Chapter 13: Navigation [1]

Think of navigation as a hierarchal progression. The first level is using natural features to orient yourself. This is important because you will always have your knowledge, but you may not have navigational aids with you. It does not rely on any external features or instruments with which to assist your navigation. This includes the watch method to determine north, differential heating, and celestial navigation. The second level uses traditional or what people might now consider "primitive technologies" for navigation. This includes the use of maps and compass for navigation. It also includes navigational charts and compass. The use of map and compass is still a staple of navigation today. The third level includes navigation using ancillary methods such as GPS (Global Positioning Satellites) or similar methods.

It is important to view these three levels of navigation as complementing each other. They are not used in isolation of each other. For example, GPS may provide one route. However, this route should correspond with what you perceive to be the correct route using natural features. You should always be evaluating what is occurring in terms of natural features and navigation and seek congruence between them.

This chapter views navigation in terms of the three levels. These are the use of natural features. map and compass, and high technology. The map and compass section is divided into three sections maps, compass and map and compass

Chapter 13.1: Use of Natural Features

The first level focuses on the use of natural features for orientation and navigation. These techniques rely on your knowledge and on the use of your brain. It is your last line of defense. Actually, it is your first line of defense. In a very real sense, you will always have these two elements with you. If you lose your compass and don't know how to navigate using natural features, you will become lost or disoriented more quickly. In time of a disaster or war, satellite communications may become useless. The use of GPS (Global Positioning Satellites) will most likely become useless. Any device utilizing GPS will become useless also. Several of the methods presented in this section are common sense, once understood. Having a sense of orientation and awareness of your surroundings to orient yourself is comforting. It reduces panic and it reduces the likelihood of becoming disoriented.

Conceptually, think of orientation and navigation as hierarchal or a three tier approach. Ground level is using natural features for orientation and navigation. It is the making of mental maps and being interconnected with the environment in which you are traveling. The second tier is the use of map and compass. These are low tech tools that if you have them with you, you can navigate. The third tier is the use of high technology including GPS. The focus of this first section emphasizes the use of natural features for orientation and navigation.

Orientation – Orientation is "*knowing where you are in relationship to features in the landscape around you.*" It is the comparison of features in the landscape with a person's mental map in his/her mind. It is your first line of defense. It is the base line approach. Even if you use the technological methods of orientation such as GPS or other electronic approaches, the use of natural features to orient yourself

[1] This article was written by Robert B. Kauffman who is solely responsible for its content.

complements these technological approaches. It a form of validation. It connects you with where you are and with your surroundings. This is important because if for any reason, GPS or a similar technologies fail, it helps to prevent becoming disoriented.

Navigation – Navigation is defined as "*the art of knowing where you are and where you want to go*." Usually, it uses a reference point (e.g. north) to provide the orientation necessary to navigate from one location to another. The reference point need not be north. It could be a lake, cliff or other prominent landmark. In an era of GPS, global positioning, MapQuest®, Google Maps®, and other internet tools, navigation can utilize a user friendly map or series of commands. It is still navigation because you are moving from point A to point B using a fixed reference point even if it is a GPA satellite.

This section focuses on the first tier of the navigational hierarchy. This section focuses on the use of natural features to provide orientation with the surroundings and mental maps of the landscape. This is the use of your surroundings to orient yourself. The second section is the use of mechanical methods to navigation. This is the traditional area of using map and compass. The third section focuses on the use of electronic means of navigation. Currently, the last two sections are in separate sections from this one.

Mental Maps

Mental maps are a person's first line of defense. When all other systems fail, mental maps are the fall back position. And when all other systems are operating, mental maps complement the other systems. Gatty (1983) identifies three different ways people orient themselves to their surroundings. These are covered in this section. In addition, taking mental pictures and looking back on the fork in the trail discussed in the next section can greatly aid in orienting yourself upon returning.

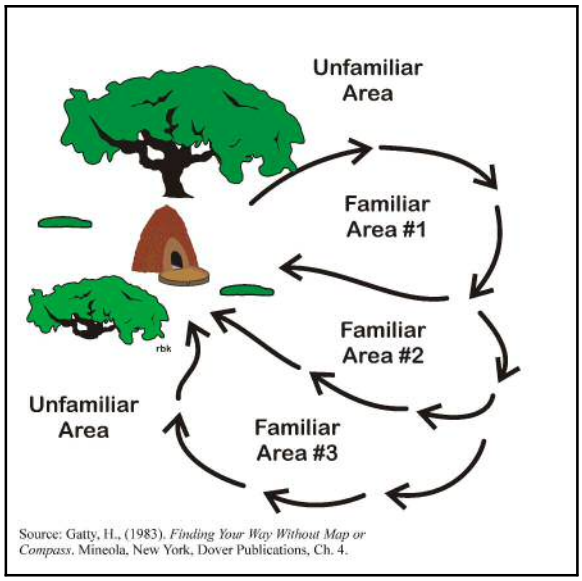

Figure 13.1 – Home Centered Reference System – Source: author – [file:\NA-HomeCentered[144].jpg]

Home Centered Reference System – In the home centered reference system, Gatty (1983) notes that the native starts from the home and explores an unfamiliar area that becomes familiar area #1 (Figure 13.1). Next, the native explores a new unfamiliar area that becomes familiar area #2. Once this area becomes familiar, the native explores a third unfamiliar area that becomes familiar area #3. Key to all these explorations is that the home is the center or place from which the search originates and returns. Hence, the reference to it as the home centered reference system.

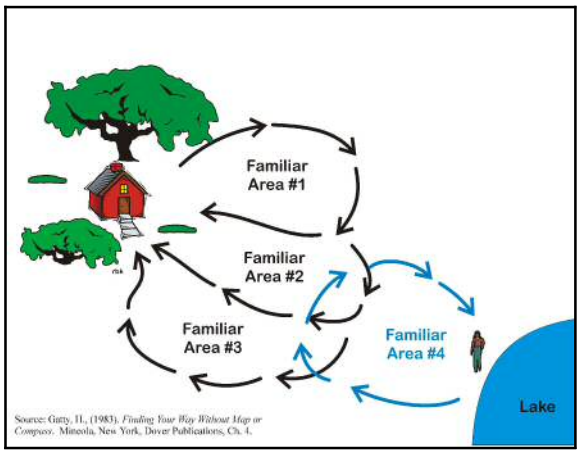

Figure 13.2 – Local Reference System – Source: author – [file:\NA-LocalReferenceSystem[144].jpg]

Also, this approach is used by people today where they use their house as the origin of their search and they explore outwardly within their community to find the grocery store, park and other nearby services.

Local Reference System – The local reference system is really an extension or modification of the home centered reference system (Figure 13.2). In contrast to the home centered system that uses the home as the reference point, the local reference system uses prominent features within an area as the reference point with which to orient other features.

Self-centered Reference System – In the self-centered system, everything is oriented or centered around the individual (Figure 13.3). It is typically used by the modern traveler, particular those who use GPS. Gatty (1983) notes that the traveler divides the horizon into north, south, east, and west. They use a compass to orient themselves with its modern version being GPS. He notes that if there is a disconnect anywhere in the system, the traveler easily becomes disoriented and lost because they are now in an unfamiliar area.

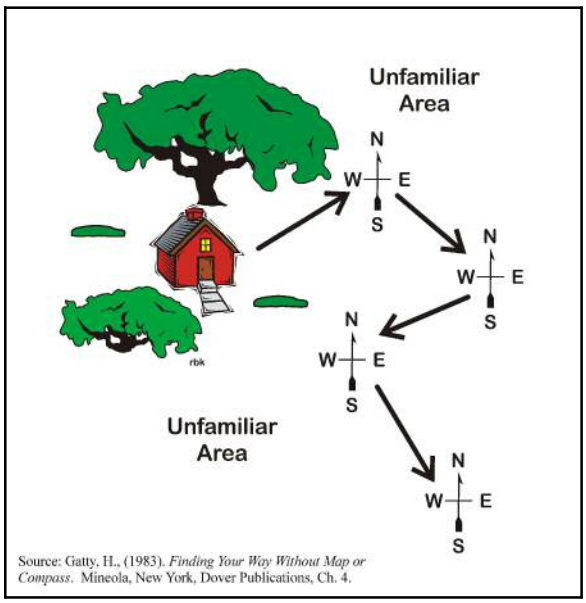

Figure 13.3 – Self-centered Reference System – Source: author – [file:\NA-SelfCentered[144].jpg]

Modern GPS and similar navigational devices are examples of the modern variation of a self-centered reference system. They are useful tools that can easily lead to disorientation when they fail or become inoperative. It is easy to plug into the computer two locations and then blindly follow the directions. If everything goes correctly, you get to where you want to go. However, you are not oriented regarding where you are in terms of your surroundings. You are blindly following the directions. And, it is easy to fall into this situation where you are blindly following the directions without being oriented to your surroundings. It makes it easier to become lost and totally disoriented.

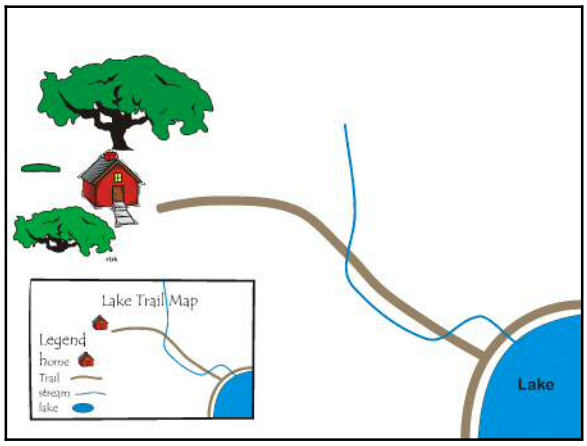

Figure 13.4 – Local Reference Maps – Source: author – [file:\NA-LocalReferenceMap[144].jpg]

Local Reference Maps – The logical extension of the local reference system is the local reference map (Figure 13.4). It uses symbols to represent prominent features. In Figure 13.4, features might include the lake, stream, home, and trail. A simple legend can be added indicating the features as can a scale. These features help make the map transferable to other people.

Used in combination with the identification of natural features in the environment, the use of high tech and natural methods can complement each other. This author uses GoogleMaps® extensively to both navigate and orientate in new locations. GoogleMaps® is used to locate a park amenity in a city where the author is going to visit. When onsite, the map is used to navigate a trip to the location. The map provides orientation because the objects in reality are in the same location as they are on the map. The examination of the map leads to such familiarity with the location, it is as if this author had lived there and was totally oriented with the surroundings. The familiarity with the surroundings provided by the maps becomes in reality a variation of the local reference system.

Finding North Using Natural Methods

A compass or GPS can easily determine north. However, there are numerous methods using natural methods for locating north. Several of these are covered in this section. They are good to know because they are useful in orienting yourself even if you are using more technological methods. They serve as a useful backup or verification to the more technological methods. There should be congruence between the methods used.

Effects of Differential Heating – In the northern hemisphere, the sun is in the southern portion of the sky. In winter, the sun's rays create ***differential heating*** between the southern and northern facing side of objects such as trees, lamp post, bollards and other objects (Figure 13.5). The differential heating will melt more of the snow on the southern facing portion of the tree than the northern facing portion. This method actually works and is reasonably reliable. As always, sample several trees. Try not to rely on just one example.

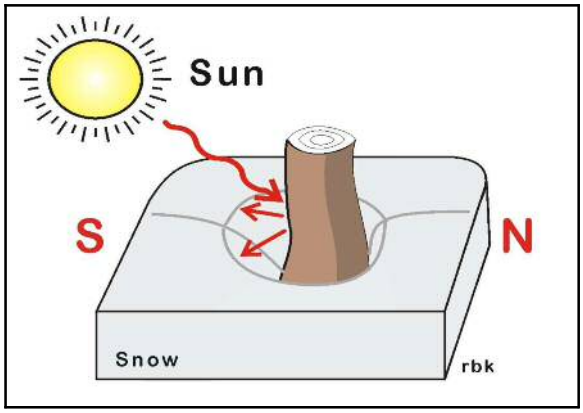

Figure 13.5: Differential Heating – Winter – Actually, this method of orientation is fairly reliable.

A less reliable method utilizes differential heating during summer. The differential heating results in the southern facing portion of the tree being dryer than the northern portion of the tree (Figure 13.6). This differential results in moss and ferns growing on the moister northern portion of the tree. This method is less reliable because there can be many intervening factors affecting the growth of different species. If the over-story is fairly dense, the entire forest floor will be moist and lined with ferns. Conversely, the differential heating may be insufficient to cause moss to grow on just the north side and not to grow on the east, west, or south sides.

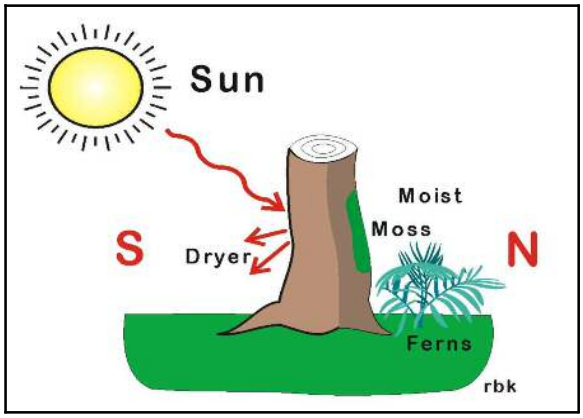

Figure 13.6: Differential Heating – Summer – Be careful using this method since it if very unreliable.

Having noted this, larger areas often reflect the effects of differential heating. On the east coast where a stream or creek cuts through a hill, the side of the canyon on the south side receives less sunlight than the slope on the northern side. Often, dense stands of hemlocks will be found on the more sheltered side of the canyon than on the more exposed northern side. Again, this is a generalization that is not always true.

Rather than using it to predict north, this principle usually works well in reverse. If you know a north/south orientation and you look at the stream cut through a hill, the differences in vegetation on the north and south slopes often seem to correspond to this principle.

Prevailing Winds and Tree Growth – An additional method of orientation that often works includes the effect of ***prevailing winds*** and ***tree growth***. In the northern hemisphere the prevailing winds are generally from the west. The upper air currents tend to move from the west to the east. This affects tree growth. The westerly winds tend to retard tree growth on the west side of the tree. This is true for exposed trees standing alone in their surroundings. Protected trees in a forest area would not normally demonstrate this principle. In addition, the limbs on the southern portion tend to grow longer than those on the north side. They are seeking the sun and extending their limbs outward toward the sun.

Figure 13.7: Affect of Westerly Winds on Trees – Source: Author

Examine the evergreen trees next to the road in Figure 13.7 and a closeup of the top of the same two trees in Figure 13.8. The area and the trees are exposed. They are susceptible to the wind. They are bent. The top branches are longer on the lee or down wind side of the tree (Figure 13.8). The dramatic difference is most likely due to two reasons. First, the east side of the tree grows toward the sun. Second, the exposed needles on the branches on the west side are literally sandblasted by the wind and snow. Close examination of the trees along the edge of the field reveals that they are also bending toward the left. Their growth is congruent with the effects occurring to the two evergreen trees.

Figure 13.8: Affect of Westerly Winds on Tree Tops – Source: Author

Before rendering an opinion, it is important to examine the trees and their surroundings. Trees overhanging roads tend to lean toward and overhang the road. Care needs to be taken that this is not the case for these two trees. Also, visual examination of the trees in the forest exhibit similar growth and shaping behavior as the two exposed trees but to a lesser degree. A complete examination of the trees and their surrounding in the pictures suggests that the prevailing winds are from the west and from the right in the photograph.

Celestial Navigation – *Celestial navigation* can provide orientation and navigation (Figure 13.9). Polaris is the North Star. Since it is located over the North Pole, the North Star provides orientation. The North Star is the last star in the handle of the small dipper and the big dipper points to it. Orion's belt provides an east/west axis and orientation. The planets move from east to west in the night sky. Find a tree or other object which can be used for sighting to determine the movement of the planets.

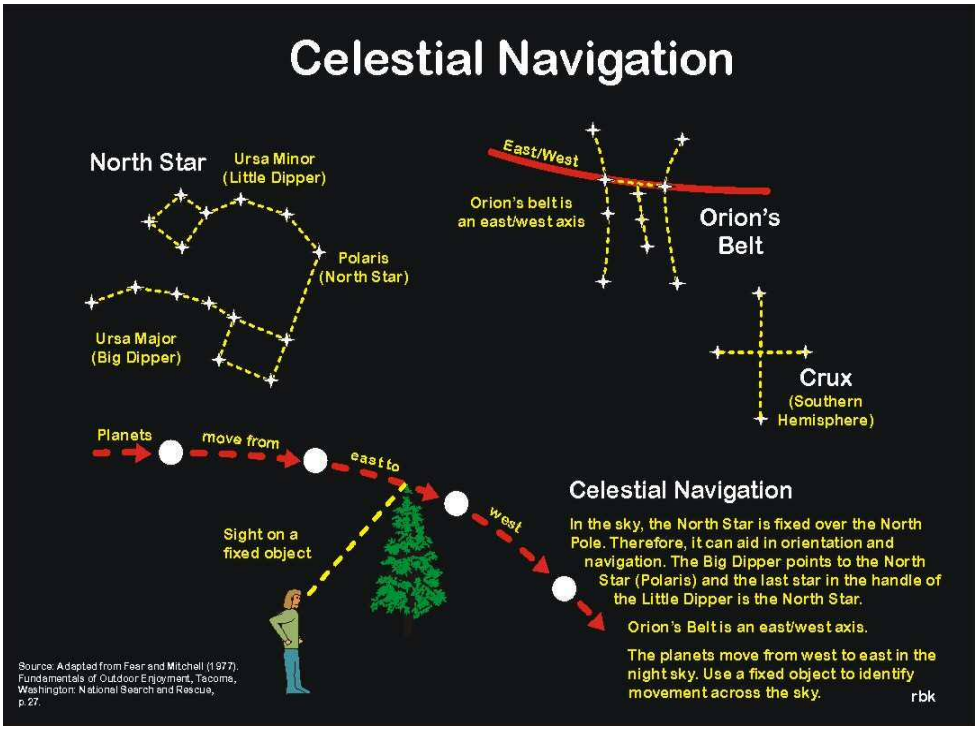

Figure 13.9: Celestial Navigation

<u>Watch Methods</u> – The *watch method* of determining the north/south axis is included in this section also. It is included because it can be used even if you don't have a watch. The sun rises in the east and sets in the west. In a mechanical sense, it moves across the sky. Its movement correlates with the time of day. The watch method utilizes the mechanical movement of the sun across the sky with the time of day (Figure 13.10). Simply point the hour hand of a traditional watch toward the sun. Bisect the angle made by the hour hand and 12:00. This is the north/south axis. South is between the hour hand and 12:00. North faces the other direction.

Cell Phone Watch Method – A *cell phone* doesn't have a clock face (Figure 13.11). If you have the appropriate apt, you can picture time as a traditional clock face. You don't need it because you can mentally superimpose the clock face on the cell phone. The critical component is the knowing the time. Once you know the time, estimate the hour hand and superimpose it and the clock face on the cell phone so that the hour hand is pointing toward the sun. Then follow the previous directions.

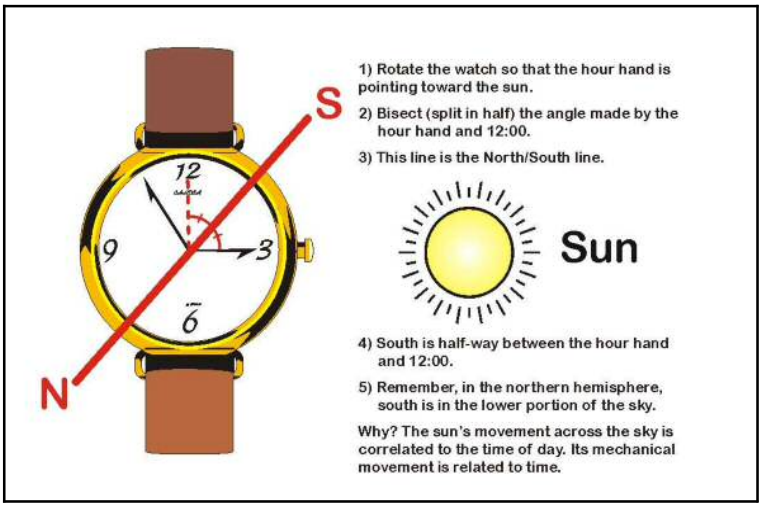

Figure 13.10: Watch Method – to determine north

Watch Method without a Watch – The last version of the watch method is using the watch method without a watch (Figure 13.12). It requires estimating the time of day. Again, once you have the time of day, you create a hypothetical clock and point your arms toward the sun and 12:00. Again, you will need to work backwards to estimate where 12:00 is located. Look up bisecting the angle created by your two arms. Your line of vision is south. North is directly behind you. Yes, this is imprecise but it will orient you and if you want to go in a general direction you can do so.

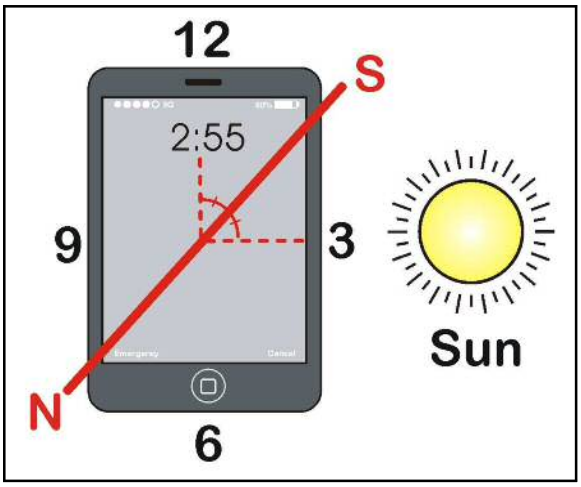

Figure 13.11: Cell Phone Method

Watch Method Using a Shadow – The bollard in the snow demonstrates differential heating and melting of the snow (Figure 13.13 and see Figure 13.5). The same bollard casts a shadow that can be used to determine north and to provide direction. In addition, the time of day needs to be known, even if it is an approximation.

The shadow is related to the time of day line. When the photograph was taken, the time was approximately 2:00 pm. Next, the 12:00 noon position needs to be calculated. The 12:00 position line will move counter clockwise as the time increases. As with the watch face method, the angle between 12:00 and 2:00 is bisected. This line forms the North/South line.

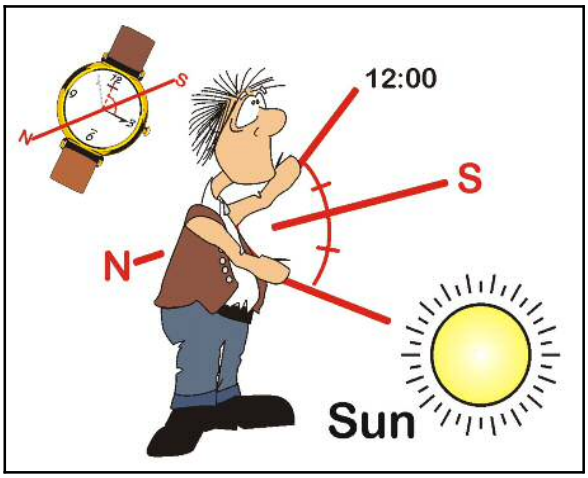

Figure 13.12: Using the Watch Method without a Watch

Using the shadow, the north and south positions are reversed with the previously described method. Rather than north pointing away from the angle made by the 12:00 and 2:00 lines, north is on the same side of the angle made by the two lines. This makes sense because the shadow is pointing away from the sun. The watch face method points the time line toward the sun. The watch face method is superimposed on the photo in Figure 13.13.

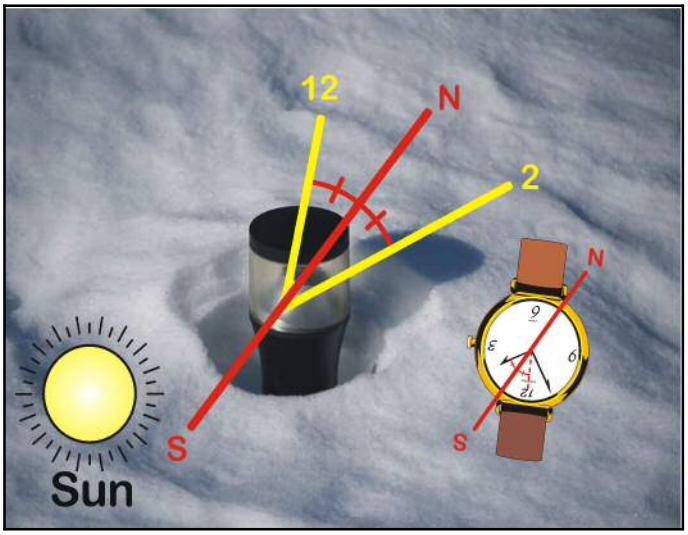

Figure 13.13: The Shadow Knows – Using the shadow and modified watch method to determine north.

Navigational Techniques

Orientation focuses more on orienting the person with their surroundings. Navigation focuses more on moving within the landscape. It utilizes the concept of orientation for its foundation. However, it is people on the move. Regarding basic movement of people, a great deal can be learned from the search and rescue literature and their focus on the behavior of lost victims. In addition, a great deal can be learned from trackers who also focus on people's movements.

Lost Person's Behavior – Gleaned from the search and rescue literature, lost person's behavior is useful in determining unfettered travel in the backcountry (Koester, 2008). In terms of this discussion, the importance of this material is that the unfettered travel of people without the use of navigational aids to orient themselves is not random. It is predictable.

Walking in Circles – People walking without navigational or orientation aids will tend to walk in circles. According to Gatty (1983), it has nothing to do with being right or left handed. He notes that the symmetrical human body is not truly symmetrical. In this case, one leg is normally bigger and stronger than the other leg. Roughly 55% of the population will veer to the right and 45% will veer to the left.

Lost Person's Behavior – To a degree, people's behavior when lost is predicable. As might be expected, people will tend to walk downhill rather than uphill (Koester, 2008). For example, 45% of lost people will walk downhill and 21% will stay at the same level. In contrast, only 34% will walk uphill. Behaviorally by activity, only 7% of hikers and hunters will move uphill. Fifty percent of the hikers will descend. Roughly 67% of children will move downhill or remain at the same level.

Also, as might be expected, rivers and streams form barriers. Most people will tend to avoid crossing them. If there is a trail, road, or abandoned railroad right-of-way, people will tend to use them because of their ease of travel, unless of course, the person is purposely not seeking to be found.

Mental Maps – The mind makes mental maps all the time. You drive to the grocery store. You turn right onto the boulevard. You identify a street sign, building or other landmark and know where this is where you turn. You have made a mental map. A useful trick is to turn around and make a mental picture of the trail just traveled (Figure 13.14). You should do this as a matter of course. This is particularly helpful if you come to a fork in the trail. If you have to retrace your route, you will have made a mental picture of the fork in the trail and you will better remember which fork to take. This technique is also useful when driving down the highway. As you pass an exit on the return side of road, look in your rear view mirror and make a mental picture of the exit.

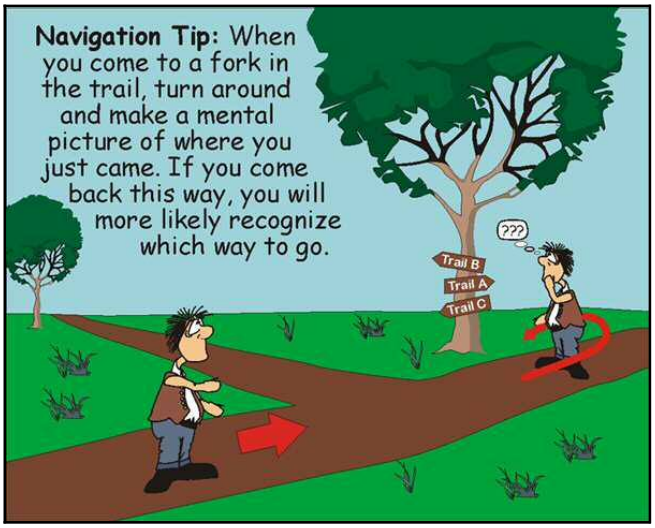

Figure 13.14: Turn Around, Look and Make a Mental Map of the Trail Just Traveled.

Speed of Travel – Speed of travel is often overlooked as an aid in navigation. Although it is an imprecise measure of distance traveled, it complements the other travel aids and provides a sense of where you are.

Speed of travel tells you how far you have gone and how far you should have gone. The range of speeds for a hiker or backpacker range from 1.5 to 3 mph. This is with a 30" pace. Altitude, terrain, group or individual travel, and motivation will significantly influence speed of travel. Groups tend to travel more slowly than individuals. Measure your speed of travel over known distances and you will have an accurate predictor of your speed of travel for you or your group.

A canoe can travel from 2.5 to 4 mph. Currents, headwinds, tail-winds, group or individual travel, and motivation will significantly influence speed of travel. A headwind will slow travel and a tailwind will increase the speed of travel.

The best method to determine your speed of travel is to measure it over a known distance. As you start your trip purposely measure your time and distance using a map as you progress. Calculate your rate of travel for your group. This technique provides an actual metric.

If you are traveling at roughly two miles an hour, after three hours you would expect to have traveled six miles. You look at a map. You notice that for the first six miles, the trail or waterway moves in an easterly direction. Then it turns and moves in a southernly direction. You determine your general sense of direction using the watch method or even a compass. It doesn't matter. If after six hours of travel, you are not traveling in a southernly direction, you might begin to wonder if you took a wrong turn. Or, you simply could behind schedule and adjust your average speed of travel by lowering your speed. In this example, the speed of travel, time spent traveling, orientation using the watch method and a map complement each other in navigation and in providing you a sense of orientation of where you are or should be.

When traveling in the backcountry, this author uses speed of travel and congruence to acclimatize himself into backcountry travel. We go from sitting behind a desk to traveling in a canoe with map and compass. Mentally, we need to re-acclimatize ourselves to backcountry travel and this new environment. We need to tune our senses and reorient ourselves. Speed of travel coupled with the other methods discussed here greatly aid with this acclimatization.

The speed of and distance traveled technique are frequently used by automobile drivers. Traveling at 60 mph on an interstate, most travelers realize they are traveling a mile a minute. Thirty minutes equals 30 miles. Sixty minutes equals sixty miles. There is an intuitive relationship between time and distance and each can be used to help determine the other.

Aiming-off – Aiming-off is an orienteering technique that is useful in general navigation. Rather than aiming directly for a small object that could easily be missed, the traveler uses a "collector" and then aims-off to the target. A collector is a large or continuous object such as river, lake, road, power line, or similar object that can easily be targeted. In a very real sense, it creates a boundary to one's travel.

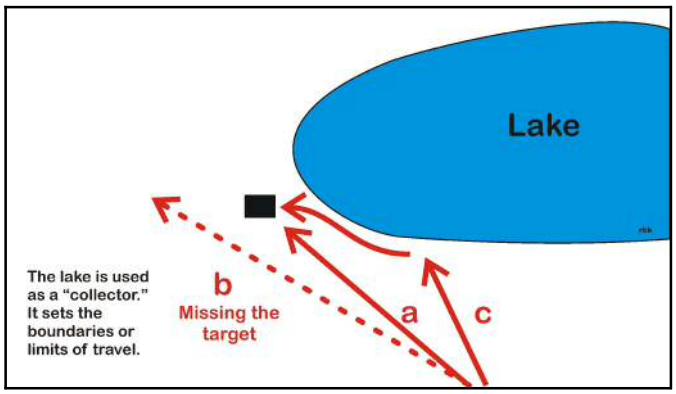

Figure 13.15 – Aiming-off Using a Lake – Source: author – [file:\NA-AimOffLake4[144].jpg]

Two examples of aiming-off are provided. In Figure 13.15, a lake is used as the collector. Aiming for it is relatively easy. It is a simple matter of intersecting with it and bearing left to find the house.

In the second example, a river is used as the collector (Figure 13.16). The strategy is to aim to the left of the object and the bend in the river. The bend is easily found and the building is right around the corner.

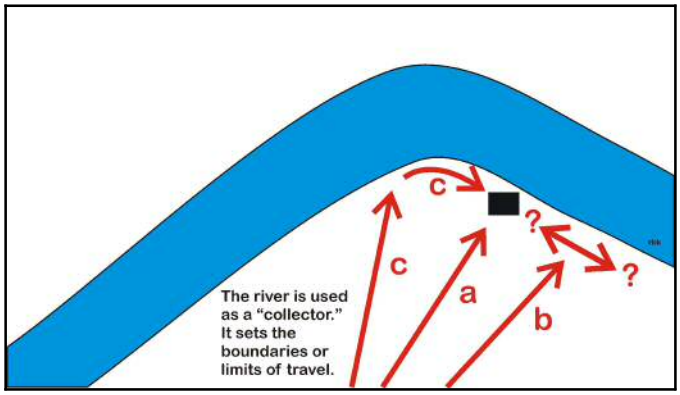

Figure 13.16 – Aiming-off Using a River – Source: author – [file:\NA-AimOffLake4[144].jpg]

Estimating Distance with Shape, Form, and Color of Objects – Shape, form and color are affected by viewing distance. Scenes can be divided into three general zones: foreground, middle ground, and background. The U.S. Forest Service has done considerable research on this topic as it relates to visual management of forest landscapes (U.S. Forest Service, 1974). The changes in shape, form and color (hews) of the landscape can be used in estimating distances and in navigation.

The U.S. Forest Service (1974) identified three zones. The foreground ranges up to 1/4 to ½ mile from the viewer. Middle ground ranges from 1/4 to ½ mile to three to five miles from the viewer. The background extends beyond three to five miles from the viewer. Each of these zones has different characters and the exact same object(s) in one zone will have a different shape, color or color when viewed in another zone.

The zones and the changes that occur in viewing similar objects in each zone are illustrated in the overlook on the Kangamangus highway near Conway, New Hampshire (Figure 13.17). It is the same forest in the foreground, middle-ground and background. However, the changes in form, shape and color are readily identifiable in each of the three zones. In fact, the changes can be used in reverse to predict general distances. This application is useful in backcountry navigation to determine relative distances.

Figure 13.17 – Kangamangus Overlook – Caption: This scenic overlook on the Kangamangus Highway demonstrates the effects of distance on the visual landscape. It demonstrates the differences in the foreground (sign and first hill in middle of the scene), middle ground (second hill on left), and the background (third hill on the right). Near Conway, New Hampshire. Source: author – [file:\SLIDES-VIS\DSC_0024.JPG]

The following is a zone by zone analysis of the scene viewed from the Kangamangus overlook (Figure 13.17). In the foreground, the tree limbs and leaves on the trees are easily distinguishable. The first hill in the center of the picture is still part of the foreground. The individual limbs on the trees are still easily distinguishable and the scene is most likely less than ½ a mile away. The hill on the left is in the middle-ground and is most likely over half-a-mile away. Note that the individual trees have begun to merge together and there is a color shift noticeable even on a black and white version of the photo. Over three to five miles away, the mountains on the right are clearly visible in the background. The same species of trees now appear as a solid plane and even the shadow of the cloud presents itself as a single object on the hillside. Again, note the color shift that is evident even in the black and white version of this photograph.

In backcountry navigation, a boater crossing a bay can easily determine the relative distances from shore or to destinations by using these visual principles. The closer the traveler gets to shore or the destination, the background characteristics will give way to the middle ground characteristics and then to those of the foreground. In the background, trees will merge together into one plane or mass. As the traveler merges into the middle ground, those same trees will emerge as individual trees but the limb structure won't be pronounced. Also, the hues will change toward looking more natural. As the traveler enters the foreground, the limbs of individual trees will become pronounced. The traveler can conclude the relative distance and that he/she is getting closer rather than further away from the shore.

A more sophisticated application of this principle is that gaps in the color transition may indicate bays or similar features that can correspond with features on a map. The changes in hew, size of objects and their shape occurs continuously with distance. Therefore, two ridge lines will create a gap in hew, object sizes, and their shapes because the distance between the two ridges is blocked by the ridge in the foreground. This feature is evident in Figure 13.17 with the ridge lines between the hill in the foreground blocking

the hill in the middle ground.

Summary

Even if you go high tech for your navigation, your first line of defense should still be the use of natural features with which to orient yourself and to aid in navigation. The use of natural features to orient yourself provides a useful backup to the high tech approaches. More importantly, it provides the link between the high tech approaches and features within the local environment. Intuitively, most people use a variation of the local reference system to orient themselves with features within their environment. The better able you are to make this connection, the less likely you will become disoriented and lost when the high tech method fail or are unavailable. The bottom line is that you always have your knowledge with you to help orient yourself in time of need.

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