Land Navigation

While it is handy to know how to find directions by the sun or stars, such methods are useless in adverse weather conditions. Knowing how to find the North Star doesn't do much good if you can't see any stars due to clouds, fog or a blizzard. Even an overcast sky prevents you from using wristwatch or shadow and stick methods of finding north. In a wilderness emergency or during a military operation, waiting for clear skies could cost lives. Modern technology has given us portable Global Positioning System (GPS) satellite receivers, which are wonderful navigation aids as long as you have batteries, but compasses and topographic maps are still the primary tools to use when moving around in the outdoors. The first rule of gunfighting is "always bring a gun" and the first rule of heading into the boonies is "always carry a compass." A good compass will enable you to align your map with magnetic and true north, find your way to a destination, follow your route to a destination and find your way back to your starting point. The two basic types of compass are the sighting type (like the military lensatic compass) and the orienteering type.

Lensatic Compass. The military lensatic compass is very rugged and is useful both day and night. Luminous markings are either the more expensive tritium self-luminous type (which fade over a period of about ten years) or the painted type which require periodic refreshing with a light source (a red filtered flashlight works fine for this purpose and won't destroy your night vision). A standard model costs about $50 and the tritium model is about $85. The cover has a sighting wire and two luminous sighting lines or dots for night use. The base contains an induction damped floating magnetic dial that rotates freely when held level and settles in about six seconds. The dial is locked in place when the cover is closed; the rear sight must be opened more than 45ø for the dial to rotate freely. Printed on the dial in luminous figures are a line (over a non-luminous arrow) which points to magnetic north and the letters E and W pointing to east and west. Older lensatic compasses have a luminous north arrow and luminous letters E, W and S. The dial has two scales; the outer scale denoting mils (0 to 6400; usually used for calling in artillery or airstrikes) and the inner scale printed in red and denoting degrees (0ø to 360ø, clockwise from north). The degree scale has a reference line or number every 5ø. There is a glass cover with a fixed black index line. Current issue lensatic compasses have a luminous area under the index line which allows the dial to be read at night. The bezel ring is a rotating glass face with a luminous line (used in conjunction with the north seeking arrow) and a ratchet device which clicks when it is turned (used for setting the compass at night). The bezel makes 120 clicks when rotated fully; each click equals 3 degrees. Less expensive commercial copies of the lensatic compass often omit this important click feature. The rear sight contains a lens to read the dial and a slot used in conjunction with the front sight wire to line up on distant objects.

Orienteering Compass. An orienteering compass has a circular housing mounted on a rectangular base. The baseplate has a fixed index line, usually with an arrow labeled "direction of travel," parallel to its longer edge and bisecting the shorter edge. The circular housing has a glass or plastic face and markings indicating the four cardinal points (north 0ø or 360ø, east 90ø, south 180ø, west 270ø) and degree lines numbered clockwise starting at north. Larger diameter housings are usually marked with a line or number every 2ø, while smaller housings may only have markings every 5ø. The bottom of the housing has an etched arrow pointing towards the north marking on the ring. The entire housing can be rotated on the baseplate. Beneath the glass is the magnetic needle, which floats free; one end, usually colored red, points towards magnetic north. Most quality orienteering compasses have liquid damped needles that settle in about 5 seconds. An orienteering compass can substitute for a protractor for drawing directional lines, or azimuths, on a map. The edges of the baseplate usually have ruler or map scale markings which are used for measuring distance on a map. Some models have a magnifying lens in the baseplate for reading fine print or starting a fire in an emergency. A good orienteering compass, like the Silva Explorer III or the Suunto Leader M-3D, can be purchased for about half the cost of a military lensatic compass (about $20-$25). While a less expensive "starter" model, costing about $10, is okay for training use or as a spare, you should pay a few more dollars and get one with luminous markings for night use (or remember to carry plenty of extra flashlight batteries). The best models, like the Silva Ranger Type 15 or the Suunto Professional MC-1D (about $50) add a sighting mirror to the basic orienteering compass and are adjustable for magnetic declination (more about that later).

Carry a Spare Compass. A vital part of any compass is the lanyard. Remember to use it attached to your uniform or load-bearing equipment or at least looped around your neck. A corollary to Murphy's Law states that the one time you neglect to use the lanyard will be the time your boat capsizes in the middle of a swamp or you drop your compass off a mountain. It is always prudent to carry a backup compass in case of loss or damage to your primary compass. A spare compass need not be fancy or expensive; a $5 watchband survival compass or an $8 zipper pull compass can at least give you an idea of which direction is which. As previously mentioned, an inexpensive "starter" model orienteering compass makes a good spare. Two great spare compasses which sell for about $20 are the Suunto M-9 wrist sighting compass with a luminous dial and the Silva Landmark 27; an orienteering compass, smaller than a matchbox, with luminous markings and a sighting mirror. Also for about $20, the Silva Explorer III is a decent primary compass and an excellent spare; two of these fine compasses will cost you less than one genuine military lensatic compass.

Topographic Maps. Topographic maps are representations which show the shape of the Earth's surface by contour lines. Contours are imaginary lines that join points of equal elevation on the land above or below sea level. On U.S. Geological Survey (USGS) maps, contour lines are printed in brown. Every fifth line is printed heavier and somewhere along these index contours the elevation is printed. The difference in elevation between any two contour lines, known as the contour interval, is printed at the bottom of the map. Maps of relatively flat areas may have a contour interval of 10 feet or less, while maps of mountainous areas may have a contour interval of 100 feet or more. In places where contours are spaced close together, the land is more steep than in places where the contours are further apart. Spot elevations are also printed on important landmarks like hilltops and mountain peaks. With practice, you will be able to visualize the shape of land you have never seen just by examining contour lines. Topographic maps also present information in the form of lines and symbols representing such features as roads, trails, buildings and streams. Colors have meaning on topographic maps. Revisions of USGS maps determined from aerial photographs and not yet confirmed by an actual field survey are printed in purple. Green denotes woodland thick enough for a platoon of 27 men to hide from aerial observation in one acre. This standard predates aircraft with Forward Looking Infrared (FLIR) technology, which can spot troops through foliage. White represents non-wooded terrain, which can be anything from a boulder field to a grassy meadow. Blue indicates water, such as streams, lakes, rivers and swamps. A solid blue line around a lake or stream indicates that water is perennial; a dashed blue line indicates that water flow is intermittent. Black indicates manmade things like trails, settlements, railroad tracks, roads, buildings, and so on. Red shows more prominent manmade features and divisions like major roads, fence lines, land grants, and the lines of townships, ranges and sections. Incidentally, red markings on the map disappear under red filtered light; use the purple filter of your G.I. flashlight if you need to read red markings at night. Natural magnetic anomalies which can throw off your compass needle (like an iron ore mountain) are few, but are generally noted on a map where they do exist. For more information about topographic maps published by the USGS, order a free catalog, state index and a brochure explaining topographic map symbols by calling 1-800-USA-MAPS. Topographic maps are also available from the U.S. Forest Service, various state agencies and commercial sources like the Green Trails 15-minute series.

Map Scales and Grids. The DeLorme Mapping Company publishes a "Washington Atlas and Gazetteer" ($16.95), which contains topographic maps of the entire state printed at 1:150,000 scale with a contour interval of 100 meters. While such maps are useful for trip planning and are better than no map at all, more detailed maps are better for the foot traveler. USGS 7«-minute series maps (covering an area of 7«-minutes of latitude by 7«-minutes of longitude) are printed at 1:24,000 scale, which means that one unit of measure on the map represents 24,000 of the same unit on the ground (1 inch on the map represents 2000 actual feet). USGS 15-minute series maps are printed at 1:62,500 scale (1 inch on the map represents about 1 mile). Military maps most frequently used by the foot soldier are printed at 1:50,000 scale (2-centimeters represents one kilometer); the current issue lensatic compass has a 1:50,000 scale ruler marked from 0 to 6000 meters. Military maps generally have 1000-meter, or one kilometer, Military Grid Reference System (MGRS) grid squares printed on them. Any point on a military map can be identified by a six- or eight-digit MGRS grid coordinate number (preceded by a two-letter prefix showing which map sheet it comes from), which can be used to pinpoint and communicate your position or indicate other important points on the map, like enemy positions or rendezvous points. MGRS grid coordinates can also be used for notes to keep track of your travel. MGRS grid coordinates are read right and up from the lower left corner of any grid square. For example, if a hilltop is located in the grid square bordered on the left by line 65 and is 3-tenths of the way across the square, then the first three digits of the six-digit MGRS grid coordinate are 653. If the same grid square is bordered on the bottom by line 67 and the hilltop is 4-tenths of the way up from that line, then the last three digits are 674. If we are using map sheet FL for the above example, then the full six-digit MGRS grid coordinate is FL653674. An eight-digit MGRS grid coordinate simply uses a finer graduation to locate a point with more precision; the first four digits indicate how far to the right the point is and the last four digits show how far up the point is. Expensive, feature-laden GPS units can provide MGRS grid coordinates, but these don't do you much good without military maps. However, some of the least expensive GPS units can designate Universal Transverse Mercator (UTM) grid coordinates, which can be used with USGS topographic maps. On USGS maps, you can create your own UTM grid squares by drawing horizontal and vertical lines with a fine-point pen connecting the numbered UTM tick marks around the map edges. With UTM grid coordinates, you precede the numbers with the title of the map sheet instead of the MGRS two-letter prefix. Grid coordinate systems other than MGRS and UTM also exist, like the one used with Green Trails maps. These maps are divided into four quadrants and each corner is labeled with the letter A, B, C or D. The edges of the map have a number or tick mark every 2-tenths of a mile. The first two digits indicate how many miles east or west from a corner a point is and the last two digits indicate how far north or south a point is. For example, a road junction 3.2 miles east and 4.5 miles south of corner A would be designated with the coordinate A3245. Military protractors with grid scale readers, as well as grid scale reader templates with 1000 meter squares in the USGS standard scales of 1:24,000 and 1:62,500, are available from RM Products (5857 NE 180th Street, Seattle, WA 98155; phone 1-206-485-4738).

Finding an Azimuth With a Compass. Iron or steel objects, like your rifle, knife, belt buckle, steel helmet, vehicle or the frying pan in your rucksack can throw off a compass needle, as can phone wires, power lines and electrical devices like radios. When taking a compass reading, your compass should be at least «-meter away from your rifle; 10-meters from phone lines; 18-meters from vehicles; 55-meters from high-tension power lines. A compass must always be held level to allow the magnetic dial or needle to freely rotate. The method for determining a magnetic azimuth (or bearing) to a distant object depends upon the type of compass you are using. A lensatic compass can be held to your cheek and, after aligning the rear slot with the front wire and the object, the azimuth can be read through the lens under the fixed black index line. Alternatively, you can open the cover all the way, hold the compass with both hands centered on your body with your elbows firmly at your sides, turn your entire body towards the distant object and then read the azimuth by looking down beneath the index line. The center-hold method is less accurate than the compass-to-cheek method, but is the method to use at night. Rotate the bezel so that the luminous line on the face is aligned with the north arrow on the dial and the compass is set for following an azimuth. At night you can set a lensatic compass for a desired azimuth by the click method (each click equals 3ø). Rotate the bezel until the luminous line is over the fixed black index line. Divide your desired azimuth by three and rotate the bezel that number of clicks counterclockwise. If the number of clicks is over 60, then subtract from 120 and turn the bezel clockwise. For example, your desired azimuth is 330ø, divided by three gives 110 clicks counterclockwise or 10 clicks clockwise. Follow the azimuth you set by using the center-hold method, align the north arrow with the luminous line on the face and proceed in a line with the luminous markings or sight wire on the opened cover. An orienteering compass is held in the same manner as the lensatic center-hold method; point the direction of travel arrow at the distant object, rotate the circular housing to align the north end of the needle with the north arrow marking etched on the base of the housing, and then read the azimuth at the baseplate index line. The arrow etched in the bottom of the housing is wider than and completely surrounds the needle when properly aligned. Aligning the arrow and needle is called "boxing the needle" and this procedure automatically sets the compass for following an azimuth (a separate step with a lensatic compass). Be sure that you have lined up the north end of the needle with the arrow. If you mistakenly line up the south end of the needle with the arrow, you will be turned around 180ø; instead of returning home you will head off in the completely wrong direction. Hold an orienteering compass with a sighting mirror to your cheek like a lensatic compass, align the mirror line with the index line on the baseplate, sight on a distant object through the sighting notch, box the needle and read the azimuth at the baseplate index line. It's much easier than it sounds and is very accurate.

Back Azimuths. A back azimuth is like a return address. It is the direction from a distant object to your present position. For example, if you are sighting on a mountain a little south of due west and determine the azimuth to be 240ø, then the back azimuth is 60ø. Some orienteering compasses have a second index line opposite the direction of travel index line, which allows you to accurately read the back azimuth on the other side of the circular housing. Another method is to align the south end of the needle with the north arrow on the housing and directly read the back azimuth. If you are using a military lensatic compass, you can figure the back azimuth mathematically; if your azimuth is less than 180ø then add 180ø, if your azimuth is more than 180ø then subtract 180ø. If the bezel has already been rotated to set an azimuth, then you can set the back azimuth by rotating it 60 clicks in either direction.

Declination. The magnetic north pole of the Earth is just above Hudson's Bay, about 1,400 miles south of the true North Pole. Declination is the difference between magnetic north and true north. When you use a compass without reference to a map, so that its use is based solely upon magnetic azimuths, you can ignore declination. However, when using a compass with a map you must correct for declination (unless you intend to get lost, which sort of defeats the purpose of using a map and compass). Topographic maps are drawn according to true north and contain a declination diagram in their lower margin showing the amount of adjustment that must be made between measured map grid azimuths and magnetic compass azimuths. The magnetic North Pole and the Earth's magnetic field shifts slightly over time. Unless you need a very precise reading or your map is seriously out of date, this slight variation in the amount of declination can usually be ignored. The declination diagram on maps is often revised with eachprinting, whether or not the entire map is revised. One leg of the declination diagram (usually marked with a star) points straight up on the map and points to true north. A second leg (usually marked GN) points to grid north and coincides with grid coordinate lines. The difference between true north and grid north is usually very small. The final leg (usually marked with a single barbed arrow and the letters MN) points to magnetic north. If the magnetic north line is to the right of the true north line, then the declination is East. The angle of declination and its direction is referred to by the military as the G-M (grid-magnetic) angle. The G-M angle in the Yakima area is about 20ø East, meaning that your compass needle points 20ø east of true north. With this amount of declination, if you intend to proceed on a true map grid azimuth of due west and follow a magnetic azimuth of 270ø, you will be over 1.5 miles north of your intended destination after traveling only five miles; enough to get you thoroughly lost. The rule for converting true map grid azimuths to magnetic azimuths for East G-M angles is to subtract the G-M angle (add West G-M angles). In the above example, a magnetic azimuth of 250ø (270ø minus the 20ø East G-M angle) would lead you right to your due west destination. When converting from a magnetic compass reading to a true map grid azimuth you add East G-M angles and subtract West G-M angles. Probably the easiest way to remember the conversion rules is with the word "GaMES"; Grid to Magnetic East Subtract. From this one rule you can figure out the appropriate adjustment for an opposite situation. Some orienteering compasses, like the Silva Ranger Type 15, have a mechanical adjustment feature which allows you to set declination by offsetting the arrow on the housing bottom and the degree scale on the outer ring by the proper amount. Once set, the magnetic azimuths you read with your compass will automatically coincide with true map grid azimuths (unless you move into an area with a different declination). Some orienteering compasses, like the Silva Explorer III, have a declination scale etched into the housing bottom. To use this feature when sighting an azimuth, instead of boxing the needle you align the end of the needle with the appropriate declination number and then read a grid (not magnetic) azimuth at the base-plate index line. Instead of adjusting your compass (or adjusting how you read it) you can adjust your map for declination. With a pen or pencil, extend the magnetic north line on the declination diagram across the map; measure the angle with a protractor since it is not necessarily printed to scale. Draw parallel lines over the entire map at any convenient interval (1", 2" or the width of your ruler) and you will create new grid lines aligned with magnetic north. If you place the north-south (or 0ø) line of a protractor over or parallel to your new magnetic grid lines, then the angle you measure to any point will be a magnetic azimuth which you can follow without adjusting your compass for declination.

Orienting a Map. Orienting a map means turning it so that straight up on the map actually points to true north on the ground and that the hilltop or stream to the left of your position on the map will actually be to your left on the ground. It is much less likely that you will get turned around and lost if your map is oriented while you are referring to it. Even without using your compass, you may be able to find your position and which direction you need to head just by comparing terrain features with an oriented map. If you choose not to draw magnetic grid lines over your whole map, you should at least draw one line at a measured G-M angle from the declination diagram. This allows you to orient your map by placing your compass over the line and rotating both the map and compass until the needle is over that line (north end towards the top of the map).

Finding an Azimuth From a Map. Once your map is oriented, you can read a magnetic azimuth from point A to point B with a military lensatic compass by drawing a line connecting the points, placing the straight edge of the opened compass along the line with the cover directed towards point B, and then reading the magnetic azimuth under the fixed black index line. Finding an azimuth from a map with an orienteering compass does not require the map to be oriented, but it might be less confusing if you go ahead and orient it anyway. Place the long edge of the baseplate along the line you wish to follow with the direction of travel arrow pointed towards your destination, rotate the circular housing until its arrow is pointing towards the top of the map and is over or parallel to a grid line and read the azimuth at the index line on the baseplate. If you line up the housing arrow with magnetic grid lines which you have drawn, then you read a magnetic azimuth. If you line up the housing arrow with true north grid lines, then you read a grid azimuth and will have to adjust for declination before following a magnetic azimuth indicated by your compass.

Following a Magnetic Azimuth. If you keep your eye glued to your compass while traveling, you will probably drift off your path, fall in a hole, walk off a cliff or at least stumble into a lot of trees. Because of intervening terrain, you may not even be able to see your ultimate destination. Once you have set an azimuth on your compass, either by sighting or from a map, hold the compass in a level position and pivot your body until the north arrow of a military lensatic compass is lined up with the luminous mark on its face; with an orienteering compass, without rotating the circular housing, pivot your body until the north end of the needle is aligned with the housing arrow; then look along the sighting wire or line and pick out an object, like a distinctive rock or tree, to walk towards. Try to also spot another object further along the azimuth in line with the first one. As you reach the first object, find another in line with and beyond the second. This way you won't have to refer to your compass at every intermediate checkpoint along your path and won't multiply any small error you may have made in reading the compass. If you intend to return along a back azimuth to your starting point, occasionally glance back over your shoulder to familiarize yourself with the terrain; it may look very different from another perspective. If you have to detour around rough or impassable terrain, pick an angle (like 45ø or 60ø) and add it to your original azimuth. Sight a landmark along the new azimuth and proceed towards it keeping track of the time or distance traveled. When it looks like you can return to your original course, subtract the same angle from the original azimuth and travel back the same time or distance along the new setting. This should get you back to your original path, which you can verify by setting your compass back to the original azimuth and sighting on your destination. Of course, you can reverse the addition and subtraction to detour around the other side of an obstacle. As long as you don't overshoot your destination before returning to your original path, you can travel along your original azimuth before returning from a detour. If you have set an azimuth on a military lensatic compass by rotating the bezel to align the luminous line with the north arrow, you can easily make a detour adjustment by turning the bezel a particular number of clicks either clockwise or counterclockwise (e.g. 15 clicks for 45ø) and double that number of clicks in the opposite direction to return from the detour.

Offsets and Baselines. While the best compasses can be accurately read to about «ø, the average person reading the average compass will likely be one or two degrees off. When U.S. Army soldiers are tested with the lensatic compass, a 3ø error with the compass-to-cheek method and a 10ø error with the center-hold method is considered acceptable. Beause of sighting errors in reading your compass, or simply due to drifting slightly off course, it is unlikely that you will travel to the exact point you picked out on a map. Many destinations will be located somewhere along a linear landmark, like a road or stream. For example, assume your destination is a road junction. After traveling what you think is the right amount you reach the road, but the junction is nowhere in sight. Do you turn left or right? If you make a deliberate offset of 5ø or 10ø to the left or right before starting out, you will know which way to turn when you reach the linear landmark. The amount of an offset is determined by the distance to be travelled; longer distances require smaller offsets. Offsets should also be used when returning to your starting point along a back azimuth. In order to find your way back, it is useful to find or make a baseline at your starting point roughly perpendicular to your intended route of travel. A baseline can be a manmade or natural linear landmark, like a road, trail, stream or lake shore. It can even be an imaginary line between two landmarks. While the woodsman of the past could blaze a baseline with his axe, marking trees for a distance on either side of his camp, this is no longer acceptable. You can mark a baseline by tying strips of brightly colored plastic or cloth to trees or brush every 50 yards or so (be sure to remove them before leaving the area). The danger with relying on this method is that an over zealous environmentalist may take down your markings which are sullying "his" pristine wilderness with visual pollution. The distance to your destination determines how long your baseline should be. If you plan to return from a great distance, you will need a longer baseline to make sure you hit it upon return. A road or stream which sharply curves or ends a short distance from your base camp won't be much help on your return trip. With either a map inspection or ground observation, make sure your baseline really continues for a sufficient distance.

Keep a Travel Log. Before proceeding on any journey guided by your compass, mark your starting point on your map and make a written note of its grid coordinates, the magnetic azimuth you will be following and the time. Keep a written record as you travel every time you stop or make a major course change, such as a detour around impassable terrain or a different leg of a planned zig-zag route. If possible, also keep track of the distance you travel on each leg of your journey. For about $5, Brigade Quartermasters (1025 Cobb International Blvd, Kennesaw, GA 30144-4300; 1-800-338-4327) sells a simple device, based upon the Chinese abacus system, called a Ranger Pace Counter. It consists of a piece of parachute cord with a set of four beads and a set of nine beads separated by knots which you attach to your load-bearing equipment or loop through a buttonhole. The average person's left foot hits the ground 65 times in 100 meters, but you should determine the pace count for your own stride. Every time you travel 100 meters pull down one bead from the set of nine; at 1000 meters pull the nine beads back up and pull down one from the set of four (the kilometer beads). When all the beads are down, travel 100 meters further, note 5 kilometers on your travel log, make sure you have clean, dry socks and start over. The British Army teaches a similar method for keeping track of distance using a piece of parachute cord with ten knots tied in it. The cord is placed through a buttonhole and one knot is pulled through for each 100 meters. With an accurate travel log you can return to your starting point by following back azimuths for the same time or distance traveled on each leg of a route. An accurate travel log will even enable you to navigate anywhere without a map using just your compass and you don't even have to correct for the G-M declination angle. You follow magnetic azimuths and draw lines on paper (or in the dirt) or cut sticks and lay them out in the direction of each leg of your route, aligning them with your compass or protractor. The lengths of the lines or sticks are made in proportion to the time or distance traveled. From this diagram or model you can determine the magnetic azimuth and shortest route back to your starting point or back to any other point along even the most convoluted route. This method (particularly useful in open terrain with few landmarks to guide off of) is taught in detail in the book "The Green Beret's Compass Course: The New Way to Stay Found (Not Lost) Anywhere" (Path Finder Publications, 1296 East Gibson Rd, Suite E-301, Woodland, CA 95776; $9.95 + $1.50 s&h; deduct $1.00 for Postal money order).

Locating Your Position on a Map. Resection (also known as triangulation or cross-bearings) is the technique used to locate your position by plotting intersecting lines from two distant points on the ground that you can also identify on your map, such as hilltops or road junctions. Resection can be used to verify that you really are where you think you are or just to keep track of your progress along an intended route of travel. With your compass, take a magnetic azimuth from your unknown position to the first distant point, convert to a back azimuth, correct for declination (convert to a grid azimuth) and, using a protractor, draw a line from the distant point along the converted azimuth. Repeat with the second distant point and where the two lines cross is your position. Modified resection can be used if you know you are located somewhere along a linear landmark that you can find on your map, like a particular road, trail, fence line, stream or lake shore. In this case a back azimuth from a single recognizable distant point pinpoints your position where it crosses the known linear landmark. Naturally, if you are on a winding road or trail which the plotted line crosses twice (or more), you will have to plot a line from a second point to find your position. Since it is not really possible to read a compass perfectly, it helps to minimize error if you can use two identifiable landmarks which have back azimuths roughly perpendicular to each other. If you plot a back azimuth from a third known point (or from a second known point using modified resection), you should have a smalltriangle containing your position where the three lines come together. You can also plot lines from distant points using your compass instead of a protractor. With a military lensatic compass, orient your map towards magnetic north, place the compass on the map with the ruler edge on the distant point you sighted and the magnetic azimuth (not the back azimuth) under the fixed black index line, then draw a line from the cover end back towards the base. With an orienteering compass the map need not be oriented. After sighting a magnetic azimuth to a distant point, without disturbing the circular housing, align the directional arrow etched into the base with magnetic grid lines drawn on your map, lay one of the long edges of the baseplate on the distant point and plot your line in the direction opposite the direction of travel arrow. If you choose to align the housing with true north grid lines instead of magnetic north grid lines, you will have to first correct the azimuth setting for declination by turning the circular housing (add the amount of an East G-M angle; subtract a West G-M angle) before plotting the line. When plotting lines on your map, draw them lightly using a thin lead (0.5mm) mechanical pencil; they can be removed later with a non-abrasive eraser without destroying the map.

Plotting a Distant Point on a Map. You can plot an unknown distant or inaccessible point using the technique called intersection. With your compass, determine the magnetic azimuth to the distant point from two different known positions (this technique involves some walking). With a protractor, plot the azimuths from the two known positions and the lines will cross at the location of the distant point. You can also plot azimuths from your known positions towards the unknown point with your compass in the manner described in the previous section; just reverse the direction in which you draw the line. Intersection has a military application for pinpointing enemy positions. It can also be used to verify that a distant landmark you are looking at is really the one you think it is on your map.

There is a line in the science fiction cult movie "Buckaroo Banzai" which says "Wherever you go, there you are." With training, practice and proper use, a good compass and a topographic map will let you know where that really is, which just might save your life someday.