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The Height of Mount Everest

(Plates 10, 11)

Recent expeditions to Everest from the north have contributed new material towards both the configuration of its summit and the exact calculation of its height.

When the peak now called 'Everest' was first observed in 1847 by J W Armstrong of the Survey of India, it was labelled 'Peak b'. Situated about 70 miles west of Kangchenjunga, it looked undistinguished and was often nearly invisible, being overshadowed by Makalu (Peak XIII), a more dominant looking mountain when viewed from up to 200 miles to the south. However, rough calculations put the height of 'Peak b' at 28,800ft.¹ (See Fig 1)

Between 27 November 1849 and 17 January 1850 the same mountain, now called 'Peak h' and then 'Peak XV', was observed by J O Nicholson from six stations between 108 and 118 miles to the south on the plains of India using a 24-inch theodolite. Radhanath Sikhdar, the chief computer to Andrew Waugh who had succeeded George Everest as Superintendent of the Great Trigonometrical Survey, calculated the results. It was not until 1852 that the computations were sufficiently advanced to indicate that Peak XV was higher than any other known mountain. But it was only in 1856 that the individual readings of 28,990ft, 28,992ft, 28,998ft, 29,002ft, 29,005ft and 29,026ft were considered sufficiently reliable for the average height of 29,002ft to be recorded. This was due to atmospheric refraction which was still being investigated.^{2,3} It was only then, some nine years after the 'discovery' of the peak in 1847, that it was considered a sufficiently reliable figure for Andrew Waugh to convey it to Sir Roderick Murchison, President of the Royal Geographical Society in London, as the correct height of Everest.⁴ It was the world's highest mountain and, considering the distance from which these figures were computed, it is extraordinary how closely they approached the currently accepted height of 29,028ft (8848m).² Further observations were made between 1880 and 1902 from Darjeeling, and a height of 29,141ft (8882m) was calculated,⁵ but this figure did not gain general acceptance.

With the opening of Nepal in 1950 surveyors were allowed to within 30-40 miles of Everest and a small Indian survey team reached Namche Bazar, 18 miles south of the mountain, in 1953. Between 1952 and 1954 a new and sophisticated survey network was set up by B L Gulatee, then in charge of the geodetic and research branch of the Survey of India. From the main network already established in India a chain of six quadrilateral figures went N towards the Himalaya, ending in an 8-sided figure. From points on

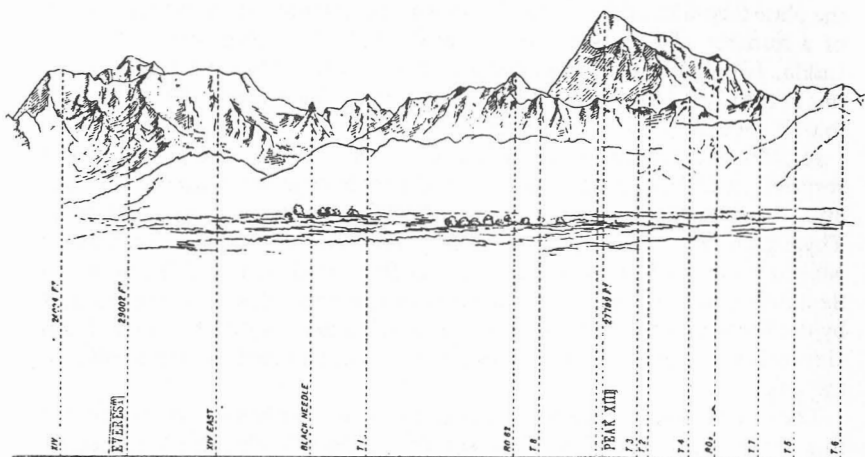


Fig 1 Everest and 'Peak XIII' from Bangura Trig. station
(Distance of Everest about 126 miles, and 'Peak XIII' about 118 miles.)

this, Everest was observed on numerous occasions at distances between 29 and 47 miles. Today's accepted position – latitude N $27^{\circ}59'15.85''$; longitude E $86^{\circ}55'39.51''$, and altitude $29,028\text{ft} \pm 0.8\text{ft}$ (8848m) – is the result of this work. However, all the stations were grouped in an area S and SW of the mountain.⁶

In 1960 Chinese surveyors under Professor Wang Wenying covered the north side of Everest and accepted the 1954 Indian survey's position and height. It was on that expedition, on 25 May at 4.20am, that Wang Fu-chou, Kombu and Xu Yin-hua reached the summit – the first ascent from the north.

In 1975 the Chinese mounted a large combined scientific and mountaineering expedition to Everest. The Survey was brought a major step forward by putting a survey tripod as a target on the summit on 27 May. From 13 control points between 5600m and 6300m and between 7km and 12km from the summit, a height (excluding the thickness of the snow cover) of $29,029\text{ft} \pm 1.1\text{ft}$ (8848.13m) was computed, above the mean sea-level of the Yellow (China) Sea about 2000 miles away! It was also observed that Everest was rising at a mean rate of 0.15mm each year.⁷

In 1987 a re-examination of the height of Everest was made by an Italian party using global positioning systems (GPS) and electronic distance-measuring (EDM) lasers. These established conclusively that Everest was by a large margin the world's highest peak, with K2 (Mt Godwin-Austen) in the Karakoram the second highest at 28,250ft.

In 1991 Professor Roger Bilham of the Department of Geophysics of the University of Colorado at Boulder, whose main research interest was in



9. The Second Step and Summit catch the morning sun.
(*John Tinker*) (p25)



10. The Summit of Everest looking SW, 27 May 1993. An oxygen bottle and prayer flags can be seen about 12ft from the surface on the NE side of the mountain. (*Dawson Stelfox*) (p15, p30)

the plate tectonics of the Nepal Himalaya, carried out a major repositioning of a number of GPS stations in Nepal. He set up four new stations at Lukla, Namche Bazar, Pheriche and Kala Pattar respectively, as well as one at the ruined Rongbuk monastery. His main finding was that the Everest massif seemed to be rising in one block rather than in segments.

In 1992 two prisms for the reflection of laser beams were placed on the summit on 12 May, a day when over 30 people crowded onto the summit, and measurements were made with EDM lasers from a new station at Thyangboche in Nepal by a small survey team backed by the Boston Science Museum and its honorary director Bradford Washburn and his wife.⁸ In September of the same year, after prisms had been placed on the summit by the Italians, a Sino-Italian party measured the height of Everest from six stations, three in Tibet and three in Nepal, and each within 8 miles of the peak.

The official result of these Italian-Chinese surveys has recently appeared in a major article in *G P S World* by Georgio Poretti, Claudio Marchesini, and Alberto Beinat, all of Italy.⁹ The new Everest altitude is reported to be 8848.65m. However, this new altitude for Everest is based on field work which assumes Everest's summit is bedrock – and that this bedrock was 2.55m below the snow surface of the summit at the end of September 1992. But an article by Bradford Washburn¹⁰ on the configuration of the summit indicates that the new Italian altitude was in fact based on the very hard ice layer encountered by Todd Burleson, Peter Athans and Vernon Tejas when they were placing Washburn's laser prisms on the summit on 12 May 1992.

In 1993 Dawson Stelfox reached the summit from the north side¹¹ and took photographs of the First and Second Steps and their approaches. He also took one from the summit looking north-east (*Plate 11*). In this, the two-prism assembly of the 1992 (Washburn) party is shown clearly, whilst behind it is some equipment, left by the Italian party, which had apparently been blown over during the winter of 1992/93 and replaced by an unknown hand in the spring of 1993.

Another photo by Stelfox taken some yards from the summit looking south-west (*Plate 10*) shows an oxygen bottle and prayer flags visible in the snow about 12ft from the surface on the NE side of the mountain. Presumably these were originally left on the surface snow of the summit and were buried by successive snowfalls.

It seems from these photographs and other observations that extra snow is added to the summit during each monsoon; this settles and gets blown away by the ferocious winter winds, the height of Everest remaining much the same.

Winds of 165mph from the west-south-west were recorded by Washburn in his Learjet in December 1984 when he flew over Everest at 39,000ft. The direction of this prevailing wind, which is parallel to the NE ridge and at right angles to the ridge between the south and main summit, probably explains why there appear to be no cornices reported on the NE ridge overlooking the Kangshung face, whilst there are large ones on the ridge between the south and main summits overhanging this face.



11. The Summit of Everest looking NE, 27 May 1993. In the foreground is a two-prism assembly left by Todd Burleson on 15 May 1992 at the request of Bradford Washburn. Behind it is some equipment left by an Italian survey team on 30 September 1992. (*Dawson Stelfox*) (p15, p30)

This recent work emphasises how accurate were the observations and calculations of the many British and Indian surveyors in the past who worked under poor conditions and with much less sophisticated equipment than is available today. Their work was most aptly and correctly named 'The Great Trigonometrical Survey'.

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