

Survey of An Dun

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The Team:

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1) **Introduction**

An Dun (Section 5B, OS 1:50000 Map 42, Grid Ref. NN717805) is a Corbett and a Marilyn. This mountain has two tops about 400m apart that lie on a South to North direction. Currently the OS 1:25000 map shows spot heights of 827m and 826m for the North and South Tops respectively so the North Top is considered to be the summit. However, previously the OS maps had indicated that the South Top was the higher and the map change created controversy about the location of the hill's summit. On 16 March 2008 the authors visited An Dun and tried to resolve with Abney Levels which Top was the higher. Because of poor weather conditions and the fact that we were near the level of resolution of the instruments, we were unable to identify conclusively the hill's summit. However, we thought that the South Top was probably the higher and we reported this at that time to the RHB group.

The purpose of the survey was to identify the highest points of the North and South Tops using the more accurate surveying equipment of automatic level and staff, to line survey between these two points in order to identify the highest point of An Dun and then to quantify the height difference between these two points.

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

Ground surveys to determine the position of the highest points of the Tops and height difference between them were carried out using a Leica NA730 Professional Automatic level (X30 telescopic system), tripod and a "1m" E-staff extendable to 5m.

Conditions for the survey were very good. The wind was light, visibility excellent and the temperature about 15 degrees Celsius. The survey took place between 12.00hrs and 14.00hrs GMT.

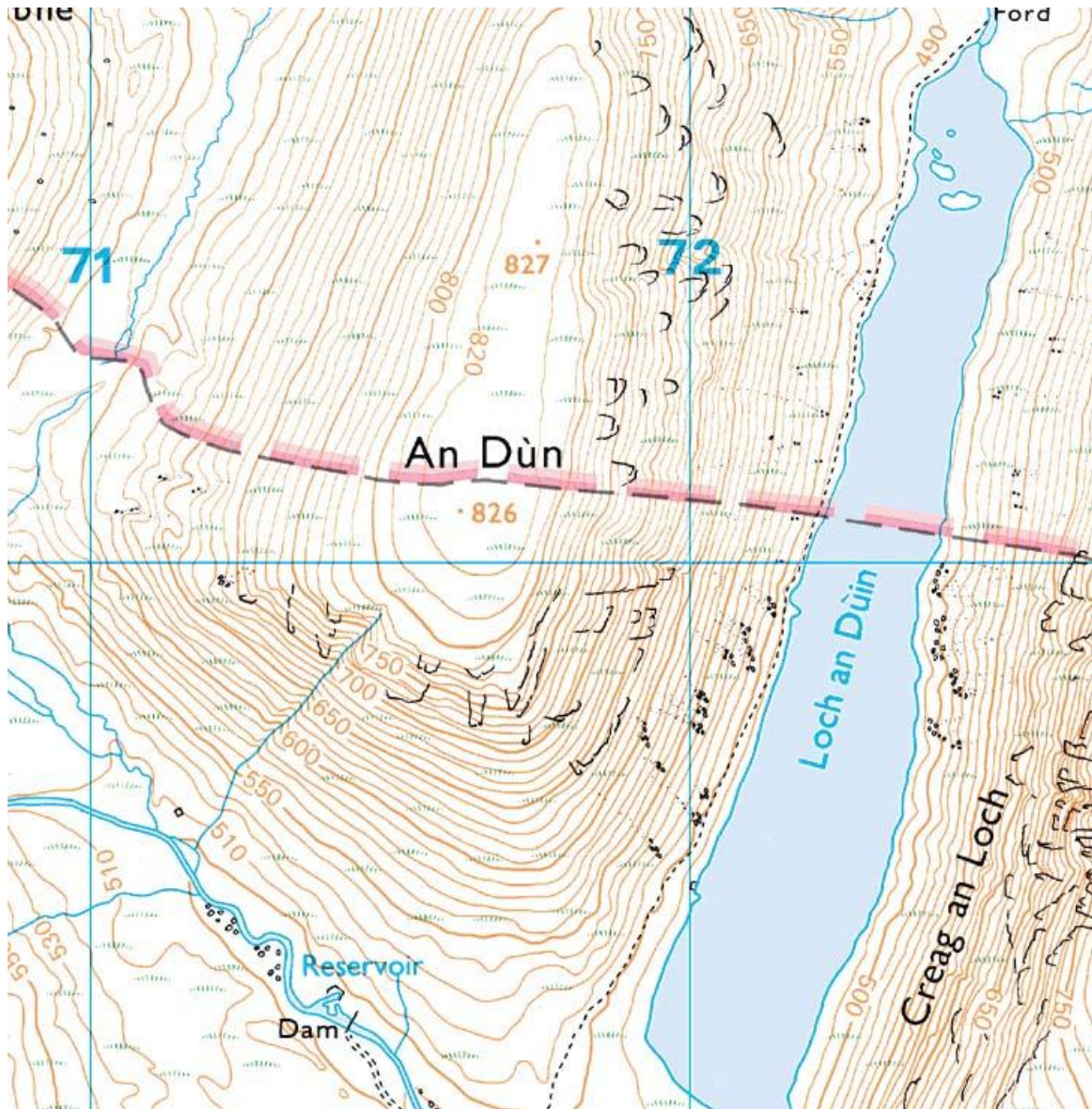
3) **The Survey**

3.1) **Character of Hill**

An Dun lies in the Southern Grampians about 5km South and 9km East of the small village of Dalwhinnie on the A9. Together with the adjacent Corbett to the East, Maol Creag an Loch, these two hills are very remote and are surrounded by very steep terrain. Between them lies the isolated Loch an Duin and also the route of the ancient Gaick Pass which leads from Atholl in the South to Badenoch in the North. The summit area of An Dun is quite flat and is an extensive area of short grass and stony ground. The North and South Tops are about 400m apart and the ground between them dips by about 4m.

The best approach to the hill is from the South on the A9 near Dalnacardoch Lodge where there is ample parking on the minor road that leads West to Trinafour. The wide track follows Edendon Water for about 9km to the Sronphadruig Lodge just South of Loch an Duin. In this

area there was recent evidence of flooding and a substantial length of the track had been washed away. A new concrete bridge had been built to give access to the West bank of the river. The ascent of An Dùn is then completed by a 300m steep climb up the grass and heather southern slopes to reach the South Top and the summit plateau. An extract from the Ordnance Survey 1:25000 map is included below.



3.2) Summary of Survey Method

The survey commenced at the South Top. The first task using level and staff was to identify the highest point in this area and mark its position. Next we transferred the level and staff to the North Top and repeated the procedure there. Finally we carried out line surveys from North to South Top and then in the reverse direction in order to measure the height difference between the two highest points. "Triple Wire Levelling" was carried out as standard procedure in order to avoid gross errors in staff readings.

3.3) The South Top

The South Top is marked with a large cairn but even visually this does not appear to be at the highest point. When we carried out our Abney level survey in 2008, we showed that ground about 30m in a nearly northerly direction was about 0.5m higher and we marked this position at the time with a small cairn. This cairn has since been destroyed, but we were able to identify the position from the GPS measurements we had taken previously.

Having set up the Leica NA730 level at a convenient position near the large cairn, we systematically took staff readings in order to locate the highest point in this area. This was confirmed as a point 29m away and on a bearing of 350 degrees from the large cairn. We measured this position to be 0.38m higher than the base of the large cairn and this confirmed our previous measurement. We marked this position by building another cairn.

The ten-figure Grid References measured for the highest point of the South Top were:-

Garmin Map60CSx	NN 71651 80134	Accuracy 2m	Height = 835m
Garmin Venture	NN 71652 80135	Accuracy 5m	Height = 835m
Garmin Etrex	NN 71652 80134	Accuracy 5m	Height = 838m
Magellan Explorist 100	NN 71650 80134	Accuracy 3m	Height = 837m

The ten-figure Grid References measured at the base of the large cairn were:-

Garmin Map60CSx	NN 71662 80104	Accuracy 3m	Height = 832m
Garmin Venture	NN 71661 80107	Accuracy 4m	Height = 832m
Garmin Etrex	NN 71661 80105	Accuracy 5m	Height = 836m
Magellan Explorist 100	NN 71658 80102	Accuracy 3m	Height = 829m

3.4) The North Top

The Leica NA730 level was set up on the tripod near to the cairn and staff readings were taken systematically to locate the highest point of the North Top. In fact, the cairn was found to be placed on the highest point in this area.

The ten-figure Grid References measured for the base of the cairn were:-

Garmin Map60CSx	NN 71737 80495	Accuracy 2m	Height = 830m
Garmin Venture	NN 71736 80498	Accuracy 3m	Height = 833m
Garmin Etrex	NN 71736 80496	Accuracy 5m	Height = 831m
Magellan Explorist 100	NN 71737 80497	Accuracy 6m	Height = 827m

3.5) Line Survey between the two Tops

The line survey was started at the cairn on the North Top and a position was chosen and marked at its base. This survey was carried out using the standard procedure for line surveying. The staff was held vertically over the marked position by the cairn having set up the level on the tripod at a convenient position in the direction of the South Top. Once a set of staff readings had been taken (backsights BS), the staff was then moved to a position further towards the South Top, but the level was not moved apart from a rotation through “180 degrees” to take another set of readings (Foresight FS). The process of alternately moving the staff and level was repeated until the final reading was taken with the staff positioned at the highest point on the South Top.

Readings were taken from the horizontal, lower and upper stadia lines of the level (Triple Point levelling) to obtain three sets of data to provide a check on any staff misreading and also to improve accuracy with more reading sets. If the average of a reading set is more than 1mm different from the horizontal line reading, then another set of readings is taken. The full sets of results are shown in Appendix 1.

The process was then repeated in the opposite direction, that is from the South to the North Top. The two sets of results show the South Top to be higher by 0.026m and 0.031m respectively. We had previously taken staff measurement around each of the individual highest points on the respective Tops and had shown that there was about a 0.03m variation in ground level at each Top. This variation is comparable to the difference in height between the two Tops.

4) Discussion of Results

The difference between the two line surveys, that is the closing error, is 5mm. From previous experience with line surveys this is a little higher than expected but still quite satisfactory. We could have carried out another line survey but we considered that even if we reduced the closing error to, for example 3mm, it would not change the conclusion that we can draw from the measurements. With a 0.03m variation in the ground level around each Top, and a measured height difference between the Tops of 0.03m, we could easily have chosen two points for the line survey that would have made the North Top the higher. Realistically we have to conclude that the highest points of the North and South Tops are of equal height. No further visits are planned and Ordnance Survey will be informed with the suggestion that equal spot heights should be placed on the map for each Top.

5) Summary and Conclusions

The **summit of An Dun** comprises the **North and South Tops which are of equal height to within 0.03m.**

The ***Grid References** for the highest points of the **North and South Tops** are **NN 71737 80496** and **NN 71651 80134** respectively.

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

John Barnard and Graham Jackson, 17 April 2012.

Appendix 1: Line Survey Results

Title:- Survey of An Dun

Instrument:- Leica NA730 Automatic level

Date:- 24/03/2012

Point Number	Horizontal Line		Lower Stadia Line		Upper Stadia Line		Mean BS metres	Mean FS metres
	Backsight BS metres	Foresight FS metres	Backsight BS metres	Foresight FS metres	Backsight BS metres	Foresight FS metres		
Survey from North Top to South Top (Level GJ, Staff JB)								
1	0.219	3.592	0.101	3.305	0.339	3.880	0.220	3.592
2	0.918	1.386	0.529	1.140	1.308	1.632	0.918	1.386
3	3.208	0.502	2.874	0.281	3.539	0.727	3.207	0.503
4	1.732	0.620	1.481	0.462	1.981	0.780	1.731	0.621
SUM =							6.076	6.102
Height difference (m) =							-0.026	
Survey from South Top to North Top (Level JB, Staff GJ)								
1	0.620	1.588	0.462	1.299	0.780	1.876	0.621	1.588
2	0.288	2.240	0.113	1.882	0.465	2.600	0.289	2.241
3	0.568	0.430	0.104	0.259	1.035	0.600	0.569	0.430
4	3.169	0.357	2.960	0.246	3.376	0.470	3.168	0.358
SUM =							4.647	4.616
Height difference (m) =							0.031	