Getting your Bearings
A Saddle Point

Chris
Well, here we are. This is Hollins Cross.

Mike
Yeah, that's right. This is a saddle here. We've got six paths meeting at a point. If we go over to this side, you get a good view over Edale. And if we go over here, we can see Castleton. This path – that leads to where we were this morning.

Elisabeth
I think I'll take a photo.

Narrator
Hollins Cross isn't just a viewpoint. You might recall it was described as a *saddle point* by Mike Underhill. It gets that name because the shape of the land surface there resembles the shape of a horse's saddle. And that surface, which is recognisable from its characteristic contour patterns, is mathematically interesting in its own right.

Patterns of contour lines can allow you to identify some surface features easily. For instance, a simple feature is represented by these contour loops, fitting inside one another. They either indicate a hill rising to a maximum point or a dell dropping to a minimum point. To decide between them, you need to know the height details. In this case the contours rise in height as they go inwards, and so you must be looking down on a hill; and this is the very highest point, or maximum point, of the hill. This is a characteristic pattern for the saddle point. Mathematically speaking, the saddle point in the centre is both a maximum point on the surface in one direction and also a minimum point on the surface in the other direction.

When you know the contour heights, you can see which parts of the saddle rise up and which slope down. The line in this direction first crosses contours which increase in height to the saddle point and then decrease in height again on the other side. So its profile has a maximum height at the saddle point. On the other hand, the line in this direction crosses *these* contours, which first descend in height to the saddle point and then rise in height again. So in this case a profile taken along the line would drop to a minimum height at the saddle point.

The saddle point on Hollins Cross isn't very pronounced, but it's the best point to cross over the ridge, as you can see from these other tracks up to the saddle and over the top. Each of these paths travels diagonally up the flanks of the ridge to provide as gentle a climb as possible.

Looking from a lower position at this northern side of the ridge, you can see the dip – the minimum point in the ridge path. But, being a saddle point, this line, which is at right angles to the ridge, will be the direction in which the hillside is steepest. It rises to a maximum height at Hollins Cross itself, as you can see in this view where we've

cut a section of the hill away to show you the profile across the saddle. So, that's the mathematics of Hollins Cross, an example of a saddle point, which has a maximum point in one direction as well as a minimum point in another direction. And, as you can see, it's also an ideal point for viewing the surrounding area.

But leaving behind the comparatively level path from Mam Tor to Hollins Cross, our walkers have next to negotiate Back Tor. The problem isn't so much how to locate the Tor, but rather how to climb it! If you examine the contour lines on your map, you'll see that the gradient of the path up Back Tor is going to be steep, because the contours are close together. It works out to be about five metres up for every ten metres forward, which looks like this in reality. Here's the shape of Back Tor. On some maps, you'll find that very steep hillsides are represented by a cliff-face symbol like this. The terrain around Back Tor is another good example of a dramatic change in gradient over a short distance. Looking down from above, you can see the contour lines are close together near the Tor. But a little way away, to the north of Back Tor, you can see that the contours get further and further apart. The wider spacing represents this gentler gradient towards the bottom of the Edale valley, as compared to Back Tor rising steeply alongside.