

GLEANINGS

IN

SCIENCE.

No. 15.—March, 1830.

I.—*Biographical Sketch of the late Col. Lambton, Superintendent of the Trigonometrical Survey of India.*

Amongst the many useful and interesting topics which at our outset we proposed the plan of the GLEANINGS should embrace, none appeared to us more worthy of attention than Biography. To collect and record some traces of the career of those who, in India, have distinguished themselves, either by their scientific acquirements, their useful labours, or their curious researches, has been long a desideratum. However barren an Indian life may appear of incident, it is always interesting to learn the little which may be known of those who are remarkable amongst their fellows. And in every country the lives of men devoted to the sciences, pass in a noiseless tenour, affording little of that bustling incident or development of character which may be thought necessary to excite the reader's curiosity, or to fix his attention. Such men have little to relate beyond facts connected with the progress of their enquiries and their victories over difficulties: but even these are far from uninteresting to the general reader; while to the student they are highly useful, both as a stimulus to improvement in showing what may be done, and as beacons to guide the way in showing how. That the biography of those who have been engaged all their lives in scientific pursuit may be made interesting even to the unscientific reader, is evident, from the success which the last volume of the *Library of Entertaining Knowledge*¹ has met with. And notwithstanding the objections that have been made to what has been called a fanciful division of knowledge into useful and entertaining, (the critic asserting all knowledge to be entertaining as well as useful,) it is still certain that the division of biography is more generally entertaining than any other branch of knowledge. As our work too has got the character of being more abstruse and less inviting than necessary, we propose to open our present number with the lighter subject of biography, though we shall be reduced to the necessity of telling a twice told tale.

Of the many names which might be selected, it would be difficult to find a more suitable one for the commencement of our task than that we have chosen: we mean rather as regards his well earned fame and general celebrity, than as attaching much importance to the very few particulars which are known concerning him. These are, indeed, unusually scanty: nor would it be possible, perhaps, to obtain the attention of the reader for them, were it not that they relate equally to the history of that great undertaking in which he spent twenty years of his life, and by which he gained for himself a rank amongst the first mathematicians of his day. We need scarcely inform our readers, that the particulars of our narrative are taken from a series of letters published in the *Madras Government Gazette*, and reprinted in the *Bengal Hurkaru*. These letters were written by one who lived on terms of intimacy with the subject of them for twenty years. The style of them, as well as many of the expressions, seem those of a foreigner not quite familiar with the idiom of the English language². Instead, therefore, of reprinting them, we have recast the whole, and have introduced such remarks as

¹ Containing the life of Ferguson.

² If our conjecture, as to the author of these letters, be correct, he appears to have paid the debt of nature himself very soon after he had performed this last duty to his friend's memory.

seem called for by the occasion, with one or two trifling particulars, which we happen to have acquired through the medium of some private letters of the late Colonel, to which we had access through the kindness of a friend.

Col. Lambton appears to have been remarkable for great reserve even towards his friends; at least in all particulars relating to his origin or to his family. It is not known where he was born, or what was the condition of his parents, further than that his silence, perhaps, warrants us in supposing the latter to have been humble; which supposition is in some measure confirmed by a casual admission made to his friend, that much of his early savings had gone to support one of them. Even the date of his birth is not known with any certainty: the writer of the letters fixes it in 1753, on the credit of the following anecdote, which, as it throws light on his character, we shall give in his friend's words.

"Being on duty with him in the Coorg country, in the year 1803, Captain Lambton told me that, a few days before, at a dinner party at Morikera¹, the Raja of Coorg, Veer Rajender Wooriar (a well known personage) came, about desert time, with his suite, as he was wont to do, to converse with the company: when, from an odd whim, he proposed that every body present, himself not excepted, should declare their age; and to set the example, His Highness mentioned his own forthwith. The ladies who were present, met the challenge handsomely, as did every body else in the company, excepting the Philosopher, who rejected it as an instance of ridiculous curiosity. 'What would you have said (he observed to me) if I had acknowledged Fifty?'"

Although the place of his birth be not accurately known, his friends think he was either of Lancashire or Durham; and that if not born at Darlington, he at least resided there during his youth. As that town was the residence also of the famous mathematician Emerson, it is not improbable that he owed his initiation into mathematical studies to that eminent compiler. This is rendered more probable by his being fond of repeating anecdotes of Mr. Emerson, having relation to his singularities of disposition and person. But however this may be, his education was known to be chiefly his own work; nor was he ever heard to acknowledge himself indebted to any teacher for what he had acquired. He had the best teacher in his own steady attachment to his pursuit, and in his zeal to make himself master of it.

That his thoughts were early directed to these pursuits, appears by his having been employed in 1784, soon after his arrival in America, with the 33rd regiment, to which he belonged, as a surveyor, to measure the grants of lands passed by the Government to the new settlers. During this service he suffered, according to his own account, a severe injury in his eye. Employing a common theodolite to observe a solar eclipse, he omitted to attach any coloured glasses to the eye piece, the consequence of which was a cauterization of the retina of the left eye by the sun's image falling on it. This accident, though it did not deprive him of the sight of the eye, yet it occasioned the view by it to be distorted.

Soon after this accident Mr. Lambton's friends in Europe (and particularly the late Sir Brook Watson, commissary general of the army in North America) procured him the appointment of barrack-master of the province of New Brunswick, with a salary of £400 per annum; a provision which seemed to bury him for life in the forests of North America: In reality, however, it proved the cause of that celebrity which he subsequently acquired in Asia; for it was during his sequestration of thirteen years in that wild country, that, either from choice, or from an abundance of leisure, he applied himself to the study of the mathematics, and (to use his own words) "laid the foundation of that knowledge, which was one day to bring him to the notice of the world."

Independently of the civil appointment which he thus obtained, Mr. Lambton was suffered to retain his ensigncy in the 33d regiment; though, from want of personal attendance, he obtained no promotion; and was superseded during several years. It was at last the Honorable Lieutenant-Colonel Wellesley² (then Wesley) who, during his command of the regiment, recommended him for a Lieutenancy. Thus chance first gave an opportunity to that illustrious nobleman to promote Mr. Lambton's progress in life.

In the year 1795, His R. H. the Duke of York having resolved on reforming the British Army, and raising it to that degree of efficiency which has made it since unrivalled in Europe, determined to clear it from all its useless members; and ordered that all officers who held civil appointments, independently of their military commissions, should declare by which service they meant to abide. Lieutenant Lambton,

¹ The capital and principal residence of the Coorg Rajahs.

² The present Duke of Wellington.

on this emergency, consulted his old patron Sir Brook Watson, who, impressed with a persuasion (very common in those times in England) that to go to India, and to acquire a fortune there, were the same thing, advised him to prefer his Lieutenancy; and having sent him a letter of introduction to Lieutenant-General Sir Alured Clarke, then Commander in Chief in India, Lieutenant Lambton joined the 33d regiment at Calcutta, in the year 1797, after an absence of thirteen years from the corps.

His disappointment was great, on his arrival in Fort William, to observe the real state of affairs. A subaltern's prospects (he having no means of purchasing promotion, and, as he then thought, no interest to obtain it in any other way) appeared to him any thing but brilliant, even in India, when viewed closely. He appeared to have regretted the sacrifice he had made, and to have feared "that he had heedlessly cast off his sheet anchor," as he expressed it. A barrack-master in New Brunswick on £400 a year might well think he had made a bad choice, when he found himself snugly settled down to a subaltern's duty, and a subaltern's pay in the garrison of Fort William.

However, Sir Brook Watson's recommendation to Sir Alured Clarke, on which Lieutenant Lambton had placed little reliance, proved to be of more service than he had anticipated; for the appointment of Brigade Major to the King's troops under the presidency of Fort St. George having become vacant, His Excellency presented it to him. By the 33rd Regiment having at the same time been ordered to the Coast for the purpose of being employed in the war against Tipu Sultan, Lieutenant Lambton saw new prospects open to his view, and he had the advantage of coming round in the same ship with Colonel Wellesley, who having by mere accident been instrumental before in forwarding his views, was now about to give him his support on the grounds of personal knowledge and on a much more important occasion.—The Fitz-William, East Indiaman, (on board of which the head-quarters of the 33d regiment had embarked,) having struck on Saugor Sand, on coming out of the river in stormy weather, they were, with the other passengers, nearly lost on that occasion. The storm, however, having abated, and the wind veering round, the danger ceased. One may see, in such circumstances as these, on what slight accidents sometimes hang the destinies of nations. It would be curious, though useless, to speculate what might have been the present state of Europe had the wind then not veered round at the Sand-heads in Bengal.

Col. Wellesley seemed to take little notice of Brigade Major Lambton during their voyage, nor did he pay him any attention beyond that which all the officers of the regiment received from him. But on their arrival at Madras, Lambton being disappointed in the expectation he had formed of living in the Commander in Chief's family, was invited by Col. Wellesley to reside with him; a proof, notwithstanding his reserve, that he had formed a favorable opinion of the Brigade Major. This opinion was expressed some days after to an officer of the regiment, who was also addicted to mathematical studies¹. The Colonel asked him what he thought of Lambton's attainments; to which, having replied that they were very respectable, he rejoined, that, though no judge himself on such subjects, he could easily believe him to be a proficient, by what he had observed of his acquirements in other pursuits. Yet his manner continued, to the subject of his enquiries and eulogy, so reserved, that Lambton had fully made up his mind to leave his hospitable roof. In discussing the matter with the same officer, being advised not to be too hasty, and told that he was sure the Colonel had a high opinion of him, and if an opportunity of serving him should occur, he was sure he would seize it; he answered, "I would believe it if he would do me the honor to speak to me." He allowed himself, however, to be prevailed on by his friend, and continued Colonel Wellesley's guest all the time the regiment remained at Madras; that is to say, till the opening of the Mysore campaign.

When the army under Lieutenant-General Harris, which was destined for the siege of Tipu's capital, was organized, Brigade Major Lambton found himself attached to the 1st Brigade, 2d Division, under Major-General (afterwards Sir David) Baird. During the siege he lost no opportunity of making himself useful, and particularly during the storm, where he rallied the left column, the progress of which had been checked by the enemy. The particulars of this service are to be found in Major Beaton's *Account of the Mysore Campaign*, and we think they justify the opinion, that had circumstances required or allowed of his turning his attention exclusively to military affairs, he would have become an able and a distinguished officer.

¹ The writer of the letters from which this sketch is compiled.

A curious circumstance occurred during the siege, which serves to show the practical value of even a very elementary knowledge of astronomy. On the 4th of April, 1799, General Baird received orders to proceed, during the approaching night, with part of the right division, and scour a large orchard, where it was supposed Tipú had established an advanced post. After repeatedly traversing the orchard without finding any one, the general resolved to return. It so happened, however, that from the various windings the detachment had made, the column took a direction which was not the one intended. Brigade Major Lambton, who of course accompanied General Baird as his staff, observed by the position of the pole-star, that instead of proceeding south, in which direction their camp was situated; they were marching north, that is to say, upon Tipú's whole army. He communicated his opinion to the general; with the grounds on which it rested: but the latter, who was no astronomer, answered, "He knew very well where he was going without consulting the stars." Presently the detachment fell in with one of the enemy's outposts, which was soon dispersed. The General now began to think that Lambton's opinion might be, after all, correct. A light was ordered to be struck, and on referring to a pocket compass, it was found that *the stars were right!* If we mistake not, we have heard a somewhat similar story of an officer on the Bengal side of India, who conducted a detachment across the western desert to their destination by a reference to the position of the pole-star, during a night-march, and when such a thing as a pocket or any other compass was not available. Such knowledge as this can be scarcely dignified with the name of astronomy—every peasant in England, we should suppose, knows *Charles wain*, and could readily, from its position, point out the north; the wonder is to find men of education, and, above all, military men, ignorant of such simple matters.

It was after the successful termination of the war with Tipú, that Brigade-Major Lambton brought forward his plan of a geographical survey of part of the peninsula of India. This work subsequently became the nucleus of the Great Trigonometrical Survey of India, which, carried on for 20 years, at the expense of the Honorable Company, has spread a net-work of triangles over nearly the whole of the peninsula, and, advancing into the Bengal dependencies, has reached the 24th degree of latitude:—a work that has earned for the author of it well-merited eulogiums from the first mathematicians of the day, and obtained for him the distinction of being elected member of the two first learned Societies in the world:—A work too, which reflects almost equal credit on his employers, as steady patrons of science. The Honorable Company's Government have, in fact, in this effort for the promotion of sound geography, and the obtaining a knowledge of the dimensions and figure of the earth, thrown the regal governments of Europe into the shade; and we agree with the writer in the *Edinburgh Review*, in his notice of this very survey, "that their liberal and enlarged views cannot be too highly commended."

The first idea was, however, more circumscribed, and was confined to the throwing a series of triangles across from Madras to the opposite coast, for the purpose of determining the breadth of the peninsula in that latitude, and the fixing the latitudes and longitudes of a great many important places, the geography of which was supposed to be very erroneous. His plan being laid before Colonel Wellesley, the latter handed it up to Government, with his recommendation and support. Mr. Josiah Webb, then secretary to Government, had also a favorable opinion of the undertaking; and in consequence of the representations of these two gentlemen, the first patrons of the project, Lord Clive and his council sanctioned it, and directed Major Lambton to prepare the necessary estimates and information for the passing the special orders of Government.

The juncture was every way favorable; for it happened that at that time some superior instruments, which Lord Macartney had taken to China, under the idea that they would prove very interesting to a people who pride themselves on their knowledge of astronomy, had found their way to India, and were immediately available for the purposes of the survey. The emperor of China having taken no notice either of the instruments or of the astronomer, Dr. Dinwiddie, in whose charge they were, Lord Macartney had presented them, on his return from China, to that gentleman, who remained in India. Brigade Major Lambton, who had, when stationed in Fort William, an opportunity of examining them, had ascertained that they were fully adapted to the prosecution of his survey. They consisted of a zenith sector of 5 feet radius; a 100 feet steel chain, by Ramsden; a levelling-instrument, similar to that used in General Roy's operations in England; and a chronometer, by Arnold. An altitude and azimuth circle, with a theodolite-like

that used by General Roy, were in addition ordered from England. In 1804 every thing requisite had arrived; and about the same time, on Captain Lambton's application, Lieutenant Warren, H. M.'s 23d Regiment, was appointed his assistant.

The instruments received from Calcutta were, however, from misuse and neglect, some of them in bad order. In particular the object glass of the zenith sector could not be moved so as to adjust the focus. No observation could be made with the instrument. Nor was there a possibility of procuring the assistance of any skilful mechanic to correct any of these defects or supply any trifling deficiencies. But Captain Lambton himself possessed considerable mechanical skill; his genius was fertile in resources; nor was he ever unprepared for these or any other difficulties. He contrived to adjust the sector so as to render it fit for taking the most delicate observations; and its performance in the course of the survey is the best proof of his success. A still more puzzling difficulty occurred, soon after the commencement of the angular observations with the great theodolite, which was near interrupting the progress of the survey for some time. In hoisting the instrument to the top of one of the lofty pagodas, which formed the stations in the Tanjore country, the guy rope having broke, the instrument was dashed against the building, and it was at first supposed irreparably injured. Notwithstanding the intricacy and complexity of the frame work of the instrument, which it is said contained 2000 screws, he determined to take it to pieces, and finding the axis uninjured, and only a small part of the limb damaged, he was able to restore it so as to obtain equally good observations with it as before the accident. In fact, without this power, for which he was remarkable, of providing for every exigency, his work must have been subject to continual interruptions. In Europe such matters are easily managed, and occasion no embarrassment to the surveyor; but it is otherwise in India. To conduct such a work as this of Captain Lambton's, it was necessary to have not only the acquirements of the mathematician, but in some degree those of the instrument maker.

Had Captain Lambton been opposed by no obstructions but these,—had his attention been only directed to obviate such difficulties, his progress must have been as satisfactory as it was rapid. But there were, unfortunately, others less easy to be surmounted, and which, renewed from time to time during the whole progress of his survey, must, from their very nature, have been irksome in the extreme. We allude to the prejudices and hostility which the subject of our paper had to encounter at his outset, and even subsequently, owing to the general ignorance which prevailed, amongst influential personages, (a few excepted,) of the importance, or even nature of his operations. What we do not understand, we are naturally disposed to undervalue; and in this way may be accounted for much of the opposition he met with. It was desirable to obtain the sanction of the Court of Directors for the prosecution of the work, but so incorrect an idea had been given of the nature of it in England, that Major Rennel, who had been consulted on the subject, gave it as his opinion, "that there being already a topographical survey of Mysore, instituted under Captain Colin Mackenzie of the engineers, he saw no necessity for having two at the same time, because the same surveyor who delineated geographically (topographically) the country, might very well carry on the necessary astronomical observations for correcting the position of the principal stations." We think very highly of the father of our Indian Geography, and yield to no one in admiration of his sagacity and skill in combining heterogeneous materials, and extracting from conflicting statements results so nearly approaching to truth, as to leave little for his successors beyond the task of confirming his statements. But we assert,—and a reference to his memoir will bear us out in the assertion,—that science was not his forte; nor had he earned his acquirements in mathematical learning to the level of his contemporaries in Europe: Colonel Wellesley might justly observe, in comparing his opinion with that set forth in Captain Lambton's prospectus, "that one or the other must be very ignorant." Fortunately, however, this prospectus had been forwarded to Dr. Maskelyne, then Astronomer Royal, through his relative Lord Clive; and he having explained to Major Rennel the real nature of the survey, the latter, very handsomely, came forward and declared to the Court, that he had been misinformed; and wrote also to Captain Lambton to urge him to prosecute his labours.

It appears that he had many other opponents beside Major Rennel;—men who, though totally ignorant of the subject, were disposed to think, in the pride of office,

¹ In 18 months a series of triangles was carried across from the Coromandel to the Malabar Coast, extending between the parallels of 12 and 14; this work included the measurement of three bases.

nothing too great for their grasp. Others again, with a short sighted and narrow economy, could find no inducement to sanction an expense for the attainment of objects falling so little within the compass of their ideas of utility. It has been made a question before now, whether men in office might not render their services more valuable to the state, if furnished with some portion of useful knowledge; if possessed of some notion, however faint, of the nature and objects of science. "It is very little known or considered how deeply government and its officers are called on for scientific knowledge, and how widely and seriously they are daily engaged in carrying on operations which depend often purely on science, often on technical knowledge, or knowledge of the arts, and on a different kind of education from that which is considered an education in business; operations also which cannot be conducted without these kinds of knowledge whence-ever it is to come¹." To particularize, we need only mention such questions as those of the currency, the mint, the bank, extensive plans of public improvement, such as drainage of marshes, improvements in navigation, manufacture of gunpowder, &c. No one can seriously suppose that questions of this kind can be satisfactorily treated by men whose acquirements, if they have any, are purely literary, whatever may be their knowledge of official routine. To understand and judge of such subjects, knowledge, not learning is required; and it is obvious to all how much a government may go astray and become the dupes of interested or crack-brained projectors, as they may often also lose the services of useful and able men, if not competent to decide on their attainments by their own lights.

The members of the Finance Committee at Madras appear to have had great difficulty in comprehending the object of Captain Lambton's survey. The manner in which one of their leading members illustrated the opinion of the Committee, is sufficiently original to be worthy of preservation in the history of the operation. "If any traveller," he says, "wished to proceed to Seringapatam, he need only say so to his head palankeen bearer, and he vouched that he would find his way to that place without having recourse to Col. Lambton's map." A most undeniable truth! Whether however the sole use of a map, or of correct geographical knowledge, is to enable a dawk traveller to find his way to his station, appears to admit of some doubts. To us it appears that it is perhaps one of the least importance: the gentleman in question, however, thought otherwise, and accordingly decided against the Survey. This committee, as it may be supposed, plagued Captain Lambton with endless absurd questions and comments; and he having consulted his feelings rather than his judgment in some of his answers, offence was taken, and the matter reported to Lord W. Bentinck, at the time governor of Madras. His Lordship, who patronised the work, out of kindness, warned him against giving way to his feelings, in a public correspondence; but he would make no concession, and declared "that if he were to be placed, any how, under the control of persons who could not possibly understand the nature of his business, and who acted with ill-will towards him, he begged to withdraw from his undertaking." Lord Bentinck was pleased to overlook this proof of sturdiness, and even promised him his support, provided he would learn to temporise and attend to the decorum of official forms.

Such was the opposition he met with, and such the prejudices he had to overcome. But on the other hand he was happy in obtaining the patronage of men of enlarged views, and, fortunately for him, of sufficient influence, to defeat opposition and neutralise this prejudice. Besides his steady patron Colonel Wellesley, there were others who distinguished him by a uniform support, and whose support was often of the greatest use when the fate of the Survey hung trembling in the scales. The late Mr. William Petrie, formerly member of council and acting Governor of Fort Saint George, and subsequently Governor of Penang, who so justly obtained the title of *The Macenas of Southern India*, was a steady patron of the work, and gave it his support, not only officially but privately, through the means of an extensive correspondence carried on with England. Lieutenant-Colonel John Munro, late Quarter Master General at Madras, was also enabled to perform a very important service to the cause of the survey and of science during the eventful presidency of Sir G. Barlow. Having heard that the Government contemplated the abolition of the Survey, he waited on the Governor for the purpose of representing the utility of the operations in a military point of view, more especially as exhibited in the results of the Topographical Survey then carrying on, the triangles of which rested on the positions determined by Captain Lambton. This survey was the work of the Military Institution which had been established under the superintendance of Captain A. Troyer, for the purpose of teaching

¹ Westminster Review, vol. ix. p. 346.

officers of the army the method of topographical surveying,—an acquirement, we may say, absolutely necessary to military men. He had the merit of stating his case in so clear and convincing a manner, that the intention to abolish the Survey was relinquished. Captain Lambton had also a warm friend and admirer in Mr. Andrew Scott, of the Madras Civil Service,—perhaps the man in India best qualified to appreciate his labours. He was first judge of the court of appeal, but, owing to his well known attainments, was generally consulted by the Government on all such questions as had any connection with science. His favorable opinion of Captain Lambton, and the countenance he gave the Survey, were doubtless of great value in supporting it against the ill founded objections of the ignorant. To these names we may add those of Lords Minto and Hastings, from both of which noblemen he received that encouragement and support which their enlarged minds and well-known liberality entitled him to expect.

On the 10th April, 1802, the work was commenced¹ by the measurement of a base line of 40006,4 feet, near Bangalore, in 12° 54' N. Latitude. This, it is well known, is an operation of the greatest delicacy, and requiring all the attention of the observer,—all the refinements of modern science; inasmuch as it is the *base* or ground-work of the whole operation, which, as that is, will be correct or otherwise. The first base line, measured with any thing like an approach to accuracy, that of Picard's survey in France, was measured with wooden rods, painted to protect them from the changes attributable to variation of the weather. De Lambre and Mechain again used rulers made of platina and copper, which were insensible to ordinary changes of weather, and by their indications gave the elements of the correction for temperature. General Roy, in the English survey, began by using deal rods, but found them so variable, owing to atmospheric influence, that he was induced to re-measure the base on Hounslow Heath with glass rods. The latter apparatus, though accurate, was troublesome in use, and a steel chain, jointed like a watch-chain, which was found equally accurate and much more convenient, was substituted in the continuation of the English operations. Captain Lambton also used a chain similar to that used in England, and with the same precautions. The chain was laid in coffers or long boxes, supported on stout pickets driven into the ground, and their heads dressed even by means of a telescope. At one end of the chain was the draw-post, to the head of which the hither end of the chain being fastened, could be moved a little backwards or forwards by means of a finger screw. Near the handle of the chain, and at the point where its measuring length was supposed to commence, there was a brass scale, with divisions, which was fixed to the head of another picket, distinct both from the draw-post and from those supporting the coffers. This scale could, by means of a screw, be moved backwards and forwards on the head of the post till it coincided with the mark on the chain. A similar arrangement was made at the other end, but the handle of the chain, instead of being firmly attached to the *weigh* post, as it is called, has a rope passing over a pulley; and to this rope is appended a weight of 28lbs. to keep the chain stretched. This arrangement, it is obvious, enables the measurer to move his chain backwards or forwards with the greatest nicety, and when satisfied that it is correctly placed, to keep it there perfectly steady; while by means of the registers he marks exactly the places of the two extremities of the chain. The chain is then taken forward, and the hither end being adjusted to the scale which had before marked the fore end, a new chain's length is laid off, and so on till the base be finished. Thermometers are placed in the coffers to determine the temperature of the chain; and the rate of expansion being previously determined by experiment, the necessary corrections may be made for the varying temperature of the measurement. The quantity of this correction had been found by Colonels Williams and Mudge, to be on 100 feet ,0075 inch for every 1° of Fahrenheit; but Captain Lambton, by some experiment, performed with the chain itself, in October 1800, found ,00725", which quantity he applied as the correction of his measurement. Small as the above difference may appear to be, it would yet occasion, on a base of seven miles, a dif-

¹ While waiting for the arrival of the instruments from England, Captain Lambton had, in the latter end of October, measured a base near Bangalore in 12° 54' N. Latitude, partly to serve as a base of verification,—partly for continuing the series to the Malabar Coast. The ground was such as to occasion many breaks in the line, and though carefully measured, it was afterwards deemed expedient, on finding that a line of equal length could be had without any impediment, to reject it altogether and to measure a new base, which was done in 1804. The real commencement of the Survey was, therefore, as above stated.

• As. Res. vol. viii.

ference of nearly two feet, supposing the change of temperature to be 20° , which in India it might well be. And this may serve to give some idea of the nature of these operations and of the extreme nicety required.

Besides the chain originally belonging to Dr. Dinwiddie, a second was obtained from England, exactly similar. Its length had been fixed in the temperature of 50° . This chain was preserved as the standard, and to its indications were reduced all the measurements made with the other. The length of this standard chain was afterwards corrected for a trifling discrepancy detected by Captain Kater, when comparing standards at home, previously to establishing a uniform system of weights and measures.

The next operation was to establish the triangles, and make the angular measurements. These, in the older surveys, had been effected by the employment of a quadrant furnished with two telescopes, which by means of a proper mounting and stand, could be placed in the plane of the objects. But the quadrant has long given way, both in this particular work and in astronomical observations, to the full circle, which is free from several errors inherent in the former. The introduction of the circle naturally led the way to Mayer's capital improvement, by the application of the repeating property; and Borda having devised a very convenient form of instrument, it was used by De Lambre and Mechain in their survey. The continental observers appear to have rated this instrument too high; nor do we wonder at it, when we consider how satisfactory in theory the principle of their construction is, and how independent it renders them of bad division. General Roy again, who thought he might depend upon the skill of our artists to divide the limb of the instrument correctly, preferred one of a different construction. This was the great theodolite, a plate of which may be seen in Adam's Graphical Essays.

The theodolite has its principal circle in the plane of the horizon, and its telescope, like that of a transit instrument, fitted for describing verticals. The angles are, therefore, taken at once as fitted for calculation, and do not require reduction, as those observed with the French repeating circle, being in the plane of the objects and inclined to the horizon. This is certainly a great advantage. Another advantage which the English observers secured, was that of placing the centre of the angular instrument, exactly over or under the centre of the signal observed from other stations—whereas in the French survey, it was almost always placed on one side, and in consequence the observed angles required a second reduction to bring them to what they would have been if observed at the centre of the station. Captain Lambton, using a theodolite similar to that of the English survey, was generally guided in all respects by the example of the conductors of it.

In May 1804, a base of verification of 39793.7 feet was measured by Lieutenant Warren, Captain Lambton's assistant, near Bangalore; and though the distance was 160 miles nearly, the computed and measured lengths of this base differed only 3.7 inches, or about half an inch in a mile: a proof of the great care and accuracy with which the work had been conducted. The series of triangles were continued across to the other coast, along a belt of country extending 2° in latitude, detecting several errors in the positions of very principal places, and in the breadth of the peninsula one of about 40 miles.

In the 10th volume Asiatic Researches will be found a list of the positions determined by this series of triangles, amounting to 256. It would lead us too far into intricate and technical discussions to explain his methods of calculation; suffice it to say, they were the same as those employed in the English survey, and included the consideration of the figure of the earth. But as some doubt existed with regard to this point, it was necessarily determined from data furnished by the Survey itself. Along with the general series of triangles, therefore, which spread over the country in every direction, for the purpose of fixing geographical positions, there was a meridional series, arranged and measured with every attention to accuracy; and at certain points along this line, zenith distances were observed; for the purpose of determining the value of the celestial arc in degrees and minutes, while the triangles furnished the length in feet. In 1801 and 1802, a series had been established on a meridian about thirty-five miles west of Madras, and the arc which was $1^{\circ} 34' 56''$ gave 60494 fathoms for the length of the degree, in lat $12^{\circ} 32'$ and 61059 for that of the perpendicular to the meridian. But this series was afterwards rejected, and the meridian of Dodagontah chosen. The series on this meridian was begun in 1805, at Paugur and Yerracoudah, depending on the Bangalore base. In 1806 it was carried down to the Coimbatore, where a base of verification was measured. From this series the length of the degree of the meridian in latitude $12^{\circ} 55'$ was found to be 60498 fathoms, and that of the perpendicular

60748, the latter differing considerably from the former result. This series was afterwards continued to the southward as far as Punnac, near Cape Comorin; a base of verification of 30507.5 feet, being measured near Tinereilly, in February 1809. The arc now extended from Punnac to Dodagontah, having an amplitude of $4^{\circ} 50'$. This arc gave the value of the meridional degree, in latitude $10^{\circ} 34'$ as 60496 fathoms. But observations having been made also at Paugur and Bonasundrum, north of Dodagontah, the length seemed to be 60462 and 60409, for latitudes $11^{\circ} 4'$ and $11^{\circ} 8'$. This difference led to the suspicion of derangement of the plummet by some secret influence at Dodagontah, and, the meridional arc being in 1811 continued north from Paugur to Gootee, where a new base was measured; the length was now $6^{\circ} 56'$, and the degree for the middle point or latitude, $11^{\circ} 38'$ —60480 fathoms¹. In 1815 the series was still farther prolonged to Daumergidda, and a base of 30866.2 measured near Beder, for the check and verification of the operations. It had now become the largest arc ever measured in any country, having an amplitude of $9^{\circ} 53' 45''$. The value of the degree in latitude $13^{\circ} 6'$ appeared to be 60480, and the perpendicular degree is deduced by determining the ellipticity or figure of the earth, which a comparison of the measurements in India, and in England, France and Sweden, would give. This is found to be $\frac{3}{8}x$, from which, as a datum with the mean dimensions of the spheroid, the lengths of the degree of latitude, of the perpendicular to the meridian, and of longitude, from 0 to 30° are calculated. These are given in the 134th volume of the Asiatic Researches, and with them a very full table of geographical positions computed from them.

It must not be supposed that from 1802 to 1815, Major Lambton was occupied solely with these meridional measurements. They were in fact but a small part of his labours. He had covered the peninsula as high as 15° , with a network of triangles. "The whole of the peninsula is now completed from Goa on the west, to Mausilapatam on the east, with all the interior country from Cape Comorin to the southern boundaries of the Nizam's and Marhatta's territories. In that great extent of country, every object that could be of use in geography or in facilitating the detailed surveys of the provinces, has been laid down with precision. All the great rivers sketched in in a general manner, and all the great ranges of mountains slightly depicted²." In fact, it is to Colonel Lambton we owe all that we know of precision in the geography of the south of India, and if the northern parts or the Bengal presidency can furnish no map of equal accuracy, it is because we have had no Lambton. Or perhaps it would be more just to say, because we have had no patrons like those which it was Colonel Lambton's good fortune to meet with; for we have the authority of the poet to say, that

Sint Mæcenates non deerunt Marones.

The published accounts of Colonel Lambton's operations conclude with the Beder base and the above arc of $9^{\circ} 53'$. But it is known, that in 1822 he had extended the arc to near Ellichpoor, a little north of the parallel of 24° , thus completing an arc of nearly 16° . And a base of verification of 37914, was measured near Takulkhera. The other particulars, however, of this section of the arc are not known. From his private letters it appears, that he looked forward to carrying on the work to the banks of the Jumna, which he supposed his meridian would intersect near Agra. But Col. Lambton was no longer a young man, and twenty years of such work as he had been engaged in could not have improved his constitution. In 1810 he appears to have contracted an asthmatic disorder, from which he had latterly suffered much, and which was probably aggravated by the remedies which he was obliged to have recourse to, to allay the distress and exhaustion occasioned by its attacks. He was not fated to complete the extensive plan he had sketched; for in January 1823, a severe attack of his disorder put an end to his labours and his life together. He died at Hingin Ghat, 26th January, on the road from Hydrabad to Nagpoor, whether he was proceeding at the time. His first assistant, Captain Everest, as well as the medical officer attached to the survey, (the

¹ The discrepancies found in comparing consecutive degrees in all the great surveys of England, France and India, has been attributed either to irregularities of the earth's figure or to disturbances of the plummet. Were this the place to dilate on the subject, we are prepared to show that a very large share of these discrepancies is due to unavoidable errors of observation, and to nothing else.

² The French arc, from Barcelona to Dunkirk, was only $9^{\circ} 40'$. It has been since prolonged to Formentera, making an extent of upwards of 12° .

³ As. Res. vol. xiii. p. 7.

late Mr. Voysey,) were absent at the time, having been detached for the prosecution of a subordinate operation, which was intended to connect the presidency of Bombay with the general series of triangles. But he had the attendance of two of the sub-assistants of the survey, Mr. De Penning and Mr. Rossenrode, whose grateful attentions must no doubt have soothed his last hours. Thus died, at an obscure village in central India, Lieutenant-Colonel William Lambton, H. M. 33d Regiment, aged 70⁴. It was suggested we believe to the Government to erect some small, but lasting monument to mark the spot where his remains had been deposited. Whether the suggestion was ever attended to, we know not. His best and most durable monument will be the history of the great work in which were spent so many years of his life.

Colonel Lambton's stature was above the common size; his complexion was fair, and his hair tending to red. His face wanted expression, and the accident mentioned p. 74. gave a cast to his eye which rendered his looks rather vulgar and unmeaning. He was never married, though his friends appear to think that his wishes some times pointed that way latterly.

To a considerable portion of general knowledge and a respectable share of erudition, he united much simplicity of character; so much so, as to give many people a very inadequate idea of his powers of mind and knowledge of the world. Some peculiarity of manner too adhered to him, from having lived so long out of the world, and he is said in consequence to have appeared to disadvantage in mixed companies, and particularly in the company of women. But to those who could, through this singularity, discern merit, his conversation was found alike entertaining and instructive. He had strong prejudices, yet no man was more quick in discovering talent or ready in acknowledging it; and of this a remarkable instance occurred in the case of a gentleman, who having been appointed his assistant without his being consulted, was regarded with no very favorable feelings. But the gentleman having joined the survey, Colonel Lambton was not long in remarking his talent. He acknowledged to a friend "that he had been completely mistaken in his prepossessions; that he was a genius of no common stamp, and that he would certainly shine one day conspicuous amongst the scientific men of his time." A prediction that was fulfilled to the letter, the individual in question 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.

He was of a quick and haaty temper apparently, yet in reality most kind and considerate. His servants were affectionately attached to him, and grew old in his service; and of his public followers he counted (as he wrote to a friend in 1822) three generations in his camp. The young men attached to the survey as sub-assistants he treated with uniform kindness and with much consideration; and in return they looked up to him as to a father. No stronger testimony could be borne to his excellence, than the unaffected sorrow of these people, when his demise took place. They felt that in the master they had lost a friend.

He read the Latin, French, and Italian authors, at least those who treated on science, with the same fluency as those of his own language. He was not, however, a good classical scholar, nor had he much taste for the fine arts or even for literature. His official style was neither eloquent nor yet lucid. He expressed himself with plainness, but not always with clearness;—a fault we think we have observed in other mathematicians. His private correspondence bore marks of haste and negligence, and he seldom attempted to correct a letter. He was, we are told, a first rate mathematician, and as such was in correspondence with many very celebrated philosophers in Europe, amongst whom we may mention Messrs. De Lambre and La Place in France; Dr. Young, Captain Kater and Mr. F. Fallows in England. He was a corresponding member of the French Institute, and a Fellow of the Royal Society of London.

⁴ According to the date of his birth established by the story, p. 74. A notice of his death, given in the *Government Gazette* of that time, makes him 75.