue Purposes the British Territory of the Bombay Presidency is divided into Thirteen Divisions or Collectorates.

DIVISIONS.	DISTRICTS.	AREA: Of each District.	AREA: Of each Division.	POPULATION: Of each District.	POPULATION: Of each Division.
			Sq. Miles.		
Surat			1,629		433,260
Broach			1,319		262,631
Ahmedabad			4,356		590,754
Kaira			1,869		536,513
Khandeish			9,311		685,619
Tannah			5,477		764,320
Poonah			5,298		604,990
Ahmednuggur, including Nassick Sub-collectorate.			9,931		929,809
Sholapore			4,991		613,863
Belgaum			5,405		860,193
Dharwar			3,837		647,196
Rutnagherry			3,964		625,782
Bombay Island, including Colaba Island.			18		566,119
	Carried down		57,405		8,151,049

The following are the Non-Regulation Provinces under the Control of the Bombay Government.

DIVISIONS.	DISTRICTS.	AREA: Of each District.	AREA: Of each Division.	POPULATION: Of each District.	POPULATION: Of each Division.
			Sq. Miles.		
	Brought down		57,405		8,151,049
			318		53,453
Colaba				250,000	
Sinde	Shikapore	6,120		700,000	
	Hydrabad	30,000		324,744	
	Kurrachee	16,000			1,274,744
			52,120		1,005,771
Sattara			10,222		
	Total		120,065		10,485,017
EASTERN STRAITS SETTLEMENTS.					
	Penang	160		39,589	
	Province Wellesley	140		51,509	
			300		91,098
	Singapore	275			57,421
	Malacca	1,000			54,021
	Total		1,575		202,540

NATIVE STATES:

Not under the direct Rule, but within the Limits of the Political Supremacy of the East India Company, classed with reference to the British Authority with which they are immediately connected.

DIVISIONS.	STATES.	AREA		POPULATION		Nature of Connexion with the British Government.	REMARKS.
		Of each State.	Of each Division.	Of each State.	Of each Division.		
	BENGAL:	*Sq. Miles.*	*Sq. Miles.*				
Political Resident, Hyderabad	Hyderabad or Nizam	-	95,337	-	10,666,080	Subsidiary alliance.	
Political Resident, Oude	Oude	-	23,738	-	2,970,000	Subsidiary alliance.	
Political Resident, Nepaul	Nepaul	-	54,500	-	1,040,000	- - This State is not under British protection, but the Rajah is bound by treaty to abide, in certain cases, by the decision of the British Government, and prohibited from retaining in his service subjects of any European or American state.	
Political Resident, Nagpore	Nagpore or Berar	-	76,432	-	4,650,000	Subsidiary alliance.	
	Gwalior	33,119	-	3,228,512	-	Subsidiary alliance.	
	Bundelcund:						
	Adjyghur	340	-	45,000	-	- - Tributary and protected, but without subsidiary engagements	Chiefs reinstated or confirmed in their possessions upon the annexation of Bundelcund to the British dominions in 1802, when ceded by the Peishwah for the payment of the subsidiary force.
	Allypoora	85	-	9,000	-	Protection on the part of the British Government; submission and allegiance on the part of the native states	
	Bijawur	920	-	90,000	-		
	Baonee	127	-	18,800	-		
	Behut	15	-	2,500	-		
	Bijna	27	-	2,800	-		
	Berounda	275	-	24,000	-		
	Bhysondah	8	-	2,000	-		
	Behree	30	-	2,500	-		
	Chirkaree	880	-	81,000	-	Tributary and protected - -	
	Chutterpore	1,240	-	120,000	-	Protection on the part of the British Government; submission and allegiance on the part of native states -	
	Dutteah	850	-	120,000	-		
	Doorwai	18	-	3,000	-		
	Gurowlee	50	-	5,000	-		
	Gorihar	76	-	7,500	-		
	Jhansi	2,532	-	200,000	-		
	Jussoo	180	-	24,000	-		
	Jignee	27	-	2,800	-		
	Khuddee	22	-	2,800	-		

Governor-general's Agent for Scindia's dominions, Bundelcund, Saugor, and Nerbudda Territories.

Governor-general's Agent for Scindia's dominions, Bundelcund, Saugor, and Nerbudda Territories	Kampta	1			300							
	Logasee	29			3,500							
	Mukree	10			1,600							ditto
	Mowagoon	16			1,800							
	Nyagaon	30			5,000							
	Oorcha	2,160			192,000							Tributary and protected
	Punna	088			67,500							
	Paharee	4			800							
	Pulrah	10			1,600							Protection on the part of the British Government; submission and allegiance on the part of the native states
	Paldeo	28			3,500							
	Poorwa	12			1,800							
	Sumpthur	175			28,000							
	Surehlah	35			4,500							
	Tohree Futtepoor	36			6,000							Tributary and protected
	Taraon	12			2,000							
	Saugor and Nerbudda Territory:											
	Kothee	100			30,000							Protection on the part of the British Government; submission and allegiance on the part of the native states
	Mylheer	1,026			100,000							
	Ocheyrah	436			120,000							
	Reva and Mookundpore	9,827			1,200,000							
	Sohawul	179			80,000							
	Shagurh	676			30,000							
						50,311		5,871,112				ditto.
	Indore	8,318			815,164							Subsidiary alliance.
	Amjherra	584			57,282							-- Protected by the British Government. Tributary to Scindia
	Alle Mohun or Rajpoor Ali	708			09,384							Tributary and protected
	Burwanee	1,380			13,800							Dependent but not tributary
	Dhar	1,070			104,860							Under British protection
	Dewas	256			26,088							-- Under British protection, and bound to furnish a contingent force
												Under British protection
Resident at Indore	Jowra and its Jaghiredars	872			85,456							-- Under British protection.
	Jaboora	1,348			132,104							Tributary to Holcar, and contributes in aid of Malwa Bheel corps
	Rutlam	930			91,728							-- Protected by the British.
	Seeta Mhow	208			20,384							Tributary to Scindia
						15,630		1,415,200				-- ditto
Bhopal Political Agent, under Resident at Indore	Bhopal	6,764			663,656							-- Under British protection, and bound to maintain a contingent force
												-- Protected, but tributary to Scindia and Holcar
	Rajgurh and Nursinghur	1,348			132,104							Under British protection
	Koorwaee	200			19,600							
						8,312		815,360				

(continued)

NATIVE STATES—*continued.*

DIVISIONS.	STATES.	AREA: Of each State.	AREA: Of each Division.	POPULATION: Of each State.	POPULATION: Of each Division.	Nature of Connexion with the British Government.	REMARKS.
	BENGAL—*continued.*	*Sq. Miles.*	*Sq. Miles.*				
Governor-general's Agent for States of Rajpootana	Under direct charge of Govr-general's agent for States of Rajpootana: Alwur	3,573		280,000		Under British protection, but not tributary.	
	Bhurtpore	1,978		600,000			
	Bikaneer	17,676		539,250			
	Jessulmeer	12,252		74,400			
	Kishengurh	724		70,952			
	Kerowlee	1,878		187,800			
	Tonk and its dependencies.	1,864		182,672			
	Dholepore	1,626		550,000		Independent.	
	Harrowtee Political Agency: Kotah	4,339		433,900		Tributary and protected.	
	Shallawur	2,200		220,000			
	Boondee	2,291		229,100			
	Political Agency: Joudpore	35,672		1,783,600			
	Political Agency: Jeypore	15,251		1,891,124			
	Mewar Agency: Odeypore	11,614		1,161,400		Protected by British Government, but tributary to Holcar.	
	Pertabgurh	1,457		145,700			
	Doongerpore	1,000		100,000		Tributary and protected.	
	Banswara	1,440		144,000			
	Political Agency: Serohee	3,024		151,200			
			119,859		8,745,098		
Agent in Rochilcund	Rampoor		720		320,400	Protected, but not tributary.	
Superintendent of Hill States	Hill States:						
	Bhagul	100		40,000		Tributary and protected	Chiefs confirmed in their possessions at the close of the Nepaul war in 1815.
	Bughat	30		3,420		Protected, but not tributary	
	Bujee	70		25,000		Tributary and protected	
	Bejah	5		3,000			
	Bulsun	64		5,000			
	Bussahir	3,000		150,000			
	Dhamie	25		3,000			

Superintendent of Hill States	Dhoorcattie	-	-	-	5	-	-	200	-	-	-	Tributary and protected	-
	Gurwhal	-	-	-	4,500	-	-	100,000	-	-	-	Protected, but not tributary	-
	Hindoor or Nalagurh	-	-	-	233	-	-	20,000	-	-	-		
	Joolul	-	-	-	330	-	-	15,000	-	-	-	Tributary and protected	-
	Kothar	-	-	-	12	-	-	4,000	-	-	-		
	Koomyhar	-	-	-	12	-	-	2,500	-	-	-		- - Chiefs confirmed in their possessions at the close of the Nepaul war in 1815.
	Keonthul	-	-	-	272	-	-	26,000	-	-	-	Protected, but not tributary	-
	Koomharsin	-	-	-	56	-	-	12,000	-	-	-		
	Kuhloor	-	-	-	150	-	-	32,250	-	-	-		
	Mangul	-	-	-	15	-	-	1,000	-	-	-		
	Muhlog	-	-	-	50	-	-	13,000	-	-	-		
	Manee Meyrah	-	-	-	80	-	-	16,720	-	-	-		
	Sirmoor	-	-	-	1,075	-	-	62,350	-	-	-		
	Mundi	-	-	-	759	-	-	113,091	-	-	-	Tributary and protected	- - Chiefs confirmed in their possessions upon the acquisition of the Julundur Doab.
	Sookeit	-	-	-	174	-	-	26,926	-	-	-		
						11,017			673,457				
Delhi Agency	Jhujjur	-	-	-	1,230	-	-	110,700	-	-	-	Under British protection, but not tributary.	
	Bahadoorgurh	-	-	-	48	-	-	14,400	-	-	-		
	Bullubgurh	-	-	-	190	-	-	57,000	-	-	-		
	Patowdee	-	-	-	74	-	-	6,660	-	-	-		
	Deojana	-	-	-	71	-	-	6,390	-	-	-		
	Loharoo	-	-	-	200	-	-	18,000	-	-	-		
	Furrucknuggur	-	-	-	22	-	-	4,400	-	-	-		
						1,835			217,550				
	Seik Protected States:												
Commissioner and Superintendent, Cis-Sutlej States	Puttiala	-	-	-	4,448	-	-	662,752	-	-	-	Protected	- - Seik states taken under British protection by treaty with the Ruler of the Punjaub, 25 April 1809, but not tributary.
	Jheend	-	-	-	376	-	-	56,024	-	-	-		
	Furreedkote	-	-	-	308	-	-	45,892	-	-	-		
	Rai Kote	-	-	-	6	-	-	894	-	-	-		
	Boorech (Dealgurh)	-	-	-	80	-	-	11,920	-	-	-		
	Mundote	-	-	-	780	-	-	116,220	-	-	-		
	Chichrowlee	-	-	-	63	-	-	9,387	-	-	-		
	Nabha	-	-	-	541	-	-	80,609	-	-	-		
	Mulair Kotla	-	-	-	144	-	-	21,456	-	-	-		
						6,746			1,006,154				
Political Agent, South West Frontier	Korea	-	-	-	2,225	-	-	100,000	-	-	-	Tributary and protected	- - These states are comprised within the territory ceded to the British by the Rajah of Nagpore, under the treaty of 1826.
	Sirjooja	-	-	-	5,441	-	-	316,252	-	-	-		
	Jushpoor	-	-	-	617	-	-	27,765	-	-	-		
	Odeypore	-	-	-	2,306	-	-	133,748	-	-	-		
	Suctee	-	-	-	268	-	-	12,060	-	-	-		
	Sohnpor	-	-	-	1,467	-	-	66,015	-	-	-		
	Burgun	-	-	-	399	-	-	17,955	-	-	-		
	Nowagur	-	-	-	1,512	-	-	68,040	-	-	-		
	Ryghur	-	-	-	1,421	-	-	63,945	-	-	-		
	Patna	-	-	-	1,158	-	-	52,110	-	-	-		
					16,814	-	-		857,890				

(continued)

NATIVE STATES—*continued.*

DIVISIONS.	STATES.	AREA: Of each State.	AREA: Of each Division.	POPULATION: Of each State.	POPULATION: Of each Division.	Nature of Connexion with the British Government.	REMARKS.
	BENGAL—*continued.*	*Sq. Miles.*	*Sq. Miles.*				
Political Agent, South West Frontier	Gangpoor	2,493		112,185		Tributary, and protected	These states are comprised within the territory ceded to the British by the Rajah of Nagpore, under the treaty of 1826.
	Keriall	1,512		68,040			
	Bonei	1,057		47,565			
	Phooljee	890		40,050			
	Sarunghur	799		35,955			
	Bora Samba	622		27,990			
	Bombra	1,244		55,980			
	Singboom, Kursava, Serickala (Petty States included in British district of Singbhoom)		25,431		1,245,655		
Superintendent at Darjeeling	Sikkim		2,504		92,648	Tributary, and protected.	
Board of Administration for Affairs of the Punjaub	Bahwulpore		20,003		600,000	Protected, but not tributary; dependent, but not bound by subsidiary engagements.	
	Gholab Singh		25,123		750,000	British supremacy acknowledged; to be assisted in defending himself from his enemies.	
Governor-General's Agent, North East Frontier	Cooch Behar	1,364		136,400		Tributary, and protected.	
	Tuleram Senaputty	2,000		30,000		Protected.	
	Cossya and Garrow Hills:						
	Garrows, The	2,268					
	Ram Rye	328					
	Nustung	360					
	Muriow	283					
	Molyong	110		65,205		Protection on the part of the British Government; submission on the part of the Native States.	
	Mahram	162					
	Osimla	350					
	Kyrim, and other petty chiefs	486	7,711		231,605		

Political Agent	Munneepore	-	7,584	-	75,840	Protected, but not tributary.
	Tipperah (Independent) country covered with jungle.	-	7,632	-	7,632	Independent.
	Cuttack Mehals:					
	Dhenkanaul					
	Autgur					
	Berumbah					
	Tiggreah					
	Banky					
	Nyaghur					
	Kundiapurra	7,695	-	346,275	-	Tributary.
	Runpoor					
	Hindole					
	Angool					
	Nursingpoor					
	Talchur					
	Neelgur					
	Koonjerry	5,022	-	225,990		
	Mohurbunge	2,025	-	91,125		
	Boad	1,377	-	61,965		
	Autmallic	648	-	29,160		
	Duspulla	162	-	7,290		
			16,929		761,805	
	TOTAL BENGAL		583,404		43,054,596	
	MADRAS:					
Resident at Cochin	Cochin	-	1,088	-	288,176	Subsidiary alliance.
Commissioner of Mysore	Mysore	-	30,886	-	3,000,000	- - Subsidiary alliance; at present under British management.
Resident at Travancore	Travancore	-	4,722	-	1,011,824	Subsidiary alliance.
Government Agent for district of Vizagapatam.	Jeypore and Hill Zemindars	-	13,041	-	391,230	Protected.
	TOTAL MADRAS		50,637		4,691,230	

(*continued*)

NATIVE STATES—*continued.*

DIVISIONS.	STATES.	AREA: Of each State.	AREA: Of each Division.	POPULATION: Of each State.	POPULATION: Of each Division.	Nature of Connexion with the British Government.	REMARKS.
	BOMBAY:	*Sq. Miles.*	*Sq. Miles.*				
Political Resident at Baroda	Baroda (Guicowar's dominions)	- - -	4,399	- - -	325,526	Subsidiary alliance.	
Ditto at Kattywar	Kattywar (several petty chiefs)	- - -	19,850	- - -	1,468,900		
Political Agent at Pahlunpore	Pahlunpore	1,850	- - -	136,900	- - -	- - Under British control; tributary to the Guicowar.	
	Radhunpore	850	- - -	62,900	- - -		
	Warye	- - -	- - -	- - -	- - -		
	Thurraud	- - -	- - -	- - -	- - -		
	Merwara	- - -	- - -	- - -	- - -		
	Wow	- - -	- - -	- - -	- - -		
	Soegaum	- - -	- - -	- - -	- - -		
	Charcut	2,325	- - -	172,050	- - -		
	Therwarra	- - -	- - -	- - -	- - -		
	Deodur	- - -	- - -	- - -	- - -		
	Baubier	- - -	- - -	- - -	- - -		
	Thurra	- - -	- - -	- - -	- - -		
	Kankrej	- - -	- - -	- - -	- - -		
	Chowrar	225	- - -	16,650	- - -		
			5,250		388,500		
Collector of Kaira	Cambay	500	- - -	37,000	- - -	Tributary and protected.	
	Ballasinore	258	- - -	19,092	- - -		
			758		56,092		
Agent to Governor at Surat	Dhurrumpoor	225	- - -	16,650	- - -	Protected, but not tributary.	
	Banda	325	- - -	24,050	- - -		
	Suckeen	300	- - -	22,200	- - -		
			850		62,900		
Collector of Ahmednuggur	The Daung Rajahs	950	- - -	70,300	- - -	Tributary and protected.	
	Peint	750	- - -	55,500	- - -		
	Hursool	- - -	- - -	- - -	- - -		
			1,700		125,800		
Political Agent of Colapore	Colapore	- - -	3,445	- - -	500,000	- - Protected, and under British management.	
Political Superintendent of Sawunt Warree.	Sawunt Warree	- - -	800	- - -	120,000	- - Protected; and at present under British management.	
Political Agent in Myhee Caunta	Myhee Caunta	- - -	3,400	- - -	251,600	- - Under British control; tributary to the Guicowar.	
	Daunta	- - -	- - -	- - -	- - -		
	Edur	- - -	- - -	- - -	- - -		
	Ahmednuggur	- - -	- - -	- - -	- - -		
	Peit and other petty states	- - -	- - -	- - -	- - -		

Political Agent in Rewa Caunta	Rewa Caunta	4,879		361,046				
	Loonawarra							
	Soauth							
	Barreea							
	Odeypore (Chota)							
	Mewassee States							
	Rajpeepla and other petty states							
	Wusravee and adjacent country	450	5,329	33,300	394,346			Under British control; tributary to Guicowar and Scindia.
Political Agent in Cutch	Cutch		6,784		500,536			Subsidiary alliance.
	Sattara Jaghiredars:							
	Akulkote		75		8,325			
Akulkote under superintendence of Collector of Sholapore; remaining chiefs under Commissioner in Sattara	Bhore	included in Sattara						
	Juth							
	Ound							
	Phultun							
	Wylee							Tributary and protected.
Political Agent in Southern Mahratta Country	Southern Mahratta Jaghiredars		3,700		410,700			
	Sanglee							
	Koonwar							
	Meeruj							
	Jhumkundee							
	Moodhole							
	Nurgoond							
	Hablee							
	Savanoor							
	TOTAL BOMBAY		56,320		4,613,225			
French	FOREIGN POSSESSIONS:							
	Pondicherry	107		70,743				
	Karical	63		49,307				
	Yanaon	13		6,881				
	Mahè	2		2,616				
	Chandernagore	3	188	32,670	171,217			
Portuguese	PORTUGUESE POSSESSIONS:							
	Goa, and the Island of Demaun and Dieu.	800	800	unknown.				

ABSTRACT.

ABSTRACT.

BRITISH STATES.	AREA.	POPULATION.	AREA.	POPULATION.
	Sq. Miles.			
Bengal - - - - -	325,652	47,958,320		
North Western Provinces -	85,571	23,800,549		
Madras - - - - -	144,889	16,339,426		
Bombay - - - - -	120,065	10,485,017		
Eastern Straits Settlements -	1,575	202,540		
			677,752	98,785,852
NATIVE STATES:				
Bengal - - - - -	583,404	43,054,596		
Madras - - - - -	50,637	4,691,230		
Bombay - - - - -	56,320	4,613,225		
			690,361	52,359,051*
			1,368,113	151,144,903
FOREIGN STATES:				
French - - - - -	188	171,217		
Portuguese - - - -	800	not known		
			988	171,217
		GRAND TOTAL - - -	1,369,101	151,316,120

* It is proper to observe that this statement of the population of the Native States must be regarded only as an approximation to the actual amount. In a large number of cases the particulars have been derived from official sources; where no information of an official character existed, recourse was had to such publications as had reference to the subject; but some of these, it is right to mention, are not of recent date. Thus, the population of the States of Central India is given chiefly on the authority of Sir John Malcolm, and that of the Rajpoot States on that of Colonel Tod. In regard to the few States where no information from any quarter was attainable, the density of the population has been calculated in the same ratio to their areas as was found to prevail in the territories by which they are respectively surrounded.

THE judicial divisions correspond generally with the revenue subdivisions, which have already been given.

There do not appear to be any divisions, distinct from those recognised for revenue and judicial purposes, that can properly be called civil.

The military divisions, with the districts comprehended within their respective limits, are as under :—

BENGAL.

PRESIDENCY GARRISON.—Fort William and Allypoor.

PRESIDENCY DIVISION, comprising—

Assam.	Backergunge.	Bancoora.
Chittagong.	Cooch Behar.	Burdwan.
Arracan.	Rungpoor.	Nuddea.
Jyntia.	Dinagepoor.	
Sylhet.	Malda.	Jessore.
Goalparah.	Bogra.	Singbhoom.
Mymensing.	Beerbhoom.	Barabhoom.
Tipperah.	Moorshedabad.	Midnapore.
Dacca.	Rajeshye.	
Dacca.	Pubna.	Hoogly.
Jelalpoor.	Pachite.	24 Pergunnahs.
		Baraset.

DINAPORE

DINAPORE DIVISION:

Sarun.	Patna.	Palamow.
Tirhoot.	Monghyr.	Ramgurh.
Purnea.	Bhagulpoor.	Odeepoor.
Eastern Ghazepoor.	Behar.	Chota Nagpoor.
N. E. Shahabad.	Sirgooja.	Sumbulpoor.

BENARES DIVISION:

Goruckpoor.	Allahabad.	Rewa.
Azimgurh.	Benares.	Singrowlee.
Juanpoor.	S. E. Shahabad.	Eastern Bundelcund.
Western Ghazeepoor.		

CAWNPORE DIVISION:

Oude.	Etawah.	Humeerpore.
Furruckabad.	Cawnpore.	Banda.
Mynpoorie.	Futtehpoor.	Western Bundelcund.

MEERUT DIVISION:

Gurwhal.	Moradabad.	Shahjehanpoor.
Kumaon.	Meerut.	Delhi.
Dehra Doon.	Boolundshuhur.	Goorgaon.
Suharunpoor.	Pilleebheet.	Allygurh.
Moozuffurnuggur.	Bareilly.	Muttra.
Bijnoor.	Budaon.	Agra.

SIRHIND DIVISION:

Cis-Sutlej States.	Bhuttiana.	Paneeput.
Hill States.	Hurreana.	Kurnal.

GWALIOR DIVISION:

Scindia's Territory.

JULUNDER DOAB DIVISION:

Julunder Doab.

PUNJAUB DIVISION:

Middle districts of the Punjaub, from the Suliman Mountains on the west to Kooloo on the east.

SINDE SAGUR DIVISION:

Upper part of Punjaub, between the Indus and the Jelum River, and bounded by the Salt Range.

PESHAWUR DIVISION:

North-western part of the Punjaub, bounded by the Indus River and the Salt Range.

MOOLTAN DIVISION:

Lower, or southern part of the Punjaub.

MADRAS.

CENTRAL DIVISION:

Guntoor - - - -	North and South Arcot.
Nellore - - - -	Chingleput and the northern part of Salem.

NORTHERN DIVISION:

Masulipatam, Rajahmundry, Vizagapatam, Ganjam, and the Bengal districts of Cuttack.

SOUTHERN DIVISION:

Southern part of Salem, Coimbatore, Trichinopoly, Tanjore, Madura, Tinnevelly, and the Travancore Territory.

MYSORE

MYSORE DIVISION:

The Rajah of Mysore's dominions.

MALABAR AND CANARA DIVISION:

The Malabar and Canara Collectorates.

CEDED DISTRICT DIVISION:

Cuddapah, Bellary and Kurnool.

Hyderabad subsidiary force is stationed in the Nizam's dominions.

Nagpore subsidiary force is stationed in the Nagpore Rajah's territory.

SAUGOR DISTRICT:

Saugor and Nerbudda territory.

Besides the above-named divisions, Madras troops are stationed at Darwar, Kulladgee, and Sholapoor, in the Bombay Presidency, and also at the stations of Moulmein, Penang, Malacca, Singapoor, Labuan; and, in conjunction with the Bombay troops, garrison Aden.

BOMBAY.

PRESIDENCY GARRISON comprises all the troops stationed on the Island of Bombay.

SOUTHERN DIVISION:

Southern part of Rutnagherry.	Belgaum.	Kolapoor.
Sholapoor.	Dharwar.	The Southern Mahratta Country.
	Sawunt Warree.	

POONA DIVISION:

Khandeish.	Tannah.	The Sattara Territory.
Ahmednuggur.	Poonah.	

NORTHERN DIVISION:

Ahmedabad.	The Guicowar's territory of Kattywar and Baroda.
Kaira.	
Surat.	
Broach.	

SCIND DIVISION:

Scind, Cutch.

Rajpootana field force occupies the various territories forming Rajpootana.

Besides the above-named districts, Bombay troops occupy the detached fort of Asserghur, and, in conjunction with the Madras troops, garrison Aden.

In addition to grain and pulse, which are grown very generally in all parts of India, the undermentioned staple articles are produced, principally in the districts hereafter stated:—

Coffee.—Chota Nagpore, Malabar, Travancore, and Mysore.

Opium.—Patna, Benares, Malwa.

Tobacco.—Masulipatam, Rajhamundy, Coimbatore, Sandoway.

Sugar.—In the Valley of the Ganges, and in many parts under all the Presidencies.

Cotton.—(New Orleans), Dharwar, Coimbatore, and Candeish. (Native), Dacca, Tinnevelly, Surat, Broach, Berar, Omutwarra.

Silk.—Moorshedabad, Burdwan, Assam.

Indigo.—Jessore, and other districts of the Lower Provinces of Bengal.

Tea.—In Assam, and in the Kumaon and Deyra Dhoon Plantations in the Himalays.

(Errors excepted.)

Statistical Office, East India House,
31 March 1851.

Edw. Thornton.

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