

Radhanath Sikdar and the Final Phase of Measuring Peak XV

Ashish Lahiri*

(Received 31 December 2014)

Abstract

Radhanath Sikdar was the only Indian mathematician who took part in the stupendous effort to finally compute the height of Peak XV within a reasonable limit of error. George Everest had nothing to do with it. Radhanath Sikdar, who was the Chief Computer at the Calcutta Office of the Survey of India (SOI) since 1849, did not participate in any field operation pertaining to the calculation of Peak XV, carried out, with varying success, by a number of people, especially Waugh, Armstrong, Peyton, Hennessey and Nicholson. From 1849 onwards all these field readings were as a matter of routine examined by Radhanath Sikdar at the Calcutta office and his observations sent to Waugh stationed at Dehra Dun. A study of the internal letters and memos of the SOI for the period 1851-1861 shows that the task of bringing order to the hopelessly confused data coming from the field was entrusted with Sikdar. By efficiently applying the method of the Minimum Squares, he minimised the error factor and perhaps showed that the figure would be 29000 feet. Thus, while Radhanath Sikdar was certainly not the “discoverer” of Mount Everest, nor the only person responsible for the final computations, he certainly was the pivot round whom the computations were conducted.

Key words: Chief computer, Method of minimum squares, Mount Everest, Peak XV, Radhanath Sikdar, Sir Andrew Waugh.

1. INTRODUCTION

Nature in its 10 November 1904 issue carried an article titled ‘Mount Everest: The story of a Long Controversy’ by S. G. Burrard, the then Surveyor-General of India. He wrote:

About 1852 the chief computer of the office at Calcutta informed Sir Andrew Waugh that a peak designated XV had been found to be higher than any other hitherto measured in the world. The peak was discovered by the computers to have been observed from six different stations; on no occasion had the observer suspected that he was viewing through the telescope the highest point of the earth.

Ever since S. G. Burrard wrote this, controversy has been raging as to the exact role played by Radhanath Sikdar (1813-1870), who had taken over as the ‘Chief Computer’ in 1849 at the Calcutta Head Office of the SOI. Both G. B.

Airy and C. K. Howard-Bury supported Burrard’s claim, while Phillimore ‘disputed this because of the location.’ At one pole was the understandable nationalist frenzy which claimed that Sikdar was the calculator of the highest peak, eventually christened ‘Mount Everest’ in 1856 after overcoming some serious objections; on the other was the curious reluctance to give the native his due. Some historians of science have gone so far as to claim that Sikdar had *nothing* to do with the final phase of the said calculation. The bulk of this claim rests on the ‘fact’ that the final calculations were made at Dehra Dun, while the Chief Computer had his office at Calcutta. After referring to the glowing praise heaped by George Everest on Radhanath’s mathematical genius, J R Smith in his magisterial *Everest: the Man and the Mountain* (1999) wrote, ‘However, whilst there

*Flat 2, Titli Apartment, P-121, Kalindi Housing Estate, Kolkata-700089. Email: ashish.lahiri@gmail.com

are some who also credited him with the computation that determined the height of Peak XV (Mount Everest) as 29,002 feet, there is only contrary evidence available. It would appear that at the time of that computation Radhanath was in Calcutta while the computation work on the Himalayan observations was taking place in Dehra Dun (Smith, 1999, p.132).’ On the other hand, John Keay (2001), after painstaking research, opines that ‘it is quite probable that Sickdhar’s [that’s how he spelt his surname - A.L.] computations provided the first clear proof of XV’s superiority (Key, 2001, p.166).’

While recent research has to some extent cleared the mist, the confusion still persists owing to the lack of any decisive evidence regarding the extent of Radhanath’s involvement in Project Peak XV. I do not claim to present such evidence here. Nevertheless, on the strength of some intra-SOI correspondence available at the National Archives, New Delhi, I propose to show that while Radhanath certainly did not take any field reading of Peak XV, he was indeed the pivot round whom the final phase calculations revolved. For a proper understanding of his role and the circumstances in which these computations were made, it is perhaps advisable to note the phases through which this measurement was made possible - the field activities and the office-room computations which co-ordinated them.

2. THE VARIOUS PHASES

For the sake of his convenience, George Everest had persuaded the East India Company administration to maintain a dual structure of the Great Trigonometrical Survey of India (GTSI), later the SOI. ‘While the computational, graphic and administrative core of the Survey of India was to remain in Calcutta under Joshua de Penning’, the field headquarter was to be situated at Dehra Dun. ‘There it has remained ever since (Keay, 2001, p.142). Everest had retired from the SOI in 1843 after completing the mind-boggling survey

of the Great Arc and gone back to England. So, at least this much is incontrovertible that the man after whom the highest peak in the world is named had absolutely nothing to do with it [prompting Sven Hedin to comment in 1926, rather harshly, that ‘By sheer accident without a trace of want of breath, he [Everest] has become undying’ (Smith, 1999, p.212)]. As a matter of fact, he was so completely engrossed in the Great Arc project that he had little interest in measuring the peaks of the Himalayas. ‘Bagging mountain peaks was not his business. For those who had pursued the subject, often with inferior instruments and speculative observations, he felt only contempt (Keay, 2001, p.162).’ Initially it was his protégé and successor Andrew Scott Waugh who took the task of calculating the peaks of the Eastern flank of the Himalayas in real earnest. In 1847 ‘Waugh found a new contender for the title of the world’s highest mountain and so reopened the debate about the height of the Himalayas (Key, 2001, p.162).’

3. INITIAL OBSERVATIONS

At first Waugh directed his theodolite - ‘almost casually’, as Keay puts it - to the very prominent Kanchenjunga. At that time Nanda Devi was credited with the greatest elevation still measured. Dhaulagiri was another strong contender. He found that the ‘Western peak of Kanchenjunga attains an elevation of no less than 28, 176 feet above the sea, which far exceeds what has hitherto been conjectured’, being nearly three thousand feet taller than Nanda Devi. So, was Kanchenjunga the highest peak? Waugh was a very cautious man. He did not announce this ‘discovery’.

Why? Because, doubts had arisen about another, a ‘shy, rather obscure peak’, quite difficult to observe. ‘This distant peak, lying to the north of Kanchenjunga and at least 120 miles away on the Nepal-Tibet border’ was termed ‘gamma’ by him and he had a suspicion that this might even exceed Kanchenjunga (Keay, 2001, p.164).

Away at Muzaffarpur in Bihar, John Armstrong was at the same time taking readings of an obscure peak which he simply named 'b'. From his calculations, the height of 'b' would be 28,799 feet. While Waugh suspected that this 'b' might be none other than his 'gamma', he was reluctant to accept Armstrong's calculations as correct, because of the great distance from which the readings were taken and because of the still imperfectly understood problems of 'atmospheric refraction'. To pile confusion upon confusion, Armstrong had also observed yet another high peak which he called 'a'. The problem was getting difficult and increasingly obfuscating. John Peyton was asked by Waugh to verify Armstrong's peak 'b', as also peak 'a'. However, the peculiarities of weather proved insurmountable for John Peyton. He 'found it impossible to have towers ready early enough in the season for mountain triangulation (Keay, 2001, p.165).' Thus, what with Waugh's gamma and Armstrong's a and b, the picture was quite complicated by 1848.

Meanwhile, Radhanath Sikdar (RS) had been promoted as Chief Computer and had taken charge at Calcutta in 1849.

After John Peyton, it was James Nicholson (also spelt Nicolson) who, in December 1849, tried his hand at obtaining a reliable reading of the mysterious peak. And, to compound an already compounded situation, he came out with his 'sharp peak h.' But he was certain that this 'h' was the same as Armstrong's 'b' and Waugh's 'gamma', 'a' being finally left out of the competition. So he concentrated on gamma/b/h. 'Numerous angles, both vertical and horizontal, were taken, six of which were used in the final computations.'

Thus in early 1850 the observational situation was like this:

John Armstrong (b) - November 1847, Muzaffarpur

AS Waugh and Charles Lane (γ) - 1847, Darjeeling

John Nicholson (h) - 1849-January 1850, six readings obtained by using a 24 inch theodolite at various stations on the North-East Longitudinal Series, all more than 100 miles away from the peak (Smith, 1999, pp.193-194).

This was early 1850. Both Waugh and Nicholson had the hunch that they were on target. To clear at least the nomenclatural confusion, if not the identity crisis, they gave the ' γ /b/h' a singular designation: Peak XV. But what was its actual height? Despite the accumulation of a huge pile of observational data, where was the clinching computation? Who was to bring order to the medley and how? Were the prevailing theories and processes capable of dealing with such a stupendously complicated task? Quite clearly, more sophisticated methods of computation were the need of the hour. They must move on from where Everest had left.

It was in this situation that in 'December 1850 Waugh asked his chief computer Radhanath Sikdar in Calcutta to revise the form of computing geographical positions of snow peaks at distances in excess of 100 miles and azimuths up to 45° from North (Smith, 1999, p.191).' From here the controversy starts. One account goes that it was Radhanath who in 1852 'first realised that XV was the world's highest' peak; Phillimore himself, as is well known, dismissed this story. The interesting point is that 'there is no corroboration that 1852 was the first year that the Surveyor-General knew for certain of the great height of Peak XV. As early as 1848 he had reported Armstrong's height for b and this would have been confirmed by Nicholson's field computations of 1850 (Smith, 1999, p.191).'

4. SIKDAR AS CHIEF COMPUTER

Keeping this background in mind, let us now see what hard evidence can we discern so as to determine the extent of Sikdar's involvement in this final stage of the calculation.

Recently I have been able to see at the National Archives, New Delhi, some official correspondence ranging from 7 January 1851 to 18 November 1861 between RS stationed at Calcutta and various SOI officials, particularly A S Waugh (ASW), the Surveyor-General stationed at Dehra Dun. This more or less coincides with the period in which the final calculations were made. Before anything else, I would like to point out that the correspondence clearly brings out, *inter alia*, the system that prevailed within the SOI. The system worked like this: All field readings, the raw field data collected by surveyors were submitted to the Chief Computer at the Calcutta Office, who studied, processed and corrected them according to set technical procedures, much of which were set by himself. After such processing, the documents along with his critical comments, were sent to the Surveyor-General's office at Dehra Dun, who of course would re-check it with own staff and was the final authority on announcing anything officially. As a matter of fact, the memos and reports establish beyond doubt that the SOI was at that period going through a transitional phase so far as computing methods were concerned. And RS was the man who was considered the specialist in this regard. That is why he was entrusted with the job of refurbishing the mathematical tools of computation, as we have seen earlier. Therefore, one can for ever nail the argument that since RS was stationed at Calcutta, he could not have access to the field readings regarding the Darjeeling Series observations; for he did have.

How intense was his study and involvement is shown from the following :

On 9th January, 1851 he sends a General Report. On 14th he writes a longish critical summary on the Memoirs of the Royal Astronomical Society and the day after, i.e., on 15th, he sends Waugh a critical commentary on Taylor's Scientific Memoirs. Once again, on 3.2.1851 he sends Waugh a memo on 'Methods of Computing.' After a comparative lull, during which period he wrote

many memos and letters on other subjects, some of them purely administrative, on July 10, 1851 we find him coming back to the subject of computational methods. The subject is: "Dehra Dhoon Trilaterals made agreeably to the Theorem of Minimum Squares". Making the computations 'agreeable to the Theory of the Minimum Squares' was indeed his specific theme now. Hereafter we find him engrossed with this method. On 4. 8. 51 he writes to Waugh on "Computation of Heights" and once again on 22. 8 on "Computation Methods." Finally, on 17.9.1851, as a sort of culmination to an intensive process of study, he pours out two huge papers explaining at length, with equations, diagrams and illustrations, the Method of Minimum Squares.

5. METHOD OF MINIMUM SQUARES

Why was RS so keen on mastering and disseminating the method of the minimum (or least) squares? The answer would become obvious if we study the outline of the history of the development of this process.

The method of least squares grew out of the fields of astronomy and geodesy as scientists and mathematicians sought to provide solutions to the challenges of navigating the Earth's oceans during the Age of Exploration. It was particularly suited for solving problems where large amounts of conflicting data were available, where 'there are more equations than unknowns.' With this method one can ensure that 'the overall solution minimizes the sum of the squares of errors made in the results of every single equation.' The method was the culmination of several advances that had taken place during the course of the eighteenth century:

- The combination of different observations as being the best estimate of the true value; errors decrease with aggregation rather than increase, perhaps first expressed by Roger Cotes in 1722.
- The combination of different observations taken under the *same* conditions contrary to

simply trying one's best to observe and record a single observation accurately. The approach was known as the method of averages. This approach was notably used by Tobias Mayer while studying the librations of the moon in 1750, and by Pierre-Simon Laplace in his work in explaining the differences in motion of Jupiter and Saturn in 1788.

- The combination of different observations taken under *different* conditions. The method came to be known as the method of least absolute deviation. It was notably performed by Roger Joseph Boscovich in his work on the shape of the earth in 1757 and by Pierre-Simon Laplace for the same problem in 1799.
- The development of a criterion that can be evaluated to determine when the solution with the minimum error has been achieved. Laplace tried to specify a mathematical form of the probability density for the errors and define a method of estimation that minimizes the error of estimation ¹.

It was Radhanath who studied, mastered and applied this process with precision to the wildly conflicting raw data available with him, thus minimizing the errors. Obviously, this was no mere idle academic activity; the Chief Computer was living up to his famed mathematical acumen in the background of something very urgent and very difficult. Clearly, something momentous was cooking. This was apparent both from Waugh's and other SOI officials' tone, Sikdar included.

6. TENSION

The first indication of some tension, that something is not entirely smooth in the process, appears in a letter by RS to ASW. Let me quote the letter in its entirety, keeping intact the officialese prevailing in mid-19th c. India.

Surveyor Genls Office
Calcutta, 6th June 1852

To

Lieutt Coll. (Sic!) A. S. Waugh Engrs
Surv^r Gen^l of India
Dehra Dun

Sir,

May I request the favor of your instructions as to whether Darjeeling Triangulation should be introduced into the Calcutta Series Report. I think that the operation would most appropriately be brought into the N. E. Long^l Series Report, and perhaps this has been already done at your Head Quarters. I am necessitated to make this reference because in 1849 when I left Dehra Dun, if I remember right, it was your intention that the Darjeeling work should appear in the Calcutta Series Report, and I have been favoured with no intimations of your having ordered a different arrangement.

I have the honor to be

Sir,
Your most obed^t Serv^t
Radhanath Sickdhar (Signature)
Chief Computer

I have not been able to find out Waugh's reply to this poignant query of RS's, which perhaps indicates that Waugh had indeed 'ordered a different arrangement' and kept the North East Longitudinal Report out of bounds for RS and that the latter had not taken this too kindly.

The importance of this letter becomes immediately clear in view of what J. R. Smith writes in his above-mentioned book: 'Radhanath had left Dehra Dun in January 1849 to supervise the major computations and report writing in Calcutta. In the Report he submitted in 1856 there was no reference whatever to the North East Longitudinal series from which the observations were made to the snow peaks. This was dealt with in Dehra Dun by John Hennessey. Waugh acknowledged this fact when referring to the snow peak computations (Smith, 1999, p.191).' This is considered proof enough that RS was out of the

¹ These details are collected from Wikipedia.

Peak XV calculation team. But what had happened in the intervening period, i.e., 1850-1856? The letters and memos that I have seen seem to provide an answer.

We find Sikdar writing to Waugh in 1852 and reminding him that originally it was Waugh's intention that the Calcutta Series Report should include in 'the North East Longitudinal series from which the observations were made to the snow peaks'. Thus between 1849 and 1852, something had changed. Waugh had changed his original plan and officially excluded Radhanath from mentioning that series in his 1856 report.

If, however, we read Sikdar's letter between the lines, keeping in mind the background described above, it should be obvious that while releasing Sikdar from Dehra Dun Waugh had wished that the Darjeeling series reports should be included under the Calcutta Series, which means it would directly be under the purview of RS. We have to remember that by 1849, Waugh himself had observed the mysterious peak ('γ') and Armstrong had done the same from Muzaffarpur ('b'). Waugh had instructed Peyton, the then Chief Computer, to clear the confusion; but nothing had resulted. And yet, Waugh was sure that they were in the vicinity of a big deal. Under these circumstances, it was quite natural on the part of Waugh to entrust the data processing part with RS. What had happened in the meantime to prompt RS to ask whether his boss at Dehra Dun had changed opinion (which, indeed, he had)? We may recall that Nicholson had, by 1850, started observing Peak XV pretty closely from as many as six positions, was taking numerous readings, but was quite confused when it came to the mathematics of the convoluted angles. Which is where RS excelled.

Therefore, one may reasonably infer that despite Waugh's attempt at debarring RS from the North East Longitudinal Series operations, circumstances forced him to ask the same RS to clarify the computational confusion by applying

the new methods based on the latter's mastery over the Theory of Minimum Squares. This is also corroborated by Smith's comment that 'In December 1850 Waugh asked his chief computer Radhanath Sickdhar in Calcutta to revise the form of computing geographical positions of snow peaks at distances in excess of 100 miles and with azimuths up to 45° from the north. For the next few years he was discussing refraction coefficients and the datum zero height (height value of the point from which the values of the mountains were to be calculated) which had to wait until Tennant completed tidal observations at Karachi at the end of 1855 (Smith, 1999, p.191).'

That explains why the announcement of Peak XV's final height had to wait until 1856. In the intervening period RS had been at his most active. Table 1 gives some idea as to the depth and extent of his involvement.

I would like to draw particular attention to the letters dated 4. 6. and 6. 6. 1853, which establish beyond doubt RS's position in the North East Longitudinal Series computations, with particular reference to Darjeeling. Again on 12.1. 1855, Hennessey himself, who was one of the major players in this story, consults RS on 'Darjeeling Series Angles.' A few months later, on 30.5.1855 ASW himself writes to RS from "Dehra Dhoon" that "I am extremely desirous to collect together all observations available on the Snowy mountains so as to arrange in one view all the results of that kind of Geographical information. You will therefore oblige me by searching the records under your charge with the view of discovering any angle books containing observations to the Himalaya mountains or papers connected therewith. *I shall be glad to be favoured with your opinion on the subject.*" Not only that, RS was asked to 'Please forward the enclosed to Mr. Nicolson at Darjeeling retaining a transcript for your office.' Nicolson, as we have noted, was one of the key observers so far as crucial field readings were concerned.

Table 1

Date	From	To	Subject
6.11.1851	RS	AS Waugh	Correction of error in Calcutta Merid. Series
29.11.1851	RS	AS Waugh	Examining Angle Books
2.3.1852	RS	AS Waugh	Math Formulae
28.4.1852	RS	AS Waugh	Error
30.4.1852	RS	AS Waugh	Methods of Computation
4.5.1852	RS	AS Waugh	Errors
13.5.1852	RS	AS Waugh	Sonakoda Base Line
22.5.1852	RS	AS Waugh	Khanpuria Base Line
31.5.1852	RS	AS Waugh	Problem of "Spheroidal Excess"
18.6.1852	RS	AS Waugh	Hurialong and Parasnath Series (Armstrong and Nicolson)
25.6.1852	RS	AS Waugh	Computational Methods
21.3.1853	Renny Tailyour	RS	Banog Barometric readings: seeking help form RS regarding rules of conversion.
10.4.1853	Illegible, Attached to the Assam Longitudinal Series	RS	Information on Hooghly River Survey
? ? 1853	Renny Tailyour	RS	Banog Barometric readings: seeking help form RS regarding rules of conversion.
3.6.1853	RS	A S Waugh	Khanpuria Base Line
4.6.1853	RS	AS Waugh	NE Longitudinal Series
6.6.1853	RS	A S Waugh	Darjeeling
21.8.1853	J O Nicolson	RS	Re: Parasnath Meridional Sires: Seeks assistance from RS on writing report
12.1. 1855	Hennessey	RS	Darjeeling Series Angles
30.5.1855, "Dehra Dhoon"	A S Waugh	RS	"I am extremely desirous to collect together all observations available on the Snowy mountains so as to arrange in one view all the results of that kind of Geographical information. You will therefore oblige me by searching the records under your charge with the view of discovering any angle books containing observations to the Himalaya mountains or papers connected therewith.
18.7.1856	A S Waugh	RS	"correction required to the heights of distant mountains to reduce to the ellipsoids when the difference between the latitude is great. I shall be glad to be favoured with your opinion on the subject. Please forward the enclosed to Mr. Nicolson at Darjeeling retaining a transcript for your office."
25.8.1856	A S Waugh	RS	Re: 1) Spheroidal Correction. 2) "I am glad that the name I have given to the highest snowy peak has given satisfaction to yourself as well as other superior members of the Department."

And then, more than a year later, on 25.8.1856 comes the historic letter from Waugh to Radhanath asserting that

I am glad that the name I have given to the highest snowy peak has given satisfaction to yourself as well as other superior members of the Department.

Is this not an acknowledgement of the role played by Radhanath in clearing the confusion regarding the calculation of Peak XV?

7. 1856 AND AFTER

But the story does not end even here. ‘At a meeting of the Asiatic Society of Bengal on 6 August 1856 Major Thuillier announced on behalf of Colonel Waugh, the Surveyor General, the discovery of a mountain in the Himalayan Range that placed it higher than any previously ascertained value (Smith, 1999, p.212).’ The rest is only too well known. We are not here concerned with the ‘naming game’, replete with high drama. The interesting fact is that, as Smith has noted, ‘it was not until 1860 that Waugh felt justified in

concluding that this was the highest peak in Asia (Smith, 1999, p.198).’ So the process of checking and re-checking had continued even after 1856, with RS still very much at his mathematical best. This is evident from the RS-SOI correspondence of the period (Table 2).

On 4.9.1858 we find Thuillier, the Deputy Surveyor-General, asking RS to furnish ‘corrected heights of several series, including NE Himalaya Longitudinal.’ As late as 1861 Thuillier writes to RS on Nicolson’s computations. One might mention, just in passing, that RS retired in 1862.

In this background, it is interesting to note that J R Smith, the official biographer of George Everest, accedes that computing Peak XV ‘was a team effort’ in which Nicholson and Hennessey played a prominent part. On the strength of the facts cited above, I would like to suggest that this ‘team’ included Radhanath Sikdar, the Chief Computer who handled and processed the data at the final stage before submitting it to his boss at Dehra Dun.

Table 2

Date	From	To	Subject
19.12.1856	A S Waugh	RS	Computational Methods
27.1.1857	A S Waugh	RS	Computational Methods
7.5. 1857	RS	ASW	Corrections in Malancha Series Heightst
25.11.1857	On authority of A S W	RS	Rept. on Tidal Observations
3.4.1858	Montgomerie, 1st Assst, GTS Kashmir Survey	RS	Seeking advice on Barometrical Reading as per RS system
29.6. 1858	A S Waugh	RS	Asking for document to be sent to G. Everest at England.
19.8.1858	H L Thuillier	RS	Computation re: North Parasnath Series
4.9.1858	H L Thuillier	RS	Furnishing of corrected heights of several series, including NE Himalaya Longitudinal
5.12.1858	A S Waugh	RS	Computations of Ferozepur conducted by RS in 1844
18.11.1861	H L Thuillier	RS	Nicolson’s Computations

8. CONCLUSION

Considering all these facts, therefore, I would like to conclude that

- 1) George Everest had nothing to do with what is now known as Mount Everest.
- 2) Radhanath Sikdar, who was the Chief Computer at the Calcutta Office of the SOI since 1849, did not participate in any field operation pertaining to the calculation of Peak XV.
- 3) These field operations were carried out, with varying success, by a number of people, especially Waugh, Lane, Armstrong, Peyton, Hennessey and Nicholson.
- 4) From 1849 onwards all these field readings were as a matter of routine examined by Radhanath Sikdar at the Calcutta office and his observations sent to Waugh stationed at Dehra Dun.
- 5) The task of bringing order to the hopelessly confused data coming from the field was entrusted with Sikdar.
- 6) In the process he solved the problem arising out of the error factor resultant on the atmospheric refraction.
- 7) By applying the method of the Minimum squares, he minimised the error factor and perhaps showed that the figure would be 29000 feet. I say 'perhaps', because no papers relating to that particular calculation by RS have come to my notice.
- 8) Thus, while Radhanath Sikdar was certainly not the "discoverer" of Mount Everest, nor the only person responsible for the final computations, he certainly was the pivot round whom the computations were conducted. And it is based on this combined effort that Waugh could ultimately announce that Peak XV was the tallest in the world.
- 9) Radhanath Sikdar was the only Indian from the Calcutta office who participated in the stupendous effort to finally compute the height of Peak XV within a reasonable limit of error.

BIBLIOGRAPHY

- Keay, John, *The Great Arc*, Harper Collins, London, 2001
- Smith, J R, *Everest: The Man and the Mountain*, Whittles Publishing, Scotland, UK, 1999