

Survey of Tal y Fan

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BBC Reporter and Cameraman: Graham Satchell and Keith Jacobsen

1) **Introduction**

Tal y Fan (Hill 2031, Section 30B, OS 1:50000 Map 115, OS 1:25000 Map 17E, Grid Ref. SH729726), is currently listed as a “Hewitt” and a “Nuttall” and is situated in the Northern Carneddau. It is the most northerly mountain in Wales that exceeds 2000feet. The summit is marked with a spot height of 610m and therefore just exceeds 2000 feet (609.60m).

Having recently surveyed Thack Moor in Cumbria, this hill was found to exceed 2000 feet by just 0.02m and the resulting publicity in the national press played on the theme of “The Englishman that went up a hill and came down a mountain” the film written and directed by Christopher Monger and starring Hugh Grant. At the request of the BBC, we were asked if we could survey a mountain that could possibly be demoted to a hill and Tal y Fan was chosen for this survey. Tal y Fan was surveyed on 5 May 2013 in the presence of the BBC who filmed the event and Mark Greaves from OS who later processed the data on Bernese software that evening. The announcement of the measured height was made on BBC’s Breakfast TV programme on the following day.

2) **Equipment used and Conditions for Survey**

Ground surveys to determine the position of the summit were carried out using a Leica NA730 Professional Automatic level (X30 telescopic system)/tripod system and a “1m” E-staff extendable to 5m.

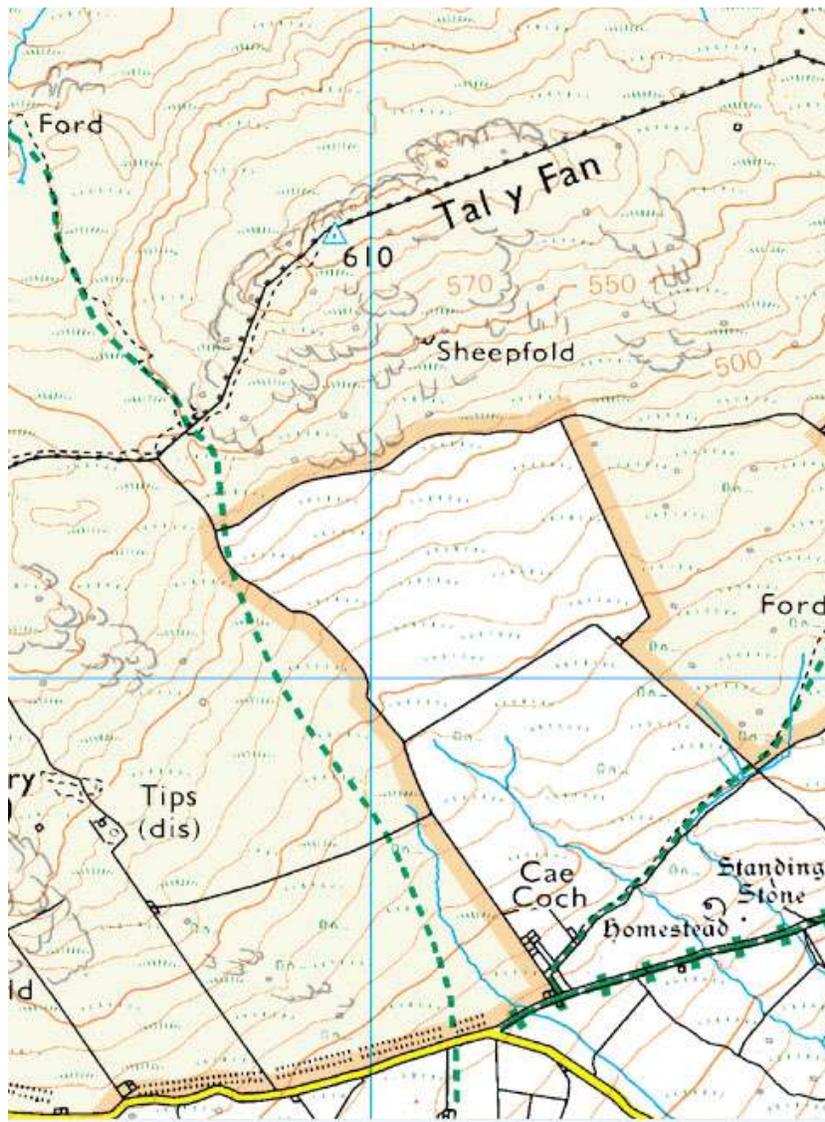
Absolute height was measured using a Leica Viva GS15 Professional GNSS receiver. It is a dual-frequency, 24-channel instrument, which means it can lock on to a maximum of 12 satellites and receive two signals (at different frequencies) from each of these satellites. The latter feature reduces inaccuracies that result from atmospheric degradation of the satellite signal. As a stand-alone instrument, it is capable of giving position and height to an accuracy of about one and five metres respectively. Note that a hand-held GPS receiver can only receive up to 12 satellites and each at a single frequency and therefore it has a poorer positional accuracy of +/-5m and a height accuracy of no better than 10 metres. Despite the on-board features of the receiver, there are still sources that create residual errors. To obtain accurate positions and heights, corrections were made to the GPS data via imported RINEX data from the Ordnance Survey which were post-processed using Bernese software and later using Leica Geo Office Version 7.01 software.

Conditions for the survey, which took place between 14.30hr and 17.30hr BST, were excellent. The weather was warm, about 20 degrees Celsius, with sunshine and good visibility. The wind was light and therefore had no effect on the survey.

2.1) Character of Hill

Tal y Fan, in the North East Carneddau, is the most northerly 2000 foot mountain in Wales and dominates the view from Conwy which lies about 7km to the North East. It lies on a North East spur of the Carneddau “ridge” which starts at Abergwyngregyn on the coast and leads to Llyn Ogwen in the South. Access to this mountain can easily be obtained from a number of different directions but the easiest route is from the minor road that runs in an East West direction to the South of the mountain and terminates at a small car park. From this car park a wide track, which is an ancient Roman road, continues North West to Bwlch y Ddeufaen (Pass of the Two Stones) where there are two prehistoric monoliths.

A footpath starts about 1km East of the car park, and goes in a North Westerly direction to the bwlch between Foel Lwyd and Tal y Fan. From there a track leads up to the summit of Tal y Fan on the north side of a stone wall. A ladder-stile provides access over the wall to the Southern side where the trig point and summit are located. The flanks and summit area of Tal y Fan are covered with grass/heather and outcrops of rock. An extract of the OS 1:25000 map with summit features is shown below.



2.2) The Summit Survey

The summit area is traversed with a high dry stone wall running from South West to North East. The Leica automatic level was set up at a convenient point on the South side of the wall and staff measurements were taken at high points on both sides of the wall in order to locate the exact summit position. This was the top of an embedded rock about 3m away from the trig pillar and is shown in the photograph in Appendix 1. This point was measured to be 0.23m higher than the second highest point.

Since it was not possible to set up the Leica Viva GS15 directly over the highest point, it was set up on flat ground between the summit of the mountain and the trig point. The antenna was mounted on a 2.000m pole and data were collected for 2 hours with an epoch time of 15 seconds. A photograph of the set up is shown in Appendix 1. The staff measurements at the summit and GPS set up point were:-

Staff reading at summit = 0.185m

Staff reading at GPS set up position = 0.809m

This means that a height correction of $0.809 - 0.185 = 0.624\text{m}$ needs to be added to the GPS measurement for the height of Tal y Fan.

The ten-figure Grid References measured for the summit were:-

Garmin Montana 600 SH 72940 72653 Accuracy 3m Height = 611m

Garmin Oregon 450 SH 72941 72652 Accuracy 4m Height = 614m

The position and height data for the summit that were recorded by the Leica Viva GS15 and post-processed by Ordnance Survey with Bernese software and using predicted ephemeris data imported OS RINEX data from the nearest six OS Active Base stations were:-

System	Easting	Northing	Height(m)
GS15	272937.919	372649.691	609.98

Subsequently the same data were processed using Leica Geo Office Version 7.01 using the calculated tropospheric model, broadcast ephemeris, and data imported from the nearest eight active OS Base stations. The results were:-

System	Easting	error(1SD)	Northing	error(1SD)	Height(m)	error(1SD)
GS15	272937.913	0.003	372649.685	0.002	609.990	0.008

In both sets of calculations the height correction of 0.624m was subtracted from the height of the pole and therefore a vertical offset of 1.376m was used.

3) Discussion of Results

The height of Tal y Fan was measured to be 609.98m which is in agreement with the spot height of 610m recorded on OS maps. As this height is 0.38m above 2000.0 feet (609.60m), Tal y Fan clearly remains a “mountain” and this result was reported on BBC Breakfast TV on 6 May 2013.

Since the position of the summit was the top of an embedded rock, there is negligible measurement uncertainty associated with its correct location. The main error in the height determination is

associated with the GPS measurement itself, and for 2 hours of data we would expect this to be within +/-0.05m (three times standard deviation).

4) **Summary and Conclusions**

The **summit** of **Tal y Fan** is at grid reference * **SH 72941 72653** and is the top of a rock. Its **height** was measured to be **609.98+/-0.05m**.

* NB average hand-held Garmin GPS grids are quoted in the summary.

John Barnard, Graham Jackson and Myrddyn Phillips, 20 May 2013.

Appendix 1
Location of the summit of Tal y Fan



Leica Viva_GS15 set up on a 2.000m pole for summit measurement

