REPORT

ON THE

1. Mussoorie and Landour Survey.
2. Kumaon and Gurhwal Survey.
3. Ranikhet Survey.
4. Kosi Valley Survey.
5. Extension of Peshawur and Khagan Triangulation.

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DURING 1869-70.

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MAJOR T. G. MONTGOMERIE, R.E.,

Dy. SUPERINTENDENT G. T. SURVEY IN CHARGE.

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Dy. SUPERINTENDENT, 1st GRADE.,

IN CHARGE KUMAON AND GURHWAL SURVEY PARTY.

(1.) During the recess of 1869 all the computations connected with the previous season's triangulation were completed.

Kumaon and Gurhwal Maps.

(2.) Three contoured and 2 skeleton sheets, on the scale of one inch to the mile, of the Kumaon and Gurhwal mountains were prepared, including the sheet showing the hills round Almorah, a very difficult one owing to the amount of detail and the unusually large number of villages.

Mussoorie and Landour Maps.

Twelve contoured and 10 skeleton sheets, on the scale of twelve inches to the mile, were prepared of the Mussoorie and Landour Survey. Progress was also made with other sheets of both surveys. The hill shading of the above sheets has improved.

Mussoorie and Landour Survey.

(3.) During the recess, field operations connected with the Mussoorie and Landour Survey were prosecuted whenever the weather permitted.

(4.) The redemarcation of the boundary was continued in conjunction with the Civil Authorities; 62,480 yards, or 35¼ miles were retraced, and the proper positions for pillars along the whole of this line were pointed out; a great part of these were subsequently built, and the positions of 176 of them were finally fixed before the end of the recess, further progress being arrested till

the remainder of the pillars were built, these will probably be ready during the ensuing year The work is progressing satisfactorily, and is now likely to be finished by the end of 1870.

(5.) The heights of most of the boundary pillars were determined with aneroid barometers which may be useful for further identification if required, the differences of height being very great. The materials for the whole of the sheets of the survey are ready and would have been published early in 1870, if the Civil Authorities could have had the pillars built before the surveyors took the field for their regular work.

Survey in the higher ranges of the Himalayas.

(6.) A portion of the highest part of the great Himalayan Range having to be triangulated for further topographical operations, early preparations were made for the purpose.

On the southern side of the Himalayas the highest ground can only be attacked with a fair prospect of success immediately after the rainy season, early in October. The snow line is then at its highest and the atmosphere is clear, but the work can not be carried on after the first heavy fall of snow, which is generally brought on by a storm in December, the exact time varying every year. The time available for survey operations in the highest ground is consequently very limited. It might be supposed that the hot weather immediately before the rains in May and June would be well suited to survey work in the snowy ranges, but all experience has proved that it is not so, at that time though the sun is very powerful it makes the atmosphere very hazy, and produces a constant succession of small clouds. Hence also a large amount of electricity, which proves troublesome, and at some times dangerous to those working on the snow.

(7.) The snow line moreover up to the very beginning of the rains or the end of June is actually very much lower down than it is after the rains.

(8.) On the Kashmir Survey the necessity for carrying the triangulation over the Pir Panjal snowy range in the spring rendered that operation more troublesome even than that of crossing the much higher range of the main Himalayas, which was effected after the rains.

(9). Survey operations in the higher ranges are consequently now as a rule carried on after the rainy season.

(10). On this occasion the surveyors were equipped and started while the rains were still in progress, so as to reach their ground about the time the rains were likely to cease. This added much to the discomfort of the march, but was necessary so as to secure every day of the short time available.

Gurhwal.

(11.) In Gurhwal, the triangulation was carried up to Joshimath, at the junction of the two upper branches of the Alaknunda river, the southern source of the Ganges.

From Joshimath one minor series of triangles was carried up the Vishnu-gunga branch to a little beyond Badrinath, and another was carried up the Dhauli River as far as Niti.

The portion on the Alaknunda was carried over very rugged mountains, and the two minor series involved many difficult and lofty stations of observation of from 12,000 to 17,000 feet above the sea. The work progressed very satisfactorily, but was brought to a close by an unusually early fall of snow. The total area triangulated in Gurhwal was 1,906 square miles.

Kumaon.

(12.) In Kumaon the triangulation was at the same time carried along the outer part of the great snowy range, requiring some very high stations, further progress being stopped by the same fall of snow.

The total area triangulated in Kumaon was 685 square miles.

(13.) Owing the cold weather setting in so suddenly, and so early, the work involved more even than the usual exposure, and before the parties could be withdrawn a few of the men suffered slightly from frost bite.

(14.) As regards the filling in of topographical details no progress was made with the general maps owing to the whole strength of the party having been diverted to other work.

Ranikhet Survey.

(15.) At the end of 1869 the Government of India made an urgent request for "an accurate Survey on a large Scale" of the new Hill Sanatarium of Ranikhet, and of the Kosi valley leading up to it. Orders were consequently received to stop all the regular work, and the surveyors were directed to assemble at Ranikhet and on the Kosi. This took some time, as the members of the survey were scattered all over the mountains and forests of Gurhwal and Kumaon. The party had made all its preparations for a very different style of work, and its equipment required alteration, a very difficult matter at so great a distance from Head-Quarters, and with so little time to do it in.

(16.) The style of work required for a large scale survey being in many ways different from that of the more general work on a small scale, it was necessary that some of the junior surveyors should be trained to the new style of work, and that all should get accustomed to it before much progress could be made.

Ranikhet Survey commenced in January, 1870.

(17.) Notwithstanding all these hindrances the Surveyors were rapidly concentrated, and the necessary instruments were collected from all sides. The training required was given, and the new work was commenced early in January 1870.

(18.) Ranikhet rises to nearly 7,000 feet above the sea, and when the surveyors commenced work snow was lying on parts of the hill side. The hills are covered with a dense forest and jungle, which added much to the difficulties of the survey, the more especially as it was necessary to avoid all cutting as much as possible.

Position of Ranikhet.

(19.) Ranikhet is on a broad ridge with easy slopes on the north, though generally precipitous on the south side. It lies about 20 miles direct north of Nynee Tal, 13 miles west of Almorah, 32 miles East of Ramnu gur, which is at the foot of the hills. It commands a magnificent view of the hills of Kumaon, crowned by the great Himalayan range, including all the gigantic snowy peaks from Jumnootri and Gungootri on the west to Api and other groups far east in Nepal, having more immediately above it those of Nandadevi, Trisool, &c., rising from 20,000 to 25,661 feet above the sea. The snowy range occupying no less than 160 degrees of the horizon and altogether forming a view with which but few places in the Himalayas can contend.

Rain-fall.

(20.) Ranikhet is separated from the plains by an outer ridge of mountains known as the Gagur range, culminating in the peaks of Cheenar, Buddundoora and Saonchalia, all about 8,500 feet above the sea; this range, being generally much higher than Ranikhet, no doubt in some measure protects it from the monsoons, and the average rain-fall measured up to the end of 1869 was only about 70 inches, much less than at Nynee Tal, which is on the Gagur range; the general average however will probably prove to be somewhat over 70, as the rain-falls hitherto measured are mostly those of unusually dry seasons.

Supply of Water.

(21.) The supply of water in the present Cantonments is remarkably good, both as to quantity and quality,* and the same may be said generally as to the whole area surveyed, the number of good springs or streams of water noted being great, and not very much below the ridge. Though there are no higher hills in the neighbourhood to give a supply of water from above, which is the preferable arrangement, yet with proper precautions no doubt the conservancy could be satisfactorily provided for.

(22.) The portioning off of the ground having been arranged, the triangulation and travers-

* *Vide* Appendix for Analysis of Water by Dr. Murray Thomson.

ing were carried on simultaneously and as soon as a sufficiency of fixed points were ready the sketching was commenced.

Delineation of the Mountains.

(23.) The features of the Ranikhet hills have been delineated by contour line shading, but as the Government expressed a wish to have an accurate Survey, "representing in detail the various features of the ground," it was necessary, as the scale (12 inches to the mile) was very large, to give somewhat more certainty to the run of the eye contour lines than is required for a small scale.

(24.) With this view the heights of a very large number of points were determined trigonometrically, and pocket reflecting levels were used to assist in getting the run of the contour lines between the trigonometrical stations. The trigonometrical stations prevented any accumulation of error, and it was always possible to see that a line of any particular level should run above or below the neighbouring stations, and by paying attention to this, a degree of general accuracy has been attained in the lines of the contour shading, that, as far as I know, has never been attempted before in any Survey executed in India.

Contour lines.

(25.) The Department of Public Works had cut a number of contour lines on the sides of the mountain, but these were confined to the more easy part of the Cantonment, the more difficult ground having none marked on it, they only extended to about one-fifteenth of the area marked out for Survey.

Approximate Contour lines.

Wherever these cut lines existed they were laid down on the maps by traverse, and their heights were determined trigonometrically, they then acted as a valuable guide for the eye contour lines in their immediate neighbourhood, but on the ground generally there was nothing of the kind available, and it was necessary to rely on the heights of the trigonometrial stations for starting points, and to use the reflecting levels, rough hand levels, &c., to determine the run of the lines. By this means and in between by judging carefully with the eye the whole of the lines of the shading were entered on the field sheets. In this way all the features and incidents of the hills were carefully expressed.

(26.) Finally certain contour lines viz., those at 5000, 5500, 5800, 6000, 6500, 6700, 6800 and 6900 feet were selected as the guiding lines for the whole survey. These lines were very carefully determined by comparison with the neighbouring trigonometrical and barometrical heights, and by running them into the cut contours whenever they were available.

(27.) Bearing in mind that in all the heights of 386 or nearly 16 points per square mile were fixed, the amount of accuracy that could be secured in running these lines was very considerable, as much in fact as could be expected without actually marking out the contours with a spirit level, and it is estimated that these approximate eye contour lines will probably rarely be found to be more than 100 feet out as to their position. This remark more especially applying to the more valuable or highest part of the ground surveyed.

(28.) The vertical height between the lines of the shading may be said to be generally about 8 feet, this difference of height was selected after trial with reference to the general slopes of the ground, the horizontal distance between them being that which on a average was likely to give the proper distance between the lines on the paper so as to show the run of the ground most clearly and artistically without making them too close for photozincography. A complicated problem with numerous conflicting conditions, the difficulties of which it is not easy to explain. These approximate eye contour lines running from one sheet into another has enabled the work to be put together in such a way as to give great unity to the whole of the shading, so much so that though the fair sheets had, (owing to the necessity for unusual promptness), to be done by no less than six different draftsmen, and could hardly be fairly tested in any way but as separate sheets each by itself. Yet on joining the whole of these 11 sheets together, the shading (owing in a great measure to the care taken in fixing the controlling lines,) has been found to amalgamate in a

most satisfactory way, and the whole to form a very accordant map of the mountains surveyed. Greater unity could hardly have been secured unless the shading had been confided to one draftsman only.

(29.) The boundaries of the Cantonment present and proposed, and of Mr. Troup's various private estates required to be very carefully laid down. In every case application was made for a responsible person to point them out. For the Cantonment, the boundary was clear enough being defined by a cut in the ground with cairns of dry stones every here and there. With Mr. Troup's estates it was not always so clear, and in one instance Lieutenant Hill on application to the Settlement Officer was informed that the boundary between two points was the line which was likely to be the easiest for walking, a very vague definition, about which two proprietors would be certain to disagree if the ground became valuable. In my opinion the boundaries throughout should be at once defined by substantial pillars, otherwise endless disputes and trouble will arise hereafter, and unless great care is taken to build on the site of the cairns pointed out to the Surveyors, even the Cantonment boundary may require re-survey when the ditch is obliterated as it probably will be in a few years.

Boundaries.

(30.) The triangulation covered an area of 31 square miles, and the sketching an area of 15,640 acres or 24½ square miles, the whole of this large area was triangulated and traversed early in the year, the results were computed in the field, and by the end of May the whole of the details were filled in, the Survey having taken the six Surveyors rather less than 5 months to execute.

(31.) The fair sheets embracing the whole work were completed during the recess, and by the beginning of November the whole of them viz. 11 shaded sheets and 11 Skeleton sheets had been printed by the photozincographic process.

(32.) The ground surveyed, embracing as it does the upper part of a minor ridge of the Himalayas, presented all the ordinary difficulties of mountain Surveying. The triangulation and the sketching, was rendered more difficult than usual by the dense forest, the hills being covered with a sea of pines varied in the higher part with oak and rhododendron. A sufficient number of trigonometrical points were secured with great difficulty, owing to the few open spots that were available. The traversing was moreover much delayed by the tortuous nature of both the new and old roads, which wind round and round the spurs of the mountains. The sketching was more especially hindered by the forest, a greater number of plane table stations than usual being required, and a large proportion of these having to be fixed by traverse with the chain, and either a compass or the plane table, a laborious process rendered necessary by having to avoid cutting the jungle as much as possible. Some small amount of clearance was required as contrary to an impression which at one time prevailed on the spot, Surveyors cannot possibly survey hilly ground unless they can see the surface every here and there. The small clearances made are likely to be beneficial, for if the ground is used for building purposes large clearances must hereafter be made in every direction.

(33.) The triangulation fixed 497 points with 308 heights, being 16 points per square mile or one to every 40 acres. The theodolite traverses, 28½ miles in length, supplied 808 points; the prismatic compass traverses, 131 miles in length, gave 4,070 points; and the plane tables were fixed at 6,548 places partly by intersection and partly by traverse. The sketching consequently depends upon 11,426 fixed and visited points, or including the trigonometrical points 11,923 being on 15,640 acres at the average rate of about one point to $1\frac{3}{10}$ of an acre. The number varying from 1 point in 4 acres in the small amount of more open ground, up to one point in each half acre in the more densely wooded ground. The great number of points being required in consequence of the trees and shrubs, as well as the complicated nature of the ground.

(34.) The northern slopes of the upper part of Ranikhet are tolerably easy for a piece of the Himalayas, but as in all the lower ridges of these gigantic mountains, the spurs break off every here and there into rugged and precipitous ground, and in many places where paths are wanting, it is difficult to move from one spur to another. Out of the 24½ square miles 22 square miles are above 5000 feet, 6 square miles being from 5000 to 5500, 7½ from 5500 to 5800, $6\frac{4}{10}$ from 5800 to 6500,

Areas available at different altitudes in Ranikhet.

$1\frac{9}{10}$ from 6,500 to 6,800 and $\frac{2}{10}$ of a square mile or 140 acres at from 6,800 to 6,941 above the sea. The relative position of the amounts between the respective altitudes can readily be made out from the skeleton sheets and large index on which it is defined by contour lines.

(35.) Such a complete detailed survey of Ranikhet having been made, it is unfortunate that the station was not in a more advanced state at the time of survey, as all details, such as roads paths, public buildings, houses, tanks, &c., could have been entered with hardly any additional expense. Except in the Cantonments there was but little detail beyond the natural features of the mountains: everything that it was supposed might be useful hereafter was entered, and the highest points where a tolerable flow of water was found are all carefully noted on the maps; it is consequently hoped that the maps will supply all information that can be required for designing, fixing, sites of buildings, &c., or for any farther extensions of Ranikhet either large or small.

(36.) With a large scale survey ready to hand, no doubt better general designs can be made for a large sanatarium; and hereafter if care is taken to preserve the trigonometrical stations new details can be added, and if necessary the whole could be turned out on a still larger scale without much additional expense, special provision having been made for that purpose. But if the trigonometrical stations are allowed to disappear, the whole will have to be re-surveyed probably at greatly enhanced cost, as private rights will have become numerous and valuable, and labor dearer.

(37.) As soon as the Ranikhet triangulation was finished, and the points had been computed out, a portion of the surveyors were put upon the triangulation of the Kosi valley, and before the very hot weather had set in the whole length of the river, being about 60 miles, including the Kuch-Gadh, was completely triangulated down to the plains.

Kosi Valley Survey.

This latter triangulation was computed out during the recess, and the results are now ready for the detail survey, to complete which the surveyors have already started.

(38.) The direction and reduction of the Trans-Himalayan explorations involved as in previous years a good deal of extra work, the results of the explorations have been reported on separately.

Trans-Himalayan Explorations.

In the numerous explorations which the Trans-Himalayan parties have made beyond the British frontier; the peaks and points fixed by the Great Trigonometrical Survey have been invaluable as starting and closing points, and very often have acted as the means of verification for the work, when the explorers were far beyond the frontier. The great peaks of the Himalayan range having more especially proved useful in that respect as many are themselves far beyond the frontier.

(39.) In the exploration between Badukshan and Kashgar, the most northerly peaks of the Kashmir Survey, though not actually as far north as the Pamirkul Lake, were within 40 miles of it, and acted as a valuable check, and with a more experienced explorer would most probably have been the means of supplying a correct position of several points on the route. On a previous occasion the Chief Pundit, when far away in Tibet, beyond the Himalayas, got back bearings from the same place to the great Kamet and Leo-Porgyal peaks in the Himalayas, and at the same time to the Aling-Kangri group in Tibet, thus adding very considerably to the correctness of the position of the latter, which again acted as a check on points still farther away.

(40). Explorations being required of the mountains and countries to the north and north-east of Peshawar, it was decided by Colonel Walker, with a view to take advantage of the above, that as many additional peaks as possible should be fixed in that direction as could be seen from the Peshawar valley, and the mountains round as far as they were accessible in the present state of the frontier tribes.

(41). For this purpose Captain Carter was sent to Peshawar with Lieutenant McCullagh, and a detachment of the hill men of the party. Arriving at Attock on the 15th November, he came to the conclusion that he was likely to get the best view in the direction required from the Kuttuck hills, south and south east of Peshawar. He accordingly

Extension of the Peshawar and Khagan Triangulation.

visited and observed from 6 points in that range, and he afterwards observed from 4 points in and round the Eusuzfai valley, and though much delayed by hazy and bad weather, he was able to fix 171 peaks beyond the British frontiers, including 30 peaks over 15,000 feet, and 58 peaks between 9,000 and 15,000 feet above the sea. Captain Carter's report of this work is given in an Appendix. The visiting of several of the peaks involved a good deal of risk and responsibility, which was got over safely by good arrangements. Reaching the stations, moreover, involved hard work and some exposure, the bad state of the atmosphere continuing so long was especially trying, as after a troublesome ascent and waiting all day, Captain Carter was several times forced to descend without getting a clear view.

(42.) For fixing the peaks the system employed on this survey was carried out, viz., using short bases for identification, and then subsequently using the longest bases that can be obtained to give their final position. In this way the position of distant peaks is obtained with great certainty, and all confusion from change of aspect is avoided.

Hindoo-Kush Range, &c.

(43.) The peaks fixed include a great number in the Hindoo-Kush range, Kafiristan, Chitral, Swat, Bajaur, the Black mountains, &c.; they will be very valuable for the future operations of the explorers, and will assist generally in elucidating the geography of those interesting and little known countries. The work has been well done, and the results are highly creditable to Captain Carter.

(44.) Lieutenant J. Hill rejoined the party towards the end of 1869, after the surveyors had started. He took the field as soon as he could make his preparations. He was employed at first on the triangulation of the northern part of Ranikhet, and covered the whole of the ground assigned to him in time for the sketching operations. This work was thoroughly done, the points being well distributed, and supplying the detail surveyors with the means of fixing their position at all points. The selection of the station was a matter of great difficulty, as the ground included the greater part of the present Cantonments, and it was necessary to avoid all cutting of trees.

(45.) As soon as he had finished his triangulation, Lieutenant Hill took up the Superintendence of the detail survey of the northern sections, and assisted Messrs. Low, Pocock, Todd and Kinney in their sketching, &c., fixing additional points where required. He rendered very efficient aid in the above, and has thereby proved his fitness to direct the work of others. His knowledge of ground being more especially useful, as also his ingenuity in suggesting the means of meeting the various difficulties which arose in working on such a large scale, when more than ordinary accuracy was required. He triangulated 11½ square miles, fixing 126 points with 53 heights; he also computed out all his own points, and in addition did 6½ miles of traversing. In the subsequent preparation of the fair map, he rendered great assistance: his artistic knowledge of hill drawing, and quickness in detecting omissions, mistakes in delineation, or copying, and generally in examining the sheets was of great service. He also prepared an admirable contour shaded sheet from somewhat imperfect materials as regards the original shading, a difficult task, thereby showing his skill in drawing and capability of making the most of the sketching of others. His work throughout has been highly satisfactory, and the amount done has been large. Some notes drawn up by Lieutenant Hill, referring more especially to the present Ranikhet Cantonments, are given in an Appendix.

(46.) Lieutenant McCullagh assisted Captain Carter on the Peshawur triangulation, and has been separately referred to.

(47.) Mr. Beverley took the field very early, in order to carry on his triangulation in Kumaon along the outer part of the snowy range. He succeeded in extending the work considerably to the east of the Goree Valley by means of some very high stations: he was finally stopped by the snow. Mr. Beverley was then proceeding to take up another portion of the general triangulation when he was ordered to return. He at once marched to Ranikhet, and on arrival took up the triangulation of the southern portion. He prepared the necessary stations, signals, &c., and in a very short time broke up the large sides of the general triangulation in the neighbourhood, and having secured bases of a proper length, proceeded to cover with points the whole of the area

assigned to him. The ground included the most densely wooded part of the Ranikhet hills, and the work was consequently very difficult in every way, notwithstanding this very rapid progress was made, and starting points were provided for the traverses in time for the other Surveyors. Fortunately Mr. Beverley was early on the ground, and had it not been for this, and for his versatility in planning and promptness in executing new triangulations, the survey would have been very much delayed, and might not have been finished even before the rains set in.

(48.) In addition to his own work, he started Mr. Low with the theodolite traverse of the main station road, and gave him all necessary instruction for the purpose. He also directed Mr. Pocock in the triangulating of a portion of the ground. He computed out the whole of his own points, and had them ready as soon as the detail surveyors were prepared to commence sketching. He then executed about 3½ miles of check traverse with a theodolite.

His work at Ranikhet was completed, and the results were all computed by the end of February. Mr. Beverley then proceeded to take up the triangulation of the Kosi valley, here again he progressed rapidly, the ground being more open, and before the middle of April he had finished the whole length (about 30 miles) that was assigned to him.

(49.) Mr. Beverley was unremitting in his exertions, working all day in the field and computing for several hours every night, his triangulation was thoroughly well done, and the general out-turn both as to quality and quantity was highly creditable to him.

In Kumaon he triangulated 685 square miles, having on that area 250 points with 133 heights. In Ranikhet he triangulated 15½ square miles, fixing 242 points with 139 heights. In the Kosi valley he triangulated 37 square miles, fixing 390 points with 298 heights. And in addition to the above he computed whilst in the field the position of the 242 points in Ranikhet.

(50.) Mr. Ryall took the field at the end of September and extended the triangulation up the Alaknanda river as far as Joshimath, in order to provide bases for the triangulation of the two upper branches of that river. He started Mr. Low towards Budrinath and Mr. Pocock towards Niti, and assisted them in making the necessary arrangements. He then returned to the lower ground, and ultimately took up the triangulation of the lower part of the Kosi river, and there he made good progress.

(51.) As soon as a sufficient number of points was ready at Ranikhet he was transferred to that survey, and took up the sketching of the highest and consequently the most valuable portion of Ranikhet. The ground was covered by a dense forest of oak and rhododendron with a good deal of undergrowth, and with hardly an open spot on it, forming at first sight a rather appalling task, as the orders were to show all the incidents and features of the hills, and yet cutting and clearing except of the smallest amount was practically forbidden. The whole area had but one narrow path running through it, and it is not easy to imagine a more difficult piece of the mountains as far as survey operations are concerned, and it is not to be wondered at that the Surveyor was rather alarmed at the prospect. Mr. Ryall however set to work manfully, and after the first fortnight devised the means of sketching the ground, he carried on a great number of traverses, employing two native surveyors on one portion, while he checked them with another cross set of traverses. With the two native surveyors he did 62 miles of compass traverse. In this way he was able to get his position wherever he required. He then trained his men to arrange flags on the trees along the spurs, &c., so that he could fix or intersect them as he advanced. When done with, these flags were moved on to new ground day by day till the whole was finished.

(52.) Though difficult to see, the trigonometrical points were numerous, and he never had very far to go without having a check on his work, at all times his chain with either compass or plane table was in use, and he has consequently produced an admirable sketch of the ground assigned to him. In addition to this he superintended the sketching done by Mr. Peyton and assisted him in various ways. Mr. Ryall triangulated 820 square miles in Kumaon, fixing 83 points with 60 heights, and he also did 51 square miles on the Kosi, fixing 151 points with 91 heights. In Ranikhet he sketched 2,532 acres. Altogether Mr. Ryall did a capital season's work, and has given great satisfaction.

(53.) The artistic way in which he has subsequently drawn his fair sheet will I think be appreciated by every one who understands the difficulty of that style of drawing, more especially when all extraneous effects of light and shade are excluded, and the slopes of the hills are left to give their own effect.

(54.) Mr. Peyton was retained in office during the early part of the field season, for drawing purposes, but was ordered up to Ranikhet early in February, he there took up the sketching of several portions and completed 3,843 acres by the end of the season. The ground was in parts very heavily wooded, but on the whole there was more open ground than usually occurred.

(55.) Mr. Peyton worked hard, and altogether did a very good season's work: his drawing has as before been artistically done, and the out-turn large.

(56.) Mr. Low started very early to take up the triangulation in the snowy range; commencing at Joshimath: he carried a minor series up the Vishnugunga river to beyond Budrinath, visiting 10 very high and difficult stations running up to over 17,000 feet, he triangulated 446 square miles with 60 points and 39 heights. This involved a great deal of hard work and exposure, the cold latterly being intense, and great credit is due to him for carrying on the work so long.

(57.) Returning from the snow, Mr. Low was able to reach Ranikhet early, he at once took up the theodolite traverse of the main station road, and though but poorly equipped, managed to do it quickly, and very satisfactorily. He then took up the sketching of a very difficult piece of the hills, for the most part covered with a dense pine forest, this he worked at incessantly, traversing the roads with a theodolite, and the paths, &c., with a compass and chain. For the sketching generally he had constantly to use his chain, adding much to the labor. The sketching has been very well done, and represents the ground capitally. Mr. Low has improved very much in contour shading, and can express any style of ground well. His work has been most accurately done. He sketched 2,840 acres besides doing a larger amount of theodolite traverse than any other of the surveyors viz., 9½ miles, besides 5½ miles of compass traverse.

(58.) In the preparation of the fair maps he gave very great assistance, he was very assiduous moreover in examining the out-line printing, &c., and his quickness in checking the maps was particularly valuable, and hence though such a large number were in preparation at the same time, they contain very few errata and none of importance.

(59.) Mr. Low does his utmost to secure great accuracy both in the field and office. Altogether he did a very large amount of work, and its quality is highly creditable to him.

(60.) Mr. Atkinson did a large amount of computations during the recess. During the field season he at first took up the lower part of the Kosi triangulation, and progressed capitally. He then marched up to Ranikhet, there he rendered very great assistance in computing out points for the sketching, his quickness in computing preventing much delay. He then executed 3½ miles of theodolite traverse, and having done all that was required at Ranikhet took up another portion of the Kosi triangulation, and completed it very rapidly. He triangulated 58 square miles with 196 points and 95 heights.

(61.) Mr. Atkinson has proved himself to be as useful a member of the survey in the field, as he had before shown himself in computing and general office work. Altogether he has given great satisfaction.

(62.) Mr. Pocock started very early to march to the snowy range, he triangulated the Dhauli branch of the Alaknanda river, working up to Niti, this required some very high stations and involved much hardwork and exposure, the cold becoming intense, and great credit is due to him for advancing so far.

He was subsequently employed on the Ranikhet Survey, assisting at first in the triangulation. He then took up the sketching of a section, including the centre of the present Cantonments, with a very large amount of detail in the way of roads, contour lines, &c., involving 34½ miles of traverse, and altogether a very heavy piece of work.

(63.) Mr. Pocock worked well, and though his hill shading is not as yet what it ought to be, he has shown himself to be capable of taking up all kinds of work and promises to become a very useful member of the survey.

(64.) Mr. Todd was at first employed in laying down the Mussoorie boundary, fixing a large amount. He then took up the sketching of one of the Ranikhet sections. He traversed about 5 miles with the theodolite, and 5 more with the prismatic compass and chain. His ground was covered with a dense forest of pines, and his chain had to be in constant use: of this difficult ground he did 2,200 acres.

(65.) His sketching is capitally done, and shows very marked improvement; his work was found to be very accurate. Mr. Todd has altogether given great satisfaction.

His subsequent preparation of the fair sheet giving the portion he sketched, shows how well he is able to represent ground, and he now only requires a little farther practice to make himself a first rate draftsman.

(66.) Mr. Kinney took up the sketching of the North-Westerly part of Ranikhet. He made about 6 miles of traverse with the theodolite, and 17 miles with the prismatic compass and chain. His sketching covers an area of 2,755 acres. The ground has been very well delineated, and every feature has been well expressed. It was throughout found to be very accurate. He is now thoroughly versed in sketching hills on a large scale, and in traversing.

(67.) In drawing, as anticipated last year, he has improved very much, and the three sheets of Ranikhet done by him have been very characteristically rendered, and he has shown considerable skill in handling and combining the work of other surveyors. He also rendered good service in the preparation and examination of the maps. Mr. Kinney's work in field and office have given great satisfaction.

(68.) Mr. Lichfield was employed in the office on current work, &c. He also practised for a short time in traversing. During the recess he assisted in the computations; and worked assiduously, though his health has not been good.

(69.) The Native Establishment has continued to work well. The health of the men has been generally good, and they bore the constant exposure at Ranikhet cheerfully.

Native Establishment.

(70.) The sketching, besides being thoroughly tested by the traversing, was as usual examined on the spot, the discrepancies at the margins between the different surveyor's were exceedingly small, and the work throughout was proved to have been very accurately done, and the ground generally characteristically represented.

(71.) The surveyors of this party have always worked very zealously, but when the emergency of the Ranikhet Survey arose, they redoubled their exertions, knowing that there was a demand for extra promptness: they were one and all unremitting in their work. Surveying during winter at from 6 to 7,000 feet above the sea, they were not in the most comfortable place for their camps, fortunately though the first snow fell early, the winter was on the whole a tolerably mild one, and the cold in tents was not so great as it might have been.

(72.) The large scale survey of the Ranikhet, considering its elevation, the denseness of its forest and under-growth, and the time of the year when it was begun, formed in itself about as difficult a task as could be given to a body of surveyors. Added to that there were difficulties about provisions and labor, that were in themselves very trying. The surveyors moreover had difficulties at every step with respect to cantonments and private rights, more especially as to the cutting of the few trees that it was necessary to cut. Notwithstanding this, in no case were they known to have exceeded their duty, and the cutting required was done most judiciously, and if any thing was less than it ought to have been, in order to give topographers a fair chance, and this undoubtedly added very much to their labor.

(73.) No body of surveyors could have performed their work more quietly, and with so little interference with public or private property. The exertions of every one were most praise-

worthy, and the combined result has been to produce an admirable Map of Ranikhet, which forms a fitting and highly creditable memorial of their labors.

(74.) Major Montgomerie has to thank every one for the zealous and hearty way in which they worked.

Programme for ensuing season.

(75.) During the ensuing field season the details of the Kosi-River Survey will be filled in, the points having been already fixed. When that is finished the general topography of Kumaon can be continued, ample points for more than a season being available from previous triangulation; at the same time a small piece of triangulation can be carried on to supply points for the sheet East of Almorah, and as much of this will be done as possible.

(76.) The following statement shows the amount of work done on the several Surveys, and the details of the Topographical work :—

TRIANGULATION.

	Area in square miles.	1st Class Secondary Triangles.	2nd Class Secondary Triangles.	Stations visited.	Intersected points.	Heights.	Points whose elements have been computed.	Area to each point in square miles.	Area to each height in square miles.
Kumaon and Gurhwal Survey, ...	2,591	61	673	65	486	289	...	4·7	8·9
Peshawur and Kaghan Triangulation	large	12	342	12	171	140	183	...	...
Ranikhet Survey, ...	31	108	539	72	425	236	497	acre 40	acres 83
Kosi-River Survey, ...	146	171	1,070	117	618	444	735	128	205
Totals, ...	2,768	352	2,624	266	1,700	1,109	1,415	...	...

RANIKHET SURVEY.

Length of roads surveyed by the first class theodolite traverses in miles, ... $28\frac{1}{16}$

Length of paths, contours, &c., traversed with prismatic compass and chain in miles, ... 131

Barometrical (aneroid) heights, ... 78

MUSSOORIE AND LANDOUR SURVEY.

Length of boundary redemarcated and surveyed, in miles, ... $35\frac{1}{2}$

Boundary pillars fixed, ... 176

Barometrical (aneroid) heights, ... 160

DETAILS OF TOPOGRAPHY ON RANIKHET SURVEY.

	Acres.	Plane Table Stations.	Prismatic Compass Stations.	Theodolite Traverse Stations.	Total points fixed.	No. of acres to each point.	Remarks.
Mr. Ryall, ...	2,532	1,855	1,980	48	3,883	0·7	Densely wooded and complicated.
„ Peyton, ...	3,843	890	...	...	890	4·3	Comparatively open ground.
„ Low, ...	2,840	1,494	243	100	1,837	1·6	Densely wooded.
„ Pocock, ...	1,470	655	1,104	197	1,956	0·8	Much detail, contours, &c.
„ Todd, ...	2,200	1,139	227	129	1,495	1·5	Densely wooded.
„ Kinney, ...	2,755	513	516	152	1,183	2·3	More open ground.
Totals, ...	15,640	6,548	4,070	626	11,244	1·4	

(77.) Total area triangulated 2,768 square miles, with 2,976 triangles, 1,966 points and 1,109 heights.

Total area topographically surveyed 17,378 acres, on the scale of 12 inches to a mile.

T. G. MONTGOMERIE, MAJOR, R.E.,

Deputy Superintendent, G. T. Survey.

Extract from the Report on CAPTAIN CARTER'S Survey Operations on N. W. Frontier. Season 1869-70.

According to instructions contained in Major Montgomerie's letter of the 8th of October, 1869, I proceeded at the end of that month, to extend the triangulation to the North, North-East and North-West of Peshawur, with the object of cutting in such peaks as were visible in those directions, from points on or near our territory ; and also to obtain any native information of geographical interest with reference to the country lying outside our boundary.

Strength of Party.

The party consisted of myself, Lieutenant M'Cullagh, Royal Engineers, and twelve men from the Native Establishment of the Kumaon and Gurhwal Series, all hill men.

Equipment.

The instrument furnished me for my own observations was Cooke's 12-inch Theodolite No. 60, a 7-inch Theodolite in case of my visiting any peaks where the 12-inch could not well be carried up was also provided. Prismatic compass, pocket sextant and boiling point thermometers, in case of my meeting any likely men to equip them as explorers.

The party left Dehra on the 18th of October, and arrived at Attock on the 15th of November. It was at once apparent that the best, if not the only view of the hills to the North, would be obtained from the Khuttuck Range. I had been provided by Colonel Walker, the Superintendent of the G. T. Survey, with a chart of his own triangulation on those hills, and as his stations

were the most conspicuous peaks in the range, I thought I could not do better than revisit them. The country had already been staved by Colonel Johnstone, Superintendent N. W. Frontier Survey, Revenue Survey Department. There were staves on all of Colonel Walker's old stations, but on enquiry from the surveyors was informed that in no instance did they find any old mark-stones; this being the case, I was under the necessity of re-observing all these stations.

Observations were taken from the following hills on the Khuttack Range, (Attock H. S. excepted,) and occupied my time as shown by the dates opposite their names :—

Name of Stations.	From	To	No. of points.	Remarks.
Chusmai, ...	November 20th	November 26th	20	
Pir Subak, ...	November 28th	December 2nd	48	
Attock (Cis-Indus), ...	December 7th	December 10th	50	
Chujjoot Sir, ...	December 15th	December 27th	80	
Treysur, ...	December 29th	Jany. 1st, 1870	52	
Jellala Sir, ...	January 6th	January 7th	61	
Cherat, ...	January 8th	January 14th	54	

The weather up to this point had been dry, not a drop of rain falling, but with the Eusafzai valley (a sandy plain) lying between my stations of observation and points observed to, I was often prevented from observing by the atmosphere being impregnated with dust, and at other times by haze, though on each day when working at any of the above-mentioned stations, the station was visited as soon after day-break as possible, and I remained there till sun-set, knowing from former experience in observing snowy peaks, that in the early morning before the clouds begin to form from the evaporation from the snow, as well as towards sun-set, when the clouds begin to be condensed, are often the only times when snowy peaks are visible.

Up to the 14th of January, no rain had fallen, but it began to do so now. The whole of the Cherat and Jellala Sir Hill was soon covered with snow, and as I was anxious to work out a few of those points I had fixed, with the view of having something on my plane table. When visiting the Tartara peak (Tartara was not visited as will be explained presently), I proceeded to Peshawur for 10 days; here I saw Colonel Johnstone and the Commissioner, Colonel Pollock, and as the former was also desirous of visiting Tartara, it was arranged that if possible, I should visit that hill in company with Colonel Johnstone about the 7th of March.

Colonel Walker had marked Takht-i-Bhai H. S. in the Eusafzai country as a good point to observe from, I therefore determined to visit it, as well as those stations of the G. T. Survey that lie in or near the Eusafzai Valley, returning to Peshawur about the 7th of March. They were visited in the following order :—

Name of Stations.	From	To	Pts. observed.	Remarks.
Sinawur or Pujja, ...	February 8th	February 9th	Nil.	Day cloudy.
Takht-i-Bhai, ...	February 15th	February 16th	13	
Karamar, ...	February 18th	February 19th	6	
Bahingrah (Cis-Indus), ...	February 25th	February 26th	16	

On my way back to Peshawur I received a communication from the Commissioner informing me that after having interviews with some of the leading men of the Kyber clan, the project of a Survey Party visiting Tartara was not feasible. There was nothing more to be done; except that I revisited Pir Subak H. S. in hopes of being able to see a peak called A. (fixed, I believe, by Mr. James), and supposed to be on the Hindù Kush Range, but which I had not been able to see on my first visit to that station, the weather was too hazy, and I could see none of the distant hills.

With reference to this point all I can say is, that I took observations to the Sufed Koh and round eastward to the range between Khagan and Kashmir, over 150° in azimuth, and fixed all the prominent peaks I saw, and that I did not see this point; however the weather was very unfavorable, and the point might be visible from Pir Subak through some gap in the hills.

The result of my observations has been that I have fixed 171 points outside our territory, and determined the heights of 140 of them.

Of these points 30 are over 15,000 feet high.
„ „ 40 are between 12,000 and 15,000.
„ „ 18 are between 9,000 and 12,000.

The remaining points, whose heights are fixed, lie on the border ranges, averaging between 5 and 8000 feet above the sea, or lying inside the Momund, Bajour, Swat and Boneyr territories.

A great number of the points fixed depend on small bases, and though the positions thus assigned to them are not absolutely accurate, yet sufficiently so for all practical purposes, and these points would be of great assistance to any Survey Officer proceeding with an expedition into any of these territories. Small bases have this advantage, that they enable the observer to identify peaks or any tolerably prominent objects in ranges with certainty, as the differences between their appearances at the ends of such short bases is so slight, the positions obtained are near enough for geographical purposes.

Information as to the names and positions of the peaks fixed was given to me by a man called Rahat Mir, one of the Mian Kheyls (since leaving Peshawur, I hear he has got into difficulties, through some intrigue, with reference to the Wuhabie business); further information was obtained from Azad Khan, an illiterate man, but well acquainted with the Swat and Boneyr territories. Rahat Mir was educated to a certain extent, and had frequently made the journey from Peshawur to Kashgar. I believe they were both unable to point out any distant peaks with certainty, though acquainted with the names of the ranges generally.

Hindù Kush.

It has been generally supposed that the snowy peaks seen from Peshawur to the North and North-East are on the Hindù Kush, this name for a range I believe apply to the water-shed as far West as longitude 71°, but my own impression is that there is no well defined range of that name, but rather a net-work of hills. I think it is certain that they are of no great height. The Nooksàn and other passes between Kashgar and Badukshan (on the Hindù Kush) being not probably over 16,000 feet in height.

Routes.

I have been enabled to obtain some routes chiefly from Captain the Hon'ble S. Napier, Assistant Commissioner Peshawur, who was good enough to render me all assistance, and it was chiefly through him that I obtained the services of Rahat Mir and Azad Khan. Captain Ommaney, Dy. Commissioner of the Hazaree Division, was good enough to place at my disposal certain information, and a map deduced from the same, derived from information procured from a Moulvie who Captain Ommaney had sent from Tahkst on the Indus to Faizabad, Badukshan.

The nature of working in these parts is different from that of most parts of India, this is a fact better known to the present Superintendent of the G. T. Survey, then perhaps to any other Officer in the service. Our experiences of 1863, show that the Frontier Tribes are not more friendly disposed towards us than they were in 1855, at the time that Colonel Walker conducted his operations on the N. W. Frontier, and there is still a certain amount of risk and responsibility

in visiting such points as Jallala Sir, Pujja, and even Babingrah (this latter lying in close proximity to the Black Mountains).

I was on good terms with the inhabitants of both Khuttack and Eusafzai districts, following the principle on which I have always gone, while working in semi-civilized parts, viz., kindness combined with decision where the public service requires it; and being very particular that the inhabitants are never put to more inconvenience than possible, and that they receive what they consider the value of such supplies as they furnish to the camp.

In conclusion, I beg to notice that Lieut. McCullagh gave me every assistance; he took his share in observing to the stations of observations (which had signals on them), and when I was observing snowy peaks, he recorded for me, enabling me to do very much more then I could have done had I recorded my own observations. I believe he is thoroughly conversant with the principles of Triangulation.

Notes by Lieut. J. HILL, R.E., on Ranikhet.

Geological formation. The ridge on which Ranikhet is situated consists of mica schist, with traces of sandstone occurring here and there. There is no lime, therefore the houses are built of the stone of the place, cemented with mud, which is said to answer well.

Building.

Roofing and flooring flags. Good flags are found in the Ranikhet quarries. The mica slabs can be split to a thickness of from $\frac{3}{4}$" to 1", and are fit for roofing purposes. The felspar slabs used for flooring purposes are of an average size 5′ × 2′, and about from $1\frac{1}{2}$" to $1\frac{3}{4}$" thick. Real clay slate is not found in Ranikhet. The clay slates in use there are brought from Chiteli, a distance of 20 miles. The size of these slates when used for roofing is 16" × 12" and $\frac{3}{16}$" thick.

Slates.

Water. The water is good and plentiful. It has been analysed by Dr. Murray Thomson, Chemical Examiner, North-West Provinces.

Water supply to the troops, &c., in cantonments. The cantonments as at present sanctioned are for the accommodation of one European Regiment, an European Depôt of 700 men, and an European Military Prison on the Chilianno Hill. The minimum water supply of the present cantonment as measured by the D. P. W., is (excluding very small springs) 22 gallons per minute, or 31,680 gallons in a day of 24 hours. The amount of water allowed to each European Soldier is 15 gallons a day—therefore, estimating that the Regiment, Depôt and Prison would number among them 1800 Europeans, which number would require 24,000 gallons of water per diem, there would remain under the most unfavorable circumstances 7,680 gallons a day for the use of persons living in cantonments not belonging to the Regiment, Depôt, or Prison.

Temperature. In winter mild, in summer hot. The maximum temperature in the shade is a little above 80° Faht.

Out of doors, the white glare from the mica rocks, and the dust wich lies deep upon the roads, increase the oppressiveness of the summer heat.

It is hoped by those interested in Ranikhet that the bare rocks may eventually be covered with sward, and that the roads which now in hot weather are heavy and deep with dust, may when completed, prove otherwise. Unless these hopes are realized, the heat and dust, and glare will detract considerably from the comfort, as well as from the appearance of the station.

Rain-fall. Being situated on an inner range, Ranikhet escapes much of the rain which falls on the range immediately above the plain.

Its average rain-fall is said to be about 70 inches per annum, but no return has been received of the fall during 1870.

Trees. The cantonments of Ranikhet are wooded almost exclusively with the Chir pine (Pinus longifolia). Although one may come across an occasional evergreen oak or rhododendron, the general appearance of the forest con-

veys the impression that it is composed exclusively of Chir trees. Some of these trees are very fine. Roughly speaking, a well grown Chir tree, 200 years old, would not be less than 7′ 6″ in girth at 5 feet from the ground, and about 100 feet high. The wood makes excellent building timber, if protected from the weather.

Grass.

Under these pines the grass grows very scantily, and hitherto the want of grass has been much felt by the few residents at Ranikhet. It remains to be seen what arrangements will be made for the supply of a large station.

Supplies.

Supplies have, as a rule, to be brought from a distance, at considerable expense; and often with much difficulty.

Carriage.

Between Ranikhet and the plains, supplies, &c., can be carried in bullock carts or on camels, along the new cart road: in all other directions everything is carried by coolies, who are brought in (after 3 days' notice has been given) from surrounding villages.

Nature of the ground.

The hill slopes are gentle, at the same time there is very little level ground, consequently considerable portion of the hill tops is being removed to afford space for parade ground, recreation grounds, sites for barracks, and houses, &c.

Station Roads.

The station roads are broad, and have been constructed at the gentle ruling gradient of 3 in 100. As a consequence of their gentle slope they wind round the hills very circuitously.

Tree cutting.

In conducting the triangulation I was careful to avoid cutting trees, among which too much havoc had already been made both by private individuals and the D. P. W. In my own triangulation I did not fell more than half a dozen trees; and Mr. Pocock was also careful not to cut except in cases of the greatest necessity, and if it became necessary to fell a tree in private property, the consent of the proprietor was obtained before doing so.

Boundaries. D. P. W. Contours. Springs.

All boundaries were pointed out to the surveyors by responsible persons, and then carefully traversed. The D. P. W. Contours were also traversed. Trigonometrical stations having been placed on them to serve as starting and closing points, and every spring of water was carefully laid down on the Plane Tables.

Masonry Pillars.

Before leaving, I as requested by you made an arrangement with the Executive Engineer for the building of permanant masonry pillars at all the Trigonometrical Stations in Cantonments, as already explained to you by letter. These stations are very numerous, and as most of them (both high and low) have had their heights fixed trigonometrically, they will prove of great use in the future.

Annual Return of amount of Work executed in the Drawing Branch of the Office of Superintendent G. T. Survey, from 1st May 1869 to 30th April, 1870.

Description of Work.	Remarks.
Sheet No. 1 Levels in the N. W. Provinces, 2nd Edition (Compilation), ...	For Photozincography.
Do. No. 3 ditto ditto ditto ditto, ...	Ditto.
Do. No. 5 ditto with additions of Eastern and Western Jumna Canals (Compilation), *Vide Annual Return for* 1868-69, ...	Ditto.
Do. No. 7 ditto ditto For Photozincography (Compilation), ...	About ¾ of the outlining and printing.
Do. No. 8 ditto ditto ditto ditto, ...	About ⅞ of the printing finished.
Do. No. 10 ditto ditto Compilation, ...	For Photozincography.
Do. No. 11 ditto ditto ditto for Photozincography, ...	About ⅞ of the outlining and printing finished.
Do. No. 12 ditto ditto ditto, ...	For Photozincography.
Do. No. 13 ditto ditto ditto ditto, ...	Very nearly finished.
Do. No. 15 ditto ditto ditto ditto, ...	About ¾ of the outlining and printing finished.
Do. No. 16 ditto ditto ditto, ...	For Photozincography.
Do. No. 17 ditto ditto ditto, ...	Ditto.
Do. No. 18 ditto ditto ditto, ...	Ditto.
Do. No. 19 ditto ditto ditto ditto, ...	Half finished.
Map of the Districts of Rukchu, Lahul and Piti, showing the boundary between the territories of Maharaja Gulab Sing and British India. Scale 8 miles = 7 inch,	For Photozincography.
Prepared 12 Skeleton Charts of Great Trigonometrical points in the Districts of Dehra Doon, Jaonsar, Bhagarutty, &c., ...	For Major Pearson, Conservator of Forests.
Projected G. T. Stations of the Gurhagurh Meridional Series in the tracing of the District of Ferozepoor, ...	For Captain Home.
Map of N. W. Himalaya and Kashmir Survey (Compilation) for Photozincography, ..	Printing nearly finished.
Preliminary Chart of the Madras Meridional and Great Arc Series, 1865-66-67-68, ..	For Photozincography.
Do. ditto Series 1867-68 (2nd Edition), ..	Ditto.
Do. Jubbulpore Meridional Series, 1867-68, ...	Ditto.
Do. Eastern Frontier Series, 1868-69, ...	Ditto.
Do. Mangalore Meridional Series, 1865-66, 1866-67, ...	Ditto.
Do. Beder Longitudinal Series, 1868-69, ...	Ditto.
No. 1 Preliminary Charts of triangulation in the Northern Portions of the Bombay Presidency, 1857-58, ...	Ditto.
No. 4 Do. ditto ditto 1851-52 and 1861-62	Ditto.
No. 2 Do. ditto ditto for Photozincography,	Nearly finished.
No. 3 Do. ditto ditto ditto, ..	Half do.
No. 7 Do. ditto ditto ditto, ..	¼ do.
Preliminary Chart of Gurhagurh Meridional Series, 1860-61, for Photozincography, ..	¼ do.
Made numerous drawings of Bench Marks for Appendices to Level Sheets.	
Colored 1446 copies of maps of various kinds, and performed numerous other miscellaneous duties.	

GREAT TRIGONOMETRICAL SURVEY OF INDIA.

GENERAL INDEX TO RANIKHET SURVEY

Scale 2 inches = 1 mile.

1 2 3 4 5 6 7 8 9 10 11

Present Cantonments colored in red.

Mr. Troup's Estates colored in green.

Boundary of proposed addition to Cantonment in neutral tint.

Trigonometrical Stations & Heights △ 6758

Contour lines & Heights 5500

1 5 0 1 2 Miles

COMPILED UNDER THE DIRECTION OF MAJOR T. G. MONTGOMERIE, R.E., OFFG., SUPERINTENDENT G. T. SURVEY OF INDIA.

Photozincographed at the G. T. Survey Office in Dehra Doon, January 1871.