TECHNICAL RESEARCH REPORT 1120

THE ARMY NIGHT SEEING TESTER--
DEVELOPMENT AND USE

HUMAN FACTORS RESEARCH BRANCH

TAG Research and Development Command

U. S. Army

AD Div 23/1, 28/4

Human Factors Research Branch, TAGO, DA
THE ARMY NIGHT SEEING TESTER--DEVELOPMENT AND USE by
Julius E. Uhlaner and Joseph Zeidner. May 1961.
Rept. on Image Interpretation Task. 47p. incl. 11 figures. (HFRB Technical Research Report, No. 1120)
(DA Project 2L95-60-001) Unclassified Report

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Army Project Number
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Image Interpretation

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Julius E. Uhlaner and Joseph Zeidner

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Chief Scientist

May 1961

HFRB Technical Reports are intended primarily for research agencies in the Armed Forces as a means of guiding further research in the area of human resources. As research findings accumulate and suggest official action, recommendations are made separately to appropriate military agencies. Information of more general interest is presented in the first part of this report. The Technical Supplement contains details primarily of interest to research scientists.

BRIEF

THE ARMY NIGHT SEEING TESTER--DEVELOPMENT AND USE

Requirement:

To develop a simple night vision measurement device that can be used by commanders at local echelons in forming night patrols and in assigning men to special units and details given night military operations to perform.

Procedure:

Research was conducted concurrently on basic experimentation into human individual differences in the night seeing process and on the development of instruments to test night seeing ability. In a series of studies, soldier examinees were tested experimentally both on the instruments and on performance in a number of night detection courses. Correspondence between the two sets of scores was then established.

Major Research Findings:

1. Experimentation with a number of tests of night visual ability revealed two factors as being of primary importance in night seeing ability--brightness contrast sensitivity and line resolution (ability to discriminate fine detail).

2. Although a relationship between daylight seeing ability and night seeing ability could not be definitely established, a useful relationship was successfully established between seeing ability at intermediate (moonlight) levels of illumination and at very low (starlight or moonless) levels.

Tryout Findings:

1. In an infantry night reconnaissance patrol course, men who had scored high on the night seeing tester detected about twice as many planted military objects as did men who had scored low. The high scorers also gave fewer inaccurate reports.

2. In an armored night reconnaissance patrol course, the high scoring men detected military objects at 18% greater distance than did the low scoring men and identified the targets at 26% greater distance than did the low scoring men.

Application of Findings:

1. Testing at moonlight levels was adopted as meeting practical needs of the Army, at the same time simplifying testing procedures and reducing the 30-minute dark adaptation requirement prior to testing to 10 minutes.

2. It was decided that since brightness contrast and line resolution ability accounted for almost all individual variation in night seeing ability, only targets measuring these factors needed to be developed for incorporation within the tester.

3. The latest model, ANST-II, which is compact, portable, rugged, easy to operate, and which provides a stable, self-contained source of illumination calibrated at the desired level, meets Army night seeing testing needs. Test targets of the two requisite kinds are provided. This instrument has been made available to USCONARC for possible use in meeting various requirements for identifying soldiers possessing night visual ability.

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BACKGROUND

According to current tactical doctrine, survival on the battlefield depends upon successful night operations. Both World War II and the Korean war saw large-scale military operations planned and executed so as to take tactical advantage of the night hours. In fact, military history now reflects that during World War II many combat units had illustrious success because their commanders had insisted upon intensive training in darkness.

Since Korea, night movement and night combat have become standard tactical procedure, especially as a necessary condition of many of our modern weapons and modern surveillance systems. Did these developments raise any new requirements for insuring the combat effectiveness of individual soldiers under cover of darkness?

Special Devices and Training

Actually, the Army had long sought to improve the night seeing performance of its men by training them in methods of dark adaptation, scanning, and off-center vision, by familiarizing them with the appearance of objects at night and by developing instruments which increase the magnitude of the stimulus reaching the eye. And today, devices such as the metascope and the infra-red sniperscope are familiar pieces of night combat equipment which can help overcome the individual differences inevitably to be found in the night vision of any random group of soldiers.

Fundamental human factors differences in night seeing ability cannot be erased by training, however. Training may help both the man with good night vision and the man with the poor night vision, but it won't close the gap between them.

A Requirement for Human Factors Research

The importance of fundamental individual differences in the ability to see at night was first given wide recognition during World War II. Combat commanders needed means of identifying soldiers with good night vision for specific combat duties--night reconnaissance, manning of outposts, and the occupying of key positions in night attack. For these needs a selection research approach was needed to help identify those men with the ability to see well at night even before training.

In 1955 USCONARC set forth a requirement for an effective and simple test of night visual acuity to enable the Army to capitalize upon individual differences in the ability to see at night. Their request to the

Human Factors Research Branch to undertake the research was backed by the Chief, Research and Development. The present report describes the Human Factors Research Branch research and development effort at developing standardized tests of night vision which could be used by commanders to identify soldiers having high or better-than-average night seeing ability. This effort by 1960 had culminated in the development of the Army Night Seeing Tester, ANST-II.

Early Experimentation

When military requirements arose for measures of soldiers' ability to see at night, conceptualization of the night seeing process was inexact. HFRB scientists engaged in the research task found no well-organized body of prior research knowledge on which to base their approach.

Development of instrumentation for night vision testing started with bulky, complicated equipment (Figure 1). A suite of rooms constituting a 'vision laboratory' was required for testing. Targets were presented at a standard 20-foot distance from the examinee. Test administration required a team of highly trained technicians. In most test devices of the early 'alley-test' era, an extremely low level of illumination was used, and examinees were required to spend 30 minutes reaching the requisite degree of dark adaptation. The targets displayed were modeled on targets used for measuring daylight visual acuity. Problems of dark adaptation, light leakage, control of spectral and brightness qualities of the illumination, and standardization of various external factors affecting the seeing effectiveness of soldiers in night operations continually plagued the research. So long as elaborate procedures were necessary to establish adequate controls, advisability of adopting the test for field use remained questionable. The first attempts at Army testing of night vision principally helped define the task ahead--its magnitude and its special problems.

SIGNIFICANT ASPECTS OF ANST DEVELOPMENT

The Army night seeing testers developed by HFRB since 1944 in a continuous program of research should not be thought of merely as mechanical devices. They are optical instruments of great precision as well as psychological and physiological measures. Their history is one of scientific experimentation in which the disciplines of optics, physiology, and psychology were all applied.

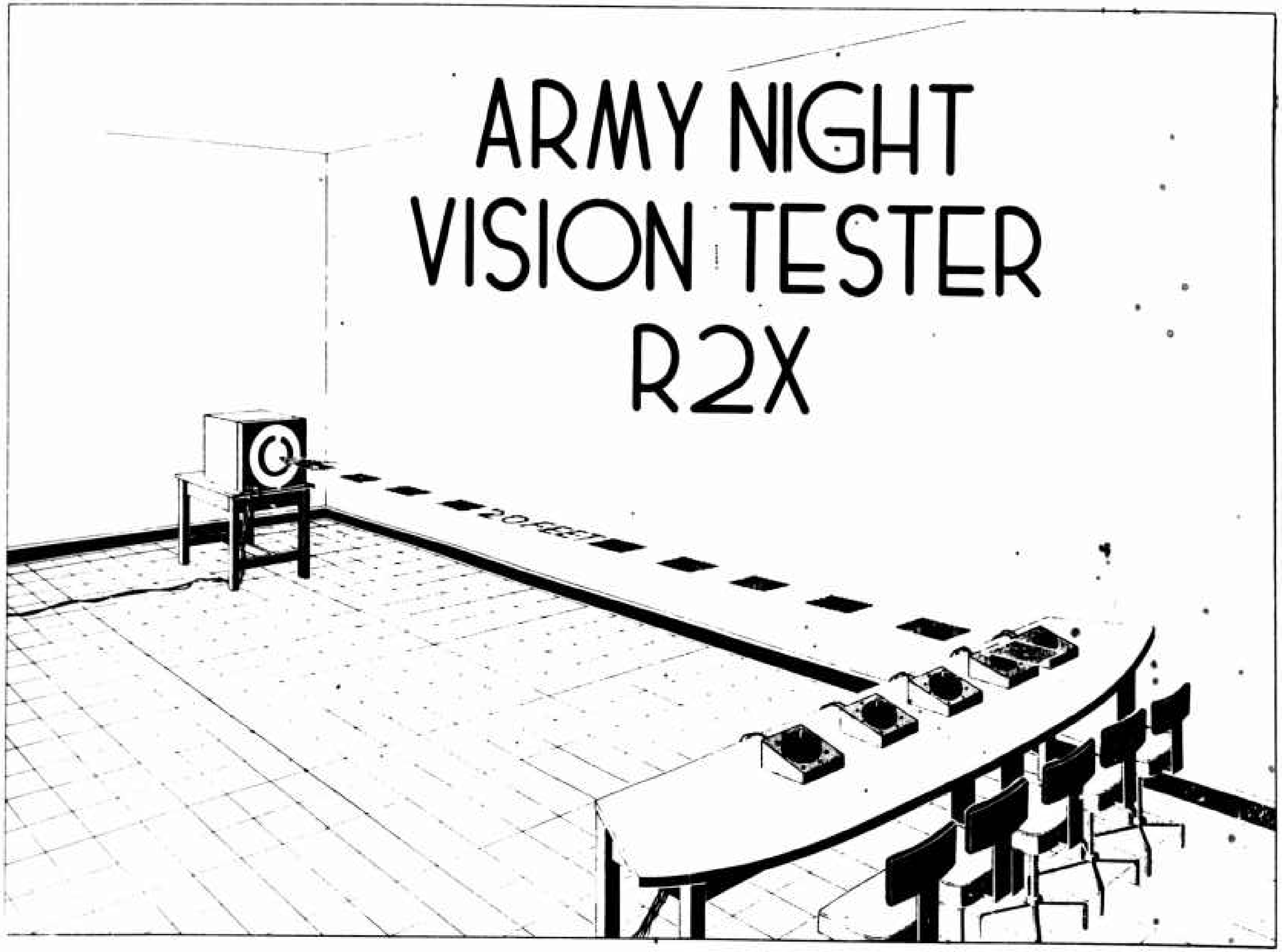


Figure 1. Early NVT with Test Alley and 5 Subject Positions

Light Level[1]

Take first the question of light level. The night seeing tester tests individual ability to see in semi-darkness, or one-quarter moonlight, rather than in very low (moonless) illumination. Earlier research had assumed that the principal military requirement for testing night vision was a very low light level. The earliest Army night vision test, for example, was designed to measure ability to see under starlight or moonless conditions. However, from consultations with military commanders, it was learned that night operations seldom take place under extremely low levels of illumination. Further, measures of seeing ability at intermediate levels not only proved to be useful measures of relative ability to see at very low levels, but in repeated experiments provided useful identification of those soldiers who can see efficiently under night field conditions.

From the operational point of view, intermediate brightness tests also involve shorter dark adaptation time, and hence permit more rapid testing. The measures are less dependent on light-tight testing conditions; testing can therefore be accomplished with a less expensive optical instrument. Fewer testing personnel are required. In all, the intermediate level tests result in a more economical assessment procedure.

Of course, testing would have been further facilitated if men whose day vision was relatively high had also turned out to be the ones who could see well at night. While some relationship was found to exist between measures of daylight vision and relative ability to see at low levels, the correspondence is not sufficiently close to warrant substitution of day vision tests for measures of night vision.[2]

Instrument Testing

Two major considerations prompted a shift from small-group testing with room size apparatus to individual testing with an optical instrument (Figure 2). For one, it had been found extremely difficult to provide standardized visual stimuli and to insure constancy of testing conditions in group testing (particularly seating position) even with small groups. And second, in comparison with the use of wall charts and test alleys, instrument testing had the advantage of more precise regulation of brightness levels and greater ease of test administration. The viewing distance is achieved optically, with consequent economy of testing space.

1/ To differentiate varying conditions of illumination, the following terms and measurements were used: photopic to indicate daylight illumination; mesopic, or 6.67 log micromicro lamberts, simulating one-quarter moonlight conditions; and scotopic, or a lower limit of 3.5 log micromicro lamberts, simulating "starlight" or moonless night illumination.

2/ Traditionally, night seeing and day seeing have been thought to involve relatively unrelated physiological and neurological processes, performed by two different types of receptor cells, one (the cones) operative at higher levels of illumination, the other (the rods) functioning at low levels. More advanced neurological investigations have indicated that there is less separation of function than was believed. In relation to other (bipolar) cells in the retina, and through interconnections of the neural structure, the two receptor systems appear to function together to an undetermined extent at all levels. At intermediate levels, both cones and rods may be operating with near-equal effectiveness.

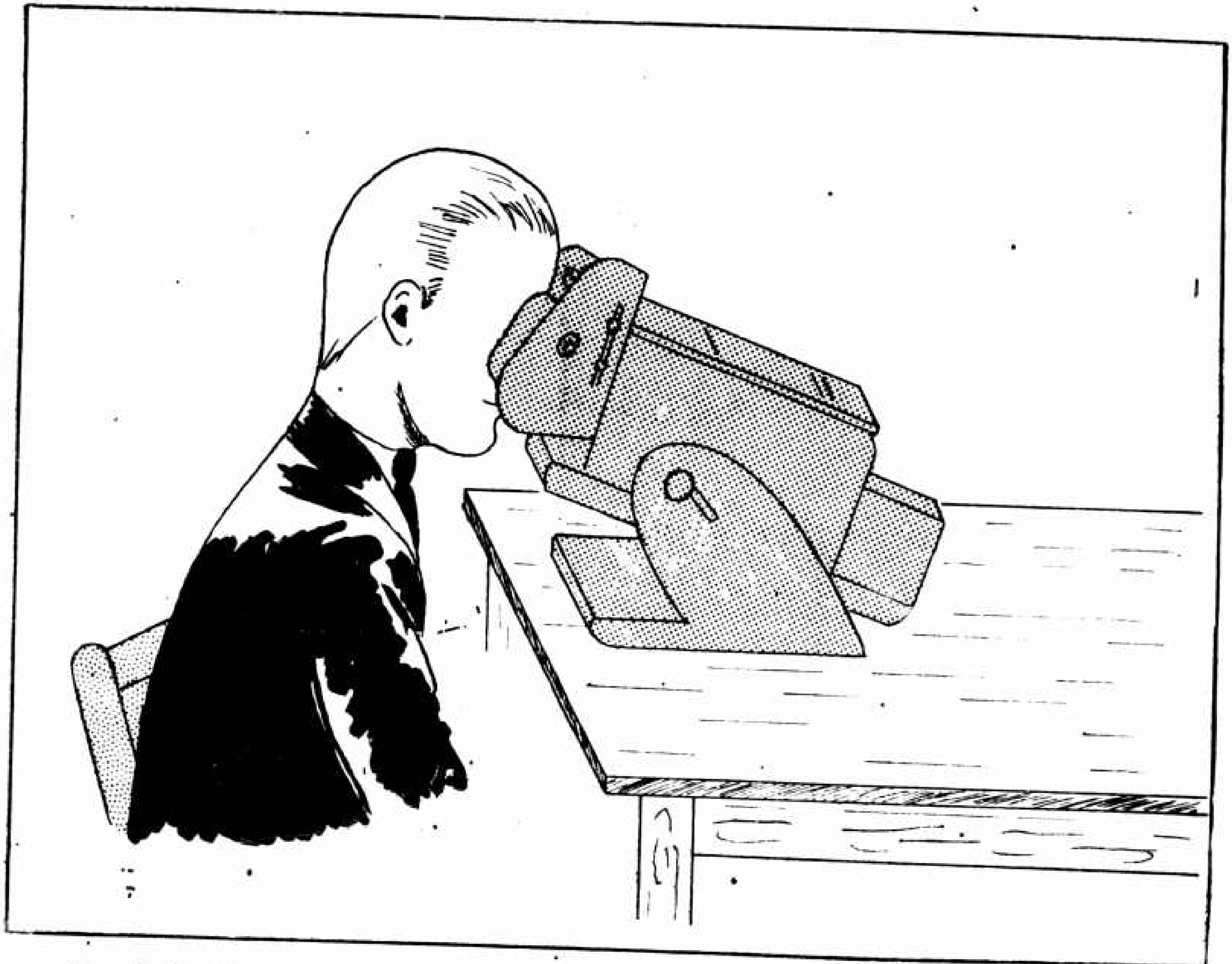


Figure 2. Binocular Instrument Testing of Night Vision

Effective binocular instruments for testing daylight visual acuity were available commercially. The first Army model for testing daylight vision was the Armed Forces Vision Tester, an Armed Forces National Research Council Vision Committee modification of the Ortho-Rater. Originally designed for measuring daylight vision in induction stations, the Armed Forces Vision Tester, after adaptation by HFRB, became the Army's first in a succession of binocular night vision testers.

Adaptation consisted of building in an incandescent bulb light source reducible to mesopic level by interposition of density filters between light source and stimulus targets. Although this arrangement was not objectionable for experimental testing, maintenance of illumination at a given level required constant attention and considerable technical skill on the part of the operator.

But by experimentation with variations in the tester, both instrumentation and procedures for night vision testing were gradually improved. The final experimental model in the series of instruments that employ an incandescent light source was the ANST-I, representing considerable improvement over The Armed Forces Vision Tester.

The target plates previously developed for mesopic vision testing (one-quarter moonlight) had to be adapted for use in the optical instrument. Plates were prepared from experimentally developed wall charts by photographic process. The amount of reduction was carefully calculated to provide the same visual angle as the counterpart wall chart presented at 20-foot viewing distance. Scores obtained with the target plates were determined by experimentation to correspond closely to wall chart scores, both in difficulty and in visual factors measured. Moreover, scores obtained with the plates were significantly more reliable than those obtained with standard operational wall charts.

The shift to an optical instrument brought with it a change from testing of small groups of five to individual testing. The difficulty (actually, the impossibility) of insuring that the standardized stimuli would be perceived in standard fashion by all examinees, irrespective of seating position with respect to the target, was thus avoided.

Test Targets

After experimentation with many different kinds of targets over a number of years and determination of the major night visual functions measured by these targets, two targets were finally selected as the most useful and representative. This research process consisted of administering to the same group of individuals a large number of tests and applying the methods of factor analysis to the resulting data. Through these means, the experimenters were able to study the basic processes of vision and to gain a better understanding of the important visual functions for night seeing.

The factors measured in the targets finally developed are brightness contrast discrimination and resolution. These two factors account for about 80 percent of individual variation in night seeing effectiveness. Thus the decision was made to concentrate on these two sets of target plates.

Brightness contrast refers to the ability to note differences in the brightness of relatively large adjacent surfaces. Sensitivity to brightness contrast is measured by a series of test targets of equal size which gradually vanish into the background. The Brightness Contrast Test of the ANST consists of successive rows of chevrons presented at a precisely calibrated light level. The examinee is required to identify the position of each chevron. The test targets vary from high to low in density and hence in difficulty, whereas the background is held constant. Positions of chevrons vary from row to row and each plate presents a different pattern of chevron positions.

Of two tanks at equal distance from an observer outpost, the one with the better cover is, of course, harder to detect, because it blends in with its background. This is where good brightness contrast sensitivity comes in handy. The man possessing it has a better chance of spotting the well camouflaged objects.

Resolution refers to the ability to distinguish fine details and is measured by a series of lines of equal contrast value. The lines gradually diminish in width. The lines in the squares vary in thickness by row, whereas length of line and background brightness are held constant. Positions of the lines are randomly varied.

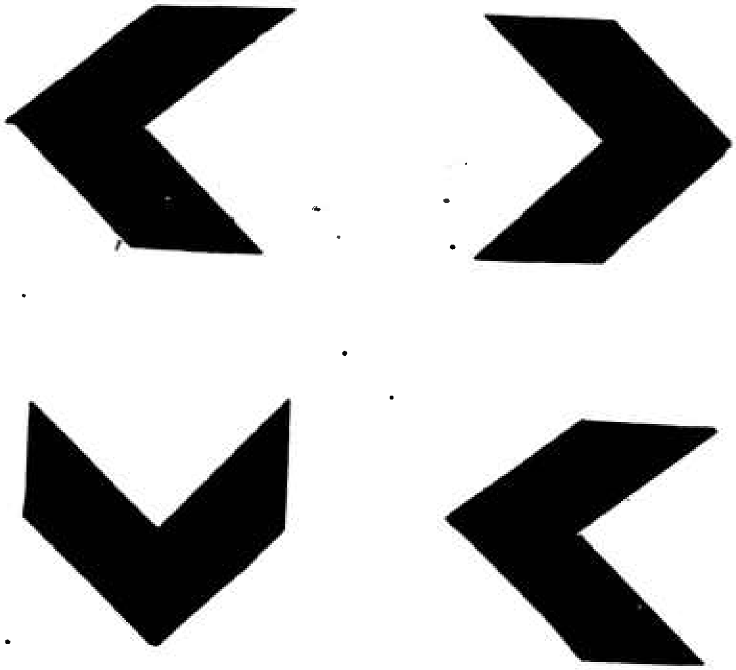
Good line resolution is useful where fine detail must be picked out. The man with a good amount of this ability might be able to identify the most distant of a series of approaching tanks against similar background or to identify very small targets close by.

To be sure, positive identification of practical targets at night usually requires both brightness contrast and resolution abilities. Brightness contrast ability alone might make the observer aware that something is on the road, but resolution ability would be necessary to pick out the general configuration of the object.

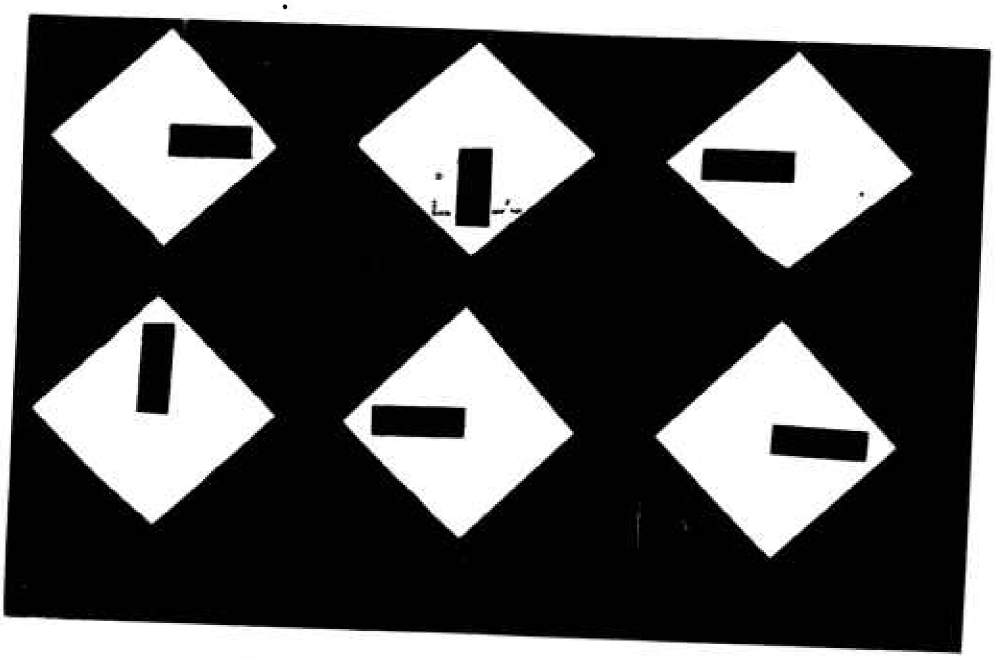
Examples of both targets are shown in Figure 3. The plates based upon these targets have undergone several modifications dictated by mechanical and physiological specifications. These modifications have principally been reductions in plate and target size to provide the precise optical viewing distance required and change from a glass to a plastic medium.

Scoring Techniques

With the shift to individual testing, complicated scoring procedures using elaborate equipment by which examinees had recorded their response



Four Brightness Contrast Test Chevrons



Six Line Resolution Test Items

Figure 3. Typical ANST Test Targets

could be eliminated. Now a single scorer checked the examinee's responses against a chart designed to make the task as simple and error-free as possible.

Three plates are used, two containing BCT (Brightness Contrast Test) chevron targets and one containing LRT (Line Resolution Test) targets. There are nine BCT targets, nine chevrons of equal brightness contrast on each target. Successive targets present progressively more difficult tasks. There are four LRT targets, four lines of items on each target, six items per line. The four LRT targets likewise progress in difficulty.

The score is basically the number of correct responses on both types of targets. The examinee is stopped, however, after making six errors out of the nine items on each BCT target and after making four out of six errors on a line of the LRT. The above procedure assures cessation of testing when success falls below chance level.

THE ARMY NIGHT SEEING TESTER, ANST-II

In comparison with early night vision testers and with earlier forms of the ANST, the operational model, ANST-II, permits greater precision of control of brightness levels and test target presentation. Variable external factors are standardized and meticulously controlled. In addition, ANST-II is an efficient, portable machine which can be set up and used in an ordinary room or enclosure, or in the field. Testing can be done by enlisted personnel after a brief period of instruction.

ANST-II was the first instrument to employ successfully a stable self-contained light source. Strontium 90 and Krypton were not quite suitable radiologically for the intended use. But a newer radioactive isotope, tritium, appeared to meet the technical requirements for use in the ANST. The substance is considered safe if used with certain precautions, precautions which can easily be established and maintained in field use and storage of the tester.

The tritium light source is stable, requiring at most a check every three months, in comparison with the hourly checks and adjustments of brightness level required with the predecessor instrument. In addition, the tritium light source has sufficient reserve brightness to permit recalibration to the desired level for an estimated period of ten years. Carrying its own light source, ANST-II requires no electrical outlet, and therefore permits wide flexibility in field use. Additionally, the 'permanent' light source eliminates the possibility of testing being interrupted when a bulb burns out.

A prototype ANST-II was constructed for the Human Factors Research Branch by the U. S. Radium Corporation, Bloomsburg, Pennsylvania. Specifications established by HFRB and incorporated in the contract are reproduced as Figure 4.

A. Optical system

1. Simulate viewing at distances beyond 20 ft.
2. Use achromatic lenses
3. Permit fusion of stereo targets for all subjects
4. Be equipped with lens mounting capable of withstanding rough handling
5. Provide a minimum of 5X magnification

B. Headpiece

1. Provide an almost light-tight seal for a wide range of head shapes and sizes. Persons who normally wear glasses must be able to wear them comfortably during testing.
2. Sanitary, durable, and readily replaceable

C. Mounting system

1. Permit immediate adjustment to persons of all heights
2. Withstand rough treatment
3. Retractable to permit easier carrying and storage

D. Tritium-activated light source

1. Approximate the spectral qualities of moonlight
2. Uniform brightness over the entire visual field
3. Provide brightness of 6.67 log micro microlamberts at the eyepiece
4. Have sufficient reserve brightness to permit recalibration to the above level for 10 years
5. Meet all safety requirements without special precautions consistent with AEC regulations
6. Provide mechanical device for rapid and accurate position adjustment of light source

E. Light box

1. Outside dimensions of approximately 5x5x7 excluding head piece
2. Rugged - withstand rough handling
3. Provide a slot approximately 1/2 x 4" at the top to permit insertion of slides.

Figure 4. Specifications for ANST-II

ANST-II, the current model, is capable of duplicating the individual measurements obtained with its predecessor, ANST-I. As with the ANST-I. the instrument provides a brightness level of one-quarter moonlight at the eye-piece. Brightness is uniform over the entire visual field. The spectral qualities of moonlight are approximated. Viewing distance is optically simulated.

The significant advantages of the new instrument, therefore, are the ease and dependability of operation it affords, the relatively low costs of construction and operation, and a high degree of portability. Complete with viewing plates and carrying case, ANST-II weighs about 10 pounds, compared to 75 pounds for ANST-I. The reduced weight and added ease of handling alone make the new instrument much more practicable for general field use (Figure 5).

Figure 5. The ANST-II

Moreover, the tritium-lighted ANST is a much more rugged instrument than its predecessor. It is simpler mechanically, with fewer parts that can get out of order. A simple lens system, for example, has been installed which contrasts favorably with the multiple prism arrangment of ANST-I which was difficult to keep in alignment. Component materials, while light in weight, are substantial and will withstand hard use.

The new instrument incorporates a mechanical arrangement which permits easy removal and replacement of target plates. Four stereo pairs of target plates can be positioned at a time, each pair being presented by a turn of a wheel. The two sets of target plates which constitute the test (one set consisting of 8 stereo pairs and the other of four) can thus be administered by repositioning the plates only twice during testing. New plastic plates are smaller, lighter, and less fragile than the glass plates used with the previous tester.

FIELD TRIALS

Each phase in the long and complicated development of the night vision tester has been the subject of exhaustive experimentation. In fact, some details of instrument and test procedure were taken to the field time and again to check practicability for field use and to evaluate possible effect on the validity of the resulting night seeing scores. Would ANST scores differentiate clearly between men who were able to deal successfully with night seeing problems under field conditions and those whose performance was inadequate for night combat duty?

A series of field trials furnished the answer. Men identified by ANST scores as having good night seeing ability were shown to be superior to men with low scores in detecting a variety of military targets in a number of different night field problems. Men with the higher scores consistently detected more targets and detected them at greater distances than did men with low scores.

Infantry Night Reconnaissance Patrol Course

To evaluate the usefulness of the ANST in selecting men for infantry patrol duty, a night reconnaissance patrol course was set up at Hilton Field, Fort Jackson, South Carolina. Enlisted men taking advanced basic training at the U. S. Army Infantry Training Center were tested with the ANST to select members of high and low groups. Quality of night seeing performance depended upon success in detecting military targets (stacked rifles, machine guns, field packs, helmets so placed as to simulate soldiers lying in the grass). The course was run on moonless nights between 8 and 12 p. m.

A strip of ground 110 yards by 1 yard was marked off with white tape to form the path of the patrol. As the soldier moved along the path, he reported his observations to the examining team through a field phone which he carried, noting both the identity of each target as it appeared to him and what he believed its position to be with respect to the path.

Men selected because they had scored high on the ANST were successful in identifying correctly, on the average, almost twice as many targets as did the men who had scored low on the tests.

Figure 6 shows a section of the course with various targets along the path. Figure 7 shows how the same section of the course looked to the average man in the low group. He would see only about 25% of the targets present. The typical high man, in comparison, would see about 50% of the targets (Figure 8). The high group was also the more accurate, only 15% of their reports being inaccurate, in contrast to 25% inaccuracy in the reports of the low group.

Stationary Observer Problem

A second field evaluation demonstrated the usefulness of the ANST in selecting men for a somewhat different type of field activity, the task of the observer from a fixed position. Again, two groups of enlisted men, one scoring high on the ANST and the other scoring low, were compared with respect to performance in a simulated night infantry tactical problem. The enlisted men in this study were from the First Brigade at Fort Benning, Georgia. Their Army experience ranged from five months to several years; their grades varied from privates Grade E2 to Master Sergeant.

The field situation in which night seeing performance was evaluated consisted of eight observer outposts. At each outpost, the soldier's task was to scan a prescribed field and report whether he saw a military object, and, if so, what the object was and its location. The procedure produced measures of three aspects of night seeing performance--number of targets detected, number of targets correctly identified, and the number of natural objects mistakenly identified as military targets. A sketch of a typical outpost is shown in Figure 9. The field problems were run on cloudless, moonless nights. Positions were set up so as to permit testing in a wide variety of terrain and background--open fields, light woods, heavy woods, uphill, downhill, and skyline. There were, in all, 46 targets, including 2 1/2-ton trucks, jeeps, mortars, machine guns, gasoline drums, stacked rifles, a pick and shovel, a tent, a 3.5-in. rocket launcher, jeeps mounted with 106 mm recoilless rifles, and human figures in a variety of positions.

On the average, the high men detected about eight more targets than did the low men (35 vs 27). Only two men from the high group failed to detect as many targets as the average low man. They also correctly identified more targets. Results are diagrammed in Figure 10.

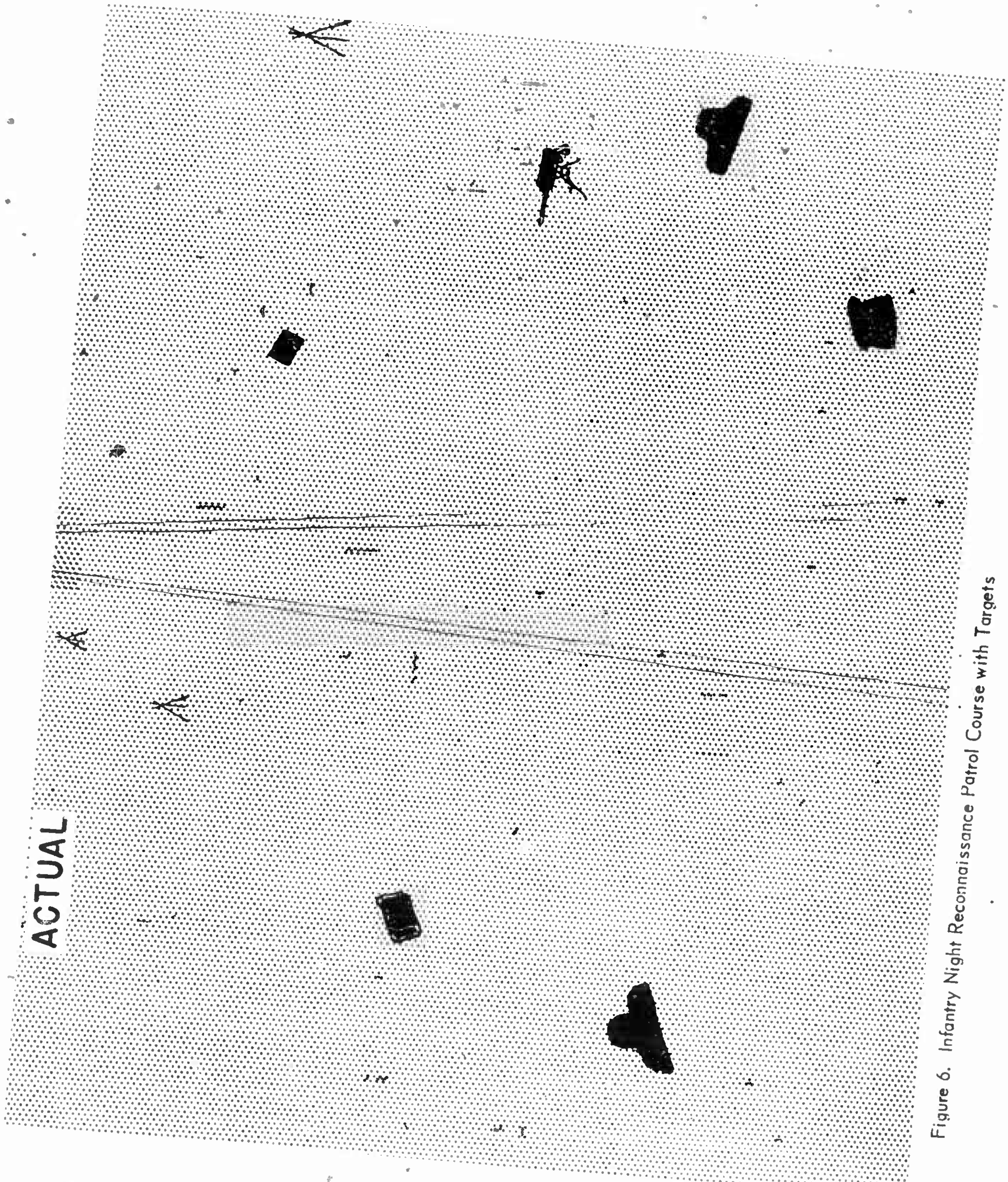


Figure 6. Infantry Night Reconnaissance Patrol Course with Targets

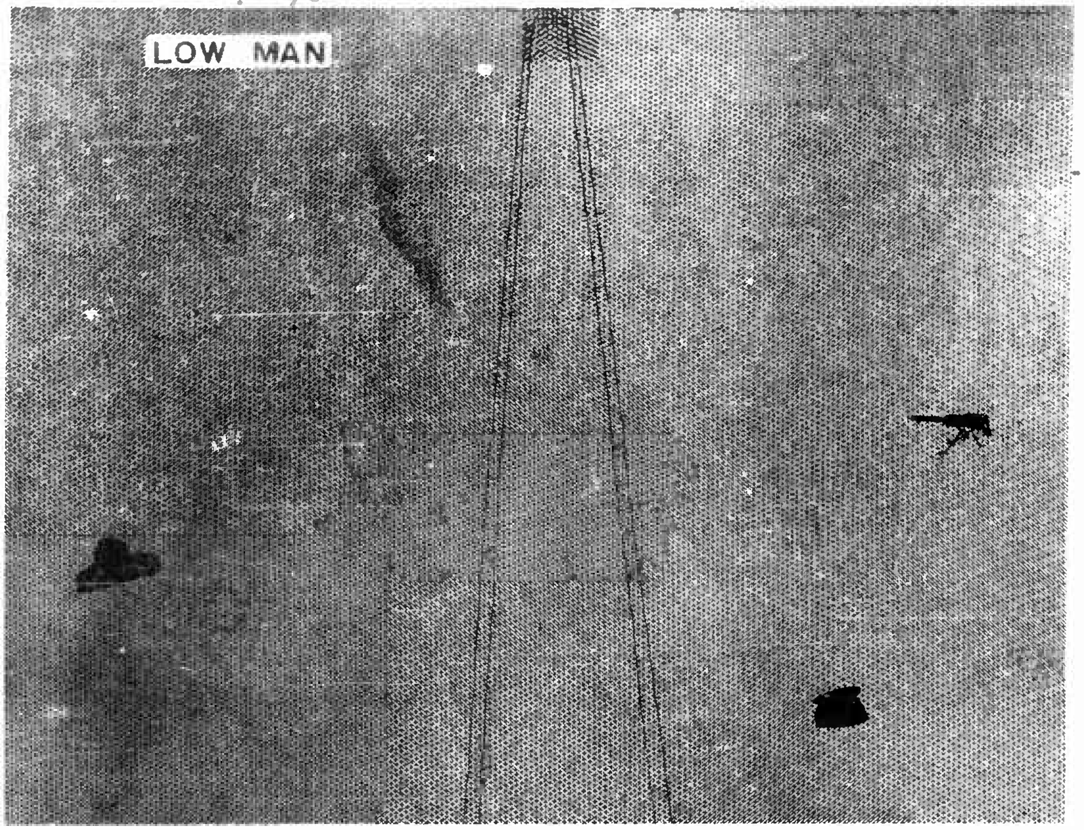


Figure 7. Infantry Night Reconnaissance Patrol Course with Targets (Low Group)

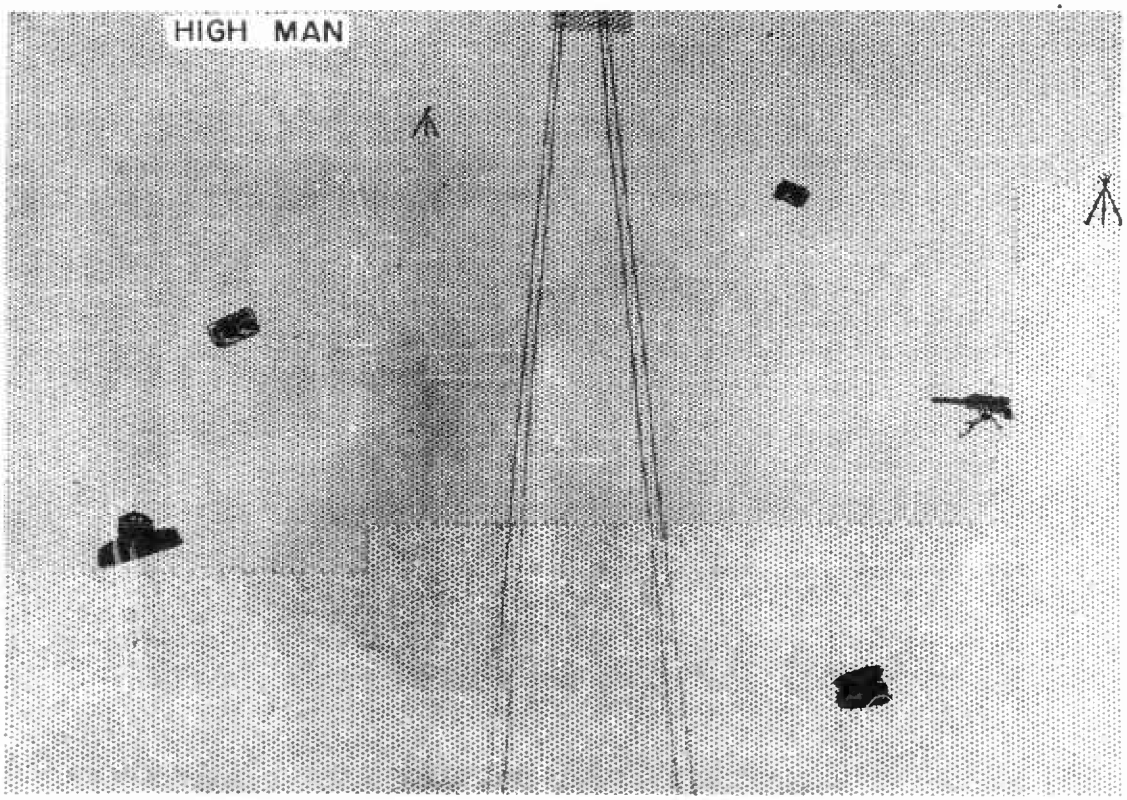


Figure 8. Infantry Night Reconnaissance Patrol Course with Targets (High Group)

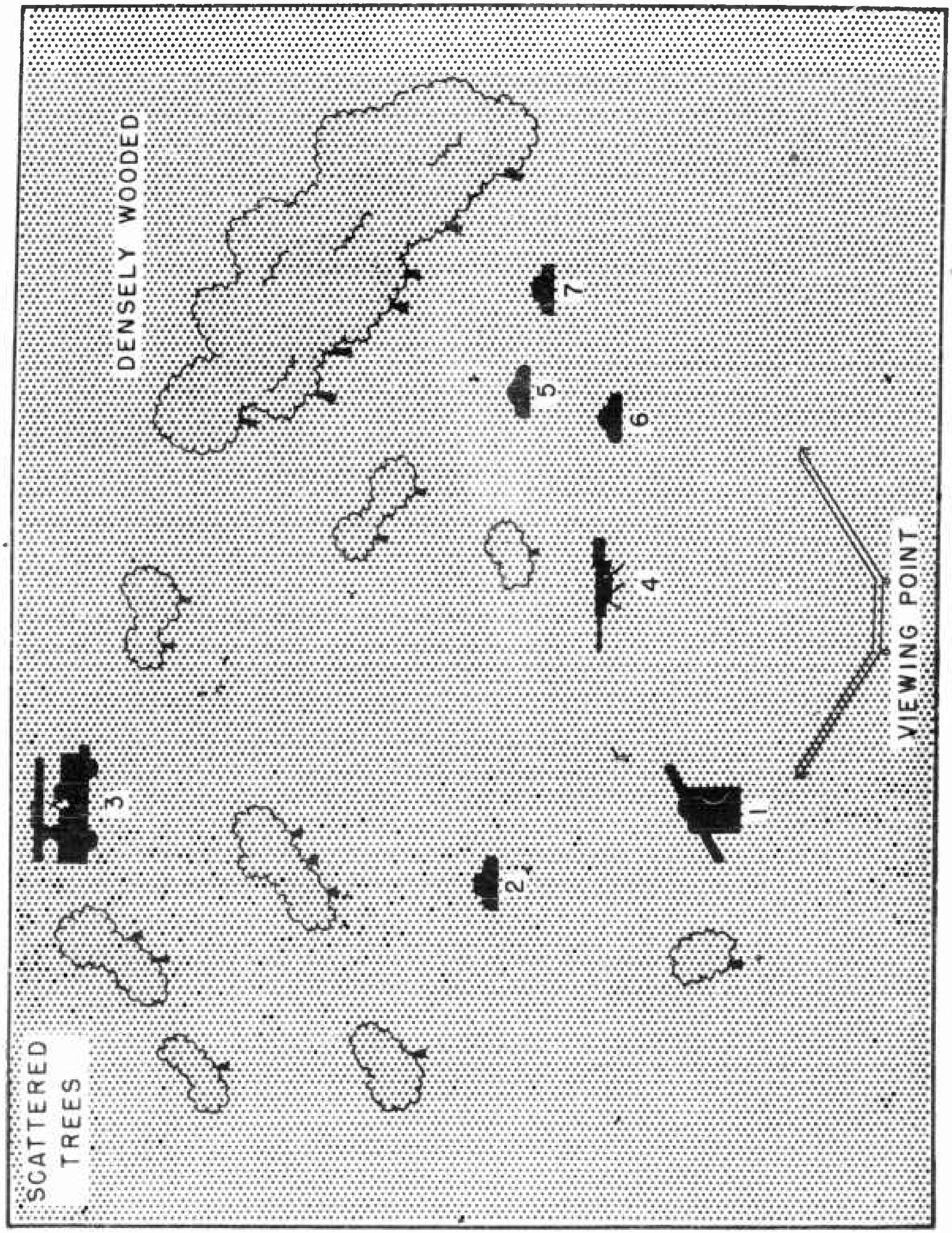


Figure 9. Top View of a Typical Fixed Position Outpost Problem

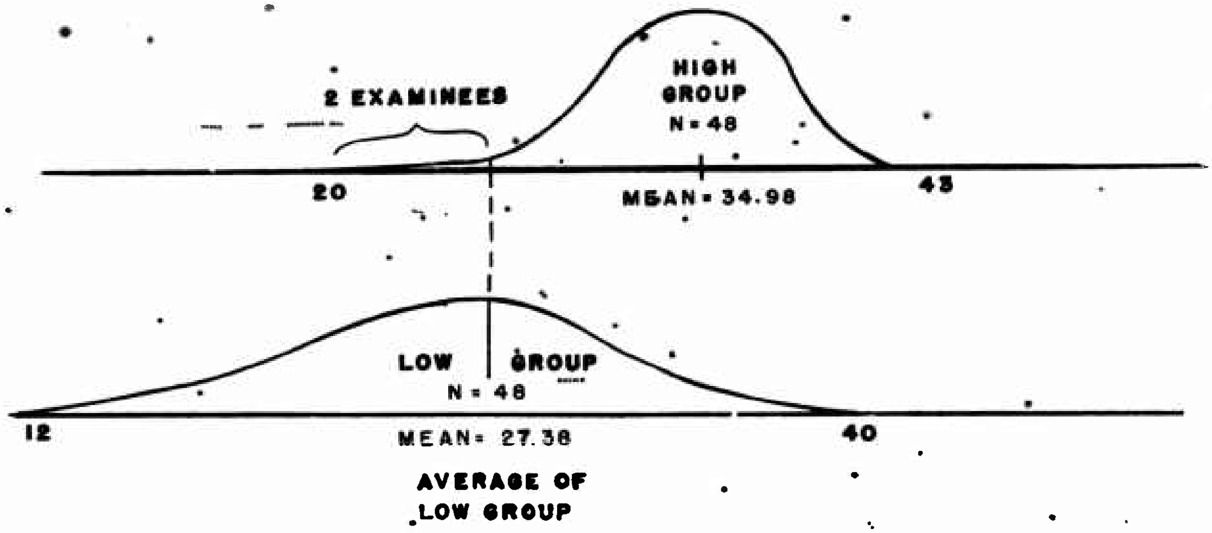


Figure 10. Detection Score Distribution for the Infantry Stationary Observer Course

Night Armored Patrol

In a third study, the night field problem was a simulated reconnaissance patrol designed to evaluate performance in detecting and identifying military vehicles and larger military targets. Enlisted men in their sixth or seventh week of the second eight weeks of basic training at Fort Knox, Kentucky were tested. For the field test, vehicles and equipment were set up against natural background as shown in Figure 11. The ground around the targets was covered with grass and low bushes. Trees surrounding the entire course prevented targets from being silhouetted against the sky. The soldier passing through the course was required to indicated the precise moment he detected the presence of a military target and then to identify the target. Scores were recorded in terms of the distance at which each man recognized the presence of a military object and the distance at which he identified it satisfactorily.

Men who scored high on the ANST consistently detected and identified the targets from greater distances than did men who scored low. The difference in performance of the two groups was greatest in the case of

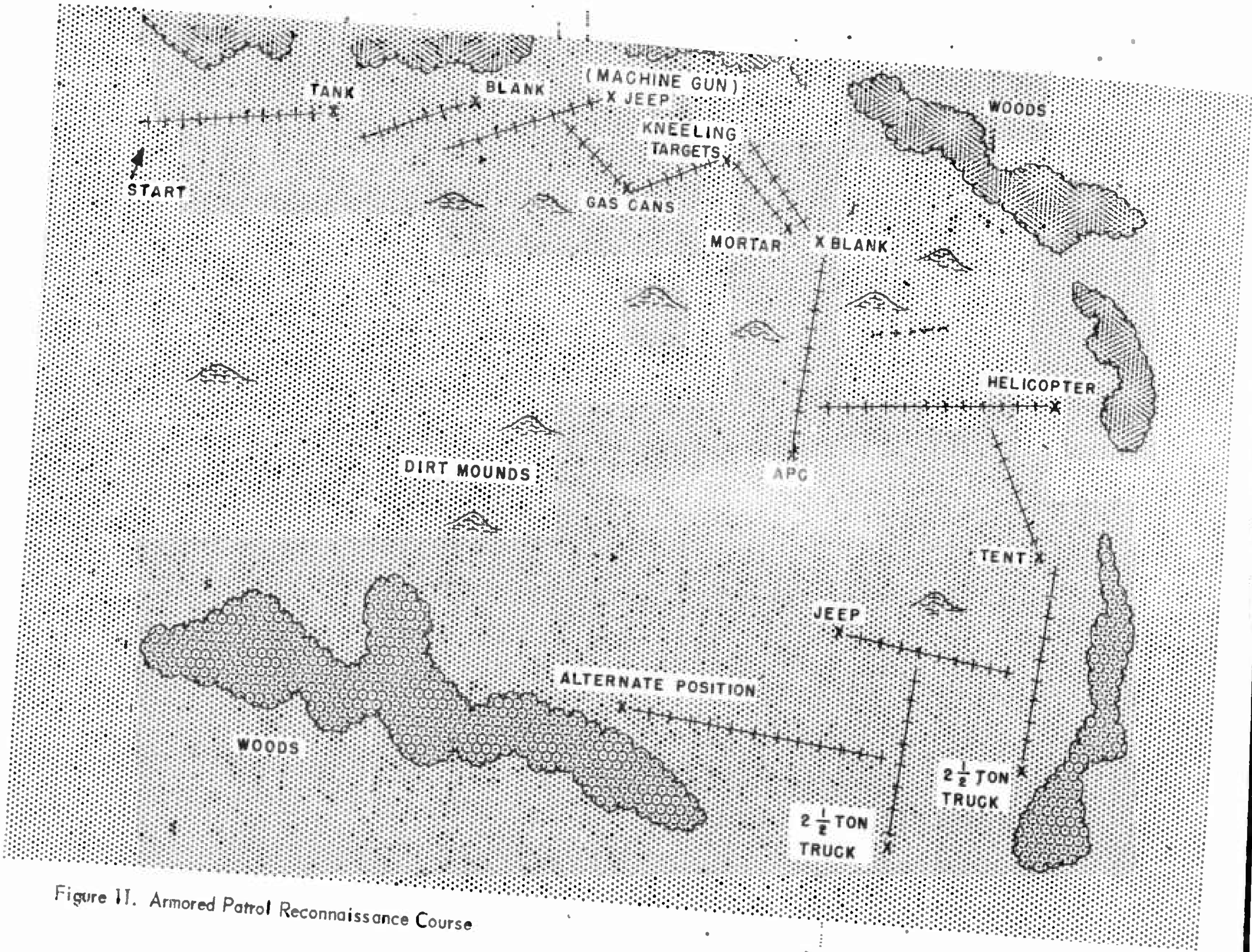


Figure 11. Armored Patrol Reconnaissance Course

large objects such as tanks and helicopters, generally considered of greatest importance in a military engagement. The high group, on the average, exceeded low group performance by the following distance:

	in detection	in identification
Large Targets	39 feet	26 feet
Medium Targets	13 feet	24 feet
Small Targets	10 feet	9 feet

Differences between the experimental groups in the three field trials were considered of practical as well as statistical significance and demonstrated the utility of the ANST in predicting the night seeing performance of infantry soldiers.

At the same time, the practicability of the ANST for field use was established. Even though the instrument used in the field trials was the ANST-I and not the current model, experimental testing imposed no special problems during the field runs. With the exception of the difference in light source--incandescent light rather than tritium--and the need for particular attention to maintaining illumination at the desired level, the experimental testing for the field trials closely approximated later field administration of the tests with the ANST-II model. Men were tested in ordinary quarters, no special accommodations being required.

SUMMARY OF FINDINGS

Early night vision tests served as a springboard for more intensive research on the night seeing process and vision testing procedures. The following research findings were applied in the test of night seeing ability currently recommended for Army use:

Individuals with best vision under daylight conditions are not necessarily those with best night seeing ability.

Night seeing ability involves two major factors: brightness contrast sensitivity and visual acuity for fine detail.

Vision tests administered at moonlight levels of illumination can be used effectively in predicting ability to see in night field situations.

Only ten minutes of dark adaptation time is required for testing at one-quarter moonlight levels, in comparison with 30 minutes required for testing in total darkness.

Measurement at moonlight levels simplifies testing and at the same time meets the practical needs of the Army.

The Army Night Seeing Tester is a reliable, standardized test of night seeing ability. The ANST-II model is engineered to the precise requirements established by experimentation on night vision testing. At the same time, it is light, portable, and rugged, well adapted for use in a variety of field conditions. Its usefulness for assignment purposes has been repeatedly demonstrated. Soldiers with high or better-than-average ANST scores in general perform more effectively in night field problems than do soldiers scoring low on the tests. A prototype device has been made available to USCONARC for possible use in meeting various requirements for identifying soldiers possessing night visual ability.

UTILIZING THE NIGHT SEEING TESTER

The Army Night Seeing Tester (ANST-II) was developed by the Human Factors Research Branch to provide a practical and effective means of evaluating military personnel according to their ability to see in the dark. Measures of night seeing ability obtained with the ANST have proved to be stable and valid measures of night seeing performance under conditions simulating night combat.

Using the information on individuals provided by the ANST, unit commanders can identify the men best qualified in night seeing ability. Combat teams can be balanced with respect to personnel having adequate capacity to see under night field conditions. Crucial assignments can be made with the assurance that accomplishment of a mission will not be impeded because soldiers in key positions are deficient in the ability to see in the dark.

THE ARMY NIGHT SEEING TESTER --
DEVELOPMENT AND USE

Technical Supplement

THE ARMY NIGHT SEEING TESTER--DEVELOPMENT AND USE

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CHRONOLOGICAL ACCOUNT OF MAJOR HFRB RESEARCH STUDIES ON NIGHT VISION TESTING

The account which follows presents in chronological order major studies which the Human Factors Research Branch has conducted in the area of night vision over a period of 15 years. A high proportion of the research effort has been devoted to the development of a testing device incorporating psychometric and practicable features essential to an operational night vision test. The studies enumerated mark essential steps in developing a practical test of night seeing ability. Each study has either added to existing knowledge of the night seeing process or has contributed some improvement in the procedural or technical mechanics of vision testing.

Pioneer Studies at Fort Sill, 1943

The Army's first major research effort in the measurement of night seeing ability took place at Fort Sill, Oklahoma, in August 1943. Members of the staff, working with military personnel of the Field Artillery School, explored the feasibility of classifying personnel according to their ability to see at night. To evaluate possible approaches to night vision testing, various types of apparatus were devised, all incorporating the principle of an incandescent or radium light source suspended in the front of a light-tight box. The basic device was known as the Army Night Vision Tester (ANVT). Six models, each embodying experimental variations in structure and lighting techniques, were validated against results of a night field reconnaissance problem. The criterion field problem yielded scores on the ability to detect and recognize common military objects along a marked path. Validity coefficients ranging from .21 to .73 were obtained (Field Artillery School, 1949). In view of the encouraging results achieved with relatively crude equipment, further research in night vision testing was considered justified. A major disadvantage of the procedure employed in the early tests was the 30 minutes dark adaptation required for each examinee prior to administration of the ANVT tests. The time requirement, coupled with the requirement for three rooms from which all light could be excluded, made it difficult to schedule testing at busy field installations.

Camp Blanding Validation, 1944

Further validation studies on the most promising of the early models (designated ANVT-15) were carried out at Camp Blanding, Florida in 1944. The Fort Sill equipment and procedures were used in testing five samples with N's ranging from 73 to 172. Correlation coefficients between ANVT measures and night field performance ranged from .52 to .55 for three of the five samples. For the remaining two samples, however, relatively low validity coefficients of .23 and .39 were obtained. The discrepancy was attributed partially to poor motivation among personnel of the latter two samples who were paratroops awaiting overseas orders. Difficulty of controlling test conditions during night field performance may also have operated to reduce validity of the predictors (Henry and Uhlaner, 1950).

In both the Fort Sill and the Camp Blanding studies of ANVT validity, test targets were presented solely under scotopic conditions (moonless night illumination). In fact, for most of the research conducted on the ANVT-15 and its successive modifications from the earliest studies to studies initiated in 1950, testing was performed under scotopic levels of illumination.

Research on Testing Procedures, Fort Knox, 1946

The Fort Sill and Camp Blanding studies had shown that the ANVT was a promising instrument for measuring the ability to see at night. However, both apparatus and test procedure needed refinement before the test could be considered practicable for field use. One of the problems noted in the early studies was the possible effect of seating arrangement on the test performance of examinees. In the typical arrangement, examinees were so positioned that both angle of view of the target and distance from examinee to target varied considerably for the different members of the examinee group. In the first of a series of three studies at Fort Knox in 1946 (N = 704), viewing angles were found to be a biasing factor when the angle of regard exceeded 20 degrees (Corbin, Karlin, and Wood, 1948). Variations in distance, although not markedly influencing the scores, were found to have some effect when changes of over 10 percent of the total distance were made. It was concluded that group testing with the ANVT could best be accomplished with 10 or fewer examinees at one time, seated in a single row at about 22.5 feet from the machine (which could be contained in an included angle of not more than 52.5 degrees).

A second study (N = 92 enlisted men) was conducted to determine the effects of practice on ANVT performance. Practice sessions were varied with respect both to number of sessions and illumination level. There was a tendency for test performance to improve slightly with practice, differences reaching statistical significance only for the experimental group receiving the maximum number (24) of practice sessions. Groups receiving practices at the highest level of illumination made the greatest gains from repeated trials.

The third and final study in the Fort Knox series was designed to provide a new set of brightness values for the ANVT and to reduce dark adaptation time to a minimum. Inductees were tested under three different scotopic illumination levels and following three different dark adaptation periods (20, 25, and 30 minutes). The 30-minute dark adaptation periods was found to provide a condition at which the examinees' ability to see at scotopic levels was maximal. Results indicated that in most situations where night vision is measured at scotopic levels of illumination, a 30-minute dark adaptation period is desirable. The need to reduce the mandatory period of preparation for testing structured to some degree the research orientation of subsequent studies in night vision testing.

Research on Mesopic Vision Measures

Emphasis on knowing how well the individual could see in total darkness had dictated development of night vision tests at scotopic levels of illumination. However, since military operations seldom proceed in total darkness but rather in varying degrees of illumination, less stringent approaches to the measurement of night vision were considered. If measures of the individual's ability to see under mesopic (moonlight), or even photopic (daylight) conditions, were found to be predictive of his ability to perform under night battle conditions, problems of night vision testing could be simplified. Accordingly, relationships among photopic, mesopic, and scotopic visual acuity were examined in a series of research studies.

The first of these studies, initiated in 1949, was designed to determine the relationship between photopic and scotopic visual acuity. Photopic visual acuity was measured by means of six wall charts (listed in Table 1) and two measures of daylight vision--near and far--obtained by means of the Bausch and Lomb Ortho-Rater. Measures of night visual acuity were obtained by means of the ANVT-R2X, a radium-illuminated version of the ANVT, in which a 2-degree black Landolt Ring was shown at 20 feet from the subjects. The sample consisted of 200 enlisted men stationed in the Washington area. Illumination varied through eight stages in the scotopic range--3.51 to 5.26 log $\mu\mu L$. From Table 1, it is evident that a positive correlation exists between photopic and scotopic visual acuity measures but that the relationship is not high enough to permit accurate prediction of one variable from the other. The findings also suggested that measures of visual acuity under some intermediate level of illumination might be usefully valid predictors of scotopic visual acuity (Uhlaner, Woods, and Machlin, 1950).

Further exploration of the relationship of photopic and mesopic visual acuity to scotopic visual acuity was accomplished by the Branch from data obtained in 1951 to 1952 using staff members as subjects. The ANVT-R2X was again used to obtain the scotopic visual acuity measures. Mesopic and photopic measures were obtained using wall charts including the Modified Landolt Ring, Line Resolution (Quadrant Variable Contrast), and Army Snellen targets presented at each of eight levels of illumination ranging from 10.16 to 6.03 log $\mu\mu L$. Results in terms of the rank order correlation between the ANVT scores and mesopic and scotopic measures are shown in Table 2 (Uhlaner, Gordon, Woods, and Zeidner, 1952).

Table 1

CORRELATION COEFFICIENTS OF THE SCOTOPIC VARIABLE (ANVT SCORE) WITH THE PHOTOPIC VARIABLES, CORRECTED FOR ATTENUATION OF THE PHOTOPIC VARIABLES (N = 200)

Photopic Variables	Correlation with ANVT	Correlation with ANVT, corrected for attentuation	Coefficient of Reliability, Test-Retest
Modified Landolt Ring	.35	.39	.80
Army Snellen Chart	.38	.40	.88
Line Resolution	.39	.42	.85
Quadrant Variable Contrast	.21	.28	.57
Dot Variable Contrast	.19	.29	.43
Checkerboard Variable Grid	.29	.32	.81
B and L Ortho-Rater (far)	.27	.29	.87
B and L Ortho-Rater (near)	.25	.27	.82

Table 2

CORRELATION COEFFICIENTS OF THE ARMY NIGHT VISION TESTER WITH RAW AND SMOOTHED WALL CHART TEST SCORES (N = 15)

Level of Illumination log $\mu\mu L$	Mod. Landolt		Army Snellen		Line Resolution	
	Raw	Smoothed	Raw	Smoothed	Raw	Smoothed
10.16	.58	.69	.42	.37	.35	.44
9.51	.61	.68	.44	.41	.12	.47
8.96	.59	.65	.47	.41	.53	.62
7.94	.69	.62	.56	.58	.48	.60
7.33	.60	.81	.57	.57	.65	.69
6.94	.62	.87	.61	.51	.53	.62
6.51	.81[a]	.82[a]	.35[a]	.63[a]	.26[a]	.58[a]
6.03	.57[a]	.62[a]	.63[a]	.63[a]	.04[a]	-.01[a]

[a] The relationships implied by these coefficients must be accepted with reservations as the mesopic tests upon which they are based showed inadequate differentiation and variance at these levels. Coefficients of .51 are significant at the 1 per cent level.

Additional testing of the same subjects by means of the Ortho-Rater made additional comparisons possible. The Ortho-Rater had been modified to permit presentation of targets at varying degrees of illumination. Sloan Visual Acuity plates containing block letters covering the visual range of 20/200 Snellen to 20/13 Snellen were presented at night levels of brightness ranging from 10.16 log $\mu\mu L$ to 6.03 log $\mu\mu L$. The relationship between scores on the scotopic test and the Ortho-Rater scores is shown in Table 3 (Uhlaner, Gordon, Woods, and Zeidner, 1952).

Table 3

CORRELATION COEFFICIENTS OF THE ARMY NIGHT VISION TESTER WITH ORTHO-RATER TEST SCORES (N = 16)

Level of Illumination Log $\mu\mu L$	Best Eye A	Best Eye B	First Binocular	Second Binocular
10.18	.18	.31	---	.12
9.51	.59	.59	---	.12
8.96	.63	.65	.40	.21
7.85	.68	.75	.54	.38
7.29	.49	.57	.40	.22
6.96	.22	.21	.51	.43
6.51	a	a	.43	.33
6.03	a	a	---	.35

[a]Inadequate differentiation of subjects was shown by the tests at these levels. Coefficients of .50 are significant at the 5 percent level.

High positive correlation between scotopic and mesopic acuity scores found in both studies suggested a degree of stability in the night vision measure. Only moderate positive correlation was found to exist between photopic and scotopic visual scores. Results reinforced the decision to concentrate on the development of tests of mesopic visual acuity as predictors of night seeing ability under military field conditions. But before shifting completely to mesopic testing, a further study of dark adaptation requirements for mesopic vision was completed (Zeidner, Gordon, and Goldstein, 1953). In administering mesopic vision tests to 100 enlisted men, periods of dark adaptation were systematically varied in length and results with different periods of preparation were compared. Dark adaptation was found to be adequate for mesopic vision testing at the end of 10 minutes. In subsequent studies of mesopic vision, dark adaptation time was therefore reduced from 30 minutes to 10 minutes, a saving of about 20 minutes for each test administered.

Development of a Practical and Efficient Tester

At about the time emphasis shifted to development of an effective mesopic vision test, there occurred a further reorientation in HFRB's vision research effort. Two major considerations prompted a shift in research approach from small group testing with room-size apparatus to individual testing and development of a precision instrument with which to administer tests of night vision. It has been found extremely difficult to provide standardized stimuli and to insure constancy of testing conditions in group testing. Further, the physical requirements of the ANVT apparatus were perceived as limiting the usefulness of the test. There was great dissatisfaction with the cumbersome equipment and testing arrangements (as well as with the lengthy dark adaptation periods) which were integral to the ANVT. Tests could not be scheduled without unduly disrupting training programs and occupying a large amount of building space for extended periods.

From 1953 on, Branch research efforts concentrated on the development of an individual testing device which would be technically adequate and at the same time feasible for operational use. The technical requirement was for an instrument which would provide adequate controls for testing at specified illumination levels and which would afford the examinee full opportunity to demonstrate his night seeing ability without residual error due to differences in equipment, position, or visual angle. The operational requirement was for an instrument which was durable and convenient to use, and which could be set up and used in any ordinary inclosure.

The Bausch and Lomb Ortho-Rater (previously used for photopic vision testing at induction stations) met certain of the stated requirements for individual testing and appeared potentially suitable to the proposed use. It was a binocular instrument which optically simulated distance viewing. After the required adaptations had been effected, the Ortho-Rater was redesignated the Modified Armed Forces Vision Tester (MAFVT). The MAFVT had a built-in light source which could be lowered to the desired mesopic level by means of density filters.

The shift to individual testing obviated the need for elaborate scoring equipment manned by a trained crew of scorers. Instead, a single scorer checked the examinee's responses against an answer sheet carefully designed to make the task as simple and error-free as possible.

Improving the Test Targets, 1953

The MAFVT represented a distinct advance in the field of night vision testing. However, further experimentation was required, particularly to determine the most suitable targets for use with the apparatus. A comprehensive study to evaluate different types of targets for night vision testing was conducted at the Engineer Center, Fort Belvoir, Virginia, beginning in 1953. The study involved evaluation of six targets:

New Army Snellen
Bausch and Lomb Checkerboard Variable Grid
Modified Landolt Ring
Line Resolution
Ortho-Rater New Army Snellen
Ortho-Rater Modified Landolt Ring

With the exception of the Ortho-Rater test plates, all targets were in the form of wall charts positioned 20 feet from the examinee. Tests were individually administered under mesopic illumination of 6.75 log $\mu\mu L$. The study resulted in the modification of five of the six targets and in the rejection of the sixth (Bausch and Lomb Checkerboard Variable Grid) as being too unreliable for use under mesopic conditions.

Based on the findings of the study, three of the original six test targets were modified to make them more suitable to night vision testing: the Landolt Ring, the Line Resolution test, and a letter-type test based on the Army Snellen Wall Chart. A fourth target was specifically tailored for testing at mesopic levels--a brightness discrimination target employing a chevron-shaped symbol of constant size. The symbol was constructed of fine parallel lines. Spaces between the lines were varied to produce shades of gray. The four targets were administered to a sample of 208 advanced trainees at Fort Belvoir in a study of target reliability. Examinees were retested 24 hours after initial testing. The highest test-retest reliability coefficient was achieved with the Mesopic Line Resolution Test ($r = .71$). The Letter test showed the next highest reliability ($r = .64$) and was the only other considered adequate for operational testing (Gordon and Houston, 1954). The Mesopic Line Resolution Test, with slight modifications, is one of the tests currently used as part of the Army Night Seeing Test.

Initial Field Trial of Mesopic Vision Test, 1953

The previous studies had indicated that the MAFVT and certain of the associated test targets had adequate reliability for operational use. The first field study to determine the validity of a mesopic vision test was conducted at Fort Benning, Georgia, in the summer of 1953. A sample of 256 infantrymen chosen at random participated in the study. The following tests were administered at specified levels of illumination by means of the MAFVT:

Army Letter Test--administered at mesopic and photopic levels
Line Resolution Test--administered at mesopic levels
Modified Landolt Ring Test--administered at scotopic levels

A night field problem constituted the criterion measure of night seeing ability. Infantry designated as aggressors were stationed in varying positions along the field course. The aggressors assumed varying positions at distances ranging from 10 to 150 yards from the examinee who was required to indicate whether he saw an aggressor and to describe the aggressor's position. The reliability coefficient (test-retest) of the criterion measure was .46. The somewhat low reliability was tentatively attributed to the possibility that significant fluctuations had occurred in the level of darkness under which successive test runs were held. The reliability of the vision tests proved to be satisfactory with coefficients ranging from .64 to .88. The mesopic Line Resolution Test proved to be a good predictor of night field performance with a validity coefficient of .51, corrected for unreliability of the criterion measure. Indeed, the test was as valid as the scotopic test, the Modified Landolt Ring (r = .52). Somewhat less valid were the photopic Army Letter Test with a corrected coefficient of .41, and the mesopic Army Letter Test, with a corrected coefficient of .31 (Marks and Uhlaner, 1955). The Benning field trial thus confirmed the effectiveness of vision tests administered at the mesopic level as predictors of practical ability to see at night, with Mesopic Line Resolution Test the most promising of the tests evaluated.

Factorial Analysis of Vision Measures, 1954

To obtain a clearer understanding of the nature of individual differences in visual acuity during dark adaptation to varying low illumination levels, and also to provide guidance for subsequent research efforts, the Branch in 1954 conducted a factorial study using data collected on 100 enlisted men stationed at Fort Myer. The men were tested with the Modified Landolt Ring and the Chevron Brightness Contrast targets at scotopic, mesopic, and photopic levels of illumination using the MAFVT to present the targets. Measures on each test were taken at successive stages of dark adaptation to scotopic, mesopic, and photopic light levels.

A principal-axes factor solution for a 35-variable intercorrelation matrix yielded eight factors of which four were found to contribute almost equally to 80 percent of the common factor variance. Examination of the four factors so obtained indicated that they could be grouped into two major classifications: factors associated with the resolution of fine detail, and factors involving the ability to perceive differences in brightness of relatively large areas (Zeidner, Goldstein, and Johnson, 1954). Findings of this study influenced subsequent HFRB night vision research in which most of the test targets have called upon the examinee's ability to perceive fine detail and to perceive brightness contrast.

The Army Night Seeing Tester (ANST)

While the MAFVT was definitely superior to the ANVT, research psychologists of the Human Factors Research Branch were convinced that even greater advances in night vision testing could be obtained by adoption of a new testing device. The Surgeon General's Vision Tester (SGVT), designed primarily for measuring photopic vision, offered certain advantages over the MAFVT. In contrast to the MAFVT, the SGVT provided a means of adjusting the current for illumination of the test targets. The apparatus was of sturdier construction than the MAFVT. It was portable, easier to maintain, and accommodated examinees with less discomfort.

Early modification in the SGVT were designed to adapt the apparatus for testing at night vision levels of illumination. Redesignated the Army Night Seeing Tester, the device incorporated the following desirable features:

Illumination was evenly distributed behind the targets.

The color composition of the source light was similar to actual night conditions.

Brightness could be maintained constantly at mesopic level (6.67 log μμL)

Ambient light could be masked out during testing so that the examinee's dark adaptation could be maintained.

Following initial trials, additional changes were made in the ANST by HFRB personnel with the assistance of the Bureau of Standards. The number of light bulbs was increased from two to six in order to achieve a better distribution of background light, and a blue filter was added to give more exactly the spectral composition of moonlight. The visual field was widened. Although the ANST had provision for adjusting the brightness of the light source, there was no way of determining when the light was set at the desired level. An illuminometer (Macbeth type) was incorporated in the ANST by means of which illumination could be matched to mesopic brightness level.

Fort Benning Field Trial, 1955

The ANST was given its first field tryout on a sample of 207 unselected trainees at Fort Benning, Georgia in the fall of 1955. The main purpose of this study was to determine the relationship of mesopic vision test scores to actual field detection performance at night. Predictor targets administered with the ANST were the Chevron Brightness Contrast Test, the Line Resolution Test, and the Landolt Ring Test. It had been observed that some target types which had not produced satisfactorily stable measures when administered in the form of wall charts proved much more reliable when incorporated in the later individual testing devices. Such was the case with the chevron brightness contrast target, originated as a wall chart for use in mesopic vision testing.

In the Benning study all tests were presented at the mesopic level (6.67 log $\mu\mu L$.) The night detection problem used as a criterion measure was the same as that used in the previous validation of the MAFVT in which soldiers designated as aggressors placed themselves in various positions at varying distances from the subject. The detection course was run under both full moon and no moon conditions. Results of this research indicated that the mesopic tests had little or no validity under "no-moon" illumination and a small but significant degree of validity for most positions under full moon conditions. Mesopic test reliabilities were only in the mid 50's. The reliabilities of the two criterion measures (testing under full moon and no-moon conditions) were in the .90's (Peters, Goldstein, and Berkhouse, 1956).

In its first use in the field, the ANST had proved to be a practical, efficient and rugged instrument well suited to the demands of field use; however, its psychometric qualities were disappointing and indicated the need for further modifications. As a first step, the light source was adjusted to insure consistency at the desired mesopic level (6.67 log $\mu\mu L$). Attention was also focussed on the targets as a possible source of unreliability. The original Brightness-Contrast Test was replaced by a device designed with the cooperation of The Bureau of Standards. Instead of using a series of chevrons of varying densities to regulate brightness-contrast, a device was introduced which changed density by means of the polarized effect obtained by the birefringance of cellophane surfaces placed at varying angles to each other. By turning a wheel in the target assembly through a specified arc, varying levels of contrast in the chevrons were produced.

Fort Jackson Field Trial, 1957

In the fall of 1957, the improved ANST was subjected to further field validation at Fort Jackson, South Carolina. The Mesopic Chevron Brightness Contrast Test, the Mesopic Line Resolution Test, and the Photopic SGVT Army Snellen Test were administered to 385 Reserve Forces Act trainees by means of the ANST. From the men originally tested the 60 men with the best performance on the mesopic tests and the 60 with the poorest scores were chosen for validation analysis. The criterion measure was performance on a standardized night reconnaissance patrol course. Men selected for the experimental samples were required to walk down a lane one yard wide and 110 yards long marked off with engineers' tape. Military type targets (field packs, stacked rifles, machine guns, and helmets placed to simulate prone infantrymen) were distributed at specified distances to the right and left of the marked path (Figure 6). Each man carried a two-way telephone and reported the military objects as he saw them to a recording monitor. To record the distance at which each target was sighted, engineers' tape calibrated in yards was fastened to the soldier's belt and reeled out as he walked down the pathway. In this way, a record of objects seen and the point from which they were seen was kept for each examinee.

Men with high scores on the ANST mesopic tests correctly identified about twice as many targets as did the low scoring men. The high group was also significantly more accurate in target detection, as distinguished from target identification--that is, they perceived the presence of more targets, even though they were unable to identify them correctly (Peters, Anderson, and Mellinger, 1959). This study demonstrated that the ANST was an effective measure of night seeing ability and provided further evidence that mesopic tests can furnish the necessary differentiations in individual night seeing ability.

Further Modification of the ANST

In the Fort Jackson field trial, the ANST was demonstrated to be sound in principle, but in need of certain refinements to facilitate operational testing. In preparation for field demonstrations scheduled for early 1959, important additional modifications were made in the instrument. When the modified tester was given preliminary tryout in testing Army personnel stationed at Fort McNair, all changes were found to contribute to making the ANST more suitable for field use. The more important changes effected at this stage of the research are listed below:

The headpiece was widened to permit testing of persons wearing Army-type glasses. (Prior to 1959, no men wearing glasses could be included in experimental samples).

The ventilation system was changed to prevent fogging of the lens system.

The blue glass filter was repositioned to prevent breaking from exposure to the heat of the light bulbs.

The polaroid chevrons were replaced with simpler photographic plates on which the full range of densities were represented.

FIELD DEMONSTRATIONS OF ANST VALIDITY

Fixed Position Observer Performance, Fort Benning, 1959

In April, 1959, with the cooperation of USCONARC, the ANST was given a field trial at Fort Benning, Georgia, aimed at demonstrating the validity of the ANST for predicting performance of infantry soldiers in situations typical of night operations, as well as the general feasibility of a night vision testing program in terms of demands upon materials, building space, and personnel. The demonstration was accomplished by comparing two samples of enlisted men, one scoring high on ANST mesopic vision tests and the other scoring low, with respect to their performance as fixed-position observers in a simulated night problem typical of infantry tactics. Experimental samples were selected from 210 men tested with the ANST under much the same conditions as would obtain were the test administered operationally, the tests being administered by enlisted personnel, with limited supervision by HFRB personnel.

The night field problem against which the predictive effectiveness of the mesopic measures was evaluated consisted of eight observer outposts (one of which is shown in Figure 9). The examinee's tasks was to scan a prescribed field of view and report to the scorer if he saw any military objects. He was also asked to name the object if he could and indicate its position. The data collected made possible three different indicators of practical night seeing ability: the number of military objects reported (detection score), the number of military objects correctly named (identification score), and the number of errors in which natural objects were mistaken for military targets (error score). Men scoring high on the ANST tests performed significantly better than the low men in both detection and identification of targets (Table 4). While there was no real difference between the samples with respect to the error score, the ratio of correct to incorrect responses definitely favored the high scorers. A correlation coefficient of .43 was found between the identification score on the night field problem and total ANST score, after correction for the missing middle group of the sample (Martinek and Mellinger, 1959).

Table 4

MEANS AND DIFFERENCES IN NUMBER OF TARGETS DETECTED AND IDENTIFIED FOR HIGH AND LOW SCORING GROUPS ON ANST

	Highest 25%	Lowest 25%	Diff.	Percent Improvement High vs Low Group
Targets Detected	35.0	27.4	7.6	27.8
Targets Identified	27.2	19.7	7.5	38.0
Errors	4.9	4.7	0.2	3.6

Armored Patrol Course, Fort Knox, 1959

A second field trial of the ANST was conducted at Fort Knox in 1959 to establish whether the ANST was as predictive of night vision performance required for Armored tactics as it had been found to be for night infantry patrol performance. ANST mesopic vision tests were administered to 193 advanced Armor trainees with 15 weeks of basic training at the Armor Training Center. As at Fort Benning, tests were administered by Army enlisted men who had had less than an hour's instruction from HFRB personnel. As in the earlier infantry studies, two experimental samples were selected from the larger sample on the basis of ANST scores, each sample numbering 40. The night field problem which provided criterion scores was a simulated night reconnaissance patrol in which standard military vehicles and equipment were set up along a marked course. As the examinee followed the indicated path, he reported to the recorder accompanying him the moment that he saw "something". He then advanced to the point where he was able to identify what he saw. (A map of the course is shown in Figure 11.) All outdoor testing was done during two moonless and cloudless nights for which photometric readings did not differ significantly. To avoid compromise of the course, some targets were interchanged on the second night of testing. On both nights, some target positions were left blank to discourage false or premature reporting by examinees. To reduce the effect of differences in illumination or other test conditions on mean scores, an equal number of high and low ANST scorers were put through the course at the same time. Scores for the field problem were in terms of distance from the object at which the examinee reported sighting a military object (detection), the distance at which he named it (identification) and the number of times he reported a natural object as a military target (misidentification).

The results presented in Table 5 indicated that men scoring high on the ANST tests were definitely superior to the low group in the night field problem. ANST measures yielded correlation coefficients of around .40 against the recognition and identification scores, indicating useful validity for selecting men for assignments requiring superior night seeing ability (Martinek, Tanck, and Mellinger, 1959).

Table 5

MEAN AND DIFFERENCES BETWEEN MEANS OF HIGH AND LOW SCORERS ON THE ANST IN YARDS IN DISTANCE REQUIRED FOR DETECTING AND IDENTIFYING MILITARY OBJECTS

		Highest 25%	Lowest 25%	Diff.	Percent Improvement High vs Low Group
Large Objects (Tanks, Trucks, Helicopters, etc.)	Detection	80.1	66.8	13.3	19.9
	Identification	49.4	40.7	8.7	21.4
Medium Sized Objects (Jeep, silhouettes)	Detection	45.5	40.9	4.6	11.2
	Identification	28.3	20.3	8.0	39.4
Small Objects (Gas cans, Tents Mortars)	Detection	17.8	15.3	2.5	16.3
	Identification	12.8	9.9	2.9	29.3

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THE ARMY NIGHT SEEING TESTER--DEVELOPMENT AND USE by
Julius E. Uhlaner and Joseph Zeidner. May 1961.
Rept. on Image Interpretation Task. 47p. incl. 11 figures. (HFRB Technical Research Report, No. 1120)
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To implement the USCONARC requirement for an effective and simple test on night visual acuity, research was conducted concurrently on basic experimentation into human individual differences in the night seeing process and on the development of instruments to test night seeing ability. Experimental testing revealed two major factors to be involved: brightness contrast sensitivity and visual acuity detail. A useful relationship was also determined between seeing ability at intermediate (moonlight) levels of illumination and at very low (starlight or moonless) levels. Development of instrumentation for night vision testing resulted in the engineering of the ANST-II, a compact, portable, rugged, and easy to use model. Field use, under varying conditions, demonstrated its practicability, usefulness, and reliability in meeting Army night seeing testing needs. An ANST-II prototype has been made available to USCONARC for possible use in meeting various requirements for identifying soldiers possessing night vision ability.

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