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Advanced Land Navigation: Development and Evaluation of a Prototype Program of Instruction

by

Theodore R. Powers

U.S. Army Infantry Human Research Unit
Fort Benning, Georgia

Under the Technical Supervision of

The George Washington University
HUMAN RESOURCES RESEARCH OFFICE
operating under contract with
THE DEPARTMENT OF THE ARMY

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Task RIFLEMAN V

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CREDITS

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Lt. Col. Lyman H. Clark was Chief of the Unit when the Task was initiated; Capt. Harry K.L. Tom was Chief at the completion of the study.

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SUMMARY AND RECOMMENDATIONS

MILITARY PROBLEM

Qualified infantrymen, because of their duty assignments, must have greater skill in land navigation than that possessed by the basic soldier. To enable infantrymen to acquire the necessary capability in land navigational techniques, an Advanced Land Navigation (ALN) training program was needed at the level of infantry advanced individual training (AIT). The research necessary for development of such a program was assigned to the U.S. Army Infantry Human Research Unit at Fort Benning, Georgia, which had previously developed the Basic Land Navigation (BLN) training program, under Task PATROL, for use in basic combat training (BCT).

RESEARCH PROBLEM

Research was needed to determine the land navigational performance required of infantrymen who have completed AIT and then to design a program of instruction that would develop the level of skill defined by that performance requirement.

RESEARCH METHOD

To provide training objectives and a standard of performance for use in the design and evaluation of training, the land navigational performance requirement appropriate to infantrymen at the level of AIT was specified. This requirement prescribes that:

(1) By day, a soldier should be able to navigate by himself over difficult, unfamiliar terrain for a distance of at least 3 kilometers and arrive at an objective that is 50 meters wide. This must be accomplished within three hours.

(2) By night, a pair of soldiers should be able to navigate over difficult, unfamiliar terrain for a distance of at least 2 kilometers and arrive at an objective that is 50 meters wide. This must be accomplished within two hours.

These specifications were based on the navigational requirements held to be generally characteristic of infantry reconnaissance patrols. The terrain and route factors contributing to navigational difficulty were classified and used to define the terrain and route characteristics of the performance requirement.

To assess the current level of navigational proficiency and to obtain information on the extent and type of improvement needed, graduates of infantry AIT were, during daylight hours, (1) tested on component skills used in navigation, and (2) required to traverse three routes ranked as easy, moderate, or difficult to navigate. On the routes classed as *easy*, 55% of the men tested reached the objectives, while on the routes classed as *moderate*, 45% of the men reached the objectives. Only 5% of the men reached the objectives on the *difficult* routes.

This diagnostic assessment provided guidance for the development of a 10-hour prototype program of instruction, which incorporated pretested innovations in operational techniques and in teaching methods. An Instructor's Guide[1] was prepared that included lesson plans, copies of slides, descriptions of training aids, and instructions for administering the course.

The experimental program was administered by noncommissioned-officer instructors to 100 enlisted men. Both the daytime and the nighttime performances of these men were then evaluated on *difficult* navigational routes as prescribed by the performance requirement.

RESULTS

In the experimental group 50% of the men met the prescribed daytime performance requirement, as opposed to only 5% of the men who had not had the experimental training.

Of the two-man teams, 76% met the performance requirement for nighttime navigation.

CONCLUSION

The 10-hour prototype program of instruction in ALN can be used to train enlisted personnel to navigate accurately over difficult, unfamiliar terrain under all conditions of visibility.

RECOMMENDATIONS[2]

It is recommended that

(1) The prototype program of instruction in ALN be used for land navigation training in infantry AIT (MOSs 111 and 112).

(2) The prototype program of instruction in ALN be used in other training programs for MOSs with similar land navigational training requirements and for refresher training.

(3) The prototype course be furnished to National Guard and Reserve components for use as appropriate.

(4) The *Instructor's Guide*,[3] including lesson plans, which comprises the content of the ALN program, be published in appropriate Army publications.

(5) The color slides developed for the course and the plastic relief model training map used in the instruction be reproduced by the Army and made available as items of issue.

[1]Reference 8.

[2]Letter, ATIT-TNG-RSH, HQ USCONARC, 6 Sep 63, subject: "HumRRO-Developed Course in Advanced Land Navigation," paras. 3 and 5, indicates action being taken to implement Recommendations (1) and (4). A complete course in land navigation, including the HumRRO-developed courses in basic and advanced land navigation, is being added to the training literature program as a Department of the Army Training Circular.

[3]Reference 8.

ADVANCED LAND NAVIGATION: DEVELOPMENT AND EVALUATION OF A PROTOTYPE PROGRAM OF INSTRUCTION

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THE PROBLEM

The land navigation instruction in basic combat training (BCT) teaches techniques that enable the navigator to move accurately over terrain that is undeveloped but comparatively easy to traverse.[1] However, to enable the infantryman to move over unfamiliar terrain under difficult mission and route conditions, more advanced methods for land navigation must be developed and taught.

Research toward this objective entails (1) specifying the advanced land navigational performance required of the infantryman, and (2) developing a course of instruction in land navigation that will enable the infantryman to satisfy this requirement.

BACKGROUND FOR THE RESEARCH

Evidence of the inability of enlisted personnel to navigate accurately had led earlier to Task PATROL, a military research program conducted at the U.S. Army Infantry Human Research Unit, Fort Benning, Georgia. The aim of this program was to develop an explicit performance requirement and a formal training program for basic land navigation. In December 1958, the 12-hour course in Basic Land Navigation (BLN) developed in Task PATROL was incorporated into the BCT program (ATP 21-114). It is now administered under the guidance of Army Subject Schedule 21-21, Land Navigation, April 1960.

The purpose of BLN instruction is to enable men who have completed BCT to carry out routine missions that involve land navigation. New doctrine, however, strongly emphasizes greater mobility of troops and more dispersion of small units. Recognizing that infantrymen need greater capability in land navigation than that provided by BCT, the U.S. Army Infantry School at Fort Benning requested research aimed at extending land navigation training at the level of advanced individual training (AIT). Since developing the capability for performing more demanding types of missions or missions over difficult terrain was beyond the scope of the Task PATROL objective, the Infantry Unit undertook this research with Subtask V of RIFLEMAN.

[1]References 2 and 3.

THE PERFORMANCE REQUIREMENT FOR ADVANCED LAND NAVIGATION

Selection of the Navigational Situation

A survey of Army field manuals, technical manuals, and related material indicated that the infantryman encounters a wide variety of navigational problems, depending on the type of mission and the characteristics of the terrain over which movement takes place. To provide a training goal that would be specific and at the same time would reflect the needs of the broad range of situations that require the infantryman to have navigational competence, the designation of a "reference situation" was needed.

It appeared from the survey that the reconnaissance patrol demands the infantryman's greatest navigational skill and flexibility. For this reason, the navigational attributes of such a patrol were selected as the characteristics of the reference situation for Advanced Land Navigation (ALN). One attribute is that the soldier who can meet the exacting navigational demands of the reconnaissance patrol can probably fulfill the navigational requirements for other types of missions within his MOS responsibilities. A reconnaissance patrol might have to modify its preselected route several times, either to avoid contact with the enemy or to move around unexpected obstacles, such as enemy minefields. Therefore, the differing missions of the reconnaissance patrol require navigation over all kinds of terrain and under various degrees of visibility. The patrol also has several attributes desirable for training purposes: The number of personnel going on a reconnaissance mission is usually small, and both the operating distance and the operating time are customarily within a moderate range that can be duplicated in a training situation.[2]

Physical Factors Affecting Navigation

Although specifying a particular mission set certain limits on the navigational situation that was to be the training target, for meaningful experimentation some way of formally stating the dimensions for terrain and route difficulty had to be developed.

Literature on terrain factors was surveyed, but few pertinent references were discovered. However, during previous navigational research at the Infantry Unit, considerable information had been gathered on this subject from military experts. The material provided a basis for a system of describing and classifying terrain and route characteristics that are important for land navigation. Eight physical factors, the basis for this system, in effect determine the difficulty of navigation: (1) amount and distribution of vegetation, (2) amount of slope, (3) recognizability of checkpoints, (4) length of total route, (5) length of

[2]A recent U.S. Army innovation is a long-range reconnaissance patrol, but the navigational requirements for this patrol are within the capability of the ALN-trained navigator.

sections of route between checkpoints, (6) number of sections between checkpoints, (7) size of obstacles, and (8) size of objective.

By systematic variation of these factors, it is possible to establish routes ranked as easy, moderate, or difficult to navigate. The average numerical values of each physical factor on each kind of route are given in Table 1.

Table 1

Values of Physical Factors at Three Levels of Navigational Difficulty

Route Difficulty and Length of Total Route (meters)	Physical Factors								
	Amount of Vegetation			Average Amount of Slope (%)	Recognizability of Checkpoints	Length of Sections of Route (meters)	Number of Sections	Diameter of Constructed Obstacles (meters)	Diameter of Objective (meters)
	Sparse (%)	Medium (%)	Dense (%)						
Easy 1600	80	15	5	0-2	Good to Excellent	350-450	4	50	250
Moderate 2400	55	25	20	3-6	Fair to Good	450-550	4	100	150
Difficult 3200	30	35	35	7-12	Poor to Fair	550-650	5	150	50

The BLN program had been designed to train the navigator to move accurately over routes that would be classed as easy under the above system. The objective of the ALN program is to teach methods that will enable the navigator to move accurately over routes classed as difficult.

On a difficult route, a navigator is not only faced with single instances of extreme physical factors but also with combinations of such factors. However, while an infantryman might on occasion encounter one or more extreme physical factors on an actual reconnaissance mission, it is unlikely that he would face a combination of extremes that would be greater than the route classed as difficult in Table 1.

Performance Requirement

By combining the navigational attributes of a reconnaissance patrol and the terrain requirements of a difficult, unfamiliar route, a performance requirement has been specified for ALN under both day and night conditions. The performance requirement prescribes that

(1) By day, a soldier should be able to navigate by himself over difficult, unfamiliar terrain for at least 3 kilometers and arrive at an objective that is 50 meters wide. This must be accomplished within three hours.

(2) By night, a pair of soldiers should be able to navigate over difficult, unfamiliar terrain for at least 2 kilometers and arrive at an objective that is 50 meters wide. This must be accomplished within two hours.

The day requirement integrates reconnaissance patrol doctrine with research experience in such areas as typical size of objective and length of mission, and desired rate of movement. The requirement includes the ability to detour around natural and man-made obstacles. The night requirement is adapted from the day specifications and reflects the effects night conditions would be expected to have on navigation and on the nature of the mission itself.

CURRENT NAVIGATIONAL PROFICIENCY

Methods of Assessing Navigational Proficiency

Land navigation—movement from point to point across unfamiliar terrain—may be accomplished by a variety of navigational methods that are directly dependent upon various basic skills. As a part of ALN research, a diagnostic baseline study was undertaken to assess the current level of the infantryman's navigational proficiency in order to identify areas in need of special attention in ALN training.

Proficiency in land navigation might be evaluated either by assessing integrated route performance or by testing individual navigational skills separately. The diagnostic study used both means of evaluation in an effort to determine the relationship between ability to navigate over unfamiliar terrain and proficiency in the component navigational skills.

An infantry division supplied 60 trained men to be used as subjects for the diagnostic study. All were graduates of BCT and infantry AIT and had participated in basic unit training. All had received a minimum of 12 hours of BLN and 10 hours of Map and Compass Usage.

In the diagnostic study all subjects were required to undergo both means of evaluation. Half received the individual skills test before navigating a route and half received the test afterward. Assessing integrated route performance was limited to daylight hours because a primary objective of the evaluation was to obtain diagnostic information, and research experience had shown that diagnostic observation was not feasible at night.[3]

Integrated Route Performance

For the purpose of assessing integrated route performance to determine the current capability of infantrymen to meet the performance requirement already specified for ALN, training routes were constructed at Fort Benning composed of the physical factors previously identified in Table 1.[4] These routes were classed as easy (each factor at its easy level, the equivalent of the BLN requirement), difficult (each factor at its difficult level, the equivalent of the ALN requirement), or moderate (the level of each factor, in general, midway between the other two).

The subjects for the baseline study were assigned to a specific route (20 subjects at each of the three levels of route difficulty) and were required to perform individually. Each subject was taken to the

[3]Reference 7.

[4]Routes included natural obstacles (not evident from preliminary map study of the route) and simulated minefields, which required the subject to detour from a planned course.

starting point of a route and given a briefing on the specific mission and on the terrain over which he would navigate. He was supplied with a lensatic compass, a map, a pace cord (string used in tallying paces), and a route card listing azimuths, distances, and checkpoints for individual sections of the route. To succeed, the soldier had to arrive at the objective within the specified time limit. Although his route card and map were marked to suggest a route, the soldier was told that, to reach the objective, he could follow any route he wished.

At the beginning of the test, each subject was randomly assigned to a specific observer, who accompanied the subject during the test to obtain detailed information on deficiencies that might be remedied in training. The observer avoided influencing the behavior of the subject in any way. He merely recorded, on a checklist, significant navigational activities as they occurred. When the exercise was completed, the observer interviewed his subject about aspects of that subject's performance on the course.

Component Navigational Skills

To obtain a better understanding of the navigational process and a more specific evaluation of subject capabilities, an operational analysis was made of land navigation activities. The experience of staff members working on Tasks PATROL and RIFLEMAN has suggested that there are seven basic navigational skills: (1) compass usage, (2) accurate pacing, (3) checkpoint recognition, (4) map orientation, (5) azimuth determination, (6) position location, and (7) map distance measurement. An achievement test was devised assessing proficiency in each skill in order to obtain more detailed information about possible training deficiencies.

Results of Assessing Navigational Proficiency

Observations made during the test of navigation over unfamiliar terrain produced a great deal of diagnostic information that guided subsequent development of the training program. In addition, the test yielded a baseline performance figure with which performance of the subsequent experimental group could be compared. On the easy routes 55% of the 20 subjects reached the objective; on the moderate routes 45% of the subjects reached the objective. Only one man out of 20 (5%) succeeded in meeting the performance requirement on the difficult routes.[5] The low proficiency level on routes classed as difficult clearly demonstrated that an ALN program was needed to teach methods for use in navigating difficult, unfamiliar terrain.

[5]As previously noted, the values of the physical factors of the *moderate* routes were about midway between the values of those of the *easy* and *difficult* routes. Since performance on the *moderate* routes was quite close to that on the *easy* routes, it appears that navigational difficulty is not directly related to the physical factors. Rather, the relationships between increasing values of the physical terrain factors and navigational difficulty seem to be curvilinear—navigational difficulty increases little when the values of the physical factors are moderate, but appreciably when the values are high.

Additional diagnostic information was provided by the results of the individual skills test. Deficiencies were evident in performance in map orientation, position location, azimuth determination, map distance measurement, and checkpoint recognition. Thus, weaknesses are rather general throughout the range of basic navigational skills.

There proved to be no significant relationships between performance on the achievement tests, where skills were assessed individually, and performance on the routes, where a combination of skills had to be applied (see Table 2[6]). A similar lack of relationships was evident in another analysis in which men with a generally good pattern of performance on the skills test were contrasted with those having a generally poor pattern. Men who had passed three or more skill tests did not perform significantly better on the routes than men who had passed fewer than three tests. The results of these analyses on the relationships between integrated route performance and component skills suggest that (1) in an ALN program, emphasis should be placed on practicing navigation in the operational setting rather than on training in individual, isolated skills, and (2) capability in land navigation should be tested only as an integrated performance in an operational setting.

Table 2

Statistical Comparison Between the Individual Skills Test and Route Behavior

Basic Skill	Chi Square* for Easy Routes	Chi Square* for Moderate Routes
1. Compass usage	.04	.01
2. Map orientation	.68	3.12
3. Position location	.01	1.62
4. Azimuth determination	.25	3.04
5. Map-distance measurement	.01	.25
6. Pacing	.00	.17
7. Checkpoint recognition	.01	.04

*None of the chi squares was significant at the .05 level.

THE ADVANCED LAND NAVIGATION TRAINING PROGRAM

Development of Training Content

General Procedure

Content for the ALN program was collected from many military sources, including field manuals, technical manuals, expert opinion (such as suggestions from the Map Reading Committee and the Ranger

[6] For the *easy* and *moderate* routes, chi-square tests were used to evaluate the relationships; the splits were made at the median for the individual tests. Because of the low proficiency (5%), such analysis could not be performed for the *difficult* route.

Department of the Infantry School), and civilian literature. Results of research previously conducted by the Infantry Unit and the U.S. Army Armor Human Research Unit at Fort Knox, Kentucky, were applied in many aspects of the course.

All the techniques of navigation developed or adapted for the ALN program were specifically designed for use over difficult terrain. The program was evaluated only on routes classed as difficult under the system shown in Table 1.

While developing a course of instruction, specific questions arose concerning navigational techniques. When past research did not provide answers and when it appeared that more complete information would contribute significantly to the quality and effectiveness of the ALN training program, experimental studies were conducted for guidance in training content.

The material finally selected for the course is descri[illegible] in the next section of the report. In the remainder of this sect[illegible] are the results of the more pertinent experiments conducted to provide effective training for ALN.[7]

Compass Techniques

The major direction finder used by the infantryman is the standard Army lensatic compass. Observation of the diagnostic base-line group indicated that the customary methods of holding a compass seemed to be cumbersome and tedious. Because use of the compass to maintain direction is a critical element in dead reckoning (one of the two major navigational processes), several experiments were conducted to find ways to improve compass training.

In the BCT cycle, two methods of using the compass are taught—BLN Day, in which the navigator holds the compass at eye level with the front cover up; and BLN Night, in which he holds the compass at eye level with the front cover down. A third, well-known method, the Center-Hold, in which the navigator holds the compass halfway between his belt and his chin with the front cover down, is not ordinarily taught in basic training, because it is assumed to be less accurate than the other two techniques.

The first training content experiment tested this assumption, for if the accuracy of the Center-Hold method was comparable to that of the other two techniques, the Center-Hold would be favorable for ALN training because of its other advantages. With this method the compass:

(1) can be used after a shorter period of instruction;
(2) is faster to use while navigating;
(3) is easier to use, the number of steps required for efficient operation being reduced from seven to two;
(4) can be used under all conditions of visibility;
(5) can be used when navigating over all kinds of terrain;

[7] A more complete description of the studies conducted by the Infantry Unit during development of this program is contained in a research memorandum (Reference 6).

(6) can be used without laying down the rifle or removing the helmet.[8]

In the experiment subjects were first tested on a stationary sighting course. They were then required, in both daylight and darkness, to navigate from point to point over unfamiliar terrain using a specified compass technique. All subjects tested each technique and traversed each route.

There proved to be no difference in the accuracies of the three methods when they were used on the stationary course; here the average error was less than 1.5° for all methods. When the methods were used in navigation, however, the Center-Hold method, both in the day and at night scored more "hits" on the "target" than did the other two methods (see Table 3). This difference approached the .05 level of statistical significance for daylight performance and was significant at better than the .05 level after dark.

Table 3

Navigational Accuracy for Three Compass-Using Methods

Compass Technique	Day			Night		
	Correct Hits[a]	Mean Miss[b] (Meters)	SD	Correct Hits[a]	Mean Miss[b] (Meters)	SD
BLN Day	19	12.8	4.6	6	35.2	23.5
BLN Night	24	12.9	5.5	5	31.9	22.9
Center-Hold	29	12.6	4.5	14	27.3	19.1

[a]Within 5 meters (left or right) of target center on a 200-meter course. Number of hits possible for each technique—48 (3 trials for 18 subjects).

[b]Average distance from target center; includes performances scored as hits.

These promising results led to further study of the Center-Hold method; its performance was tested under very difficult terrain and route conditions. Because of the extreme environmental circumstances imposed upon the navigators, it was decided that 50% correct hits would be adequate in testing the Center-Hold method. Both in the day and at night the number of hits the subjects actually scored exceeded 50% (see Table 4).

In view of the results of the experiment, the Center-Hold method of using the compass was adopted in the ALN program.

Pacing Measurement

While developing a training method for estimating distances traveled, several questions about pacing arose and were answered

[8]This point was established in a study of the reaction of the magnetic field of the lensatic compass to various pieces of metal equipment. While a distance of one meter from all hand-held weapons and pieces of equipment tested was found to be adequate to avoid possible effect on compass accuracy, a navigator can, by using the Center-Hold method, maintain compass accuracy without taking off his helmet, or laying down his rifle if the weapon is slung well back over his shoulder.

Table 4

Navigational Accuracy for the Center-Hold Method on Difficult Courses

	Correct Hits* (%)	Mean Miss (Meters)	SD
Day	60	12.4	6.6
Night	55	20.5	12.2

*Within 10 meters (left or right) of target center on a 700-meter course.

through experiments. A navigator, to compute the distance he has traveled, must first have established the length of his pace by counting his paces over a standard distance. Then he can count the number of paces he takes on a segment of the training route and convert this count into meters.

Because it seemed probable that the length of an individual's pace would tend to vary over distance, a study was conducted to see how long a pacing course should be to enable a navigator to obtain an accurate measure of his normal pace count. As common practice was to take an individual's pace count for a distance of 100 meters, this distance was used for each segment of a 1600-meter course.[9] Subjects paced the entire distance, recording their count at the end of each segment but restarting the count only at the halfway mark. The results indicate that an individual's normal pace count can be more precisely calculated if the total count is taken for a distance of at least 600 meters, since an individual's later pacing is more stable. Restarting appears, in effect, to reinstate early irregularity. Therefore, the 600-meter distance was adopted for the pacing course in ALN training.

Another question about pacing was whether an individual's pace count would be affected by radical changes in topographical relief or by differences in amount of illumination. On the Fort Benning reservation an 800-meter pacing course was built on a flat dirt road clear of any vegetation. Another course of the same length was built on a gently rolling area with a few trees. Subjects paced each course once during daylight and once during darkness. On the two courses a subject's pace count did not differ more than 3%, either at night or during the day. Because such small differences would not be likely to have any practical effect on land navigation, it would seem that a navigator can use his normal pace count for estimating distances, even though illumination and terrain conditions vary. Only local, extreme changes in relief might require him to make on-the-spot adjustments in his pace count.

In case the flat dirt road and the gently rolling area were not different enough to reveal a statistical difference in pace count, three kinds of terrain that satisfied the easy—moderate—difficult requirements illustrated by Table 1 were chosen to further test stability of

[9]So that the subject would not try to equate his pace with regularly occurring divisions between segments of the route, natural illusory effects were used to make spacing appear unequal.

pace count. Pacing lanes were established and infantrymen, using the same procedures as in the first test, determined their pace counts. Over the three kinds of terrain no significant differences in the individual counts appeared. Therefore, a trainee in the ALN program uses only one pacing standard for most navigational conditions.[10]

Detouring Techniques

Detours, which most navigators find difficult to make, occur frequently in unknown terrain. Natural obstacles such as swamps or dense vegetation, or military obstacles such as minefields will block a navigator's forward motion and force him off his base course. He must then have a technique for making accurate corrections in order to return to the route azimuth.

With the frequently used "box" technique, the navigator must make four accurate 90° turns that move him off his course, around the obstacle, and back on his course. Inaccuracies resulting from this maneuver appear to be due to errors made in the detour turns. Several experiments were, therefore, conducted to study methods of turning.

Trainees are usually taught to do parade-ground facing movements in order to make 90° turns. Under current doctrine a maximum of +5° is the allowable deviation from 90°. Subjects were tested to determine the merits of this turning method. In daylight only 35% of the subjects successfully met the conditions of the test; at night only 26% of the subjects did so (see Figure 1).[11] The facing-movement method of making 90° turns was, therefore, rejected for the ALN course.

Another method of making a 90° turn was then designed and evaluated. The navigator had to hold the standard lensatic compass in his hand and align the sighting wire parallel with his feet. He next had to turn one foot at a right angle to the other and check this alignment by referring to the compass dial. Then he had to move the other foot parallel to the first and read his detour azimuth from the compass. Of the subjects testing this method, 68% were able to turn successfully within the allowable deviation of +5°. But while the foot-compass method of making right-angle turns was superior to the previously described facing method, certain environmental conditions, such as dense vegetation, might limit its usefulness.

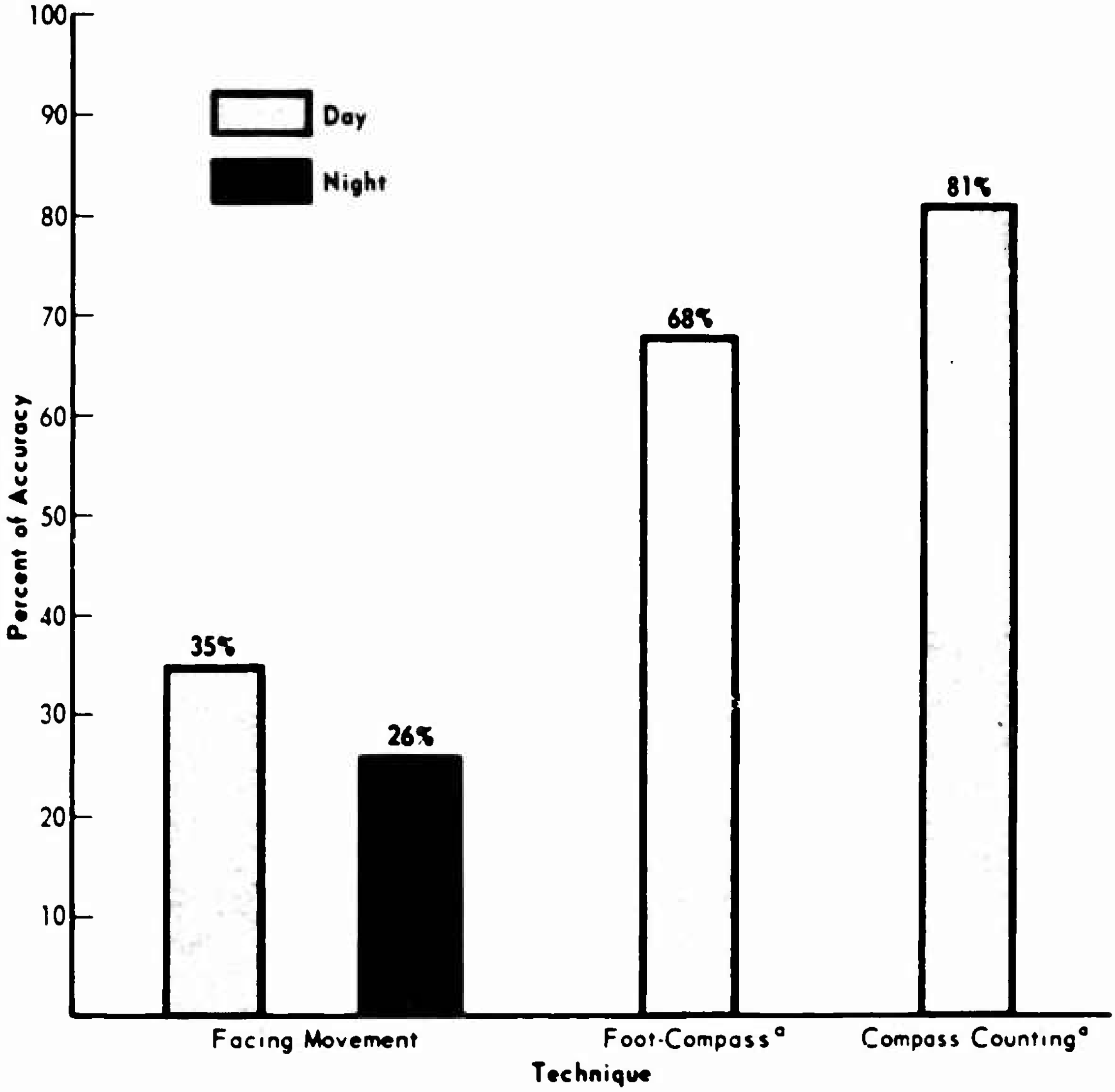
A third technique was, therefore, investigated, that of counting the tick marks on the face of the lensatic compass (where each mark represents 5°) to determine a 90° angle for a detour azimuth. Using this technique, 81% of the subjects turned successfully within the allowable deviation of +5°. The compass-counting method is also limited, however, because it cannot be used at night without a light.

It was concluded from the experiments that to enable a navigator to choose the most appropriate method for the environmental

[10]Training time would be saved if a subject did not have to determine his own normal pace count but could be assigned it somehow. Another experiment was conducted to see whether the length of a man's pace could be inferred from his height. But no significant relationships were found between the height of a subject and his normal pace count.

[11]Probably, the feedback supplied by the performance of others during close-order drill ensures more accuracy in making turns than that demonstrated here when individual turning was tested.

Accuracy of Detouring Techniques Using 90° Turns
(with ±5° allowable deviation)



[a]Not tested at night

Figure 1

conditions he faces, a variety of detouring techniques must be included in his training. (Some methods were considered too technical for ALN training purposes.)

Map-Reading Skills

In map-terrain association the navigator guides his movements with the aid of a topographic map or map substitute. This method does not require the navigator to keep constant account of his distance and direction as he does in the other major navigational method, the dead-reckoning process.

A survey[12] conducted by the Armor Unit had indicated that an infantry squad member needs to know only a few basic map-reading

[12]Reference 1.

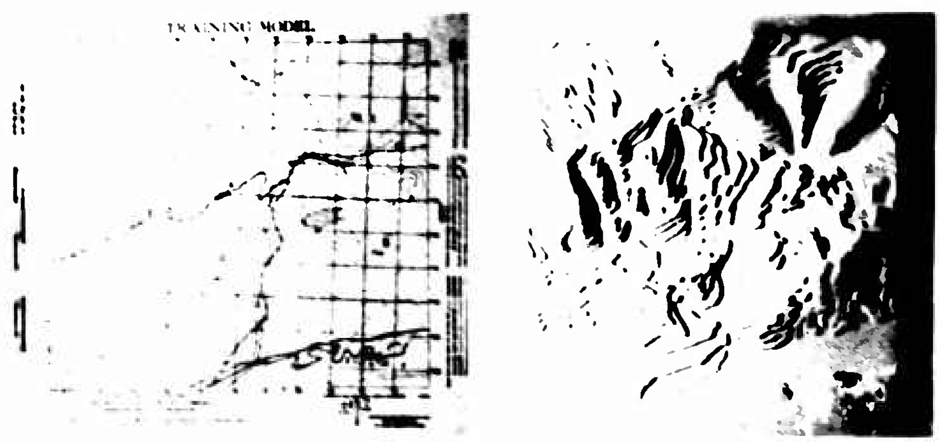
skills. An analysis, in Task RIFLEMAN, of the BCT and the infantry AIT proficiency tests also revealed that the number of basic map skills assessed in these tests is small.

On the basis of this previous research, six map-reading skills were specified as appropriate for AIT and are included in the content of the ALN program. These skills are (1) determination of grid coordinates, (2) recognition of topographic symbols, (3) contour interpretation, (4) map distance measurement, (5) map orientation, and (6) determination of azimuths.

Earlier research experience[13] had indicated that the most difficult subject for presentation and assimilation during map-reading training is the concept of contour interpretation. There are several reasons for the difficulty, but apparently the basic problem is that the map reader must visualize a three-dimensional scene when confronted with a two-dimensional piece of paper.[14]

The procedure for teaching contour interpretation in the ALN program is to present the trainee with two-dimensional and three-dimensional maps of the same area at the same time, in order to help him visualize the actual terrain. An Army Map Service demonstration device,[15] which represents the same piece of hypothetical terrain on a standard map, a contour layer model, and a three-dimensional relief map (see Figure 2), is used as a training aid for this portion of the

Contour Interpretation Training Aid



Plastic Relief Model Training Map, Army Map Service

Figure 2

[13]Reference 9.
[14]See Reference 5 for guidance in this area.
[15]Plastic Relief Model Training Map 100549, U.S. Army Map Service, Corps of Engineers.

instruction. The trainee is able to develop a realistic picture of the configuration of the earth from contour lines, within a relatively short period, by making numerous comparisons of the different types of terrain contained in this small plastic training aid.

The procedure for teaching contour interpretation in the ALN course also includes the use of five primary terrain features selected as a simplified method of describing land. The five categories—hilltop, ridge, saddle, valley, and depression—give students a standardized vocabulary with which to communicate. The Map Reading Committee at the Infantry School[16] teaches this method of land description, which, however, is not used Army-wide in current infantry AIT courses.

Description of the Program

Methods of Land Navigation

No single method of land navigation is stressed in the ALN course, because all known navigational methods have their limitations, depending on type of terrain, type of weather, amount of illumination, and amount and accuracy of map coverage. The soldier, therefore, practices several navigational techniques in the course, so that he can choose the right procedure or combination of procedures to use when facing different environmental conditions.

Little time is alloted to the practice of isolated, individual navigational skills, because the diagnostic baseline study indicated that navigators need to integrate their individual navigational skills in the operational setting. Therefore, 50% of the ALN program is assigned to the practice of route navigation.

Sequence of Instruction

The first three periods of the ALN course are devoted to classroom instruction in various aspects of navigational information and techniques. One period in the field is used to establish pace counts and demonstrate detouring, the other two periods are used for practical navigational exercises.

In general, the sequence of events in the course is planned to proceed from the simple to the complex—the less demanding night navigational exercise is presented before the day exercise. At night poor visibility makes some aspects of navigation difficult, but overall navigation as practiced in the ALN program is simpler because some of the skills are not required. At night the trainees travel in pairs and use no map, depending on dead reckoning exclusively.

During the more complex day exercise, the distance to be covered is greater than in the night exercise, each trainee is required to navigate individually, and uses a map so that he can practice the more sophisticated technique of map-terrain association.

[16]Reference 4.

Prototype Program of Instruction

The experimental course was prepared as a program of instruction in ALN, designed to be given in infantry AIT (MOSs 111 and 112). Since the time allocated for teaching any one subject in both BCT and AIT is limited, specific techniques (such as the Center-Hold compass method) and general subject matter (such as the isolation of six basic map-reading skills) were chosen that would fit well into a realistic time limit. The subject matter finally decided upon yielded a 10-hour course.

The subject matter contained in the prototype course is listed below. A more detailed outline of the course is given in Appendix A.

Period	Subject
One (1 hr.)	Center-Hold Technique of Using Compass Selection of Steering Marks Use of Skills to Report Information
Two (2 hr.)	Grid Coordinates Topographic Symbols Contour Interpretation Map Distance Measurement Map Orientation Determining Azimuths
Three (1 hr.)	Checkpoint Recognition Geographical Orientation Sun-Stick-Shadow Method of Determining Direction A Review of Methods of Land Navigation
Four (1 hr.)	Detouring Obstacles Distance Determination
Five (2 hr.)	Night Navigational Exercise
Six (3 hr.)	Day Navigational Exercise

An Instructor's Guide[17] was prepared, which includes general guidance for administering the program; lesson plans for the six class periods; and copies of the training aids, handouts and slides used during the classroom sessions. Part I of the Guide, describing the administration of the course, is reproduced as Appendix B of this report.

EVALUATION OF THE ADVANCED LAND NAVIGATION PROGRAM

Procedure

Ten noncommissioned officers with previous experience in teaching land navigation were obtained from various continental United States

[17]Reference 8.

Army training centers to serve as instructors during the evaluation of the ALN program. These 10 instructors were then trained by the staff of RIFLEMAN V to present and administer the ALN program. Six of them were made Principal Instructors and served in that capacity for specific periods of the course.

The instructors trained an experimental group of trainees composed of 100 enlisted men obtained from various units at Fort Benning. After being trained in the ALN course, these enlisted men were required to navigate over some of the same difficult routes the soldiers in the diagnostic baseline group had navigated.

During the evaluation of the ALN program, the equipment and information supplied to the experimental group and the standards and procedures required of them were the same as had been required of the baseline group. However, the subjects of the experimental group were not accompanied by observers, as were the subjects of the diagnostic baseline group.

Results

Both day and night land navigational performances were evaluated in the ALN program. During the day, when individual navigation was required, 50% of the 50 navigators tested reached their objective within the time limit. At night, under varying amounts of illumination, 76% of the 25 two-man teams met the prescribed navigational requirement.

Discussion

Comparing the daytime performance of the experimental trainees with the data obtained from the diagnostic baseline group, only one of the 20 subjects (5%) in the diagnostic group was able to meet navigational requirements on the test routes, while 50% of the experimental group trained in the ALN program performed successfully.

In night tests, when illumination ranged from complete darkness to full moonlight, 76% of the two-man teams in the ALN program met navigational requirements. This gives an indication of training effectiveness under such conditions.

The results of the evaluation demonstrate that enlisted personnel trained in the ALN program of instruction learn techniques that enable them to navigate accurately over difficult, unfamiliar terrain under all conditions of visibility.

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Appendix A

OUTLINE OF ADVANCED LAND NAVIGATION PROGRAM

PERIOD ONE—REVIEW OF DEAD RECKONING (50 min.)

1. Introduction and Purpose
2. Training Goals
3. Description and Practice of the Line-Over-Arrow, Center-Hold Technique
4. Selection and Use of Steering Marks
5. Use of Land Navigation Skills To Report Information
6. Summary
7. Instructions for Worksheet
8. Questions and Answers

PERIOD TWO—BASIC SKILLS IN MAP INTERPRETATION (100 min.)

SECTION I. Introduction (3 min.)

1. What is Map Reading?
2. The Importance of Map Reading
3. The Relationship Between Map and Ground
4. Map Information

SECTION II. Grid Coordinates (10 min.)

1. What is a Grid System?
2. How Does the Grid System Work?
3. Practical Exercise

SECTION III. Topographic Symbols (10 min.)

1. Introduction
2. Explanation of Symbols
3. Practical Exercise
4. Summary

SECTION IV. Contour Interpretation (27 min.)

1. Introduction
2. What is Contour Interpretation?
3. How Contour Lines Represent Rise and Fall of the Land
4. Contour Interval
5. What are Index Lines?
6. How Can the Slope of the Land Be Recognized?
7. How Can Contour Maps Help the Recognition of Five Primary Terrain Features?
8. Practical Exercise
9. Summary

SECTION V. <u>Map Distance Measurement</u> (15 min.)

1. Introduction
2. Ways To Measure Distance on a Map
3. Practical Exercise

SECTION VI. <u>Map Orientation</u> (20 min.)

1. Introduction
2. Orientation of the Map With the Compass
3. Orientation by Inspection
4. Practical Exercise
5. Summary

SECTION VII. <u>Determining Azimuths</u> (15 min.)

1. Introduction
2. Determining the Azimuth Between Points on the Map
3. Practical Exercise
4. Summary

PERIOD THREE—BASIC SKILLS IN MAP INTERPRETATION (CONCLUDED) (50 min.)

SECTION I. <u>Checkpoint Recognition</u> (20 min.)

1. Introduction
2. Checkpoints
3. General Discussion
4. Use of Checkpoints
5. Practical Exercise

SECTION II. <u>Geographical Orientation</u> (15 min.)

1. Introduction
2. Geographical Orientation
3. Summary

SECTION III. <u>Sun-Stick-Shadow Method of Determining Direction</u> (5 min.)

1. Introduction
2. Method

SECTION IV. <u>A Review of Methods of Land Navigation</u> (10 min.)

1. Introduction
2. Route Planning
3. Dead Reckoning
4. Map-Terrain Association
5. Summary

PERIOD FOUR—DETOURING OBSTACLES AND DISTANCE DETERMINATION (60 min.)

SECTION I. <u>Detouring Obstacles</u> (30 min.)

1. How to Detour Obstacles
2. Detours With More Than Two Lateral Legs
3. Summary
4. Practical Exercise in Facing and Determining Azimuths for Detouring

SECTION II. Distance Determination (30 min.)

1. Introduction
2. Determining the Individual Pace Count

PERIOD FIVE—NIGHT NAVIGATIONAL EXERCISE (120 min.)

1. Review of Navigational Procedures
2. Rules for the Navigational Exercise
3. Practical Exercise

PERIOD SIX—DAY NAVIGATIONAL EXERCISE (180 min.)

1. Review of Navigational Procedures
2. Rules for the Navigational Exercise
3. Practical Exercise

Appendix B

Part I of
INSTRUCTOR'S GUIDE, ADVANCED LAND NAVIGATION: A PROTOTYPE COURSE
Administration of Advanced Land Navigation Program

Chapter 1

INTRODUCTION

This Guide is intended to acquaint the instructor with the basic concepts and principles of the Advanced Land Navigation (ALN) Program. It is to be used in conjunction with the Lesson Plans included in Part II of this volume. It is hoped that the majority of questions that will arise during the implementation of the Program are answered in this Guide. Before giving an Advanced Land Navigation class, an instructor should read this Guide carefully in order to avoid errors in the interpretation of the instructional material.

The Program is divided into six periods. An outline of these periods is shown in Table I.

Table I

Outline of the ALN Program

Period	Title	Time (Hours)
One	Review of Dead Reckoning	1
Two	Basic Skills in Map Interpretation	2
Three	Basic Skills in Map Interpretation	1
Four	Detouring Obstacles and Distance Determination	1
Five	Night Navigational Exercise	2
Six	Day Navigational Exercise	3

PURPOSE OF THE PROGRAM

This Program was designed to be given in Infantry Advanced Individual Training (ATP 7-18). It is aimed at the Light Weapons Infantryman (MOS 111), E-2 to E-4 in grade, who will be a member of a rifle company. A trainee who successfully passes this Program of Instruction should be able to navigate alone or in groups over most types of rough terrain, under all conditions of visibility, for distances of at least 3 kilometers (km.), and arrive at an objective that is no more than 50 meters (m.) in width.

SIZE OF CLASS

This Program was designed for teaching ALN to a class of 150 to 225 students in 10 hr. Classes that are larger than this can also be trained in this Program, but more time will be required to conduct the field training.

NUMBER OF CADRE

During the classroom part of the Program (Periods One through Three), one principal instructor (PI) is required. The number of assistant instructors (AI) required will depend upon the size of the class, but it is suggested that there should be at least one assistant instructor for every 40 students.

One principal instructor and five assistant instructors will be required in Period Four, and two principal instructors and six assistant instructors will be needed in both Periods Five and Six. Thus, eight cadremen will be the maximum required for any period.

PRESENTATION OF THE PROGRAM

The Lesson Plans for the six periods are closely timed; however, if the principal instructor feels that he has an amusing story that will add to a teaching point, he may insert this type material, but he should always remain aware of the time limit imposed upon each period.

Perhaps the principal instructor will find that he presents the various teaching points in slightly different language than its written form in the Lesson Plans. This is quite acceptable, but it should be clearly understood that no deletions of basic concepts should be made.

This Program has been designed so that material that is presented in the early periods serves as a basis for the learning that takes place in the later periods. Therefore, there should be no deviation from the sequence of presentation, either in the periods themselves or in material within the periods.

Chapter 2

INSTRUCTIONAL AIDS

SLIDES

Colored slides are introduced in appropriate places in Periods One, Two, and Three to facilitate the teaching of specific points. There are 21 slides for Period One, 19 slides for Period Two, and 8 slides for Period Three.

Reproductions of all slides are located in the Annex for the instructor's reference. The slides themselves are items of issue.

COMPASSES

Each student is furnished a lensatic compass for use in Periods One, Two, Four, Five, and Six. Prior to issue, each compass should be checked for accuracy and preset for line-over-arrow use on the first azimuth prescribed in Period One.

Instructions have been written for the new standard lensatic compass. This compass shows all degree markings in red, as they appear on the slides accompanying the Lesson Plans. In units where the older compass, with all dial markings in black, is still in use, the instructor must modify the Lesson Plans accordingly.

It is important that compasses given to trainees are serviceable. The following is an outline of the procedure for determining the serviceability of compasses.

1. Visual Inspection for Missing Parts
   a. All the compasses should first be opened to see that the cover glass is not broken, clouded, or cracked.
   b. The front cover should be inspected to see that the sight wire is not missing or bent.
   c. The eyepiece should be placed flat against the cover glass. The index line on the cover glass should bisect the sight slot. Then, with the compass closed, it should be noted that the sight wire also bisects the sight slot. This procedure will ensure that the eyepiece is not bent.
2. Inspection for Accuracy
   a. Select an outdoor area free from the influence of metal or powerlines, where a working distance of 100 to 150 ft., cleared of obstructions to the line of sight, is available.
   b. At the inspection point, build a wooden platform upon which the compass may rest during the inspection. Set a 4 x 4-in. timber firmly in the ground with a 6 x 6-in. board fastened to the top (below eye level) with wooden dowels. Nails (metal) must not be used in the platform.
   c. Establish an aiming stake 100 to 150 ft. away in a direction coinciding with any one of the 5° tick marks appearing on the compass dial. The exact location of the stake may be established by use of an aiming circle, an engineer transit, or, in the absence of either of these, a compass selected from among several that appear to agree exactly.
   d. Trace the outline of the compass on the sighting platform so that each compass can thereafter be positioned quickly.
   e. A compass to be inspected is positioned and sighted on the aiming stake, and then the dial is read. If the compass deviates more than 2° in either direction, it should not be issued to students.
3. Inspection for Night Clarity
   a. All compasses to be inspected should be opened and exposed to either natural or artificial light for at least 60 sec. prior to inspection.

b. After the inspector has adapted himself to darkness for one-half hour, he should read the dial of each compass. Also, he should align the luminous line and the luminous arrow. Compasses which are difficult to read because of poor luminosity should not be issued to students.

Normal eyesight is essential, of course, if the inspector is to make accurate decisions. After learning to read the compass, students should be directed to present for inspection any compass that may be read only with great difficulty. Again the question of visual acuity versus the defective compass must be answered.

THE BACK AZIMUTH AND DETOURING TRAINING AID

A Back Azimuth and Detouring Training Aid is to be provided for each student in Period One. It is reproduced in Figure 11 [shown here], Period One of the Lesson Plan. Plastic replicas of this Training Aid should be standard issue for the ALN Program; however, if they are not available, the instructor must construct Training Aids for the students from Figure 11.

The Training Aid is first introduced in conjunction with the illustration of steering marks in Period One. The instructor should fully demonstrate its use at this point.

The Training Aid is to be used as a help in learning what procedures are necessary to compute the various azimuth changes. It should be stressed that this is a training aid only and will not be available to the Infantryman when actual navigation is demanded.

WORKSHEET

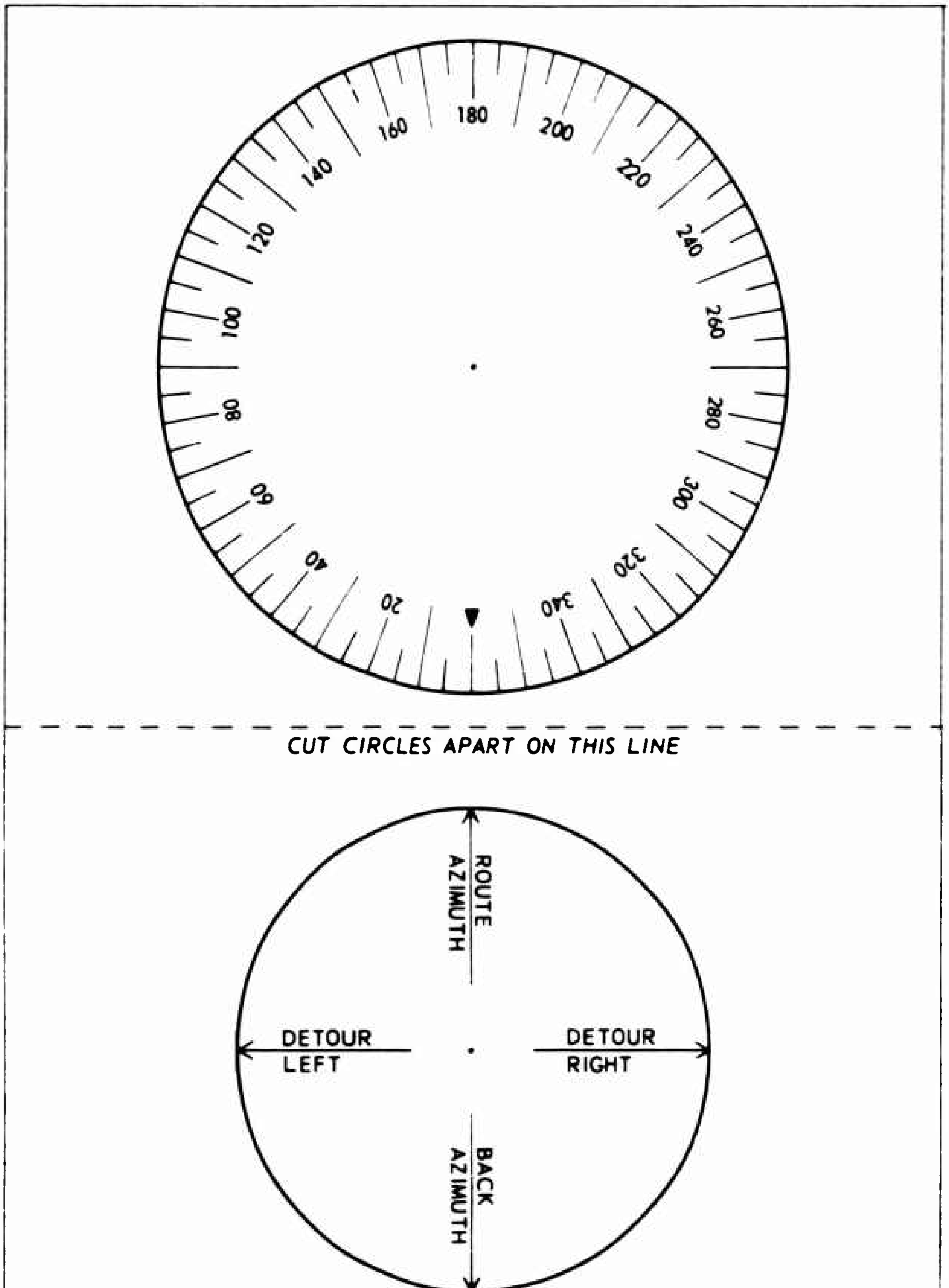
A drawing of the 360° part of the compass dial, showing only the north arrow and a series of short tick marks, is given each student in Period One. He is to reproduce, using the Training Aid, the marking system used on the compass dial, and return the worksheet at the next class.

MAPS

There are two types of maps introduced in Period Two. The first type of map is a standard topographic map having a scale of 1:50,000. This particular scale is now the standard scale for tactical use at the level of the rifle company. Therefore, in the ALN Program, all topographic maps used by the trainees, both in the classroom and the field, should have a scale of 1:50,000.

It is understood that the declination diagram on maps is currently undergoing revision. It is suggested that the margin of the map sheet that is used in training be consulted for an explanation of how the magnetic declination is computed and presented for that particular map.

As will be seen, the Lesson Plans were written for the Columbus, Georgia, map sheets (Sheet 4043 IV, Series V745, Edition 3-AMS). This is because all experimental work for the Program took place at Fort Benning, Georgia. If the local conditions are such that the Columbus sheets are unavailable, or if their use is not desired, the



TO ASSEMBLE:
CUT OUT BLACK CIRCLE AND FASTEN TO CENTER OF RED CIRCLE WITH ALUMINUM EYELET SO CIRCLES CAN BE ROTATED ON COMMON CENTER.

Figure 11. **Back Azimuth and Detouring Training Aid**

Lesson Plans can be easily adapted to use any standard topographic map sheet. If other map sheets are used, appropriate changes must be made in the Lesson Plans.

The second type of map is a special plastic training map that will be available for issue. A map of this kind absolutely must be used when the material in Period Two is presented. In our research, we used map 100549, printed by Army Map Service, Corps of Engineers.

HANDOUTS

Period Two. A handout, "Measuring Distance Along a Curved Road," is given each student on which he must find the distance between two points on a curved road. This handout is to be used in conjunction with the Practical Exercise in Section V. A copy of this handout is attached to Section V, Period Two, of the Lesson Plan.

Period Four. A handout, "Detouring Major Obstacles of Unknown Dimensions," is given each student in Section I for use in learning how to detour large obstacles. A copy of this handout is attached to Section I, Period Four, of the Lesson Plan.

PACE CORDS

One pace cord is provided for each student for use in Periods Four, Five, and Six. Pace cords should be approximately 5 mm. in diameter and 70 cm. long.

RECORD CARDS, DISTANCE DETERMINATION COURSE

One Record Card is to be provided for each student for use in Section II (Distance Determination) of Period Four. One side of the Record Card is to be used by trainees and instructors in determining standard pace count. The reverse side of the Record Card contains instructions for the student pertaining to the Distance Determination Course. The Record Card is shown in Figures 12 and 13 of Period Four of the Lesson Plan. Reproductions of Record Cards for trainees are to be made from these Figures.

Prior to class, the instructor should enter a start stake number on each Record Card. Assignment to the 18 start stakes is to be evenly distributed among the trainees. Each trainee puts his name on his Record Card.

As each student completes the Distance Determination Course, instructors will determine (by reference to the Pace Count Conversion Card) the standard pace count for each student and will complete the appropriate portion of his Record Card.

PACE COUNT CONVERSION CARD

One Pace Count Conversion Card (Fig. 14) will be provided for the PI and one for each AI for use in Section II (Distance Determination) of Period Four. To determine a student's standard pace count, instructors will read the total number of paces entered on the trainee's Record Card in the space marked "E to SS," find the 600-m. range into which the total falls, and use the data on the Conversion Card to fill the appropriate portion of the trainee's Record Card.

The Conversion Data can be typed on a 2 1/2 x 3-in. card and covered in clear plastic for protection against wear and weather. It will be necessary to use both sides of the card.

CENTER CIRCLE STEERING MARK

Instructional aids used in the Distance Determination Section will be affixed to the center circle steering mark during the briefing of students in Period Four. These aids should be attached to the center circle steering mark in a manner that will allow quick removal after the briefing. The aids and their postions on the center pole are shown in Figure 5.

Steering Mark Panels

Two of the white steering mark panels, like the ones used on the actual course, will be affixed to the center pole for demonstration. One will be marked in red letters and numbers, as the panels appear in odd-numbered lanes; and one will be marked in black letters and numbers, as the panels appear in even-numbered lanes.

Intermediate Markers

Two of the intermediate markers like the ones used on the actual course will be affixed to the center pole for demonstration. These markers, white with diagonal stripes, will also be marked, one in black and one in red, to demonstrate their use in odd- and even-numbered lanes.

Blown-Up Record Card

The enlarged top portion of a Record Card will be attached to the center pole above the other aids. Figures should be entered on this aid to emphasize the necessity for maintaining a continuous count over the assigned lane.

This card should measure 3 1/2 x 4 ft. for a class of 200 men. It should be made from heavy card stock and covered in clear plastic for protection against wear and weather. The blown-up Record Card is shown in Figure 6.

ROUTE CARDS

One Route Card will be provided for each student in Period Five. A sample Route Card, Figure 15 [shown here], is attached to Period Five of the Lesson Plan.

FLASHLIGHTS

One flashlight with a red filter will be provided for each pair of students in Period Five (Night Navigational Exercise).

ROUTE 7

	Degrees	Meters	Check Point
LEG 1	265	475	DRY STREAM
LEG 2	300	600	ROAD
LEG 3	255	400	OBJECTIVE

Figure 15 **Sample Route Card for Night Navigational Exercise**

COMBINATION MAP AND ROUTE CARDS

One Combination Map and Route Card will be provided for each student in Period Six (Day Navigational Exercise). A sample Combination Map and Route Card, Figure 16, is attached to Period Six of the Lesson Plan. This was printed at the Third Army Field Printing Plant at Fort Benning, Georgia. It is suggested that, if these are not available locally, an excellent substitute can be made by cutting the appropriate area out of a standard topographic map and pasting it on a route card. These cards can be encased in acetate and reused many times so that it is not necessary to use a new set of maps for each training company.

Chapter 3

COURSE CONSTRUCTION

Detailed notes are presented in this chapter for the construction of field facilities. It is important that the Distance Determination Course, the Night Navigational Course, and the Day Navigational Course be properly constructed to ensure that the purpose of the Advanced Land Navigation Program is accomplished.

DISTANCE DETERMINATION COURSE

The Distance Determination Course is used in Period Four for determining the individual pace count for each trainee.

Terrain Requirements[1]

The course is based on one circle 650 m. in diameter and a second circle 50 m. in diameter located on a common center. Eighteen pacing lanes radiate from the smaller circle. These lanes are each 300 m. long. Since a trainee paces out and back, his pace count is established over a 600-m. course. Our research indicates that a pacing course must be at least 500 m. in length for an individual to get a reliable estimate of his pace count.

The aim in constructing this course is to provide each man with a lane of approximately equal difficulty that is typical of the area where the pace count will be used in navigation. For the course to remain reasonably constant in difficulty during use by many troops throughout the year, it should run through areas of more permanent type vegetation. An area covered by larger trees and second growth vegetation past the age of showing marked seasonal variation is to be preferred.

Course Layout and Construction[2]

Inner circle (see Fig. 1). Select the common center point of the circles and set a flat-topped wooden post at a height slightly below eye level. Use the post as a rest for the compass while installing stakes and steering marks. Commencing at 360° magnetic azimuth, set a start stake 25 m. from the center point every 20° of arc around the full circle.

A common steering mark is located at the center of the circle. Diameter of the inner circle formed by the 18 start point stakes is 50 m. Steering marks A/E, B/D, and C are 100 m. apart. All azimuths are measured from the center of the small circle before the common steering mark is erected.

Start stakes (see Fig. 2). Paint eighteen 1 x 4 x 48-in. stakes white, and mark serially from SS 1 through SS 18 on both sides; the letters and numerals are approximately 5 in. high, 1-in. stroke. Odd-numbered stakes are lettered and numbered in red; even-numbered stakes are lettered and numbered in black. Set all start stakes 12 in. deep. Painting all surfaces prior to setting them in the ground may delay rotting.

Steering marks (see Fig. 3). Three steering mark panels are required for each of 18 lanes, a total of 54. Large panels are stapled to 1 x 4 x 54-in. boards with double-pointed tacks (staples), 3/4 in. long. Paint (or spray) the board and panels with two coats of white exterior paint on all surfaces. Letters and numbers on even-numbered lanes are in black; letters and numbers on odd-numbered lanes are in red. Both letters and numbers are 14 in. high, 3-in. stroke. A dash is placed between the letter and the number on each steering mark panel. Marine plywood is recommended for use as steering mark panels.

[1]Based on local terrain characteristics. Terrain should be typical of that over which the pace count will be applied.

[2]The course can be laid out with the standard lensatic compass. If a transit and trained survey crew is available from an Artillery or Engineer Unit, employ it.

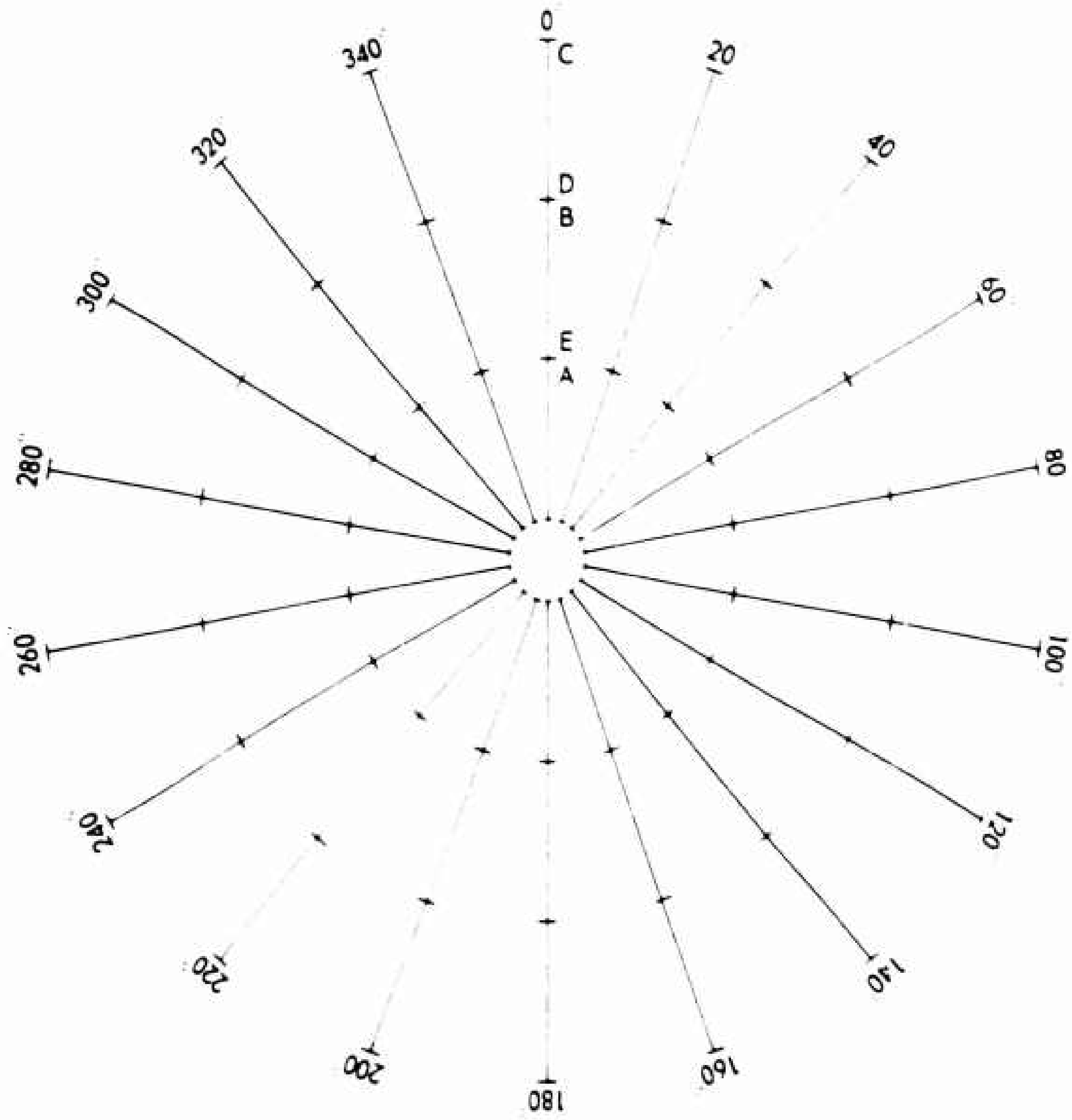


Figure 1 **Layout of Distance Determination Course**

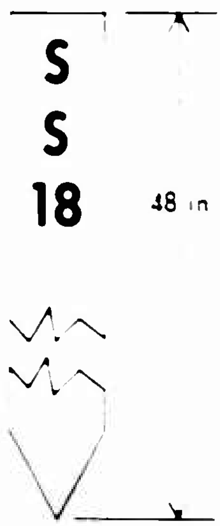


Figure 2 **Marking on Both Sides of Start Stakes**

The numerals on each set of three steering marks correspond to the numerals on the start stakes (1-18, incl.). The steering mark in Figure 3 would be marked E-18 on the reverse side. Each A/E steering mark is 100 meters from its start stake. B/D steering marks are 200 m. from the start stake, and C steering marks are 300 m. from the start stakes. Each set of three steering marks must be on the same azimuth, from the center post over the start stake, at intervals of 100 m. (Pacers move out from the start stake to steering mark "A," then to "B," then to "C." At "C," they face about and move back over the same route to "D" (reverse side of "B"), then to "E" (reverse side of "A"), and from "E" to the original start stake.)

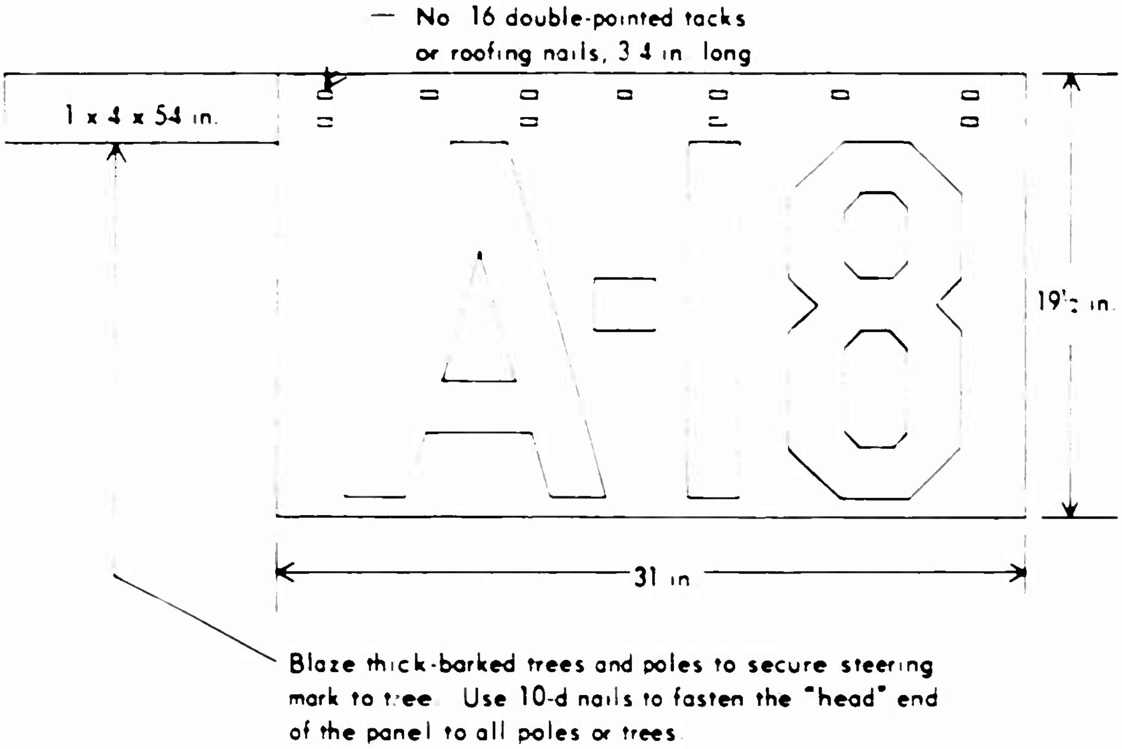


Figure 3 **Steering Mark Panel Used on Distance Determination Course**

Distance of 100 m. from the start stake to the first steering mark and between all steering marks must be exact. The first steering mark or intermediate marker must be clearly visible from its start stake and each steering mark or intermediate marker must be clearly visible from the one preceding it. Fasten the steering marks to poles or trees at the height giving best visibility. Remember that the successive steering marks must be visible on the way out and on the return after facing about at steering mark "C." Some cutting of limbs or trees may be necessary. Deviation of one or two paces from the lane azimuth can be tolerated to increase visibility without cutting limbs or trees, but the 100-m. distances must be rigidly controlled.

Intermediate markers (see Fig. 4). In thickly wooded terrain, it may be impossible to mount the large steering mark panels so the panels can be read at 100-m. intervals. In such cases, use 1 x 4 x 48-in. intermediate markers to keep subjects on course between the larger

Figure 4 Intermediate Marker

steering mark panels shown in Figure 3 Intermediate markers are painted white on both sides with alternating 4 in. diagonal stripes. On even-numbered lanes, intermediate markers are black on white. on odd-numbered lanes, intermediate markers are red on white. The land number, 3 1/2 in. high, 3/4-in. stroke, appears in the center on both sides of intermediate markers.

Center circle steering mark (see Fig. 5). This pole, located at the center of the circle formed by the start stakes, serves as a common steering mark for all lanes during the last 100 m. from steering mark "E" to soldier's assigned start stake. The man guides on the marker, but halts at his start stake.

The steering mark panels, intermediate markers, and blown-up section of the Record Card (see Fig. 6) are used during the briefing to ensure that the men are familiar with them. They should be removed from the pole before the men begin navigation on this course.

A blown-up section of the Record Card is given in Figure 6. The displays on the pole should be attached in a manner that allows quick removal after the briefing.

This training aid should be at least 3 1/2 x 4 ft. for a class of 200 men. The figures shown . . . are typical. Figures must be entered on the training aid to emphasize the necessity for maintaining a continous count over the assigned lane. The training aid is made from heavy card stock and covered with clear acetate to protect it from wear and weather. It should be hung on the center steering mark pole above the panels and intermediate markers while in use.

NIGHT NAVIGATIONAL COURSE

Course Construction

The Night Navigational Course for Period Five will be laid out as shown in Figure 7.

Measurements of the course are 1600 m. on the long axis and 480 m. on the short axis. There are 40 m. between each of the 12 starting points at each side of the course. The starting points on the west side of the course are labeled A to L and those on the east side of the course are numbered 1 to 12. Routes that traverse the area between the two sides of the course are plotted. Since routes are not plotted in a straight line, the total course distance will be over 1600 m. In the experimental course, total distances were approximately 1700 m.

The course has three line-type checkpoints crossing the entire width of the layout. Only two[1] of these line-type checkpoints (I and II in Fig. 7) are used in the night course. They should be natural terrain features spaced equally throughout the course.

[1]The third checkpoint is used in the day course.

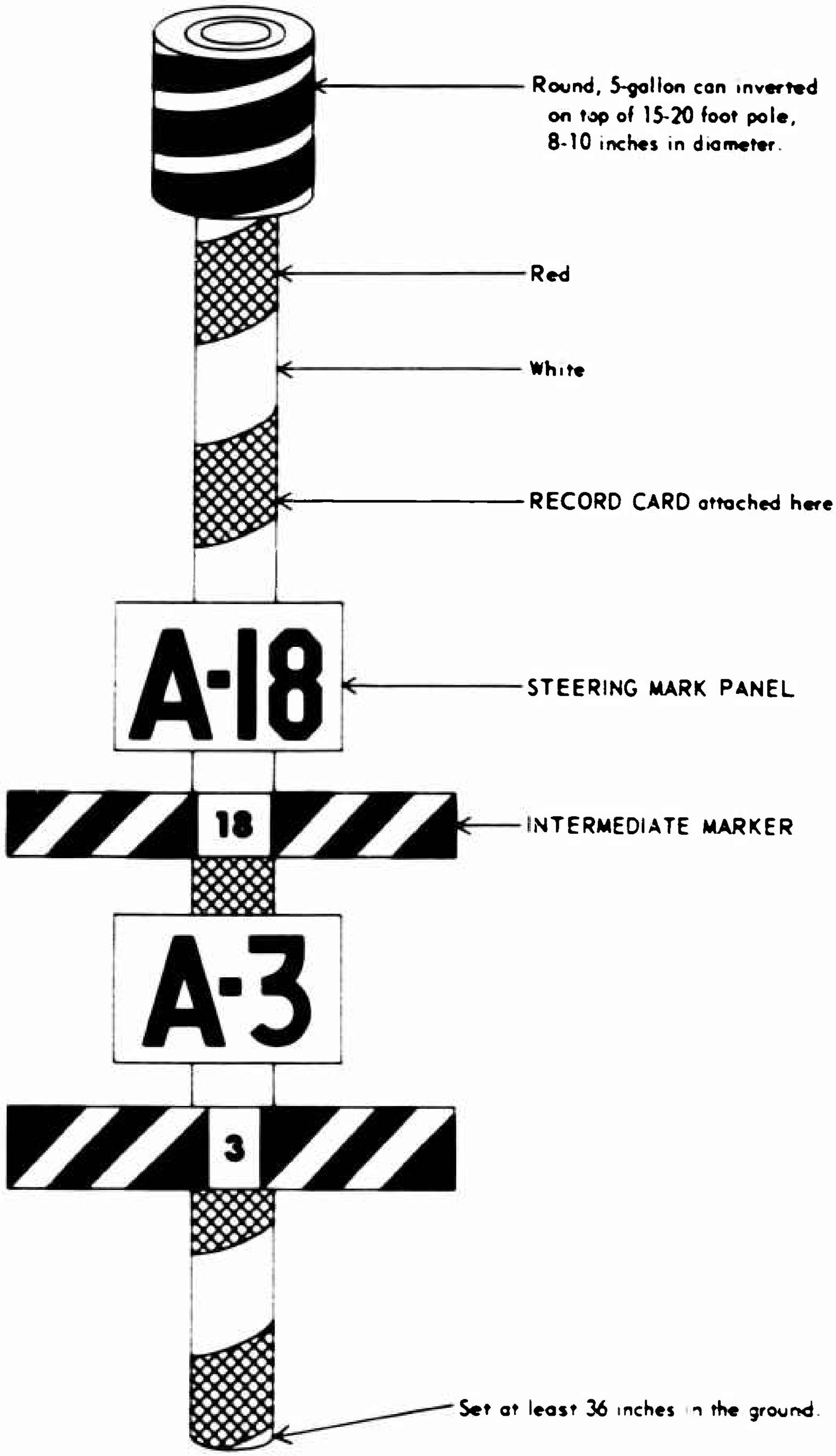


Figure 5. **Center Circle Steering Mark**

RECORD CARD
DISTANCE DETERMINATION COURSE

NAME BRITT, JAMES A.

START STAKE NO. 1

RECORD YOUR TOTAL PACE COUNT AT EACH STEERING MARK. DO **NOT** START A NEW COUNT AT EACH STEERING MARK.

SS to A 119 Paces

A to B 233 Paces

B to C 353 Paces

(Face about at C)

C to D 471 Paces

D to E 593 Paces

E to SS 722 Paces

NUMBER OF KNOTS IN PACE CORD 6

GIVE CARD TO INSTRUCTOR

Figure 6 **Blown-up Section of Record Card, Distance Determination Course**

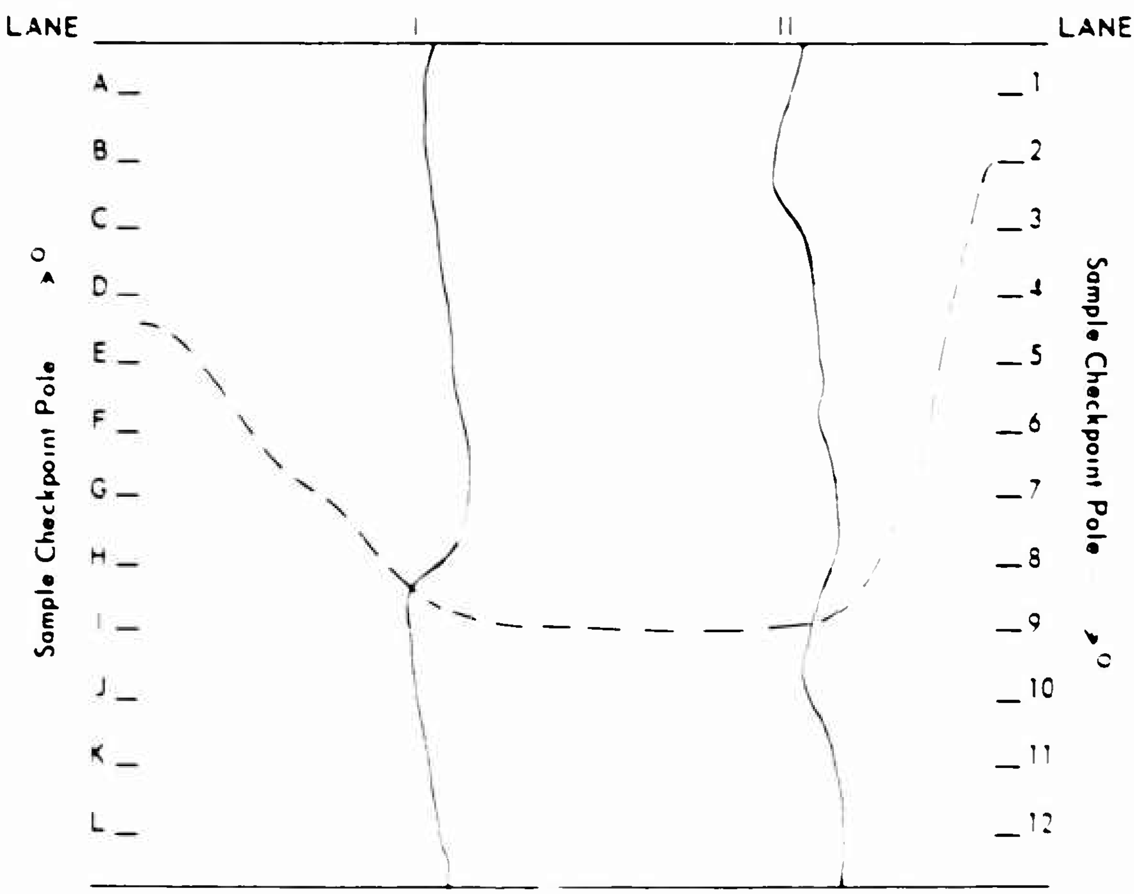


Figure 7 **Diagram of the Night Navigational Course**

Up and down the length of each line-type checkpoint are the individual route checkpoints. This is illustrated by the letters and numbers in the circles on the map in Figure 9. Thus, for any one route a specific point is selected on the line-type checkpoint and this point is the checkpoint for the particular route.

In the experimental program, we used two roads and a stream bed as the line-type checkpoints. The terrain on either side of these features was varied enough so that map-terrain association easily could be accomplished. More important, these features entirely crossed the total width of the course and were essentially parallel to the starting points. It is suggested that if you cannot locate an area with such excellent line-type checkpoints, an engineering company can be called upon to furnish a bulldozer. In about half a day, three simulated roads can be scraped across any area, and these roads can be hand drawn on the training maps.

Along these line-type checkpoints and near the individual route checkpoints are located yellow-and-black striped poles (trees may be used if permission can be gained from local sources) about 10 ft. tall (see Fig. 8). A red light is attached to each pole for use during the night exercise. On each pole is a map showing each individual route checkpoint (see Fig. 9). In the experimental program, a scale of about 1:2,500 was used and these were hand drawn. Since these were to be permanent, they were covered with acetate and have withstood the weather very well.

Note that these striped map poles are <u>not</u> located exactly on a specific checkpoint. They are distributed along the length of the chosen terrain features about 75 m. apart and at least 25 m. from the actual checkpoint. They <u>must</u> be <u>visible</u> from the checkpoint. The reason is that a trainee must go to what he thinks is his checkpoint on the ground and then to a map pole. At the map pole he must determine (1) his location and (2) the location of his checkpoint. Locating the map poles some distance away from the checkpoints forces him to use map-terrain association. The locations of map poles are <u>not</u> indicated on the training maps; only the checkpoint positions are indicated.

<u>Routes</u>

There are 12 starting points on each side of the course. Twelve different routes are plotted between these points, but, since trainees are started concurrently on both ends of the course, there are, in reality, 24 different routes in use. These routes should be plotted according to local conditions. However, it is suggested that the following considerations be taken into account when the routes are plotted.

1. All routes should be approximately the same length.
2. All routes should have approximately the same amount of vegetation on them.
3. If possible, a training area should be selected that gives a wide variety of types of terrain over the length of the course. Since this course is designed to equip the navigator to move over difficult terrain, few areas should be

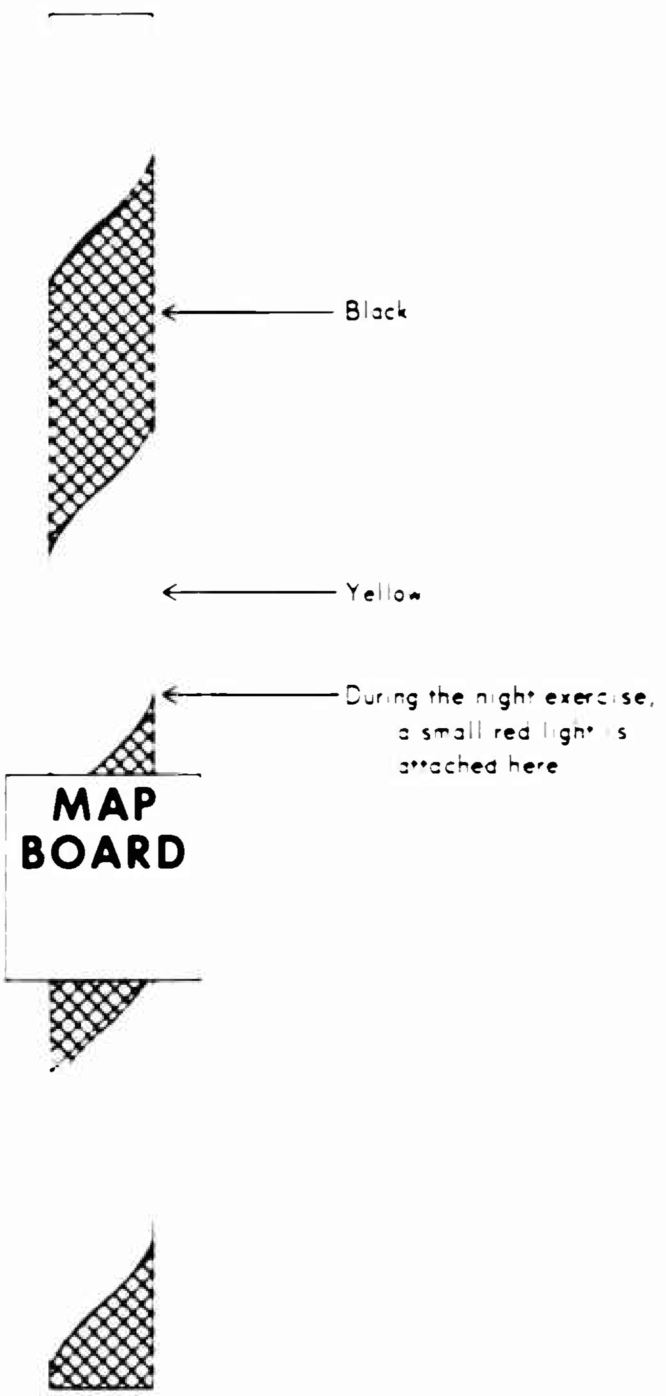


Figure 8. **Poles Used in Navigational Course**

rejected because they offer extremely dense vegetation or radical relief.

4. The terrain on either side of the line-type checkpoints should be varied so that map-terrain association can be accomplished from maps mounted on poles near the route checkpoints.
5. At the end of each leg of the route and on the line-type checkpoint, there should be a recognizable terrain feature. This may be as distinct as a hilltop, for example, but can be such things as a bend in a road or stream.
6. All routes should be free of hazards.

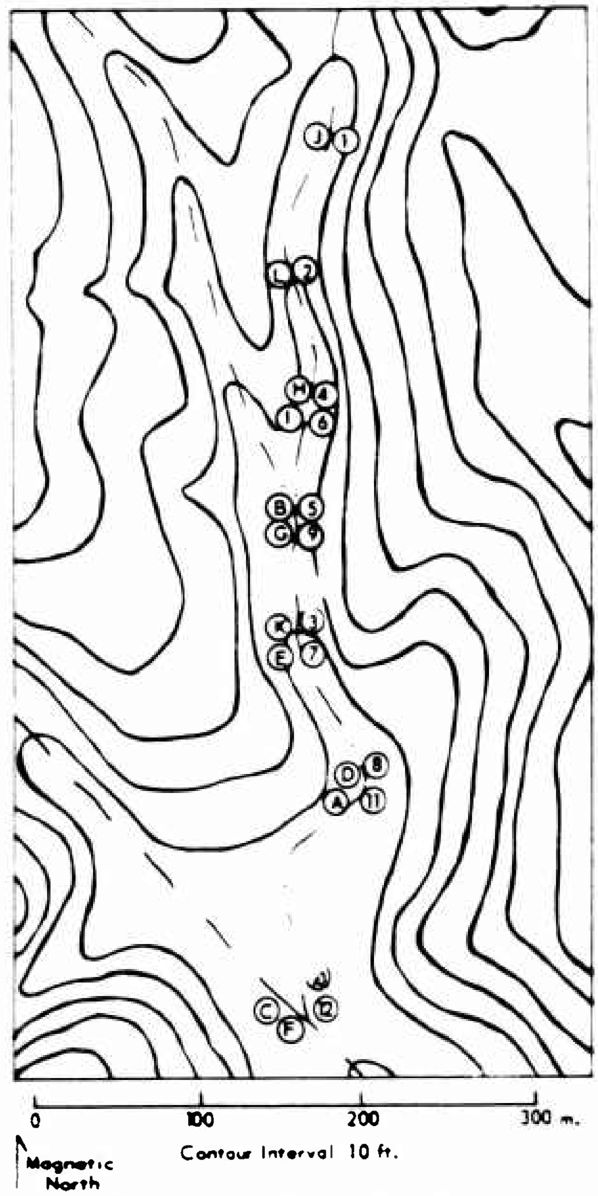


Figure 9. **Sample of Map Information Attached to Poles**

IF YOU HAVE NOT YET DETERMINED WHERE YOU THINK YOUR CHECKPOINT IS ON THE GROUND, DO THAT FIRST AND THEN GO TO THE NEAREST POLE.

THIS POLE IS NOT A CHECKPOINT.

HOWEVER BY LOOKING AT THIS MAP YOU SHOULD BE ABLE TO DETERMINE WHERE YOUR CHECKPOINT IS ON THE GROUND.

1. The red letters and the green numbers indicate checkpoint positions.
2. Look on your route card and find the letter or number of the route.
3. Now look on this map, find the correct letter or number, and by map-terrain association determine whether you have arrived at your checkpoint.
4. If you have arrived correctly, return to your checkpoint and start on the next leg of your route.
5. If you have not arrived correctly, determine where your checkpoint is on the ground and move to that point. Then start on the next leg of your route.

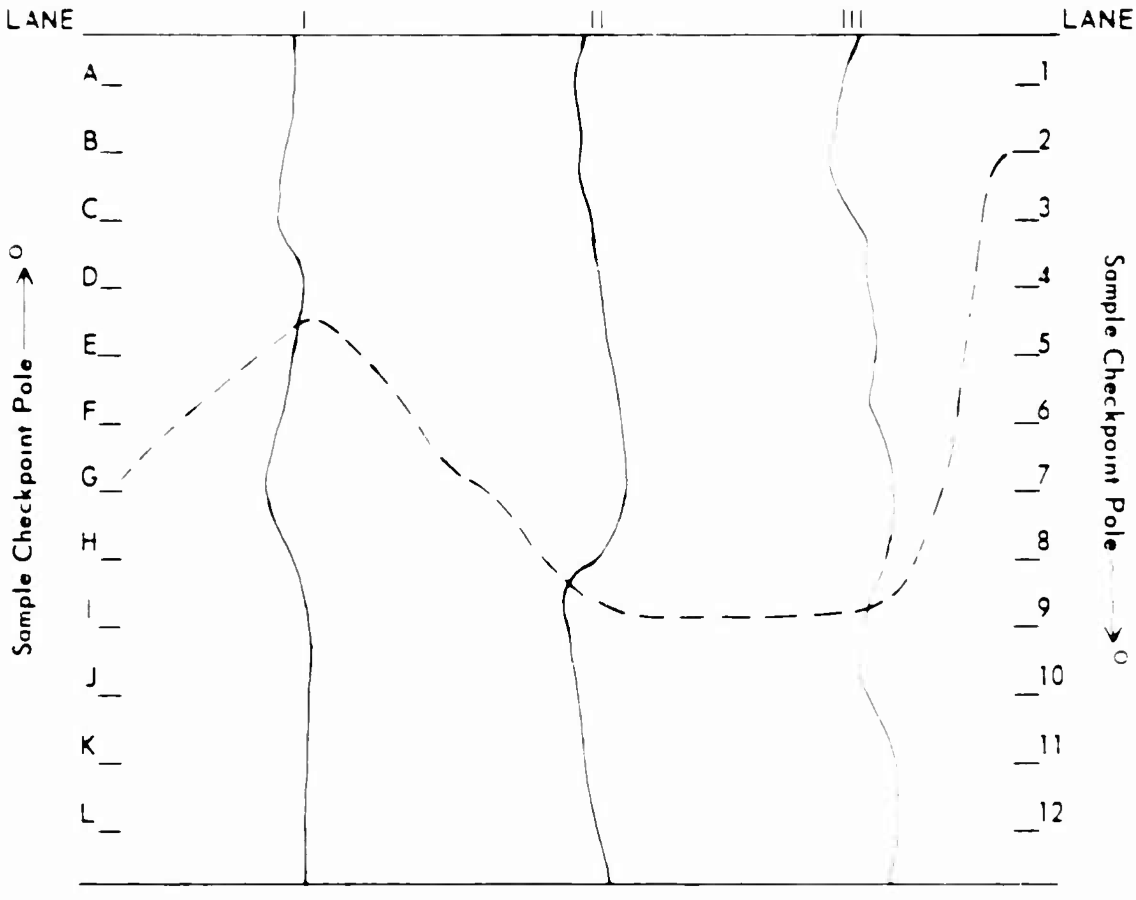


Figure 10. **Diagram of the Day Navigational Course**

DAY NAVIGATIONAL COURSE

The Day Navigational Course for Period Six will be laid out as shown in Figure 10.

The same course is used in this period as was used in Period Five with one modification. The starting points on only one side of the course are moved about 400 m. back from their night position. Thus, the starting points for the night routes on that side now become the first checkpoints on that side for the day exercise. At the other side, the starting points remain unchanged. The day course is 2000 m. in length; the width remains the same. Again, routes that traverse the area between the two sides of the course are plotted. These routes should require the individual to navigate a full 2300-m. course.

There are now three line-type checkpoints (I, II, III in Fig. 10), which are natural terrain features, spaced equally throughout the course. Between the night and day exercises, yellow-and-black striped poles must be placed in the vicinity of the additional checkpoints. This may be done at the time the start stakes are moved back 400 m.

Chapter 4

SPECIFIC INSTRUCTIONS FOR CONDUCTING THE ADVANCED LAND NAVIGATION PROGRAM

PERIOD ONE

Compass Technique

The Advanced Land Navigation Program teaches a different compass-holding method than has previously been taught to trainees. This is called the center-hold technique and requires the navigator to position the compass approximately halfway between his chin and belt and to look out over the front cover to determine the direction of his azimuth. Along with this, the compass should always be set on the desired azimuth by turning the bezel ring and aligning the north-seeking arrow with the luminous line on the cover glass.[1] This is usually referred to as the line-over-arrow technique.

Our research has indicated that the center-hold method, utilizing the line-over-arrow technique, is just as accurate as the more familiar sighting method. More important, the center-hold technique offers the following advantages over the sighting technique.

1. It is faster to use.
2. It is easier to use, as the number of steps required for efficient operation has been reduced from seven to two.
3. It can be used under all conditions of visibility.
4. It can be used when navigating over all types of terrain.
5. It can be used without putting down the rifle; however, the rifle must be slung well back over either shoulder.

Trainees should be made to realize that the center-hold method of using the compass replaces the sighting technique; thus, the sighting technique should not be used in training.[2]

When using the center-hold method utilizing the line-over-arrow technique, steering marks may or may not be used. They should be used if the terrain is open and there are many good steering marks available, since this will enable the navigator to walk long distances on his azimuth without referring to the compass. They should not be used if the vegetation is very thick or if there are no suitable steering marks available. In these instances, the navigator should make frequent reference to his compass.

Practice in Using the Compass

We have found that field practice in using the compass does not ensure success when actual navigation is tried. That is, a trainee may be able to demonstrate that he is capable of using the compass in a proficiency test, but he may become lost within a short period of

[1] Some older compasses may have two luminous lines on the cover glass. If this occurs, tell the trainee to use the *longer* line.

[2] Sighting technique may be used in detouring large obstacles at night. See Period Four Lesson Plan.

time when actual land navigation is attempted. For this reason, we practice the center-hold compass technique in the classroom for only a short period of time, and the remainder of compass practice occurs during actual navigation.

Our research indicates that the lack of relationship between proficiency testing of compass usage and land navigational ability extends to most other land navigational skills. Therefore, if a unit commander wants to keep a record to indicate the land navigational ability of his company, he should not set up an individual skills proficiency test. Rather, he must set up an acutal land navigational route and keep track of the number of trainees that are able to arrive at an objective within a time limit. Thus, if a proficiency check is desired in the present Program, it is suggested that a record be kept of the number of trainees hitting their objective during Periods Five and Six.

The commander should not expect 100% of the class to reach the objective. Because of many variables over which we have no control, an acceptable level of proficiency is not specified. The commander must determine his own standards which should be in harmony with proficiency levels in other areas of training.

Questions and Answers

The questions and answers at the back of the Lesson Plan are supplied to the instructor to be used only when necessary. The actual instruction in the period requires approximately 50 min., but the questions and answers may be used if the instructor has some time left for a general review.

PERIOD TWO

Our research has indicated that the Infantryman will profit more from a complete understanding of six basic skills necessary for map reading than he will from just a passing acquaintance of the numerous skills that make up the entire area of map reading. These basic skills, which have been identified[1] as being necessary for the LWI to know, are thoroughly covered in Period Two.

Section I. Introduction to Map Reading

The important things to stress in this section are (1) the map presents a view of the ground as it appears from directly above, and (2) the map reader should make use of the printed information on the map if he is to interpret it correctly.

Section II. Grid Coordinates

In this section, the trainee is taught to compute and interpret correctly a six-digit grid coordinate. We teach only six digits because

[1]Cogan, E.A., Willmorth, N.E., Findlay, D.C. *A Survey of Map Skills Requirements*, Technical Report 43 (U.S. Army Armor Human Research Unit, Fort Knox, Ky.), Human Resources Research Office, Alexandria, Va. (published in Washington, D.C.), September 1957.

(1) more digits than this are extremely hard to determine accurately on a map with a scale of 1:50,000, unless a coordinate scale is used, and (2) it is extremely unlikely that the LWI would have occasion to be more precise than this in using grid coordinates.

It should be noted that the use of a plastic coordinate scale is not specified in the Lesson Plan. Our research has indicated that the trainee is capable of determining a six-digit coordinate by the "eyeball" method with enough accuracy for his purposes. The reason for not specifying a coordinate scale was simply that under ordinary combat conditions the LWI does not have one of these available for his use.

Section III. Topographic Symbols

The only concept to be stressed in this section on topographic symbols is that the ten rules presented are principles which should be applied to interpret various groups of map symbols. Thus, the instructor should not, when the slide dealing with water is presented, for example, discuss each type of water portrayed by the solid blue color. Rather he should stress that, by applying one basic principle, the trainee will be able to identify this particular symbol as some type of water which is always present, whether it be lake, river, creek, etc.

The use of basic principles to interpret topographic symbols has two main advantages. The first of these is that, by utilizing these 10 specific principles, at least 72 different topographic symbols can be identified accurately. The second is that our research has indicated that many LWIs do not retain the required knowledge for specific symbols, but are able to retain a basic principle which may be applied to a wide variety of cases.

Section IV. Contour Interpretation

In this section, the student is taught how contour lines on a map show the relief of the land and how interpretation of these contour lines enables the map reader to identify five primary terrain features.

It is in this section that the plastic training map (see Chapter 2) is used the most. The important thing here is to have the trainee realize that the flat map on the left represents a two-dimensional view of the relief map on the right. Thus, when he looks at the flat map, he should visualize, in his mind, a picture of the terrain as it appears in the three-dimensional map on the right. To accomplish this end, there are several instances in which the trainee is asked to compare an area on the flat map with the same area on the relief map. The PI and the AIs should monitor the class closely to see that the trainees are making this comparison.

After the trainees are taught how contour lines show the relief of the land, they are shown how these lines can be used to identify five primary terrain features These five primary features have been established in order to standardize the labeling of terrain features in all sections of the world. By having a standardized description, all map readers will be able to communicate more effectively.

Section V. Map Distance Measurement

The important concept to stress in this section is that a map reader should be as careful as possible when he measures distances on the map. Even small errors in map measurement can cause large errors on the ground.

The trainee is required to make three measurments in practical exercises. The measurement points referred to in the Lesson Plan were arbitrarily chosen; therefore, the instructor must select similar points for the map sheet he uses. Whatever the distance selected, the class should be allowed a tolerance of 25 m. on each side of the desired answer, since measurements more accurate than this are extremely difficult to make.

Section VI. Map Orientation

Map orientation is a very simple concept, but many trainees do not understand it. The AIs should be very careful to check and see that all trainees have oriented their maps correctly since they must know this procedure in order to determine azimuths, which is taught in the next section.

The trainee is required to orient both the plastic and the topographic maps. The plastic map has a given declination of 13°. It is important that, whatever topographic map sheet is used, it should have a different declination from the plastic map, so the trainees will realize that declination is not the same from map sheet to map sheet.

Section VII. Determining Azimuths

In this section, the student learns to determine magnetic azimuths between points on a map. In teaching this section, emphasize that the map must be oriented, that the map should not be moved from its oriented position, and that the compass cover should extend in the direction of travel. If the latter is not done, the back azimuth will be obtained, which yields a 180° error.

In the practical exercise, it is permissible to let the trainees use the Back Azimuth and Detouring Training Aid to solve problems on back azimuths and detour azimuths. However, stress that the exact procedure for making these computations must be learned, since the Training Aids are not available in navigational situations.

PERIOD THREE

Section I. Checkpoint Recognition

Although the Infantryman will rarely plot his own route, it is important for him to know the limitations of any route that is given him, the various types of checkpoints he will encounter as he navigates, and the advantages and disadvantages of each of these types of checkpoints.

It is important to stress to the trainees that the examples given in the conference and demonstration are not the only checkpoints that may be encountered. They should realize that knowing the advantages and disadvantages of the types of checkpoints is what is important, not information about a specific checkpoint.

Section II. Geographical Orientation

Geographical orientation is probably an entirely new concept to the trainees. The instructor should make clear to them that basically, in this section, they are being taught to make "mental notes" as they navigate, so they will be able to walk in any general direction even without a map or a compass.

This period is not as closely timed as some of the other periods, therefore, the instructor should feel free to ask a few appropriate questions at the end of the period.

Section III. Sun-Stick-Shadow Method of Determining Direction

This method was first published in the January 1962 issue of Field and Stream in an article by Robert Owendoff. We realize the limitations of this natural method of direction finding. It is many times not altogether accurate as a method of determining direction; however, if the limitations listed below are observed, it can be very useful as a general method of indicating direction.

1. If possible, use the method between 1000 hr. and 1400 hr.
2. Be extremely accurate in marking the tips of the shadow, since a small mistake in marking can yield a large directional error.
3. The method is best used between 60° north and south latitude.

The more familiar watch-and-sun method of direction finding is only accurate for short periods during the spring and fall of the year, and at other times may yield errors up to 23°. There is also the obvious disadvantage that the watch-and-sun method does require a piece of equipment, while the sun-stick-shadow method merely requires objects gathered in the field.

Section IV. A Review of Methods of Land Navigation

Two methods of land navigation, dead reckoning and map-terrain association, are taught in this Program. The Advanced Land Navigation Program does not stress either method. Rather, the trainee should learn both methods with sufficient proficiency so that he can make an appropriate judgment on which method, or combination of methods, he should use depending on the environmental condition.

PERIOD FOUR

Section I. Detouring Obstacles

The instructor should stress that no special technique needs to be used to detour small obstacles, such as trees, bushes, small clumps of dense vegetation, etc., but he must emphasize that a count must be maintained of all paces taken that are on the route azimuth. For large obstacles, such as minefields, swamps, etc., specific instruction is given on how both a forward count and a count of deviation off the route must be maintained. It should be made clear to the trainee that this specific method need only be used to detour large obstacles.

Section II. Distance Determination

In the second part of the period, the trainee establishes one individual pace count which he should use to navigate over most types of terrain and under all conditions of visibility. The pace count is established for 25, 50, 75, and 100 m.

It is important that trainees learn to routinely tie a knot in the pace cord during this period, so they will have this habit firmly established by Periods Five and Six.

Starting the trainees on the course should offer no problem since one instructor can easily handle three lanes; however, it is important that, as the trainees return, all instructors work as quickly as possible to fill out the Record Card. Our results indicate that 200 men can establish their pace counts in 27 min., and this includes making out the Record Cards!

If a trainee has an obviously incorrect count (all counts for 100 m. should be from 95 to 150), he should be required to pace the course over again. Since pacing comprises at least 50% of dead reckoning, it is vitally important that all trainees get an accurate count during this period.

PERIOD FIVE

Conduct of Night Navigational Exercise

The company is split into two equal groups which move to opposite ends of the course. The procedure used is exactly the same for both groups. During this period, the trainees navigate in pairs. After the PI gives the 10 min. of instruction to the entire group, the group is equally distributed among 12 starting points. Each AI and the PI are responsible for three starting points. An instructor will start one pair (at route 1, for example), move to his next assigned starting point (route 2), and then move again to his last starting point (route 3). He will then retrace his steps (route 2, route 1, etc.) until all pairs assigned to him are started. The experimental program indicates that, if there are 200 men in a company, all men should be started within 12 min. after the PI completes his instruction. It should be remembered that men are started from both sides of the course at the same time. Thus, half the company is going in one direction (east, for example) and the other half will be going in the opposite direction (west, in this case). This method keeps any one route from having a large number of men on it going in the same direction and thus avoids the problem of bunching up.

Trainees are instructed, in this period, to navigate to their checkpoints and then to move to a map pole to verify their position. It is important that the instructor make sure all trainees understand this concept.

When all men have started, the selected AIs will move immediately to their assigned checkpoints. At the checkpoint, they will patrol up and down the length of the checkpoint and will have three main duties.

1. They will assist any trainees that appear confused. This will be accomplished by taking him to the nearest map pole, telling him where he is, where he is going, and discussing with him any navigational problems he is having.
2. They will break up any large groups of trainees that are traveling together.
3. They will enforce light discipline.

Those instructors who do not move to the checkpoints will stay at the ends of the course and receive troops as they finish. The finishing points of the routes are marked with the appropriate route numbers; thus, when a trainee comes to the end of the course, he can compare his route card with the symbol on the sign and tell whether he has navigated correctly. If he is off course, he can go to an instructor, tell him where he finished, and the instructor will tell him how many meters he was off and in which direction. Each instructor should carry a master list of starting and finishing point stakes for this purpose.

Since a trainee carries only a route card and a compass in this exercise, the basic navigational tool used is dead reckoning. However, even on the darkest night, a trainee should remember what terrain he has crossed. By referring to the map near the checkpoints, he should be able to determine his approximate checkpoint location by map-terrain association.

PERIOD SIX

Conduct of the Day Navigational Exercise

Before the day exercise, the start stakes at one end of the course must be moved back 400 m. from the night exercise position, and the third checkpoint must be set up.

The company splits into the same groups as in Period Five; however, each group goes to the end of the course opposite from where it was in Period Five. Basically, the same instructions and procedures are used in this period as were used in Period Five, with two exceptions. First, each trainee is required to navigate alone. Second, along with the route card, the trainee is supplied a map with his route marked on it. The experimental group used a combination map and route card as described in Chapter 2 and pictured in Period Six Lesson Plan.

When the trainee is navigating and goes to a map pole near a checkpoint, he should compare his route card map, the map on the pole, and the ground around him. In this way, he will realize how the terrain features on the ground appear on maps with two very different scales. This is important since, with increased patrolling and dispersal, more and more map substitutes will be used.

It is in this period that the trainee receives the majority of instruction in navigation by terrain features. Although the LWI will not always have a map when he is navigating, the purpose of this period is to teach the trainee how to recognize terrain features on the ground, how to move by using these terrain features, and only lastly how to do actual navigation while having a map in his hand.

It is hoped that in this period the trainee, since he navigates alone, will develop a basis for selecting a navigational method for any particular mission. Our research indicates that there are some trainees who cannot count their paces accurately enough for this type of distance estimation to be of any use to them; therefore, dead reckoning, for this group of people, will be of little use.

However, we also have evidence indicating that some trainees are incapable of interpreting a map correctly, regardless of the amount of training they have received. In these cases, dead reckoning is the best solution.

By knowing various methods of navigation, the trainee can develop the capability to navigate accurately on any mission, regardless of the type of terrain and the level of illumination.

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2 CG US ARMY EUROPE APO 403 NY ATTN OPNS DIV
6 CG FIRST ARMY GOVERNORS ISL NY ATTN G3
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1 CG THIRD ARMY FT MCPHERSON
1 CG FOURTH ARMY FT SAN HOUSTON ATTN G3
7 CG FIFTH ARMY CHICAGO ATTN ALFOC TNG
1 HQ SEVENTH ARMY OFC OF CHEM OFFR APO 46 NY
1 CG EIGHTH ARMY APO 301 SAN FRAN ATTN AG-AC
2 CG EIGHTH ARMY APO 301 SAN FRAN ATTN G3
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2 ENGNR PSYCHOL LAB PIONEERING RES DIV ARMY NATICK LABS NATICK MASS
1 TECH LIB ARMY NATICK LABS NATICK MASS
1 CG ARMY CDT DEVEL COMD CHEM BIOL + RADIOL AGY FT MCCLELLAN
1 CG ARMY PICTORIAL CTR LONG ISL ATTN APPLICAT DEVEL BR TV DIV
1 CG ARMY ELEC PG FT HUACHUCA ATTN TECH LIB
1 CG ARMY CDT DEVEL COMD EXPRM CTR FT ORD
1 SIXTH ARMY LIB DEPOT PRES OF SAN FRAN
1 CHF DEPT OF CLIN + SOC PSYCHOL WALTER REED ARMY INST OF RES
WALTER REED ARMY MED CTR
5 CG FT ORD ATTN G3 TNG DIV
1 DIR WALTER REED ARMY INST OF RES WALTER REED ARMY MED CTR
ATTN NEUROPSYCHIAT DIV
1 CO HQ ARMY ENLISTED EVAL CTR FT BENJ HARRISON
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2 CO PICATINNY ARSNL DOVER N J ATTN SMUPA VCI
1 DEF SUPPLY AGY CAMERON STATION ATTN LIB
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ATTN OPNS ANLS HUMAN FACTORS
1 CO ARMY CDT DEVEL COMD FT BENNING ATTN INF AGY
1 CO ARMY CDT DEVEL COMD FT KNOX ATTN ARMOR AGY
6 ARMY CDT DEVEL COMD FT BRAGG ATTN SPEC WARFARE AGY
3 CO ARMY CDT DEVEL COMD SPEC DOCTRINE + EQUIPMENT GP FT BELVOIR
3 ARMY WAR COLL CARLISLE BKS ATTN LIB
1 DIR OF MILIT PSYCHOL + LDRSHP US MILIT ACAD WEST POINT
1 US MILIT ACAD WEST POINT ATTN LIB
1 COMDT ARMY AVN SCH FT RUCKER ATTN SCH LIB
2 COMDT ARMY SECUR AGY TNG CTR + SCH FT DEVENS ATTN LIB
1 MED FLD SERV SCH BROOKE ARMY MED CTR FT SAM HOUSTON ATTN STIMSON LIB
10 DIR OF INSTR ARMOR SCH FT KNOX
1 COMDT ARMY CHAPLAIN SCH FT SLOCUM
1 COMDT ARMY CHEM CORPS SCH FT MCCLELLAN ATTN EDUC ADV
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1 ARMY INF SCH FT BENNING ATTN EDUC ADV
1 ARMY QM SCH FT LEE ATTN LIB
1 COMDT ARMY TRANS SCH FT EUSTIS ATTN EDUC ADV
1 COMDT ARMY MILIT POLICE SCH FT GORDON ATTN DIR OF INSTR
1 COMDT ARMY SOUTHEASTERN SIG SCH FT GORDON
1 ASST COMDT ARMY AIR DEF SCH FT BLISS ATTN CLASSF TECH LIB
10 CG ARMY ARTY + MSL CTR FT SILL ATTN AVN OFFR
1 COMDT ARMED FORCES STAFF COLL NORFOLK
1 COMDT JUDGE ADVOCATE GEN SCH U OF VA
1 EDUC CONSLT ARMY MILIT POLICE SCH FT GORDON
6 COMDT ARMY ENGNR SCH FT BELVOIR ATTN AIDRES-SY
1 CHF POLICY + TNG LIT DIV ARMY ARMOR SCH FT KNOX
1 DIR OF MILIT INSTR US MILIT ACAD WEST POINT
1 SPEC WARFARE SCH FT BRAGG ATTN LIB
2 SECY ARMY ORDNANCE GUIDED MISSILE SCH REDSTONE ARSNL
2 HQ ABERDEEN PG ATTN TECH LIB
1 COMDT ARMY QM SCH OFC DIR OF NONRESID ACTVY FT LEE ATTN TNG MEDIA DIV
1 SECY OF ARMY
1 DCS-PERS DA ATTN CHF C+S DIV
2 ASS FOR FORCE DEVEL DA ATTN CHF TNG DIV
1 HQ ARMY MAT COMD R+D DRCTE ATTN AMCRD-RC
1 ARMY PERS RES OFC ATTN CRD-AR
2 OFC OF PERS OPNS DA ATTN OPOSS-A
1 STANDARDS + SYS OFC OPO OCCUP R+D SECT ATTN OPOSS-A
1 ARMY PROVOST MARSHAL GEN
1 OFC RESERVE COMPON DA
20 COMDR DEF DOCU CTR ARLINGTON HALL STA
1 CHF OF R+D DA ATTN CHF TECH + INDSTR LIAISON OFC
1 PERS + TNG DIV ORDNC OFC OF CHF OF ORD DA
1 ARMY PERS RES OFC ATTN CRD-AIC
1 COMDT ARMY CDT SURVEIL SCH FT HUACHUCA ATTN ATSUR S3
1 PRES ARMY INF BD FT BENNING ATTN FE+SP DIV
1 PRES ARMY MAINT BD FT KNOX
1 DPTY PRES ARMY MAT COMD BD ABERDEEN PG
1 PRES ARMY TRANS BD FT EUSTIS
10 CG 4TH ARMORED DIV APO 326 NY
2 CG 10TH ARMOR GP FT IRWIN
1 CO 3D ARMORED CAV REGT APO 34 NY
6 CO 11TH ARMORED CAV REGT APO 305 NY
1 CO 14TH ARMORED CAV REGT APO 26 NY

1 CO 5TH BN 33D ARMOR FT KNOX
2 CO 2D BN 34TH ARMOR FT IRWIN
1 CALIF NG 40TH ARMORED DIV LOS ANGELES ATTN ACS-G3
1 35TH COMD HQ DIV ARMY NG JACKSONVILLE FLA
1 CG HQ 27TH ARMORED DIV NY AIR NG SYRACUSE
1 TEXAS NG 49TH ARMORED DIV DALLAS
3 CO 3D MED TANK BN 33D ARMOR APO 39 NY
2 CG 1ST INF DIV FT RILEY ATTN G3
1 CO 2D INF DIV FT BENNING ATTN DIV AVN COMDR
3 CG 4TH INF DIV FT LEWIS ATTN G3
1 CG 8TH INF DIV APO 111 NY ATTN G3
1 CG 5TH INF DIV (MECH) FT CARSON
3 CG 24TH INF DIV APO 112 NY ATTN G3
3 CG 82D ABN INF DIV FT BRAGG ATTN G3
1 CO 1ST BN (REINF) 3D INF (THE OLD GUARD) FT MEYER
1 CO HQ 2D BN 6TH INF REGT APO 742 NY
7 CO 3D BN 6TH INF REGT APO 742 NY
1 CO 171ST INF BRGD APO 731 SEATTLE
3 CG 25TH INF DIV APO 25 SAN FRAN
1 CO 4TH BG 30TH INF FT SILL
1 CO 2D BG 31ST INF REGT FT RUCKER
1 CO 3D BN 19TH INF APO 29 NY
1 CO 1ST BN 39TH INF APO 28 NY
3 CO 1ST BN (MECH) 52D INF 1ST ARMORED DIV (OLD IRONSIDES) FT HOOD
7 6TH BN (MECH) 54TH INF FT KNOX
1 CO ARMY PARTIC GP NAV TNG DEVICE CTR PT WASHINGTON ATTN CODE 01A
2 CHF AUDIO VISUAL APPLICAT OFC ARMY PICTORIAL DIV OFC OF CHF SIG OFCR
1 CHF MED RES PROJ ARMY HOSP US MILIT ACAD WEST POINT
1 CG MILIT DIST OF WASHINGTON
2 HQ ARMY LIAISON GP PROJ MICH U OF MICH
1 DIR ARMY LIB
1 CHF OF MILIT HIST DA ATTN GEN REF BR
1 82D ABN DIV FT BRAGG
1 CG 31ST ARTY BRGD AIR DEF OAKDALE PENNA
1 28TH ARTY GP AIR DEF SELFRIDGE AFB
1 CG 101ST ABN DIV FT CAMPBELL
1 CG 1ST CAV DIV APO 24 SAN FRAN
1 ARMY R+D OFC PANAMA FT CLAYTON CANAL ZONE ATTN BEHAV SCI COORD
1 CINC PACIFIC OPNS ANLS SECT FPO SAN FRAN
1 CHF RES DIV BUR OF MED + SURG DN
3 DIR PERS RES DIV BUR OF NAV PERS
3 CHF OF NAV PERS
1 CO + DIR NAV TNG DEVICE CTR PT WASHINGTON ATTN LIBN
2 HUMAN FACTORS DEPT COMM PSYCHOL DIV NAV TNG DEVICE CTR PT WASHINGTON
1 CHF OF NAV RES ATTN HEAD PERS + TNG BR CODE 458
4 OIC NAV PERS RES ACTVY NAV YD WASHINGTON
5 CO OFC OF NAV RES BR OFC FPO 39 NY
1 CO MED FLD RES LAB CAMP LEJEUNE
1 CDR NAV MSL CTR POINT MUGU CALIF ATTN TECH LIB CODE 3022
1 OIC NAV PERS RES ACTVY SAN DIEGO
1 OIC NAV PERS RES ACTVY NAV STA NAV YD ANNEX WASHINGTON
2 CONTRL NAV BASE NORFOLK
1 COMDT MARINE CORPS HQ MARINE CORPS ATTN CODE AO-1B
1 HQ MARINE CORPS ATTN AX
1 DIR MARINE CORPS EDUC CTR MARINE CORPS SCH QUANTICO
ATTN SECRET + COMP FILES GP
1 DIR MARINE CORPS INST ATTN EVAL UNIT
1 CHF OF NAV AIR TECH TNG NAV AIR STA MEMPHIS
3 DIR OF PERS PROCUR + RETENTION AIR FORCE MILIT PERS CTR RANDOLPH AFB
1 CHF SCI DIV DRCTE SCI + TECH DCS R+D HQ AIR FORCE AFRSTA
2 HQ AIR FORCE STAFF COLL SCGB 3 ANDREWS AFB
1 AERO MED RES LAB MRPTO WRIGHT-PATTERSON AFB
1 AIR MOVEMENT DESIGNATOR MRPTO WRIGHT-PATTERSON AFB
1 HQ BALLISTICS SYS DIV PERS SUBSYS BR BSOSP NORTON AFB
2 MILIT TNG CTR OPE LACKLAND AFB
2 6570TH AERO MED RES LAB MRPT WRIGHT-PATTERSON AFB
1 AIR MOVEMENT DESIGNATOR ARMY BROOKS AFB
1 DIR AIR U LIB MAXWELL AFB ATTN AUL3T-63-293
1 COMDR ARCTIC AEROMED LAB APO 731 SEATTLE
3 CENTRAL INTEL AGY ATTN OCR MAIL RM
1 DEPT OF STATE BUR OF INTEL + RES EXTERNAL RES STAFF
1 SCI INFO EXCH WASHINGTON
2 CHF REGL TNG BR TNG DIV FED AVN AGY ATTN PT 38
1 RES INFO CTR NATL BUR OF STANDARDS ATTN RES PSYCHOL
2 DUNLAP + ASSOC INC DARIEN ATTN LIB
2 RES ANLS CORP BETHESDA
1 U OF SO CALIF ELEC PERS RES GP
1 MITRE CORP BEDFORD MASS ATTN LIB
2 U OF PGH LEARNING R+D CTR ATTN DIR
1 HUMAN SCI RES INC NORFOLK
1 HUMAN ECOLOGY FUND WASHINGTON
1 HUMAN SCI RES INC MCLEAN VA
2 TECH INFO CTR ENGNR DATA SERV N AMER AVN INC COLUMBUS O
1 CHRYSLER CORP MSL DIV DETROIT ATTN TECH INFO CTR
1 INFO SYS DEPT 107 SPACE + INFO SYS DIV N AMER AVN INC DOWNEY CALIF
1 GEN DYNAMICS POMONA CALIF ATTN LIB
2 MARQUARDT CORP POMONA CALIF ATTN DEPT 980
1 CHF PERS SUBSYS AIRPLANE DIV MS 74-90 RENTON WASH
1 SYLVANIA ELECTRIC PRODUCTS INC NEEDHAM HGTS MASS ATTN PERS SUBSYS MANGR
1 THIOKOL CHEM CORP HUMETRICS DIV LOS ANGELES ATTN LIBN
1 INST FOR DEF ANLS RES + ENGNR SUPPORT DIV WASHINGTON
1 DIR CTR FOR RES ON LEARNING + TEACHING U OF MICH
1 EDITOR TNG RES ABSTR AMER SOC OF TNG DIRS U OF TENN
1 U OF CHICAGO DEPT OF SOC
1 GEO WASHINGTON U DEPT OF PSYCHOL
1 DIR SORO AMER U
6 BRITISH EMBSY BRITISH DEF RES STAFF WASHINGTON
3 CANADIAN JOINT STAFF OFC OF DEF RES MEMBER WASHINGTON
3 CANADIAN ARMY STAFF WASHINGTON ATTN GS02 TNG
3 ACS FOR INTEL FOREIGN LIAISON OFCR TO NORWEG MILIT ATTACHE
2 ACS FOR INTEL FOREIGN LIAISON OFCR FOR SWEDISH EMBSY ATTN ARMY ATTACHE

1 NATL INST FOR ALCOHOL RES OSLO
1 AUSTRALIAN EMBSY OFC OF AIR ATTACHE WASHINGTON ATTN T A RAVEN SQDN LDR
2 AUSTRALIAN EMBSY OFC OF MILIT ATTACHE WASHINGTON
1 U OF SHEFFIELD DEPT OF PSYCHOL
1 MENNINGER FOUNDATION TOPEKA
2 AMER INST FOR RES WASHINGTON
1 AMER INST FOR RES PGH ATTN LIBN
1 COLUMBIA U SCH OF BUS
3 MATRIX CORP ARLINGTON ATTN TECH LIBN
1 AMER TEL+TEL CO NY
1 U OF GEORGIA DEPT OF PSYCHOL
1 AMER INST FOR RES LOS ANGELES
1 AMER INST FOR RES PALO ALTO CALIF
1 MICH STATE U COLL OF SOC SCI
1 N MEX STATE U
1 ROWLAND + CO HADDONFIELD NJ ATTN PRES
1 NORTRONICS DIV OF NORTHROP CORP ANAHEIM CALIF
2 AIRCRAFT ARMAMENTS INC COCKEYSVILLE MD
1 AMER MACH + FOUNDRY CO GREENWICH ENGNG DIV STAMFORD CONN
2 OREGON STATE U DEPT OF MILIT SCI ATTN ADJ
1 TUFTS U HUMAN ENGNG INFO + ANLS PROJ
1 AMER PSYCHOL ASSOC WASHINGTON ATTN PSYCHOL ABSTR
1 NO ILL U HEAD DEPT OF PSYCHOL
1 GEORGIA INST OF TECH DIR SCH OF PSYCHOL
1 AMER BEHAV SCI NY
1 INTERNATL INVENTORS CONGRESS CHICAGO
1 SO ILLINOIS U DEPT OF PSYCHOL
1 NORTHWESTERN U DEPT OF INDUSTR ENGNG
1 NY STATE EDUC DEPT ABSTRACT EDITOR AVCR

1 CHF PROCESSING DIV DUKE U LIB
1 U OF CALIF GEN LIB DOCU DEPT
1 FLORIDA STATE U LIB GIFTS + EXCH
1 HARVARD U PSYCHOL LABS LIB
1 U OF ILL LIB SER DEPT
2 U OF KANSAS LIB PERIODICAL DEPT
1 U OF NEBRASKA LIBS ACQ DEPT
1 OHIO STATE U LIBS GIFT + EXCH DIV
1 PENNA STATE U PATTEE LIB DOCU DESK
1 PURDUE U LIBS PERIODICALS CHECKING FILES
1 STANFORD U LIBS DOCU LIB
1 LIBN U OF TEXAS
1 SYRACUSE U LIB SER DIV
1 U OF MINNESOTA LIB
1 STATE U OF IOWA LIBS SER ACQ
1 NO CAROLINA STATE COLL DH HILL LIB
2 BOSTON U LIBS ACQ DIV
1 U OF MICH LIBS SER DIV
1 BROWN U LIB
2 COLUMBIA U LIBS DOCU ACQ
1 DIR JOINT U LIBS NASHVILLE
2 DIR U LIB GEO WASHINGTON U
2 LIB OF CONGRESS CHF OF EXCH + GIFT DIV
1 U OF PGH DOCU LIBN
1 OFC OF DIR CATHOLIC U LIB ATTN PSYCHOL DEPT LIB
1 U OF KY MARGARET I KING LIB
1 SO ILL U ATTN LIBN SER DEPT
1 BRIGHAM YOUNG U LIB SER SECT

AD ______________________ Div. 19/2, 19/5, 23/5

Human Resources Research Office, George Washington U., Alexandria, Va. 22314

ADVANCED LAND NAVIGATION: DEVELOPMENT AND EVALUATION OF A PROTOTYPE PROGRAM OF INSTRUCTION, by Theodore R. Powers, Apr. 64, 62 p. incl. tables and figs., 9 refs. (Technical Report 89) (Contract DA 44-188-ARO-2) (DA Proj 2J024701A712) Unclassified Report

To enable infantrymen to acquire proficiency in advanced land navigation (ALN) techniques, an ALN performance requirement at the level of infantry advanced individual training (AIT) was developed in this study. Graduates of infantry AIT were tested on navigational routes of the level of difficulty prescribed by the performance requirement. This diagnostic assessment provided guidance for development of a 10-hour prototype program of instruction in ALN. The program was administered to 100 enlisted men whose performance was then evaluated on the prescribed navigational routes. In the experimental group, 50% of the men met the prescribed daytime performance requirement, as opposed to 5% of those without the experimental training; 76% met the performance requirement for nighttime navigation. The 10-hour program of instruction in ALN can be used to train enlisted men to navigate accurately over difficult, unfamiliar terrain under all conditions of visibility.

UNCLASSIFIED

1. Land navigation--Military training
I. Title: RIFLEMAN V
II. Powers, Theodore R.
III. U.S. Army Infantry Human Research Unit, Fort Benning, Ga.
IV. Contract DA 44-188-ARO-2

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