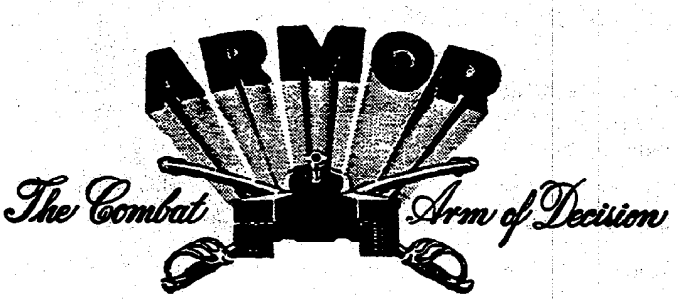
FKSM 21-26-2

HOW TO TRAIN
Map Use and Land Navigation



ARMOR OFFICER BASIC COURSE

ARMOR OFFICER ADVANCED COURSE

INFANTRY/ARMOR (IA/CMF) NONCOMMISSIONED OFFICER ADVANCED COURSE

TRAINING GROUP
US ARMY ARMOR CENTER
FORT KNOX, KENTUCKY

Conduct of Map Training on a Terrain Walk

1. Decide who is to be trained. Pvt sb trained to "think" at sqd/tank level. SGT/SSG sb trained to PSG level.

2. Select trainers. Young, enthusiastic NCO, with proper tng will probably be better than PSG

3. Locate Tng Area. Need not be lg. Route of about 1.5 - 2 km best. Should have all 8 terrain features, if poss. If does, then at least those 8 points sb stops. Oth as desired.

4. Obtain maps. 1 per Soldier if poss. Can borrow, as troops should not write on maps. Get one map per Instr at another scale, if poss, to show difference in relief depiction. 1:50,000 best for troops, 1:25,000 or 1:250,000 for Instr.

5. Assign Instr. Tactical Integ, if poss. Ideally, 1 Instr per no more than 20 pers - less if poss

6. Do it. 3 months later, do it again - rev route, or new area.

fold on line

Instructor duties on Terrain Walk

1. Let the troops do the work. You ask ?, MAKE them come up with the answer. Do not go to another topic, ?, or loc, until they have figured out answer to your question.

2. Emphasize terrain identification and distance / scale.

3. At each stop:
   a. ORIENT MAP BY TERR ASSOC, DET N
   b. IDENTIFY TERRAIN FEATURE(S)
   c. DISCUSS CONTOUR PATTERNS
   d. GET ESTIMATED AZIMUTH TO SOMETHING
   e. GIVE GRID OF NEXT POINT:
      (1) ESTIMATE DISTANCE STRAIGHT
      (2) SELECT BEST OF AXIS - ID BOUNDARIES, LANDMARKS
      (3) ESTIMATE DIST ON AXIS
   f. SEL NEW LDR (f/ea move-keep alert)
   g. MONITOR MOVE if stray, allow for short (50-100m), critique.
   h. ON MOVE POINT-OUT LANDMARKS, MICRO-RELIEF. HAVE TROOPS GET GRID OF NEARBY OBJECTS as f/Spot Report

4. DO NOT CORRECT TROOPS UNLESS YOU ARE SURE YOU ARE CORRECT. If you aren't sure, get it checked out. ●DO IT RIGHT●

fold on line

● TRAVEL the DISTANCE (see inside back cover)

fold on line

SP (Grid) _____ (Typ Terr Feat)

Dist to Point 1, straight _____ m

Pt 1 _____ Typ

Dist to pt 2, straight _____ m

Pt 2 _____ Typ

Dist to pt 3, straight _____ m

Pt 3 _____ Typ

Dist to pt 4, straight _____ m

Pt 4 _____ Typ

Dist to pt 5, straight _____ m

Pt 5 _____ Typ

Dist to pt 6, straight _____ m

Pt 6 _____ Typ

Dist to pt 7, straight _____ m

Pt 7 _____ Typ

Dist to pt 8, straight _____ m

Pt 8 _____ Typ

Dist to pt 9, straight _____ m

Pt 9 _____ Typ

Dist to pt 10, straight _____ m

Pt 10 _____ Typ

NOTES: _____

fold on line

● T R A V E L the DISTANCE

Reminders on Relief / Terrain ID:

1. Hill top of every spur, saddle top of draw.
2. Look 2-3 contours ea side of axis, psn.
3. Relief shown by contour lines at ELEV, not by FORM LINES. Shape approx, only.
4. Relief most accurate feature on map. Shown at scale - estimate distances

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REMINDERS ON MAP SKILL INTEGRATION:

1. Relief important - accurate.
2. Must be able to detect elevation difference All ridges not same height. Watch GROUND.
3. Always look at large area of map to know terrain. Don't get tunnel vision. LOOK! Look at 8-20 grid square area. Eyes on grnd.
4. Find largest stream or lake - lowest spot. Streams show drainage, low ground. Pts named in black are signifficant, use for landmarks. Learn to spot highs/lows.
5. For move, pick AXIS - boundaries that can be recognized, pick linear landmarks. REMEMBER TO WATCH DISTANCE, most prob error

fold on line

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FKSM 21-26-2

HOW TO TRAIN
MAP USE AND LAND NAVIGATION

FOREWORD

In the United States Army, most of us use Military Topographic Maps in field locations for tactical purposes.

1. The statement printed above is generally correct. Unfortunately, it is also generally forgotten by all too many persons. If you wish to improve the map skills of personnel in your unit, you must remember several facts:

- ☆ Military maps provide ADEQUATE accuracy for tactical uses.
- ☆ A Topographic map exists only to give you a picture of the ground.
- ☆ The precision stated for classroom map tasks is not possible, not necessary, and, is not even desirable, under field conditions.
- ☆ Map skills are practice-related, and are perishable -- they tend to deteriorate without adequate practice.
- ☆ Map use is an amalgamation of various tasks. To properly use a map, all the minor tasks must be properly integrated.

2. The US Army has spent millions of dollars in research to verify all of the above statements. Any map training program that does not address these facts is doomed to virtual failure.

3. Map use is an extremely simple and basic skill. The skill is needed by most Soldiers at one time or another. As map use is simple and basic, your training program should endeavour to make it an almost subconscious activity. Military units do not go to the field to navigate from one point to another -- but, they must do so as an integrated activity in the performance of other missions. That is the best way to train map use, at the small unit, and integrated.

4. The guidance in this text builds on the Common Skills navigation tasks in Department of the Army Field Manuals 21-2 and 21-3. Use of this text, in conjunction with those manuals, will allow you to use techniques used by the US Army Armor Center for years. They work!

HOW TO TRAIN
MAP USE AND LAND NAVIGATION

This Special Text is designed for use in Armor and Cavalry units, worldwide. The information contained in the text is doctrinally correct and is applicable to all elements of the US Army. The Text builds on the Map Common Tasks, principally those in Field Manuals 21-2 and 21-3. Use of the Text requires those manuals or a thorough knowledge of the Tasks.

The use of the words "he/him" in the Text is to be equally applied to the masculine and feminine genders unless otherwise specifically stated.

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HOW TO TRAIN
MAP USE AND LAND NAVIGATION

Introduction

1. Much of our current map use training is designed for the ease of the trainer. For example, most map classes start with colors and symbols, then proceed to the use of the Universal Transverse Mercator (UTM) grid system. This is done to enable the Instructor to "steer" the student around the map, using the grid. The instructor will generally steer the student to symbols for man-made objects. He uses these objects because there are symbols for virtually everything man builds or does.

2. This technique, unfortunately, introduces a very significant problem. It tends to make the student -- and the instructor -- believe that the grid is superbly accurate (It is not), that man-made features are very important (They are not), and that Black is the most important color on the map (It is not). Map instruction, as generally presented in most units, then, is a part of the problem. It was not intended to be, but it is. This long-used method has introduced a "mind-set" that relies, excessively, on all man-made objects for map use and navigation. You must remember that, of all things on the map, the man-made features are the ones most likely to be changed, moved, or torn down.

3. To steer the new student around the map, simply use the LABELED features, man-made and natural. This makes the point that the cartographer, or map-maker, labels only significant features. All hills and ridges are not named, just the big ones that are significant land marks.

4. Grid and the use of grid are also excessively emphasized. The grid is merely an address mechanism, a way for you to report locations quickly and easily -- not necessarily with great accuracy. There are numerous other systems that allow you to do this, many with more precision than is allowed by the UTM grid. We use the UTM grid because it is fast and simple. You may point-out to your Soldiers that they will not see any grid lines on the ground. They are only on the map, and, when printed, they can slip or move with relation to the ground. This is particularly true from one print run to another.

5. A great deal of training and testing time are wasted on the black stuff on the map. This is generally done because presumed "precision" is obtained. A great deal of training and testing material would also be judged totally invalid by the people who wrote the material IF THEY HAD TO PERFORM THE TASK IN THE FIELD. Intersection problems that require you to see though ridges are all too common. "Compass Courses" on surveyed land using data several years old -- data that is not valid due to shifts in the earths magnetic field -- and that force you to traverse straight-lines and 'fight' the terrain are also too prevalent.

6. The facts in paragraphs 4 and 5, above, are true because we have forgotten that a topographic map is made to give you a picture of the ground!

7. The most important and the most accurate feature on the map is the terrain -- or relief, or ground forms, all mean the same thing -- the ground. This is true by design. The vast majority of the money spent to produce a map sheet is spent on insuring the accuracy of the contour pattern. On any US or NATO standard topographic map, relief will always be the most accurate feature. Consider:

a. The map exists to give you a picture of the ground. You do not fight on the map. You do not navigate on the map. You do those things on the ground. The map is designed to assist you in doing those things by providing you an APPROXIMATE pictureof the ground.

b. The map is flat -- on a plane -- the ground is almost never flat. Ground is never flat, in fact, except on a dry Salt Lake or where it has been modified by man.

8. In view of the foregoing, it is easy to understand why relief determination is poorly taught. Paragraph 7.b, above tells us that. It is difficult to teach. Several very expensive research projects since World War II have consistently proven that about 80% of all students can recognize relief features after a few hours of instruction. The other twenty percent take from days to months. This makes for low test/evaluation pass, or "GO" rates. Therefore, the subject is downplayed, or ignored. Relief is also difficult to test. Is a given item a ridge, or is it a spur ? The question is immaterial. A large ridge in Kentucky or central Georgia is a very, very small spur in Colorado. What a given relief feature is called is unimportant -- except on a written test. You will have to judge the importance of the written test for yourself.

9. What is not clear, from the foregoing, is how we lost sight of the fact that the information in Paragraph 7.a, above is literally vital. Failure to appreciate that fact -- that the map is only produced to give you a picture of the ground -- can cause you to fail to appreciate the terrain. Failure to understand and properly use terrain, in combat, can be deadly. The intent of this text is to assist you in the training of your Soldiers in the use of the map - that picture of the ground.

10. Use of the text is simple. You will require two Soldiers Manuals, Field Manuals 21-2 and 21-3. You will also need maps of your area (One per student, if possible), and some ground over which to move. The map use tasks in the Soldiers Manuals -- and a couple that aren't in them -- are listed, in this text, in the order in which they should be taught. The order runs from most important, and used, to least important and used. You should also be aware of the facts discussed on the next page.

THE THREE MILITARY USES OF A TOPOGRAPHIC MAP

1. In the Armed Forces, we really use topographic maps for just three things:

a. We navigate cross-country and on roads.

b. We determine the grid of a point.

c. We conduct a map reconnaissance to do both of the above, and to select routes and positions. We conduct a map reconnaissance to identify things on the ground.

2. There are a number of map "tasks". These are listed on the following pages. These tasks are all valid, but you must realize that the key to map use is the ability to integrate these tasks, as required, to solve map use problems. Sometimes, one task will suffice, other timesthree or four, or even more, may be required. A great deal of practice is required for true proficiency in the tasks, and a great deal of practice is required in the integration of those tasks.

3. Ability, in the field, and with the pressures and vagueness that characterize combat, to properly integrate the map tasks and correctly use the map for the three things above is the ONLY TRUE TEST OF MAP USE WITH COMBAT ARMS APPLICABILITY.

4. Since map use in the field is the desired goal, then it logically follows that map training should be conducted in the field. Virtually all map training conducted in the classroom after Basic or Pre-Commission Training is a waste. Train in the field. Train realistically.

5. Let's briefly discuss the three map uses:

a. Navigate cross-country and on roads.

(1) This task is performed in one way or another by everyone. It is imperative that you realize that military navigation entails not only movement over, but also use of, terrain.

(2) The Compass is much -- and wrongly -- taught. Most soldiers do not have a compass. A compass is a relatively inaccurate device, as the magnetic field of the earth is in constant flux. A compass azimuth followed is, essentially, a straight line, and you cannot follow a straight line and USE the terrain tactically. A compass is necessary for navigation on less than 2% of the surface of the earth -- 98% of yournavigation will be in areas with recognizable relief. Navigation with the compass requires a lot of precise work -- not always easy -- and is very time-consuming.

(3) Most navigation is by terrain association. To use this technique, you must be able to identify terrain on the map.

b. Determine the grid of a point.

NOTE: The word 'grid' alone, by NATO agreement, is a six-digit UTM coordinate reading. Additions to the word are redundant.

(1) Determining the grid of a radio tower or a labeled point, on a map, is easy. Doing the same thing to identify one of several radio towers you see on the ground, about two kilometers away in the mist, is not easy. Grid determination in a classroom is wasted time, purely and simply. This includes grid determination by intersection or resection. Grids must be determined to report own, friendly, enemy and object locations. Grids given must be translated onto the map, and more importantly, on to the ground.

(2) To do this, you must be able to identify terrain on the map.

c. Conduct a map reconnaissance.

(1) The first thing you must realize about this is, simply, it is not taught in many places. It is not taught, yet it is far and away the most important map skill. In fact, you could make a valid case for the fact that it is the only map skill. The other two skills, listed above, are really GROUND skills -- things done on the ground based on information supplied by the map. If this is true, why is it not taught?

(2) It has not really been taught for three reasons:

(a) In years past, most soldiers had rural origins, and knew terrain.

(b) Most older soldiers, Officer and Enlisted, learned through experience how to perform the task.

(c) It is difficult to teach, as identification of terrain is key. Remember the years of tests and studies that show only 80% quickly absorb the knowledges to identify relief.

(3) The second thing you must realize about a map reconnaissance is that, militarily, it is perhaps the single most important combat skill applicable to all arms in all types of terrain, world-wide. It is also the most commonly performed map task. When we look at a map, it is most usually to perform a map reconnaissance.

(4) The third thing you must realize is that map reconnaissance, as a skill, is like most cognitive skills. It will deteriorate if not used regularly. Therefore, you must always make an effort to force your subordinates to practice and to hone their skills. Train your Privates, they will be junior leaders before you know it -- or they go PLDC or other schools.

(5) To perform a map reconnaissance, you must be able to identify terrain on the map.

●IDENTIFY TERRAIN FEATURES

(TASK 071-329-1001, FM 21-2)

1. The Standard is accurate, and adequate.

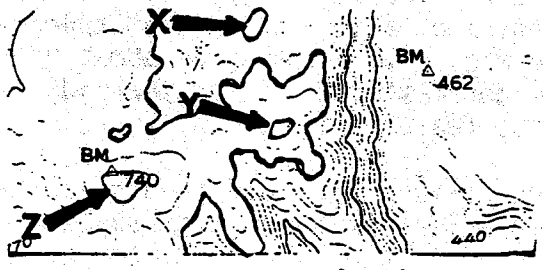
2. Wording peculiarities in the Task statement are minimal. The words Major and Minor, applied to features, can be taken to mean that a SPUR is a minor, or small, RIDGE; That a DRAW is a small VALLEY; And, that there aren't a whole lot of CLIFFs around. These are true statements, but you must not get hooked on terminology. It is really important that your Soldiers realize what the ground is like at a certain point. What they call a piece of terrain is not very significant.

3. The teaching points in the Task Statement should be slightly modified:

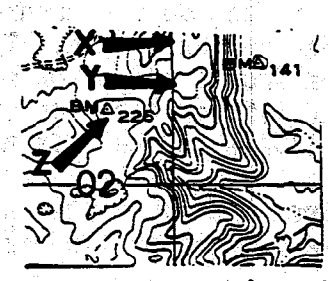
a. The use of the "U" and "V" pattern is generally true, but SHOULD BE USED ONLY WITH CAUTION. There are V-shaped ridges and spurs, just as there are U-shaped draws and valleys. These anomalies are rare, but they do exist.

b. The use of STREAM LINES is not adequately emphasized. Stream lines are placed on the map primarily to show the drainage pattern, not to show water. Streams flow only in draws or valleys. If contour patterns draw away from a stream or low ground, they indicate a DRAW. If the contour pattern bucks or protrudes toward water or low ground, a SPUR is shown.

c. You must show your Soldiers that CONTOUR INTERVAL and SCALE of the map have a very significant bearing on how relief is depicted. Note the depiction of hills, at X, Y, and Z on the map extracts below. You know the ground is the same, but the three maps show widely differing pictures. Yet, if you know what to look for, the hills are shown on all three maps.



1:24,000; 20'(6m)

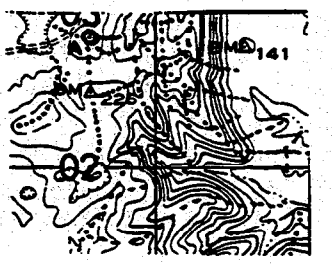


1:50,000; 34'(10m)

1:250,000; 100' (30m)

Hills will be at wide spaces between contour lines of equal elevation. Spurs will run from the tops of these hills to a limiting features — In this case, a stream

d. Here are the same three maps shown on the last page. Note the dotted lines. These are to indicate pencil lines you may draw down the center line of ridges and spurs and their branches. Draw these lines lightly. You will find that, if you draw them a few times, you can soon visualize the pattern without drawing a line.



e. Remember these simple rules:

(1) Always look two or three contour lines on each side of a route or position to know what terrain is really like. There is no flat terrain.

(2) There is a small hill atop every spur, a small saddle atop every draw. Hills and saddles always alternate. So do spurs and draws, and, ridges and valleys. Depressions and cliffs can pop-up in strange places.

(3) Relief is shown by Contour lines, which are placed on lines of given elevation. They are not FORM LINES. They do not show the exact outline of a piece of terrain. A ridge contour, for instance, may not touch a stream line, but, on the ground, that ridge will run all the way to the stream. Contour lines show only APPROXIMATE shape. Almost all features will be somewhat larger on the ground than they appear on the map.

(4) Relief features at a given point can vary slightly in relation to grid from map to map. The contour lines go on the paper in one map run, with brown ink. The grid goes on in a second run, with black ink. Thus the two can slip, in relation to each other, from map to map. Since all the brown goes on at one time, the terrain features will not slip in relation to themselves. They will be accurate, and at scale -- a draw that appears to be about a hundred meters wide on the map will be only a little wider on the ground. The center of a depression that appears to be 150 meters from a ridge top on the map. will probably be about that far, on the ground (though the edge of the depression may be at the ridge top). Relief will always be the most accurate feature on the map.

(5) Since the map exists to show relief, and since relief is the most accurate feature on the map, then relief is the key map skill.

4. Most common errors in instruction are:

a. To teach in a classroom. Don't. This task is best taught in the field

b. To not emphasize the rules above. DO EMPHASIZE THEM.

● DETERMINE THE ELEVATION OF A POINT ON THE GROUND USING A MAP

(TASK 071-329-1004)

1. The Standard is accurate and adequate.

2. Wording peculiarities in the Task statement are minimal. Those present pertain to the types of slope, properly a part of terrain analysis, and not really required for simple determination of elevation. A significant problem exists with Performance Measure 4.d., and is discussed below.

3. The teaching points in the Task Statement require only slight modification:

a. In initial training, reference to the types of slope (Paragraph 3 of the Task) may be eliminated if desired.

b. Performance measure 4.d aptly summarizes the meat of the task, however, it does not adequately emphasize that DETERMINATION OF DIRECTION OF SLOPE is where most errors occur. Emphasize determination of direction of slope. Remembering that water must be on low ground, and that stream lines are on the map to identify drainage patterns is the best clue.

4. Most common errors in instruction are:

a. Not teaching elevation as it "is not needed". Remember that the map exists to give you a picture of the ground. IF YOU CANNOT VISUALIZE THAT GROUND IN ITS THREE DIMENSIONS, YOU WILL HAVE SEVERE PROBLEMS IN MAP USE. The ability to determine elevation is not terribly vital. The ability to visualize elevation differences is critical.

b. Not adequately emphasizing determination of direction of slope. This determination is vital in elevation recognition. EMPHASIZE IT.

● IDENTIFY TOPOGRAPHICAL SYMBOLS, COLORS, AND USE MARGINAL INFORMATION

(TASK 071-329-1000, FM 21-2)

1. The Standard is adequate and accurate.

2. There are few wording peculiarities. The Task will stand as written.

3. The primary teaching point is to use an absolute minimum of man-made objects in instruction, and to point-out that the BROWN is the important -- and accurate -- color on the map.

4. The most common error in instruction is to use mostly cultural features. DO NOT!

• MEASURE DISTANCE ON A MAP

(TASK 071-329-1008, FM 21-2)

1. The Standard is accurate EXCEPT for the Straight-line Distance standard of a measurement to within ± 50 meters. This standard is unrealistic and unnecessary.

a. The horizontal accuracy of a 1:50,000 scale map is ± 25.4 meters. Add to this print-plant slippage of the black in relation to the brown, and that figure can easily double. Add a further error of up to 1% of distance measured due to paper expansion/contraction due to temperature and humidity, and you easily exceed the ± 50 meter standard. Add to these facts the point that most of the Army uses a grid (6-digit) for reporting and marking, and no one can use the 50 meter measurement. Train your troops to measure within 100 meters.

b. There is no tactical reason for a measurement to such a standard. Light weapon ranges need not be measured on the map, with the exception of the machine gun, which rounds easily and adequately to 1,000 meters.

c. If a map is properly encased or covered with acetate, which it should be for protection, then the thickness of the plastic and the width of most commonly used markers or pencils preclude the accuracy specified. The standard is a classroom standard, purely and simply. It has no place in tactical training.

2. Other than the foregoing, the Task stands as written.

3. The teaching points in the Task Statement are good and require no modification.

4. The most common error in instruction is to try to reach the straight line standard. As it is not possible, due to the factors above stated, all that is done is to lessen individual confidence. Use 100 meters for all but SQT training. For most tactical purposes, including fire support, a 200 meter tolerance is, in fact, acceptable. Since the map should be in a case, the Bar Scales will probably not be available at any rate. An estimation of distance (easily taught -- people visualize in 100 meter increments as a result of grid estimation) is usually adequate and is far more speedy.

NOTE: The factors cited in paragraph 1, above, are easily verified by referring to the basic doctrinal material from which the task was derived. It is noteworthy that the Field Artillery, which uses metal coordinate scales, 6-H pencils and an eight-digit grid, requires its Forward Observers to locate themselves no more precisely than to within 150 meters (ARTEP 6-325 and all other Cannon Battery ARTEP)

● ORIENT A MAP TO THE GROUND BY MAP-TERRAIN ASSOCIATION

(TASK 071-329-1012, FM 21-2)

1. The Standard is accurate and adequate. You will find, however, that most Soldiers can perform the Task far more accurately and far more quickly than is specified. This is true under most conditions. Occasionally, in very difficult terrain, the standard may not be met.

2. Other than the foregoing, the Task stands as written.

3. The teaching points in the Task Statement are good and require no modification.

4. The most common error in instruction is to provide two linear, man-made features with which to orient the map. This should be avoided. Another way to prevent directional errors in orientation is to point-out to your Soldiers that the Sun always rises in the general direction of east (Northeast in the summer, southeast in the winter in the US, Korea and most of Europe) and sets in the general direction of west. No matter where you are in the world, the Sun will always be on a 180 / 360 degree line at 1200, Standard time. If you are in the southern hemisphere, south of the Equator, the Sun will be on a 360° azimuth. If you are in the northern hemisphere, it will be on a 180° azimuth. Precisely north or south at 1200. And, it moves at fifteen degrees per hour, precisely. If you are at Fort Knox, and the time is 0900R, then the sun is exactly 45° east of due south.

- IN THE NORTHERN HEMISPHERE, AS A GENERAL RULE, IF YOU ARE FACING AWAY FROM THE SUN DURING THE MAIN PART OF THE DAY, YOU ARE FACING GENERALLY NORTH.

- IF MORE PRECISION IS REQUIRED, FACE THE SUN, NOTE THE TIME OF DAY, AND ESTIMATE THE ANGLE TO SOUTH. DO AN ABOUT FACE FROM SOUTH, AND YOU WILL BE FACING A MORE PRECISE NORTH.

- JUST REMEMBER -- 1200, STANDARD TIME, THE SUN IS ON A PRECISE NORTH-SOUTH LINE. THE SUN ALWAYS MOVES AT 15° PER HOUR FROM EAST TO WEST.

You can also use general slope of ground to aid you. Most terrain will have higher ground in one direction. Locate that terrain on the map, then on the ground.

● ANGLE ESTIMATION AND SIMPLE TRIANGULATION

(Not a current Soldiers Manual Task)

1. The top of the map sheet is north. The right side is east, or, more correctly, generally eastward. If you stand with the map oriented, by terrain association, and hold the map so all the text is so you can read it. Then, if you point to the right, at a 90^0 angle, you are pointing east, or 90^0, or 1,600 mils (ṁ). This is not supremely accurate, but it is an adequate angle determination for most tactical purposes, including a Call for Fire.

2. As long as you know that east is 90^0(1,600 ṁ), that south is 180^0 (3,200 ṁ), that west is 270^0(4,800 ṁ), and that north is either 0^0 or 360^0 (0 or 6,400 ṁ), you can estimate angles. If you take that knowledge and add the skill of spreading your arms 90^0, like this:

Figure 2-1

Then, you can easily get one-half that angle, or 45^0 by estimating half, like this:

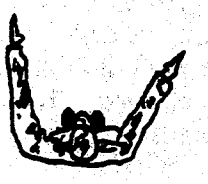


Figure 2-2

3. If you can estimate one-half of 90^0 (1,600 ṁ), then you can estimate 45^0 (800 ṁ). If you can do that, you can, from the map, estimate most angles you will need.

NOTE: You may use degrees (^{0}), or mils (ṁ), or both. The only valid reason to use degrees is for SQT purposes. Mils are more accurate, are easier to use mathematically, and are used by ALL combat arms. Use of mils will speed a call for fire.

4. The illustration on the next page (Figure 6-1) shows a Soldier using the map for simple triangulation. It also shows him estimating the angle to a point. He estimates the point to be half-way north of west (4,800 ṁ) on the way to northwest (which would be 4,800 ṁ + 45^0 or 800 ṁ = NW - 5,600 mils). Since it is only halfway to NW from W, then the GRID azimuth must be about 5,200 mils (4,800 + ½ of 800 = 5,200).

5. Do remember two things:

✪ a. YOU MUST HAVE YOUR MAP REASONABLY WELL ORIENTED TO NORTH (± 5^0).

✪ b. THE AZIMUTH YOU ESTIMATE WILL BE A GRID AZIMUTH.

(You can obtain a magnetic azimuth by converting from grid to magnetic)

6. Simple Triangulation is simple intersection. You locate yourself by referencing nearby objects; "I'm on this ridge, somewhere north of the town. There's that road -- this one on the map, so I'm roughly oriented. I'm here, where my finger is, so the enemy tank must be there, on that ridge":

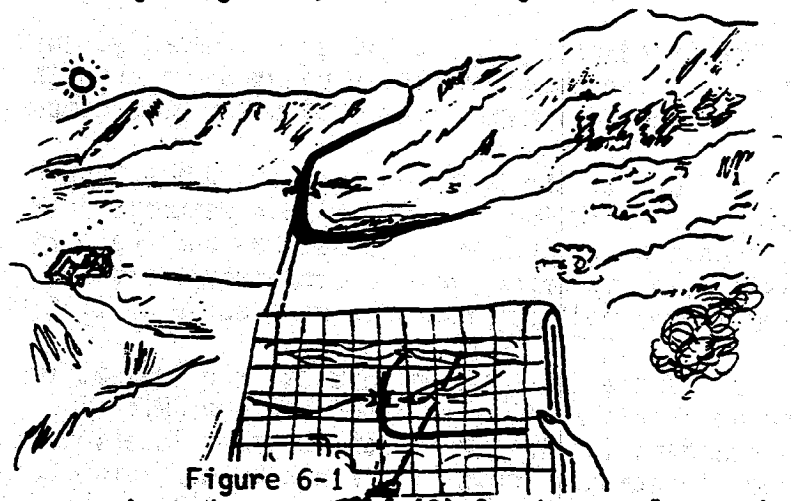


Figure 6-1

(1) With the map oriented and your finger on YOUR location, place map between you and item to be located. Look on angle shown by direction of finger and estimate range or note terrain.

(2) See how angle can be estimated, as discussed in Paragraph 4, above. Note how the road, past the curve, heads away on an approximate azimuth of 4,800 ₥. Note the azimuth to the house is about 4,000 ₥.

7. You can also locate yourself with simple triangulation. You do it all the time. How many times have you thought: "I've gotta' turn left at the next light" ? Many times, surely. You locate yourself in the field the same way. You just substitute terrain features for streets and traffic lights or buildings. One key to this is to locate nearby (visual range - a few hundred meters in the woods, many miles in the desert) high features.

✪ HINT If terrain features are named, in black, on the map, they are significant, and, usually, are good landmarks.

"Right, here, to I-65..."
Figure 7-1

"Right at the stream junction to..."
Figure 7-2

● DETERMINE THE GRID COORDINATES OF A POINT ON A MILITARY MAP USING THE MILITARY GRID REFERENCE SYSTEM

(TASK 071-329-1002, FM 21-2)

1. The Standard for six-digit grid (Correctly; just grid) is accurate and adequate. The standard for an eight-digit grid is not possible on all standard tactical maps (1:50,000) under most circumstances.

a. Due to the National Map Accuracy standard (Horizontally .02" at scale. .02 x 50,000 = 1,000" = 25.4 meters), Printing slippage (Equal to the standard, or another ± 25 meters) and the ± 1% expansion/contraction possible in map paper, due to temperature and humidity, the accuracy specified is not reliably possible at a scale of 1:50,000.

b. There is no known tactical requirement for that precision. Note any Field Artillery Cannon Battery ARTEP for location standards. The standard is 150 meters for Observer location and 250 meters for target location. Those figure are based, admittedly, on weapon effects, among other things, but they are adequate and realistic standards that are able to be reached by most persons in the field. The requirement for ± 50 meters is purely a classroom standard with applicability only ona 1:25,00 scale map -- a scale not in general use since the Army standardized on the 1:50,000 scale for a tactical map in 1957.

c. Such "precision" defeats the purpose of the grid, which is to allow RAPID position reporting.

2. There are some wording peculiarities and graphic errors in the Task Statement.

a. Refer to Note a. The implication is that a knowledge of grid will aid you in not getting lost. As the lines and square referred to can NOT BE SEEN ON THE GROUND, the connection is not clear.

b. Refer to Note b. The statement is not technically correct. It should read "... will usually have the same number."

c. Refer to Note c. The statement is not correct with reference to the eight-digit grid. It is mathematically sound, but, due to map accuracy -- the reason for the ± 50 meter standard discussed above -- it is not possible.

d. Note the error in Figure 3-66. Other than these items, the bulk of the Task Statement is adequate.

3. There are two teaching points requiring modification.

a. An eight-digit grid is not practical on a map of 1:50,000 scale.

b. Note Paragraph 3. The statement is correct, a Coordinate Scale is more accurate. Such accuracy, however is seldom required. Lower grade enlisted personnel, in particular, have little need for such accuracy. Experience here at USAARMS with Basic and OSUT trainees has shown that most Soldiers can adequately estimate a grid, and can do that better WITHOUT the Coordinate Scale.

(1) The most common error in obtaining a grid is to reverse the tenths. If a Soldier is going to do this, he will do it with or without the Scale. Further, the reversing of the horizontal scale causes some confusion. Most Soldiers can, with little training, estimate the grid to within 100 meters -- the standard.

(2) Obviously, estimation is faster than the scale. Further, Scales are easily lost or damaged. Reliance upon the Scale can have little beneficial effect for most Soldiers in most cases. Teach your troops to estimate grid.

4. The most common errors in instruction are:

a. To insist on more precison than the map will always have. A presumed accurate grid on one map may change completely on another map. This is particularly true if all maps in a unit are not from the same printing run (and this is usually the case).

b. To place undue emphasis on grid to the exclusion of other, more important tasks. This is usually done because grid training can be evaluated with relative precision. Unfortunately, as previously discussed, this tends to build psychological dependence on grid.

c. To force people to use the coordinate scale for "precision".

d. To tell people to "use a sharp pencil". This is a classroom-based delusion to achieve "accuracy". The grid exists to give a FAST method of reporting APPROXIMATE location. Insistence on unattainable precision, on the ground, is counterproductive. If the map is properly encased, for protection, the case will be marked-on with a Grease Pencil or something simliar -- these things make a dot that is one hundred meters wide -- a sharp pencil is not required.

e. To preclude all these errors, just remember why the grid exists. Teach your troops to ESTIMATE grid, quickly -- precision will come with practice -- and do your grid training IN THE FIELD WITH TERRAIN THAT CAN BE RECOGNIZED, BUT WITH OBJECTS THAT ARE NOT ON THE MAP. The things that are not on the map cause problems. Most people can locate the items on the map. It is the small building, the bunker, the moving vehicle that the map does not show, that are the problems -- and the killers.

✪ THE TRUE TEST OF GRID DETERMINATION IS IN THE FIELD, AND IS DIRECTED AT OBJECTS THE MAP ONLY HINTS AT, OR DOES NOT SHOW AT ALL.

Grid exercises in the classroom are a virtual waste of time.

● DETERMINE A LOCATION ON THE GROUND BY TERRAIN ASSOCIATION

(TASK 071-329-1005, FM 21-2)

1. The Standard is accurate and adequate, with the caveat that the specified precision is not always possible, even by highly experienced personnel.

2. The Task is worded correctly.

3. The teaching points specified are adequate.

4. The most common training error is to provide inadequate practice. This task requires constant practice in varying locations for proficiency.

● ORIENT THE MAP USING A COMPASS

(TASK 071-329-1011, FM 21-2)

● DETERMINE A MAGNETIC AZIMUTH USING A COMPASS

(TASK 071-329-1003, FM 21-2)

● DETERMINE AZIMUTHS USING A PROTRACTOR AND COMPUTE BACK-AZIMUTHS

(TASK 071-329-1031, FM 21-2/3)

All the above Tasks are adequate as presented. They are properly Tasks for Non-Commissioned Officers, as few, if any, Privates have compasses. The Tasks may be taught, as required. Dead Reckoning using the Compass is necessary in rare parts of the earth. Proficiency with the compass takes far more practice than does the use of Terrain Association as a navigational technique. Be sure you schedule adequate practice time.

✪ THE TASKS DO NOT ADDRESS THE FACT THAT THE MAGNETIC FIELD OF THE EARTH CHANGES CONSTANTLY. FOR THIS REASON, AND BECAUSE OF COMPASS INACCURACY -- ALWAYS A PROBLEM -- DEAD RECKONING IS A RELATIVELY IMPRECISE AND UNRELIABLE METHOD OF NAVIGATION. IT WILL WORK, AND MUST BE USED AT TIMES. A GOOD NAVIGATOR MUST BE ABLE TO DEAD RECKON, BUT HE MUST ALSO ALLOW FOR AN AMOUNT OF RELATIVE IMPRECISION.

● DETERMINE DIRECTION USING FIELD EXPEDIENT METHODS

(TASK 071-329-1018, FM 21-2)

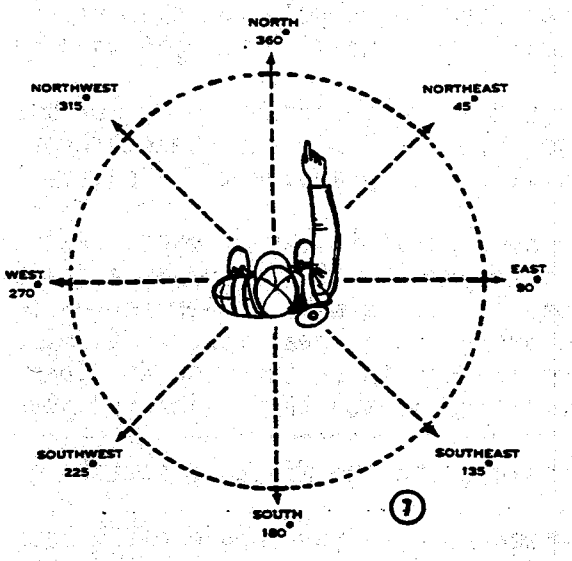
1. The Standard is adequate and accurate.

2. There are no wording anomalies in the Task Statement.

3. The Teaching Points in the task are adequate, but should be expanded to add the following.

a. These methods work, but require time that may not be available. Faster methods of using the sun are at page 7, this text.

b. Soldiers should be taught expedient azimuth estimation, as discussed in paragraphs 18 and 23, FM 21-75. A copy of one diagram from that manual is reproduced here:



FIND OTHER DIRECTIONS BY RECALLING THEIR RELATION TO NORTH.

✪ IF THE SUN CAN BE LOCATED, EVEN ROUGHLY ON A CLOUDY DAY, OR IF THE MAP CAN BE ORIENTED, BY TERRAIN, THEN NORTH IS KNOWN. IF NORTH IS KNOWN, THEN AN AZIMUTH (GRID -- which Artillery uses -- OR TRUE) ADEQUATE FOR ALL PRACTICAL PURPOSES CAN BE ESTIMATED.

● ANALYZE TERRAIN USING THE FIVE MILITARY ASPECTS OF TERRAIN

(TASK 071-331-0820, Most SL3 SM)

The Task is adequately covered in the Task Statement. Perhaps the best of many descriptions of the Military Aspects is at Paragraph 1-8, FM 5-36. NO SOLDIER SHOULD USE A MAP WITHOUT THINKING TACTICALLY, lest he acquire bad habits.

● OTHER USEFUL SKILLS AND KNOWLEDGES

1. Range Estimation.

a. This is a simple skill, easily learned, but it does take some practice to perfect the ability to consistently estimate correctly. From your location, to the desired object, simply estimate how many football fields will fit in the apparent distance. If the answer is, say, seven, then the range is approximately seven hundred meters.

b. If the answer is more than ten football fields, then try to locate a point one-half, one-third or one-quarter of the way, estimate the number of hundreds of yards (football fields) to the part way point, and then multiply by two, three, or four to obtain the approximate range.

c. This method is reasonably accurate up to about five thousand meters. There are a few minor points you should remember:

(1) If you are looking at the distant object over a CONCAVE surface (A valley), the distant object will look closer than it really is. If you look over a CONVEX surface (A ridge), the distant object will appear more distant than it actually is. Rolling terrain will have little effect.

(2) If the object is very distant, a fog or mist will probably obscure it. If, however, you can still see the object through the fog, mist, or smoke, the object will probably appear to be closer than it is.

(3) The atmosphere plays tricks on eyes. People will vary widely in the effects of the atmosphere. If you are an excellent estimator of range at Fort Knox, you may not do as well in Germany -- or at Fort Irwin. When you arrive in a new operational area, take a few minutes to practice some estimations, looking at objects on the ground. Then, check your estimates on the map. This will enable you to "calibrate" your eyes to your area.

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2. Analysis of Terrain using the Military Aspects of Terrain.

✪ While in the Armed Forces, you should NEVER look at a map without considering:

- ★ OBSERVATION AND FIELDS OF FIRE
- ★ COVER AND CONCEALMENT
- ★ OBSTACLES
- ★ KEY TERRAIN
- ★ AVENUES OF APPROACH

Remember that the real intent of map use is enablement to USE THE GROUND.

● LOCATE AN UNKNOWN POINT ON A MAP OR ON THE GROUND BY INTERSECTION

(TASK 071-329-1014)

● LOCATE AN UNKNOWN POINT ON A MAP OR ON THE GROUND BY RESECTION

(TASK 071-329-1015)

1. The Standard is only accurate in the classroom. It is not uniformly attainable under field conditions. Note the two typical "Intersection/ Resection Problems" below:

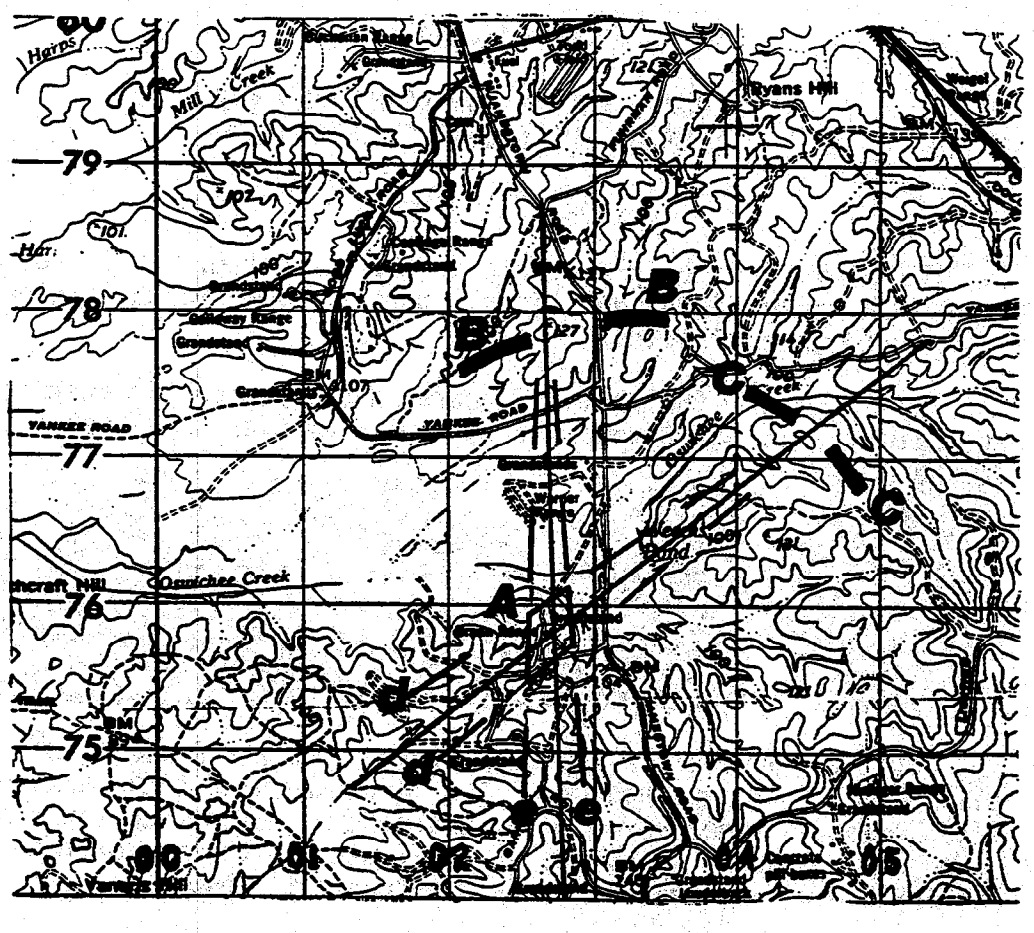
a. "Identify the feature located along a magnetic azimuth of 309° at a distance of 6,275 meters from Spot Elevation 134 located in grid square GL 0785."

(1) The problem is depicted above. The G-M Angle is 0°. The solid black line is the azimuth ray. The large numbered tick marks on that ray are thousands of meters. Three one-hundred meter tick marks have been added at the end. Note that, at 6,275 meters, the approximate center of an AIRFIELD is located. That is the "correct" answer.

(2) There are two major faults with this problem. The first flaw is, simply, that the AIRFIELD could not be seen from Spot Elevation 134 (GL 0785). Note the heavy dashed line crossing the azimuth ray at about 1,700 meters NW of the Spot Elevation. That dashed line indicates a ridge with an average elevation of about 135 meters, plus about 15 meters of trees. That constitutes a mask height of 150meters. The Spot Elevation is at 134 meters, the AIRFIELD is at 115 meters. It would not be at all possible to see the AIRFIELD. While it is admitted that sight of the airfield is not specifically mentioned, it is implied. Questions such as this create grave problems for inexperienced map users.

(3) The second error is indicated by the dashed lines diverging from the azimuth ray. These indicate lines 3° on either side of the plot line. The purchase specification for the Magnetic Compass is that it be accurate to within ± 3°. That is the reason for the standard in Determining A Magnetic Azimuth With a Compass (Task 071-329-1003 -- See page 12). As you can see, using that standard, which is realistic, as most compasses are not very accurate, gives a spread at 6,300 meters of about 300 meters on either side of the datum line. It is not realistic to expect accuracy to within 100 meters in problems of this type.

b. "The magnetic azimuth from your position to the structure in GL0577 is 53°, and to the road junction (RJ) in GL0278 is 359°. What is your location ? (Identify the feature)"



The problem is depicted above. Note the masks, at B-B and C-C. It would not be possible to see either of the described features from BRANN RANGE. (BRANN RANGE is at an elevation of 115m. The targets are at 120 and 145m, the masks are at about 125m + 15m [Trees]= 140m). Also note the ± 3° rays on each side of the primary, solid, azimuth lines (d-d; e-e) and the resulting 'box' produced (At A) in the intersection area. Note that we have a possible error of over 200 meters each way. The 100 meter standard is NOT possible in the field.

2. Other than the Standard, discussed above, there are no major wording peculiarities in the Task Statement.

3. The teaching points in the Task Statement are adequate, but caution should be exercised in the selection of locations for problems. Be sure you have line of sight, or, so-word the problem that visual acquisition is not implied. Do not rely excessively on man-made objects. Both errors tend to cause inexperienced people to believe in the use of a technique that is, in reality, seldom used in the field. The use of the technique is necessary for the truly competent map user, and the techniques are very good teaching adjuncts -- as virtually all map use tasks are exercised -- but take care that you do not inadvertantly cue-in bad habits and belief in accuracy attainment that is not uniformly possible in the field.

4. Most common errors in instruction are:

a. To not adequately emphasize the importance of accurate protractor alignment.

b. To demand an accuracy which the tools and technique will not always provide. This is particularly true with the 1:50,000 scale map.

c. To select problems that use man-made features excessively, and that do not consider intervisibility.

● NAVIGATE FROM ONE POINT ON THE GROUND TO ANOTHER POINT, DISMOUNTED

(TASK 071-329-1006)

● NAVIGATE FROM ONE POINT ON THE GROUND TO ANOTHER POINT, MOUNTED

(TASK 071-329-1030)

NOTE: The task statements used in this discussion are those produced by the US Army Infantry School in January, 1983. These tasks should be in manuals produced after that date. For those persons not having newer manuals, a summary of navigation by terrain association is inside the rear cover of this Text. Navigation by dead reckoning is adequately dealt with in older SM tasks.

1. The Standards in both Tasks are accurate and adequate.

2. There are no wording peculiarities in the Task Statements.

3. The teaching points in the Task Statements are adequate.

4. Most common errors in instruction are:

a. To emphasize dead reckoning instruction -- "compass courses" -- instead of using the primary, most used, and most militarily satisfactory mode of navigation, terrain association.

(1) Dead reckoning imposes straight-line routes, which can be very unsafe and unsatisfactory, tactically. Dead reckoning also relies upon an instrument, the compass, which was designed to be only marginally accurate, but cheap, and to be used for navigation in emergencies and on extremely flat terrain (See paragraph 5-13a, FM 21-26)

(2) Terrain association is more militarily flexible, is far faster, will cope with unexpected enemy actions or other contingencies, and is usable by marginally trained personnel on over 98% of the land surface of the earth.

(3) You will find that if you train in the techniques of navigation by terrain association initially, and allow adequate practice in those techniques (four to eight hours, in two equal periods a week or so apart) THEN teach the compass and the techniques of dead reckoning -- first, day, and then, night -- and allow adequate practice (again, four to eight hours in at least two periods a week or so apart) that your troops will be able to navigate fairly well.

b. To not allow adequate practice time. A "compass course", run by half your unit once a year is not practice. It is little more than a hassle. At least two practice runs, using both terrain association and dead reckoning should be scheduled every six months. Map skills are cognitive, and as such, are perishable. They deteriorate without use. Force your unit to practice often.

c. To schedule untrained and unready, inexperienced personnel for field training in navigation. Nothing will destroy the confidence of a soldier more quickly than to get him lost. New troops should be very carefully and slowly introduced to navigation on a realistic course. Very, very few Privates will ever have to navigate alone. All should be able to, particularly in the Combat Arms, but they must develop the skills through practice.

d. To use practical exercise courses that are unrealistic. So-called compass courses, with points at 50 meter intervals are assinine. No one has to locate things like that in combat or combat training. Points need to be situated near, not necessarily on, identifiable features. They must be easily located from 30 to 50 meters away. Points for dead reckoning and/or points for terrain association should be completely interchangeable and similiar. The object, after all, is not the point, but whether it can be located. The technique should not matter, but, should be left to the individual.

e. To not really consider the capabilities of troops when training. Numerous studies have proven that about 20% of all people need far more practice than do most in identifying relief. There is, to date, no known identifying correlation to determine, in advance, who will be able to identify relief from the map with little instruction, and who will not. You must know your people. Some will require more training, help, and practice than will others. Terrain association requires ability to look at the map, and have it present a picture of the ground. This means your men must be able to recognize contour patterns and to detect elevation variations, and do those things quickly and easily. To do that, takes a little instruction and A LOT OF PRACTICE.

f. To forget two important training dictums:

- "There's never enough time to do it right" (But, there's always enough time to do it twice....)

- " If you ain't having fun, you ain't doin' it right "

NAVIGATION BY TERRAIN ASSOCIATION

Is fast, error-tolerant,simple, and very easy to teach.

The navigator needs to be able to:

- IDENTIFY TERRAIN FEATURES FROM CONTOUR PATTERNS.
- DETERMINE ELEVATION DIFFERENCES ON THE MAP.
- ESTIMATE ROUGH GROUND DISTANCE FROM THE MAP.
- ESTIMATE ROUGH DISTANCE TRAVELLED OVER THE GROUND.
- PERFORM SIMPLE TRIANGULATION AND ESTIMATE RANGES.
- PRACTICE

There's a simple phrase that will help you remember the basic principles:

T R A V E L DISTANCE

We mean:

T o where	-- Locate grids of own location and destination. Do NOT mark map - just remember where the places are, you can do it. If the mark slips or smudges, you'll still know where you're headed.
R econ on map	-- Look at a straight-line route - it'll usually be bad.
A djust Course	-- Always consider:
V isibility	-- If you can see, you can kill. If you can be seen, you can be killed. SURVIVAL is your first concern.
E ase of Movement	-- Is the second most important consideration. If you use a difficult route, you will be noisy, will tire your people out, hurt them, hurt your equipment and increase the chance of getting lost. You achieve surprise by doing the unexpected, not by doing the expected on a dumb route. Don't even use a route - use an AXIS, it's more flexible.
L andmarks	-- Pick landmarks you will recognize based on time of day, speed, and, terrain. Remember AXIS boundaries need to be time derived, rather than distance. You will use a lot of off-route landmarks - high hills and so forth. Noteeverything on the map in the area.
DISTANCE	-- Estimate the distance between landmarks or checkpoints where you will turn or orient yourself and then, remembering that DISTANCE IS WHERE YOU ARE MOST LIKELY TO MAKE A MISTAKE (Not in estimating, but in traveling):

- TRAVEL the DISTANCE

TRAINING HINTS

1. Identification of relief, or terrain features, is the single most important skill. It is practice related, and, it is a perishable skill. Integrate relief discussions into all training. Chemical agents are more persistent in low areas, for instance. Being able to determine elevation helps most people identify land forms. Do not expect your soldiers to do well at any map tasks, in the field, if they can not identify relief.

2. Map Reconnaissance.

a. The reason the map exists -- so you can look at it and form, in your mind, a picture of the ground -- Treat the map like a centerfold. Look at the whole picture first, then home in on the area of interest. Always look at an area of many grid squares first, to appreciate the ground in the whole area. Always consider OCOKA

b. Find some water. The Blue is on the map to show you the DRAINAGE PATTERN -- the low ground. Note how ridges and spurs push streamlines away, and see how, across from the ridge, a draw will be on the other side of that streamline.

c. Try to put a picture of the ground in your mind. Visualize what will be over that next hill. Then, look at the ground nearby to orient on features you can see on the map. Ignore the man-made stuff, watch the GROUND.

3. Determining grid of a point.

a. First, note the relationship of that point to nearby features that are on the map. If none are nearby, look at distant features, and work your way in.

b. Second, do not worry to much about "precision". Accuracy comes with practice. Concentrate on speed, initially. A distant object located to within two hundred meters or so, in the field, is really very good.

4. Navigating on roads and cross-country.

a. Do not pick routes -- pick an AXIS. Get good boundaries on each side. How far apart those boundaries can be depends on the situation. It also depends on the type of move. You can tolerate boundaries six kilometers apart, monted and in the desert. On foot, in heavy jungle, a few hundred meters may be too far. Boundaries are time-sensitive, not distance sensitive. Pick boundaries you can recognize.

b. Then pick Landmarks in or near your axis, so you know where in the axis you are. Pick linear landmarks -- Power lines, Ppelines, Railroads, Hard top roads, Ridges, Things you know you will recognize. Do not use light-duty roads, there are more on the ground than on the map. If you can not find a linear feature, get an elevation change -- two contour lines, if possible. Pick a limit landmark - past your objective. You may not know your precise grid. No problem. You do know you're in your axis, and then you just need to locate a landmark.