Map and Compass

Learning navigation & way-finding

Sheet O.11

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When static camping, navigation is usually not such an issue – *you just find the camp site;* but if you really want to experience "travelling light" then you need to leave the tarmac behind and head off into the wilderness. If you want to travel out into the wilds confidently, and come back again safely, then map reading and compass navigation is an essential skill to learn.

All directions are relative... *when you're lost*

As society becomes more technological it depends more and more on location information; electronic systems – such as the cellphones, traffic information systems or satellite global position systems (GPS) – that, provided everything else in society functions normally, will work OK; but what if they didn't?

As people become more reliant on these systems, especially satellite navigation (SatNav) systems in cars or GPS systems when out walking, they are progressively losing the skill to navigate on their own. Theoretically a solar flare such as the *Carrington Event* of 1859 would interrupt and perhaps disable these systems, especially satellite-based systems like GPS (the solar storm of 1859 disabled the primitive telegraph system that existed at the time, and electrocuted some telegraph operators).

Learning map reading is a useful skill purely in its own right – it enables you to interpret what it is you can see in front of you and, through the additional information at your fingertips, extract greater meaning and enjoyment from it. But if your electronic guidance fails, or the system in general eventually falls into disrepair as the global economy adjusts to the energy depletion problem, learning the basic of compass reading and way-finding will allow you to retain your ability to move across country.

Maps

A map is a graphical representation of a piece of the Earth's surface – be that your "back yard" or the entire planet. In a more abstract sense, maps have also been associated with power and influence, as if you can map an area you can possess and control it more easily. On this point it's worth noting that the origins of Britain's mapping agency, the Ordnance Survey, were in the development of maps of Scotland in the 1750s in order to quell the Jacobite Rebellion, and later these same mapping techniques were used across the British empire.

The most important feature of any map is its scale. This is usually expressed as a ratio, for example, "1:10,000" – this would mean that one unit of measurement on the paper map would be equivalent in the real-world to 10,000 units. Or to take another example, the 1:25,000 scale map is sometimes called the "two and a half inch" map because 2½ inches on the map is equivalent to one mile on the ground (63,360 inches/mile ÷ 25,000 = 2½ inches/mile).

British Mapping

Britain has an excellent mapping system courtesy of the Ordnance Survey (OS – *at least whilst it's still a public body*). This information is available as paper maps, but increasingly you can find it on-line too.

The OS's paper maps come in different scales:

The ***Explorer* series** maps (they have orange covers) have a scale of 1:25,000 – the 1km grid squares have a 4cm spacing, equivalent to 2½" to a mile. Explorer maps are intended for people walking or riding in the countryside, and contain a lot of detail such as field boundaries and ancient monuments. If camping, these are the ideal map to help you find a good site to pitch up, find water, etc.

The ***Landranger* series** maps (pink covers) have a scale of 1:50,000 – the 1km grid squares have a spacing of 2cm, equivalent to 1¼" to the mile. They have much less detail than the Explorer maps, and whilst suitable for touring cycling they are not as easy to read for walkers – unless you're good at using the compass in order to take bearings and fix your position. The lack of detail can also make it a little hit and miss when finding a wild camping site.

Finally, there are the ***Travelmaster* series** maps (blue/grey covers) which have a scale of 1:250,000. These are of little use for walking or camping, but it can be useful to have one to hand when you're sat on a hilltop – using a compass you can identify features on the horizon many miles away. Other than that, they have very little practical use for camping.

If you go on-line you can increasingly find a lot of mapping information. The OS – you can find their web site at http://www.ordnancesurvey.co.uk/ – have their "get a map" system that lets you view mapping data from the 1:25,000 scale Explorer up to the 1:250,000 scale Travelmaster. They also have a guide to their paper maps so you can find sheet numbers.

One of the simplest sites to use is *Street Map* – http://www.streetmap.co.uk/ – as it uses the OS's map data but presents it in a better format. When you search for a location it defaults to the 1:50,000 map data, but you can zoom in to get the 1:25,000 data, or out for the 1:250,000 (and greater) maps.

Finally the *Google Maps* site – http://maps.google.co.uk/ – has not very good mapping data but it does have a satellite/aerial photograph facility. This means that you can take a "virtual walk" around an area before you get there, learn the lie of the route you want to follow, and find the best land cover and water sources for discrete wild camping.

You can get all sorts of map measuring devices – these roll across the map and read off the distance travelled. However the best and most inexpensive distance measuring device is just a piece of thin flexible wire, about 60cm/two feet long. You run the wire along the route that you want to take on the map, pinch the point at the "end" of the route, and then stretch the wire along the grid at the side of the map to read off the distance. This will give you the distance in kilometres, so it you want it in miles you'll have to convert in your head (divide by 1.6) or just get used to using kilometres.

Grid references

Note: To understand what follows it helps if you have a Landranger/Explorer OS map to hand!

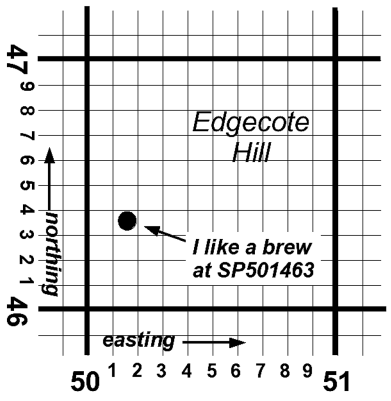
Most maps are based on a grid – parallel lines that run across the map. Usually the grid has labels – letters and/or numbers that identify individual squares so you can find locations on the map quickly. Ordnance Survey mapping uses a national grid system and so the numbers on the side of the map represent the same position, irrespective of whether you're looking at a 1:50,000 or a 1:10,000 OS map – what varies is just the spacing of the grid lines on each map series (see the box on the previous page).

The UK's national mapping grid is split into 100 kilometres square boxes, each identified by a letter – SO, TQ, NH, etc. (see http://en.wikipedia.org/wiki/British_national_grid_reference_system for a longer explanation with a diagram). So if I use the letters "SP" then that indicates that any numbers that follow relate to the grid square that covers south Midlands. In turn, each 100km grid square is divided into 10,000 kilometre square boxes. As there are 100 divisions on each size this means that the grid numbers you see on the side of OS maps run from "00" to "99" (as we measure from 0, not 1, it's always a two-digit number).

By combining grid measurements from the two axes (or sides) of the map we can fix a point on it. The convention is that we first take the "easting" – a measurement along the bottom/horizontal axis of the map; then we take a "northing" – a measurement along the side/vertical axis of the map. Another way to remember the order (it could save your life!) is to say the line "along the passage and up the stairs"; the "passage" is the easting measurement and the "stairs" are the northing measurement.

For example, let's say that I wanted to identify a 1 kilometre square in the south Midlands that contains one of my favourite local beauty spots, Edgecote Hill (I have to use a grid reference because the name isn't on the map). I first quote the 100km grid square two letter identification – "SP". Then I take an easting measurement along the bottom of the map, "50". Then I take a northing measurement along the side of the map, "46". So in the whole of the UK the reference "SP5046" defines a single kilometre square piece of land that contains Edgecote Hill.

Of course, a lot can happen inside a kilometre square piece of land, so when walking or orienteering the convention is to use a "100 metre" grid reference. To find this we divide the sides of the 1 kilometre square into ten segments, each numbered "0" to "9" – the Explorer 1:25,000 scale maps have these marked along the edge as ten small divisions between grid lines.



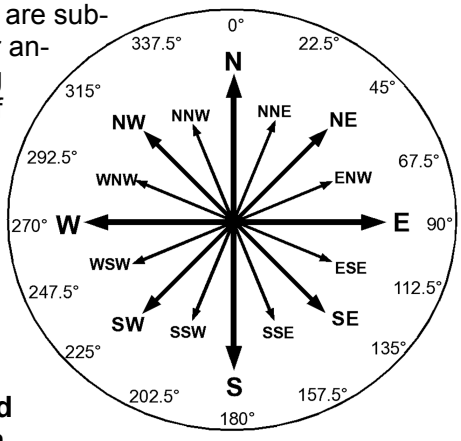
So, returning to the previous example, let's say I want to Identify the 100-metre grid square that contains the farm gate on Edgecote Hill that I like to walk out to and have a brew up. On the Landranger 1:50,000 scale maps each 1 kilometre grid square is 2 centimetres wide – so each 100 metre square is just 2 millimetres wide; on the 1:25,000 scale map the grid squares are twice as big, 4 centimetres, so each 100-metre division is 4 millimetres. To take the easting measurement I measure from the left hand side of the 1km grid square and then divide by either 2mm or 4mm (depending which scale map I'm using) and then ignore the values after the decimal point. For the gateway I like to brew up in this gives the number "1". Then I take the northing measurement in the same way from the bottom side of the grid square, and this gives me the number "3". So the full 100-metre grid square reference, unique across the whole of the UK, will be "SP501463".

It is also possible to produce a 10-metre grid reference, by dividing the grid square into 100 units, but as each division would be less than half a millimetre wide you're only going to be able to estimate the true value. In reality it's fairly easy to find someone/somewhere within a 100-metre grid square.

Directions

To learn about directions you need to learn a little bit about navigational geometry. In a circle there are 360 degrees – or 360°. In nautical navigation each degree is split into 60 minutes (60'), and each minute into 60 seconds (60"). On land you don't have to worry about such accuracy, as the distances involved are small, so we'll just be dealing in degrees.

The 360° circle of the compass is divided into the *cardinal points* – North (N), East (E), South (S) and West (W). These are subdivided into other angles representing different points of the compass – so the Carry Grant film *North-by-Northwest* (NNW) could also have been called *337.5 degrees*.



Compasses and the grid system

The Earth has a strong magnetic field, created by

the movement of liquid iron in the core of the planet. Like any magnet it has a “north” and a “south” end, so what we call “north” on the map is actually “south” on the Earth's magnetic field because it's the *opposite poles* of magnets that attract each other; but don't worry about the technicalities – from here on we'll take “north” as being what a compass indicates.

The Earth's magnetic field doesn't emanate from the poles around which the Earth rotates; at the moment the magnetic north pole is located in the far north of Canada, and the magnetic south pole is just off Antarctica, below Australia. What's even more complicated is that the magnetic pole doesn't stay still; as the liquid metal sloshes around in the core so the origin of the field changes slightly from year to year. At the moment it's moving towards northern Greenland, and in fact over thousands of years it moves between Canada and northern Siberia.

The Earth is round, so its surface is curved; the national grid system is a flat representation of a notionally flat land surface that's conveniently drawn over the land mass of Britain. For this reason the map's grid and the Earth's surface don't match up; what the grid indicates as “grid north” on the map isn't “true north”, and both of these don't relate to the mobile “magnetic north” that your compass will indicate – and as you move around Britain the relationship changes. *Complicated or what?*; well no, because every Landranger or Explorer OS map has a key, and on that key you'll find a section called “National Grid Reference System”, and in that section you'll find a measurement of the difference between grid north, magnetic north and true north; and how quickly/which direction magnetic north is moving (in minutes – e.g. 9'/year movement for 10 years is 90'; with 60'/degree that's the same as 1.5°).

In most practical circumstances, unless your life absolutely depends upon it, you can ignore the difference between true, magnetic and grid north (it's a little more significant in the far north of Scotland). A few degrees might not sound much, but if you travel a long distance the error slowly mounts up. For example, if your measurement is five degrees off then after a kilometre you're position will be about 90 metres from where it should be; after six kilometres that grows to just over a kilometre of error. In Britain, with the exception of some of the wilder parts of northern Scotland, such errors are not usually significant; but under extreme conditions, such as fog, even a few tens of metres of error can cause you to miss finding a specific point, or fail to avoid a hazard.

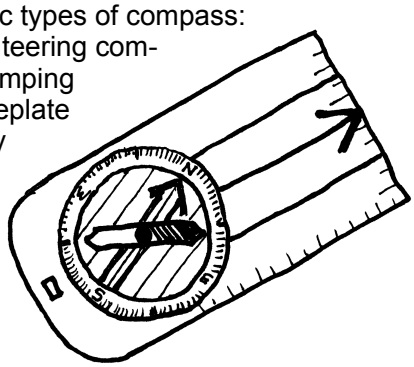
Using compasses

Compasses come in many shapes and sizes, and the price you pay will vary a lot too. The more expensive a compass is the better quality both the magnetic needle and the bearing that it swivels upon will be. Cheap compasses sometimes stick and give dodgy readings, and if you drop them the needle might fall off its pivot. The more expensive compasses, specifically designed for orienteering, are constructed to give the best results under extreme conditions (e.g., cheap compasses are sometimes filled with water and can freeze, whilst more expensive compasses will use oil that should not freeze).

How much you pay is up to you, but provided you avoid the obvious tourist/outdoor shops that sell at a premium to day trippers, the price you pay should reflect the quality of the mechanism inside.

There are two basic types of compass:

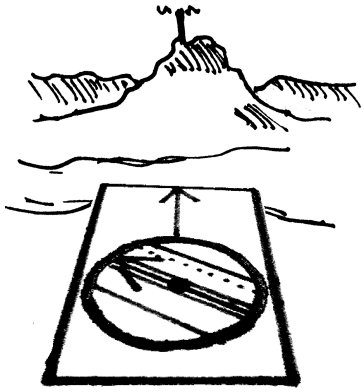
The standard orienteering compass, sold in most camping shops, has a flat baseplate with a swivelling body that allows you to measure angles. The larger the baseplate the easier it is to take bearings from the map. The baseplate will also have measuring scales, some of which are made to fit the Landranger or Explorer maps so that you can take 100-metre grid reference measurements without having to do the maths in your head.



The other type of compass, which is often only available from specialist shops, is a sighting or lensatic compass. It's more complicated, and usually they're very expensive. Whilst a standard compass might give you measurements fairly accurately to within three or five degrees, a sighting compass gives measurements to an accuracy of up to one degree or less (if used properly). It has two sights, rather like the sights on a rifle, and when you line up a point between the sights you look through a small window to see (sometimes magnified by a lens) a bearing on the scale. For most types of walking in Britain a sighting compass is a bit over the top, but if you're making maps, or trying to find the location of something in the distance to within a few tens of metres, then this is the tool that you need.

To take a bearing with a standard compass

1. Bring the compass up to your eye and then look from the centre of the pivot along the central line of the baseplate and off into the distance to the point you're measuring – allow the needle to balance and move freely.

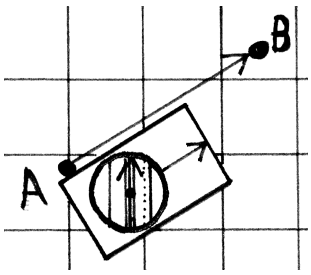


2. *Whilst taking care to keep the centre of the baseplate pointed at the object*, slowly rotate the body of the compass until the needle lines up with the central arrow/lines inside the needle chamber.

3. When you've got the needle lined up with the central lines/arrow of the chamber, and with the centre of the baseplate still lined up on the point in the distance, you can take the compass away from your eye and look at the bearing on the scale.

Note that this is the magnetic bearing; if you want to be precise for grid north, or true north, you'll need to correct for the magnetic variation accordingly.

To walk a bearing with a standard compass:



1. Carefully line-up the side of the baseplate, *in the direction of travel*, from your position (A) to the point you want to go on the map (B).

2. Twist the body of the compass so that the lines inside the chamber are parallel to the grid lines on the map – *with north pointing north on the map!* This is a bearing from grid north; if you need to correct for magnetic variation, twist the body to subtract (or add) the magnetic variance from grid north.

3. Bring the compass up to your eye and then turn your body so that the needle is sitting steadily between the lines/over the arrow in the chamber.

4. Look along the centre of the baseplate, from the pivot across the centre line, and find a point in the distance that's identified by the line – if necessary, if there's no landmark, estimate the line to follow as a "gap" between two trees, or two hills, etc.

5. Fix that point in your mind, take the compass away from your eye and then start walking towards it.

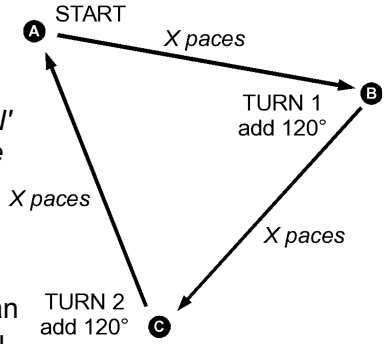
Navigation

Navigation is not just a matter of finding direction, it's also about fixing location, and finding a route to travel that might not necessarily be the shortest but it one that you'll be able to follow with certainty. ***Most of all, navigation if the art of trying to resolve the conflicting messages that you sometimes receive from the map, the compass, and what you can actually see before you.*** Remember, map makers sometimes make mistakes, and the more you walk the more you realise just how often the maps are wrong. In most cases that's because the land has changed since the map was made, usually because of new developments or because field boundaries/fences have been moved/removed.

The best way to learn how to use a compass is to get out into some "safe" countryside and start using one. To begin you could go to a local park and do a "compass walk". Pick a spot, mark it with a small pebble or stick (gamblers use coins!) and pick a bearing: Walk *X* paces then add 120° to the original bearing; walk *X* paces again and add 120°; then walk *X* paces and you be where you started.

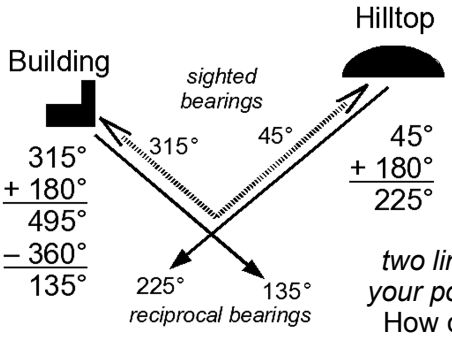
As well as walking in a triangle you can add 90° and walk a square, or 72° and walk a pentagram, or 60° and walk a hexagon. Each is progressively more difficult as each turn adds more potential for error.

The most useful skill to learn with a compass is called "resection". You fix your location on the map by taking a bearing to two or more know locations – usually landmarks or hilltops – and then calculating the "reciprocal bearing" and drawing a line back from those points on your map; where the lines cross is where, to within a few tens of metres, you are. *Note that if maths isn't your thing, you can also get a reciprocal bearing by lining the 'N' of the compass needle to the sighted bearing on the scale, then where 'S' points is the reciprocal bearing.*



Let's work through an example. To begin you take two bearings from landmarks that are roughly 90° apart. ***If they are more or less than 90° the position will slowly become less accurate, and when the points are less than 60° or more that 120° apart then the accuracy rapidly diminishes.***

In the diagram below we take a bearing on a building, 315°, and then calculate the "reciprocal angle" by adding 180°, which gives 495° (more than 360°) and so we subtract 360° and this gives us 135° – then using the compass draw a line on the map from the building on a bearing of 135°. Next we take a bearing on a hilltop, 45°, then we add 180° to give 225° – then draw a line from the hilltop on a bearing of 225°. *Ideally, where the two lines cross will be your position.*



How often you fix your position will depend upon the landscape that you're in and the hazards that you might want to try and avoid. If accuracy is very important then you might take three or four bearings, and somewhere in the nest of crossing lines is where you're position is likely to be. Sometimes you don't need to do two bearings; for example, if you're already walking along a known linear feature on the map – such as a fence line, or a river bank or a ridge line – then one bearing (ideally at 90° to the feature) should give you a fairly good position on the map.

Be sensible: *Think ahead*

A map and compass can give a false sense of security. For example, you go into the hills finding your way by compass and then the mist comes down; it's still possible to navigate in the mist but instead of walking long distances between measurements you'll have to slow down and walk short sections taking more bearings – until you run out of daylight!

In short: Practice these skills in known and safe environments before you go somewhere dangerous!... and even then plan for the worst. Just because you have a map and compass doesn't spare you the problems of getting tired, injured or running out of daylight because you didn't allow enough time for unexpected weather conditions.

Produced by the Free Range 'Energy Beyond Oil' Project – http://www.fraw.org.uk/ebo/