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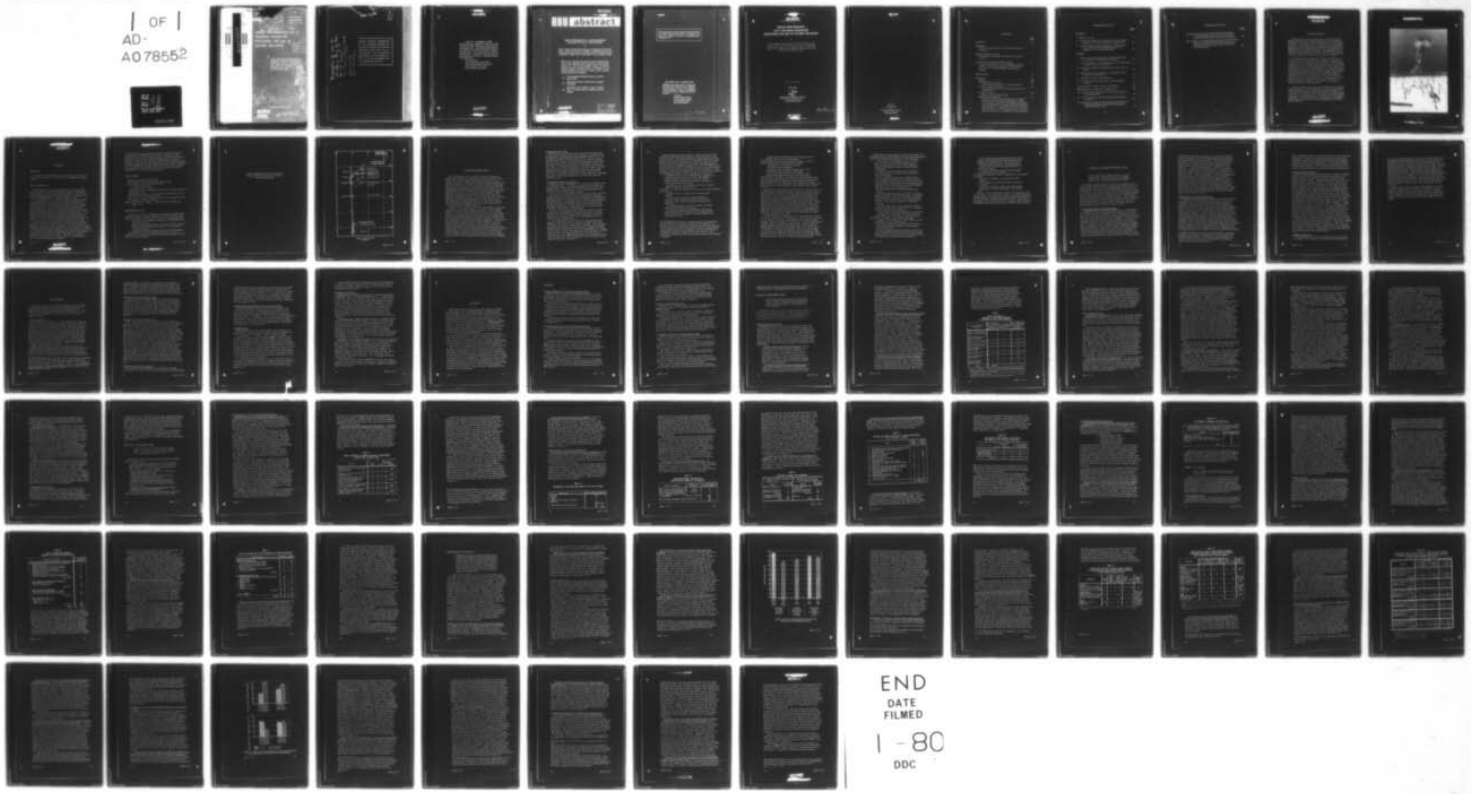

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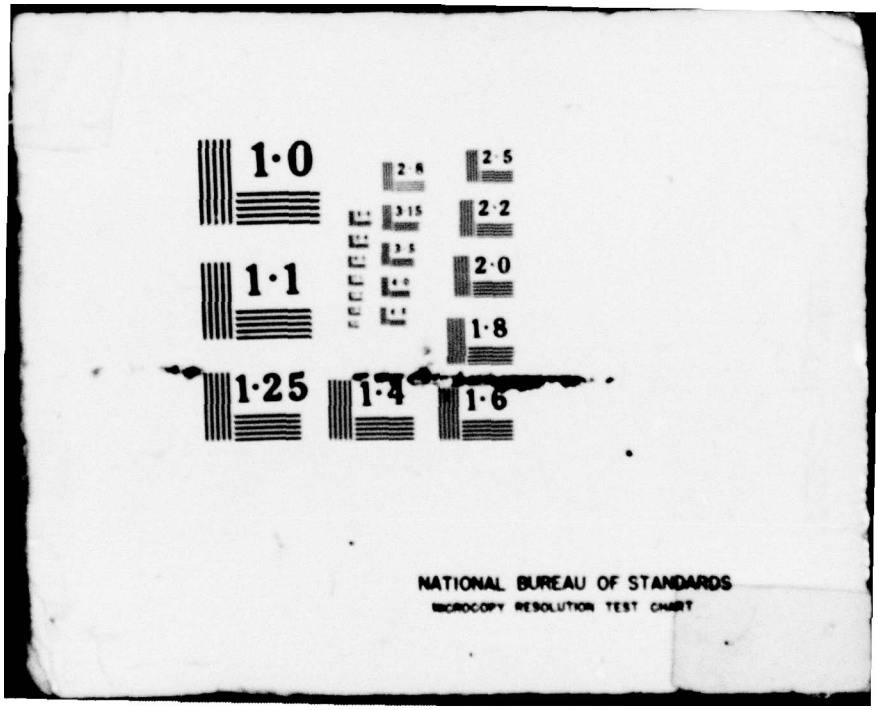
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TECHNICAL MEMORANDUM ORO-T-170

TROOP PERFORMANCE ON A TRAINING MANEUVER INVOLVING THE USE OF ATOMIC WEAPONS

By

Alfred H. Haworth (Project Chairman), Solomon O. Billingsley, Stanley W. Davis, Henry P. Gilpin, and Florence N. Trefethen, in collaboration with Lewis M. Killian, John D. Montgomery, Stanley C. Preston, and Paul V. Trefethen and with Nathaniel R. Kidder, Mary G. Page, Charles Post, and Shirley C. Dunn.

Declassified by order of Security Army by HAC per 79-516/5 per Ruth Sharky 5/14/79

DTK-013,565
DTK-74,0975

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The Director
Operations Research Office
The Johns Hopkins University
6410 Connecticut Avenue
Chevy Chase, Maryland

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ORO abstract

TROOP PERFORMANCE ON A TRAINING MANEUVER INVOLVING THE USE OF ATOMIC WEAPONS

by

Alfred H. Hausrath (Project Chairman), Suzanne G. Billingsley, Stanley W. Davis, Henry P. Griggs, and Florence N. Trefethen; in collaboration with Lewis M. Killian, John D. Montgomery, Harley O. Preston, and Paul V. Treville; and assisted by Nathaniel R. Kidder, Mary G. Page, Gladys E. Post, and Shirley C. Dunn.

ORO set out to appraise the performance and psychological reaction of troops undergoing their first experience with the A-Bomb. Analysts were with the troops (before, during, and after the Exercise) observing individual behavior as evidenced by views expressed publicly and privately, by conduct, and by emotional reaction indicated by the polygraph.

- **The men performed adequately and gave no outward signs of fright.**
- **Physiological evidence showed there was significant tension.**
- **Performance, when A-Bomb is used, of typical troops in combat cannot be predicted from this maneuver.**

abstract taken by _____ date _____

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Abstract page from: ORO-T-170
Log No. 17998
Copy No. 170
(ix + 64pp, 3 Figs., XNI Tables)
Received: 19 March 1952
Project SHOP

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Received: 15 March 1952

Project Shop

OPERATIONS RESEARCH OFFICE
The Johns Hopkins University
Chevy Chase, Maryland

Log No. 17993
Copy No. 170 of 250

UNCLASSIFIED

SECURITY [redacted] INFORMATION

Published

29 March 1952

by

OPERATIONS RESEARCH OFFICE

6410 Connecticut Avenue

Chevy Chase, Maryland

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ACKNOWLEDGMENTS

This ORO study is part of a larger study of the performance and psychological reactions of troops participating in a tactical maneuver employing an atomic bomb, initially suggested by Maj. Jay B. Mowbray, Dr. Harry F. Harlow, and Dr. John L. Finan, then of G-4, Department of the Army. They arranged a joint investigation in which Information and Education Division (Department of Defense), the Adjutant General's Office, and ORO were invited to participate. The studies were to be coordinated by the Human Resources Research Office (HUMRRO), and Dr. Finan, who became an Assistant Director in that office, was designated coordinator. Major Mowbray served as military liaison officer.

ORO gratefully acknowledges the full cooperation of Maj. Gen. W. B. Kean, Camp Commander and Exercise Director, and his staff. Lt. Col. James R. Tully, Commander of the 1st Battalion, 188th Airborne Infantry Regiment, 11th Airborne Division, and 1st Lt. Sam T. Dewhirst, Commander, Battery C, 546th Field Artillery Battalion, and their subordinate officers provided invaluable assistance. A photographic record, both still and motion pictures, of troop performance during preliminary preparations and the maneuver was prepared by Signal Corps cameramen, from the Signal Corps Photographic center under Major Ralph Tudor, and working with Maj. T. W. Gavey, of the Armed Forces Special Weapons Project. Staff Film Report No. 177 is the first extract from this film record to be released for Army use. ORO expresses its appreciation to all of the above and the officers and men of the 1st Battalion, 188th AIR, of Battery C, 546th FAB, and of III Corps at Camp Desert Rock, for their cooperation.

A separate report, jointly prepared by the Attitude Research Branch, Armed Forces I & E Division, Department of Defense, and the Attitude Assessment Branch, Troop I & E Division, Department of the Army, "A Study of Soldier Attitudes and Knowledge About Atomic Effects, Exercise Desert Rock, February, 1952," complements the ORO performance study. Both the attitude and performance studies are to be forwarded to HUMRRO, for such further analysis and comparisons as the HUMRRO staff considers useful to include in the combined report to be issued later by HUMRRO.

SIGNAL CORPS PHOTO

Watching the A-Burst 7 miles away.

SUMMARY

PROBLEM

To appraise the performance and psychological reactions of troops participating in a tactical maneuver employing an atomic bomb.

BRIEF NARRATIVE

At the request of G-4 of the Department of the Army, the Operations Research Office undertook a study of troop behavior during a maneuver involving an atomic explosion, as part of a psychological evaluation of troop performance in connection with Exercise DESERT ROCK, in October-November 1951.

On 1 November 1951, at 0725, an atomic bomb was exploded over emplacements at Yucca Flats, Nevada. an augmented Battalion Combat Team witnessed the explosion at seven miles from Ground Zero. Sixty minutes later, these troops traveled by truck to the previously prepared Battalion Combat Team position, approximately 2 miles from Ground Zero, where they inspected damage to their own weapons and emplacements. They next marched in single files to approximately 500 yards from Ground Zero, then to those positions where they could inspect damage to animals and heavy equipment exposed to the bomb, and finally returned to their trucks and were driven back to camp.

An ORO observer remained with the airborne infantry participants from 10 October, while they were still at Fort Campbell, Kentucky, until after D-day, 1 November. Six observers, including a polygraph operator plus equipment, arrived at Camp Desert Rock a week prior to D-day and accompanied the Team during the Exercise. Three observers, including the polygraph operator, visited Fort Campbell for post-exercise studies. Data were collected by observation, questioning, and polygraph test (measurement of heart rate and blood pressure changes.)

Four types of individual behavior were the objects of inquiry: (1) the publicly expressed views of troops, (2) their privately expressed views, (3) the conduct of troops, and (4) their emotional reactions as indicated by involuntary physiological responses. A study of all four kinds of behavior would, it was assumed, furnish valuable preliminary data upon which to base predictions of behavior of soldiers engaging in combat operations in which atomic weapons were employed. The exercise, however, had several marked limitations as a simulated combat situation.

CONCLUSIONS

Every man performed adequately.

Practically no men showed visible signs of fright.

Nevertheless significant tension existed:

- In camp before D-day
- At the test site, at H-hour

The A-bomb maneuver and a parachute jump were approximately comparable fears.

Physiological evidence revealed more fear than either performance or verbal responses indicated.

Performance of typical troops in combat with A-weapons cannot be predicted from this maneuver.

NOTE: See Findings, pages 20-22 and Critique of the Exercise, pages 11-14.

RECOMMENDATIONS

Because evidence was obtained that significant emotional disturbance was present in troops engaged in an atomic maneuver free from the realities and stresses of combat it is recommended that:

The maneuver be repeated using typical troops under more realistic conditions.

Physiological and performance measures be used on larger numbers of participating troops under a more adequate scientific procedure.

Comparable data be collected on men in combat situations.

These studies are believed desirable in order to assess adequately the probable performance of troops in combat involving the use of atomic weapons.

TROOP PERFORMANCE ON A TRAINING MANEUVER INVOLVING THE USE OF ATOMIC WEAPONS

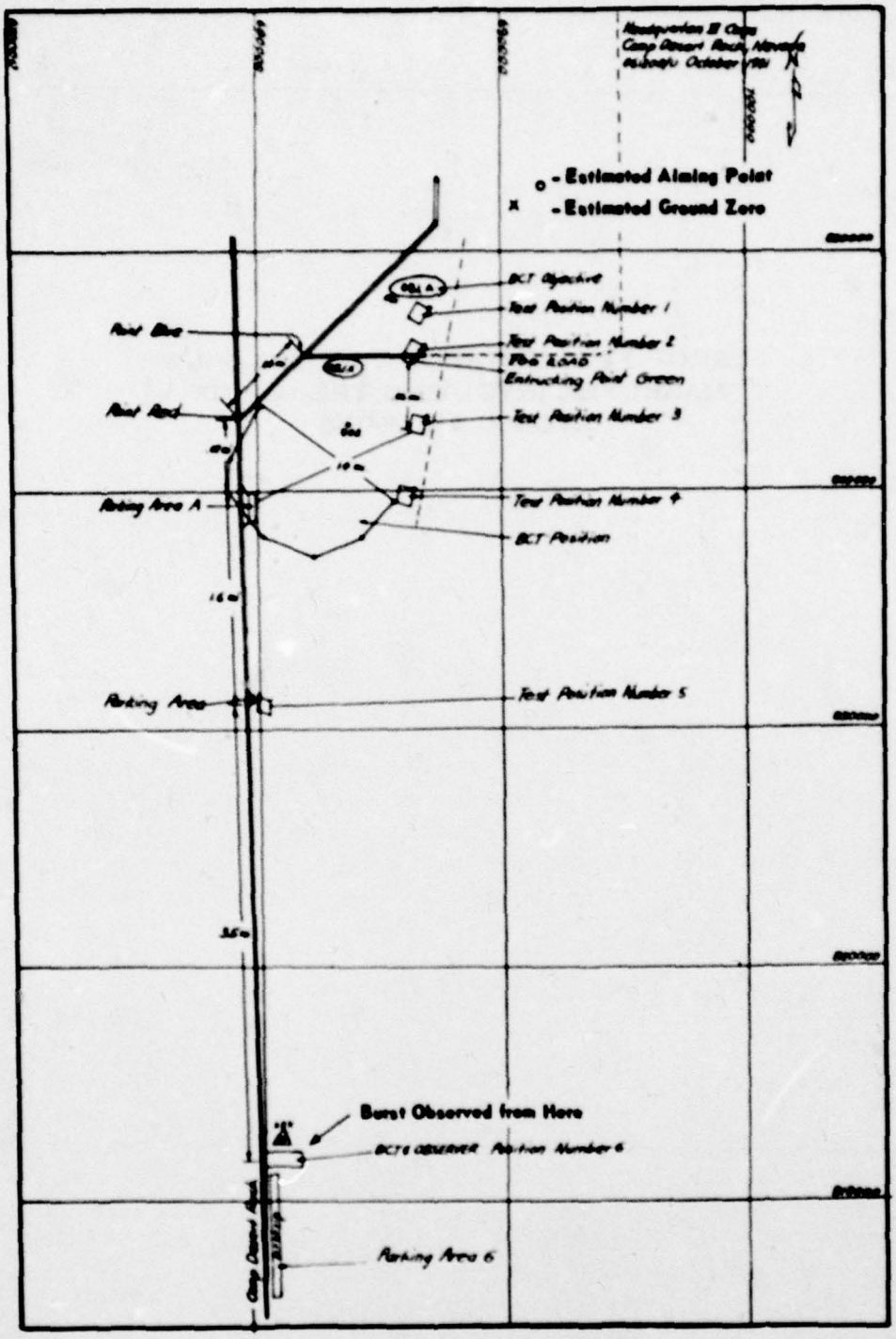

FIGURE 1.—Map of Test Site
(Not to Scale)

EXERCISE DESERT ROCK

On 17 September 1951, the Office of Public Information, Department of Defense, announced that men of the Army, Navy, and Air Force would engage in maneuvers in the series of nuclear detonations to be held at the Atomic Energy Commission's Nevada Test Site. Lt. General Joseph M. Swing, Commanding General of the Sixth Army, announced at a press interview, on 20 September, that Infantrymen who would participate in Exercise DESERT ROCK would be drawn from the 11th Airborne Division, stationed at Fort Campbell, Kentucky, while Artillery, Tank, Engineer and Supply units would come from other outfits considered to be ready for battle. The following day, Maj. General William B. Kean, Commanding General of the Third Corps, officially opened Camp Desert Rock, near Las Vegas, Nevada, where maneuver and supporting troops and official observers would be encamped during the exercise.

Troops of the 11th Airborne Division were unable to ascertain, on the basis of newspaper reports, just which of their number would be involved in the prospective maneuver. On 2 October, however, Troop Information and Education Division, Department of the Army, began a program of attitude surveys relating to the Exercise by administering a questionnaire to men selected from the 1st Battalion, 188th Airborne Infantry Regiment. Furthermore, between October 2nd and 12th, this same battalion was given a six-hour indoctrination course in nuclear weapons. Since no other battalions received similar indoctrination at that time, it became reasonably evident that the first battalion had been selected to participate. The unit received no official confirmation of this at Fort Campbell, however, and the various serials of troops became finally certain of their mission either during the flight or as they arrived in Nevada between the 12th and the 15th of October.

Preparations for D-Day

During the interval between their arrival and the day of the maneuvers, participating troops were engaged in setting up their encampment, preparing their emplacements at the test site, and attending additional indoctrination lectures. Camp recreation facilities were meagre. Because of the long hours of hard labor during the day, the 62-mile journey separating the camp from Las Vegas, and limitations on passes, few troops went into town more than once or twice during their stay at the camp. Once the foxholes and other field fortifications at the test site had been completed and equipped, an enterprise which required many days' work, troops participated in two rehearsals of the impending maneuver in which they learned the procedures they were to follow on D-day.

The Sequence of Events on D-Day

On D-day itself, 1 November 1951, there was an 0200 reveille at Camp Desert Rock. The men were given their breakfast at approximately 0300 and entrucked at 0400 for the 30-mile ride to Test Position 6, approximately 7 miles south of Ground Zero. The ride in convoy took nearly two hours.

On arrival at Test Position 6, the troops detrucked, marched to their observation positions, then broke ranks and mingled casually during the interval before reassembly for the detonation. During this wait, the orientation officer addressed the troops over the loud speaker, providing them with such information as the location of Ground Zero and the identification of three planes, including the bomb plane, which flew over the test site for the first time at about 1 hour before H-hour.

At 0715, the Battalion Combat Team was ordered to fall in at their observation positions; and at H-hour minus 1 minute, the order to "sit down and face south" was given. The troops could hear the seconds counted over the loudspeaker and, at 0725, the order "Bomb Away."

It was about thirty seconds after this order that the flash appeared. After three more seconds, the troops were told to turn around so that they could watch the fireball. They had previously been instructed to remain seated on the ground until after the shock waves had passed, which occurred roughly 30 seconds after the flash. Within 30 minutes after the shockwaves, radiation monitors with their equipment had left to check the levels of radioactivity at the emplacement area and at Test Positions 1 and 2 near Ground Zero. Official observers also entrucked to ride forward toward the area of burst.

Another half hour passed, however, before the troops of the Battalion Combat Team boarded their trucks for the first stage of their advance. Once they had arrived at the emplacement area, about 2 miles south of Ground Zero, they detrucked, were briefed and then dismissed so that they could inspect the emplacements they had built and equipment they had left. The film badges which had been attached to their rifles and other pieces of equipment were removed so that they could be handed in later to monitors. At the Battalion Combat Team emplacements and at Test Position 4 nearby, the following examples of serious damage were evident: 1/

Sandbags on foxholes were badly burned, and pieces of burning burlap had fallen on a rifle in the foxhole resulting in the rifle stock's being charred, and the bolt assembly's being affected so that it could not be moved more than an inch or two.

The windshield of a jeep had been blown out, and was found forty feet behind the vehicle.

There were, in addition, examples of moderate or minor damage in the same area:

Fatigues worn by a dummy left in the open were charred.

The wool on two sheep left above ground was scorched. One, which was assumed to have been facing the blast, had small blisters around its eyes and mouth.

The wooden linings of some revetments, and sandbags in the foxholes were charred.

A small percentage of the sandbags on the surface unshielded from direct exposure to the explosion had been scorched on the exposed side of the foxholes and some were burning.

1/ A resume of the damage in moderate detail is provided here in order that the reactions of the troops participating in the Exercise may be considered in relationship to what they observed. At the emplacements and Test Positions, all participants had the opportunity to inspect all the damage. Effects of the explosion encountered during the single file marches, however, were visible only to those sticks of men passing each particular example of damage.

A pup tent with a dummy in it was blasted flat; the dummy, however, was not damaged.

Other material in the emplacement area and the nearby test positions appeared to have suffered no damage:

All tanks were in operable condition.

Field guns were undamaged.

Nearly all rifles and small weapons were where they had been placed and were undamaged.

Two sheep which had been left in foxholes were eating hay and appeared to have suffered no harm.

The men were told that, if they had been in their foxholes with their backs toward Ground Zero and crouched close to the north wall (shielded from the explosion), they would not have been injured; that if, on the other hand, they had been above the ground, there would have been casualties to the probable extent of fifty percent.

Troops were then formed into fifteen sticks, each of which, in single file and preceded by monitors, began their advances toward a point beyond Test Position 1, bypassing Test Positions 1 and 2. Observers in some of the sticks report that from two miles to 1500 yards, the desert floor had been swept clean of loose dust and dirt, and that from 1500 to 500 yards, the desert floor was covered to a depth of three inches with loose dust and dirt. Other sticks observed that the earth had apparently been sucked from around rocks and vegetation and the ground loosened. Directly under the burst the vegetation was charred in a ring shaped area about 100 yards wide encircling a barren area about 500 yards in diameter. At Point Zero, within the ring, there was no visible scorching on the desert surface.

At about 500 yards from Ground Zero, the troops were ordered to turn and to walk toward Test Position 1, then on to Test Position 2. At each of these points, participants were invited to inspect damage. Radiation monitors checked all personnel at Test Position 2 before troops entrucked to be driven back to Test Position 5, approximately 4 miles south of Ground Zero. At Test Position 5, the Battalion Combat Team detrucked, listened to a briefing by Lt. Colonel J. R. Tully, Commander of the 1st Battalion, 188th Airborne Infantry Regiment, and were urged to inspect the equipment in that area. After the inspection interval, participants again boarded the trucks for the ride back to Camp Desert Rock.

In the course of their maneuver itinerary forward of the Battalion Combat Team position, troops had the opportunity to observe the following severe effects of the explosion:

In the area of Test Position 1, one 6-inch steel pipe, erected vertically and protruding about 7 feet, was tilted away from the blast at approximately a 40° angle and another at approximately a 20° angle.

Joshua trees as far as two miles from Ground Zero were broken off, badly charred and some were still burning.

Pieces of twisted angle iron, ranging from 6" to 6' in length were scattered over part of the area. These probably had been previously broken loose and scattered from a tower used in an earlier detonation. These pieces of metal showed levels of radioactivity which were high, but not dangerously so.

At Test Position 1, an unrevetted foxhole had caved in.

An above ground jeep had its windshield cracked, though it had been in horizontal position. Headlights were discolored, seat covers scorched and burned, and the vehicle had been moved back approximately five feet. The jeep was, however, in operable condition.

One field-type rubber water tank had collapsed and burned. One side of another tank was collapsed and the supporting stays shattered.

The left span of a Bailey bridge had been displaced.

A dummy, which had been left on the surface at about 1000 yards, was badly scorched and burned.

There was, in addition, some moderate damage:

A BAR, a 30-caliber gun, a sniperscope and most tanks had received minor damage.

2x2 wooden stakes at distances from 500 yards to a mile and a half were charred on the two sides nearest Ground Zero.

An above-ground tank had the rubber on the track nearest the explosion and at the front end of the tank partly burned. Its aerial was bent, and dark paint on the side nearest the blast severely blistered.

The wool of two sheep which had been left on the surface, 1000 yards from Ground Zero was badly scorched on rump and back. The muzzle of one sheep was blistered and one of its eyes blinded.

A jack rabbit at 500 yards appeared dazed, but was able to run off.

A lizard at 500 yards stood its ground to fight. Its tail appeared to be scorched.

The following equipment, however, appeared to have suffered no damage:

All items in foxholes at all positions or test locations.

A WA telephone and SCR 536 radio, both left on the surface.

Two of the field water tanks and a water pump.

Pill boxes, except for having their doors blown open.

On their return to Camp Desert Rock, all troops were told to take showers and change their clothes. On the following day, arrangements for transporting Airborne Infantry personnel back to Fort Campbell and field artillery personnel to Fort Lewis, Washington, were begun and, within a few days, all members of the Battalion Combat Team had been returned to their stations.

CRITIQUE OF EXERCISE DESERT ROCK

Exercise DESERT ROCK bore marked dissimilarities to an actual combat situation. These dissimilarities must be considered in attempts to predict, on the basis of the Exercise, the most probable behavior of troops in combat operations involving nuclear weapons.

It has been assumed that the use of atomic weapons in any future combat situation would be rendered more effective if commanders had a basis for anticipating probable troop behavior in the operation. For that reason, a study of the behavior of troops in a maneuver involving the explosion of an atomic bomb was undertaken. In several respects, however, Exercise DESERT ROCK was radically unlike an actual combat situation: some dissimilarities were of the sort encountered in any maneuver; others were specifically related to this first atomic maneuver. The most obvious dissimilarities and their effects upon the behavior of participating troops are discussed in this section.

Confusion Regarding Security Regulations

Although it had been announced to the press on 20 September that infantry troops for the Desert Rock maneuver were to be drawn from the 11th Airborne Division, the prospective participants from that unit had no official announcement of their mission until after their departure from Fort Campbell. On the basis of newspaper reports, communications from home and rumors, however, many of the men had guessed that they were to participate. A lieutenant, later assigned to the Headquarters Company, who had read of the test in a news magazine, requested assignment to the Battalion Combat Team; this request resulted in his being carefully questioned by the Division G-2 regarding the source of his information. At the time when departure arrangements were being announced, troops were given a talk on security,

instructed to satisfy their obligations, and informed that they would be taking part in a history-making mission from which they would return in about two weeks. The disparity between the amount of information they had been able to glean from public sources and the dearth of official statements made to them directly caused some impatience among the airborne infantrymen of the Battalion Combat Team.[2/] Participant observers reported that, for the most part, men in their units were well aware of their mission before it was officially announced to them. Operations Analysts observing troop behavior in the hour prior to the detonation heard several soldiers question the need for such rigid security regulations in view of the accuracy of press reports and of letters from home. Therefore, whereas in actual combat operations troops would generally be closer to the source of information than would their families, infantry members of the Battalion Combat Team were, until their arrival at Desert Rock, dependent on civilian sources for most of their knowledge about a mission in which they were intimately involved.

Extensiveness of Advance Preparation

All members of the Battalion Combat Team spent more than two weeks at Camp Desert Rock prior to D-day. Once their camp was set up, the principal activity during this time was preparation for the maneuver which they were eventually to perform. Such preparation involved the construction of emplacements at the test site. Since several days were allowed for the work, an unusual amount of labor and care went into the preparation of the foxholes. In some instances, the soil was so hard that airhammers were required. The artificialities of these preparations naturally appeared to many of the troops to be in sharp contrast with any combat situation they had experienced or imagined. When answering an auxiliary question in the Critical Incidents study, 4 enlisted men remarked that they had never before tried to improve a perfect foxhole for 3 days. Both before and after the completion of the emplacements, the troops were put through rehearsals for the maneuver and given additional briefings

2/ Battery C of the 546th Field Artillery Battalion, regularly stationed at Fort Lewis, Washington, was also included in the Battalion Combat Team. It was not determined whether they received official confirmation of their part in the maneuver earlier than did the rifle companies.

which, among other things, assured them of their safety on D-day. The unknowns which are usually inherent in any actual combat situation were, therefore, largely cancelled out by training and rehearsal. Fourteen company officers of the Battalion Combat Team all shared the view, after D-day, that the troops had taken the Exercise too lightly. They ascribed this partly to the fact that there had been an excess of advance briefing and preparation.

Artificiality of the Maneuver

There was no simulated combat involved in Exercise DESERT ROCK, since the Exercise did not attempt to duplicate a real tactical situation. As defined, the tactical situation for the maneuver was as follows: the Battalion Combat Team was to be dug in at its positions while an atomic bomb was exploded over an enemy force; after the detonation, the Team was to advance against the enemy into the area of burst. As conducted, there was no "enemy" force in the Exercise and the Battalion Combat Team experienced the explosion not at their emplacements but at a position 5 miles farther from Ground Zero. The "advance" was delayed until radiation levels in the maneuver zone had been checked, and troops had the opportunity to watch official observers of all kinds preceding them into the "danger" area. The single-file formation in which troops advanced toward Ground Zero was not one which would be used in most combat situations. Troops themselves were heard to comment upon this, calling the formation "a machine-gunner's paradise." To experienced troops, particularly the paratroopers, the simple infantry maneuver did not present a performance challenge commensurate with their training. Several observers reported hearing the men ask, at various times during their stay at Desert Rock, "Why use paratroopers for this?" or "Why can't we jump into the area of burst?"

Finally, most members of the Battalion Combat Team, aside from their walk toward Ground Zero and their inspection of damage, had no work assignments during the maneuver. Each man, not distracted by working activity or responsibility, was constantly in the position of observing and being observed by his companions. The maneuver, therefore, emphasized the social rather than the combat duty aspects of the total situation.

Damage Unimpressive

A flat expanse of desert, across which distances are apt to be misjudged, does not afford the opportunities to demonstrate

the effects of bomb damage as visibly as would less even terrain containing tall vegetation and/or structures. Both officers and men who were interviewed after D-day commented that they thought the Exercise could have been improved if efforts had been made to demonstrate the bomb's potential more visibly. Several mentioned that a mock village should have been constructed in the area of Ground Zero. Others suggested that foxholes and emplacements should have been placed radially from Ground Zero so that differences in damage levels at various distances could have been more easily discerned. The Combat Team's officers believed that their men would have taken the maneuver experience more seriously if, after the burst, they had received more information about the implications of the bomb damage they had observed.

The procedures described in the following pages were used to observe and measure the reactions of troops to a nuclear weapons operation under certain rigid conditions. Any predictions concerning the reactions of troops to similar operations in actual combat must allow for the limitations in personnel protection, visibility and communications which combat situations involve.

PROCEDURES

In order to insure a comprehensive approach to the problem on the basis of a single, non-repetitive training maneuver, the Operations Research Office planned and conducted several studies, each designed to observe or measure behavior by means of a particular technique. The procedures used in each are summarized here.

"Critical Incidents" 3/

This study was conducted by a staff member of the American Institute for Research under a subcontract with ORO. Fourteen company officers of the Battalion Combat Team participating in the Exercise were interviewed twice, on D-3 and D-2 and on D+7 and D+8. In the first interview, they were asked to describe in detail incidents observed in the interval between the time troops first learned about the Exercise up to the date of the interview. In the second interview, they were asked to describe incidents which occurred on D-day (1 November 1951). In addition, they were requested, at the second interview, to give their personal reactions to the entire Exercise and its implications for further training and performance in combat.

Eighty-six enlisted men selected at random from the rifle companies which had participated in the Exercise were interviewed at Fort Campbell, Kentucky, on D+9, at which time they were asked to describe, on the basis of their personal observations on D-day, examples of individual behavior which they thought showed

3/ The Critical Incidents Technique consists essentially in obtaining from eyewitnesses to events detailed descriptions of individual behavior which they judge to be effective or ineffective according to a set of specific criteria. See Flanagan, John C., Job Requirements, Current Trends in Industrial Psychology, Pittsburg, University of Pittsburgh Press, 1949.

an unusual degree of efficiency or helpfulness and examples of behavior which they thought indicated an absence of these qualities. In addition, these men were requested to give their judgments about the excitement provided by events occurring within the total exercise and to describe what activities they were engaged in immediately before and immediately after the detonation.

Intensive Interviews With Participants.

These were conducted by a staff member of the University of Oklahoma Research Institute, under a subcontract with ORO. Forty-five randomly-selected enlisted members of the Battalion Combat Team were interviewed at Desert Rock on D+1 and D+2 and at Fort Campbell, Kentucky, on D+7, D+8 and D+9. Each subject was interviewed once, the interview time ranging from 30 to 60 minutes. The questions were designed to probe the individual's observations and reactions during and after the Exercise.

Reports from Participant Observers.

These were gathered under the supervision of an ORO consultant. Twenty-one carefully-selected members of the augmented Battalion Combat Team were instructed to observe the men in their units. These participant observers were distributed on the basis of one to a platoon or its equivalent, the total strength being 822 enlisted men. The observers were carefully instructed, both by letter and oral briefing, as to method of observation. Each observer transmitted his information to an ORO investigator at three interviews, the first from D-8 to D-4, the second from D-4 to D-2 and the third on D+1 and D+2. Each interview lasted from 20 to 60 minutes, during which the investigator probed for observations of troop behavior. None of the participant observers was a trained social scientist and none had had previous experience or training in the kind of close observation and detailed reporting required for the maximum information to be extracted from this type of study. Furthermore, the observers were themselves undergoing a unique and exciting experience which tended to deflect their attention from the men around them to their own observations and reactions. Despite these limitations, they were able to provide reports which contained evidence useful to the total study.

Reports from Operations Analysts.

Five analysts, staff members or subcontractors of ORO, participated in D-day maneuvers with five different troop formations.

In order that the analysts' observations of troops on D-day might not be severely interrupted by their own first reactions to an atomic explosion, all five analysts, on D-2, witnessed an A-bomb test in which troops were not involved. On D-day, each analyst recorded his detailed observations of troop behavior during each phase of the maneuver, including, wherever possible, verbatim reports of conversations. The five reports were later synthesized into one composite report.

An After-burst Information Survey Conducted by ORO.

After the completion of the Exercise, the assumption was made that, on the basis of damage which they observed in the course of the maneuver, participating troops had derived impressions about the damage the bomb might do in combat which were inaccurate. Accordingly, a set of questions was administered to a random sample of 203 infantrymen in the Battalion Combat Team on D+1. The questions were designed to elicit information about the troops' estimates of the probable dangers to personnel resulting from a nuclear explosion.

Polygraph Study.

Physiological reactions of participants, as recorded on the Polygraph, were taken by a staff member of Russell Chatham, Inc., under a subcontract with ORO, and staff members of ORO.

On D-2 and D-1, a random sample of 29 paratroopers of the 1st Battalion, 188th Airborne Infantry Regiment, 11th Airborne Division, who were members of the Battalion Combat Team, were given a polygraph test and their verbal and physiological responses to a series of bomb-oriented and control questions were recorded. On D+13 through D+36, 27 of these paratroopers were given a second polygraph test at Fort Campbell in which their physiological and verbal responses to control questions and questions concerning the A-bomb and a parachute jump were recorded. During these tests, critical questions were used in the same relative positions, interspersed with non-critical questions.

A control group of 29 members of the 11th Airborne Division were given a polygraph test at Fort Campbell on D+14 through D+33. These were men who did not receive A-bomb indoctrination, did not participate in Exercise Desert Rock, and did not have jump experience.

Three paratroopers at Fort Campbell were given a polygraph test under conditions of known stress — while in a plane immediately prior to making a parachute jump — and were retested on the ground three days later.

Auxiliary Investigations

Continuity report from an observer who remained with participating troops from 10 October until after D-day. A staff member of ORO reported to Fort Campbell, Kentucky, on 10 October 1951, in order to observe day-to-day changes in the behavior of troops in the 1st Battalion, 188th Airborne Infantry Regiment, as their departure for maneuvers became imminent. The observer lived in close proximity with the troops and made the flight with one of the first groups proceeding from Fort Campbell to Nevada. He continued his observations during the two-week period in which the Battalion Combat Team prepared emplacements and field fortifications at the test site and rehearsed for the impending maneuver.

A survey of press reports dealing with Exercise DESERT ROCK, conducted by a staff member of ORO. In order to ascertain what advance information was made available through the press, both to the general public and to prospective participants, and to determine which aspects of the Exercise were deemed as being of greatest interest to the public, a limited survey of newspaper coverage was undertaken. Leading daily papers from the Las Vegas, Los Angeles and Fort Campbell areas were searched for the period 16 September to 5 November 1951, and a content analysis made of their references to the Exercise.

A motion picture sequence covering the activities of the Battalion Combat Team. At the request of ORO, it was arranged that cameramen of the Signal Corps photograph troop activities during the setting up of their encampment, the building of the emplacements, the rehearsals for the maneuver and the various stages of the maneuver itself. In all, 70,000 feet of film were exposed. An ORO staff member coordinated the research plans with the camera schedule, and later viewed this film. The entire film, and a short version, Staff Film Report No. 177, is available for further viewing and analysis.

The material included in the EVIDENCE section of this report has been drawn from the studies listed above. The data and working papers for each of these studies are available at ORO for reference and further analysis.

EVIDENCE

ORO collected four kinds of data on the behavior of troops participating in Exercise DESERT ROCK. Verbal behavior, what the troops said, included both publicly expressed views (what the troops said to each other and to official observers who mingled with them while they were in groups) and privately expressed views (what the troops said to investigators in interviews or wrote on prepared question forms). Physical behavior, what the troops did, included both conduct, overt muscular behavior (what the troops did which could be readily observed), and involuntary physiological reactions (the initial heart rates and the blood pressure responses of troops to specific stimuli, as measured by a polygraph apparatus).

It is believed that in this situation responding troops were apt to have reported more accurately in their privately expressed views than they did in their casual conversations or publicly expressed views. Verbal behavior which is publicly expressed is in part influenced by a desire to create a particular impression or, at least, to prevent giving a socially unacceptable impression.

Similarly, it is assumed that conduct, or overt physical action, because it is more subject to the individual's control, is less revealing of psychological stress or tension than are involuntary physiological responses. In an activity under social observation, the directly observable muscular responses which a subject makes to the situation are influenced by the individual's desire to conform to standards of social acceptability. Involuntary reactions, on the other hand, which are relatively unsusceptible both to conscious control by the subject and to observation by others, are less likely to be inhibited by social factors. Data on these physiological responses are, therefore, assumed to have a high degree of importance in this investigation.

FINDINGS

Publicly Expressed Views of Participating Troops

Before D-day, according to participant observers, the conversation of most members of the Battalion Combat Team about the maneuver expressed the views that the Army would not risk their safety and that indoctrination lectures had lessened their worries about the Exercise.

Most of the conversation heard by observers at the test site, in the 90 minutes before the detonation, was non-bomb centered.

Members of the Battalion Combat Team maintained almost complete silence during the interval between "Bomb Away" and the flash of the explosion. The flash and the two shock waves were followed by many exclamations about the intensity of the explosion.

As troops advanced on foot toward Ground Zero, their conversations expressed increasing disappointment in the amount of damage they saw.

Privately Expressed Views of Participating Troops

Practically all participants who were interviewed said that, before D-day, they felt confident of their safety in the impending maneuvers. They attributed this confidence to their conviction that the Army would take no risks on maneuvers and to the information about safety precautions given them in indoctrination talks.

In verbal responses to questions in a polygraph test, prospective participants showed more apprehension about radiation danger than about two other "dangers" related to the maneuver. Nevertheless, only 36 percent of them expressed this apprehension, as opposed to 79 percent of the non-indoctrinated subjects who were not participants.

According to the participants' responses to questions after D-day, the interval between "Bomb Away" and the flash was the most exciting point in the entire exercise.

Among 45 participants interviewed after D-day, 35 claimed that, at the time of the explosion, they had experienced feelings of fright, worry or excitement. Nineteen reported they felt some apprehension about radioactivity when advancing deep into the area of burst.

All investigators who questioned participants after D-day learned that a large majority of respondents felt that the level of damage they had observed was disappointing and that inspection of the damage had been a relatively unexciting activity.

Four-fifths (82 percent) of 203 enlisted men, responding to questions after their participation in Exercise DESERT ROCK, reported willingness to occupy foxholes less than 2 miles from Ground Zero during another atomic explosion.

Conduct of Participating Troops

Before D-day, no conduct was observed which suggested that participating troops were reluctant to take part in Exercise DESERT ROCK.

Company Officers, alerted to observe examples of effective and ineffective troop behavior during the Exercise, stated that the troops' performance on D-day was routine.

According to all observers, the performance on D-day of men in the Battalion Combat Team was efficient and orderly. Minor exceptions were: (a) numerous instances where the actions of participants seemed to indicate that they considered some of the prescribed safety measures overly cautious, and (b) the lack of interest in inspecting bomb damage indicated by the actions of the men, particularly during the latter part of the maneuver.

Physiological Reactions of Participating Troops

Airborne participants in the Exercise showed more physiological tension before D-day than afterward, and more than was shown by a control group of non-participants.

Before D-day, participants showed *significant* physiological disturbance (rise in relative systolic blood pressure) when asked about both real and hypothetical dangers specifically related to the impending A-bomb burst and maneuvers.

Participants, before D-day, showed more physiological disturbance when questioned about specific A-bomb dangers than their verbal responses indicated.

After intensive A-bomb indoctrination, troops appeared to be satisfied intellectually that the impending Exercise presented little actual danger; they showed significant emotional disturbance, however, when asked about possible A-bomb dangers.

Physiological evidence indicated that airborne participants, before D-day, showed as much emotional disturbance about atomic

radiation as about making a parachute jump from a plane — a situation known to arouse apprehension in paratroopers.

PUBLICLY EXPRESSED VIEWS

In conversations about the Exercise prior to D-day, troops generally expressed confidence in their personal safety. The explosion called forth their extensive and enthusiastic comment. During the post-burst maneuvers, however, participants voiced disappointment in the amount of bomb damage.

Information about the publicly expressed verbal behavior of participants was drawn from the reports of 21 participant observers and 5 Operations Analysts. This information is divided chronologically into conversations before D-day, conversations on D-day, and conversations after D-day.

Conversations Before D-day

Participant observers, living and working with other men in the Battalion Combat Team, were instructed to report, at scheduled interviews, conversations relative to the approaching test which they had overheard in their units. According to the reports of these observers, those topics pertaining to the exercise which were prominent subjects of discussion among the men were: (1) living conditions in the camp; (2) the rationale of the security restrictions imposed; (3) the probable purposes of the impending test; and (4) the possible dangers to troops which the test involved.

Troops "Griped" About Living Conditions. At all interviews, participant observers repeated gripes and complaints about the many discomforts of Camp Desert Rock. The quality of food, the lack of heating or light in the tents, the absence of a fully-planned program, the protracted orientation and rehearsal, and the poor transportation arrangements for men going on pass all received a liberal share of critical comment.

Troops Were Puzzled by Security Restrictions. A large majority of the 21 observers reported that, judging from conversations overheard in their units, most of the men had guessed the mission for which

they were scheduled well in advance of their arrival at Camp Desert Rock. There were, it appears, numerous bull sessions at Fort Campbell about where the battalion was going and the men "put two and two together", as one observer stated. Several of the men had displayed newspaper clippings regarding the impending Exercise and others had been given information about it through letters from home. As a result, there was some griping at Fort Campbell about the lack of any official Army announcement to the battalion and more griping at Camp Desert Rock about the security restrictions which they were instructed to observe.

Opinions About the Purposes of the Test Were Varied. During the two weeks of encampment at Desert Rock prior to D-day, there was considerable discussion among members of the Battalion Combat Team regarding the purpose of the Exercise. On this matter, a variety of views were developed. Some of the troops, according to participant observers, thought of the proposed test as a training exercise in which the Army might "find out about troops' reactions," "learn about the bomb," "reduce fears" or "gain a seasoned outfit". Others maintained that the purpose was political and that the impending Exercise would have "a psychological effect on our enemies" or would "gain prestige for the Army". There were some observers who reported that they had heard no discussion concerning the purpose of the test or that the men seemed to have no idea whatever on this subject. Others reported conversations which indicated an impatience with the entire procedure in which troops described the Exercise as "a waste of time" or questioned why paratroopers should be used to dig foxholes.

Observers Overheard Few Expressions of Anxiety. Of most pertinence to the objectives of this analysis were the participant observer reports on expressions of fear or apprehension in their units. At the time of the first scheduled interviews, 20 of the 21 participant observers reported that the men in their units were already confident about performing their roles in the

exercises. Fifteen stated that they had heard general expressions of apprehension prior to the orientation lectures, but that these lectures had "destroyed most fears". Five others summed up the attitude of men in their units in saying "We wouldn't have been afraid anyway because we know the Army couldn't afford to take risks". The one remaining observer reported that the men were still "somewhat afraid". All 21 observers were asked to enumerate and name individuals who had expressed specific anxieties regarding the test. Table I lists the results of this inquiry.

TABLE I

SPECIFIC ANXIETIES
EXPRESSED BY INDIVIDUAL SOLDIERS
AS OVERHEARD BY PARTICIPANT OBSERVERS

Type of Apprehension Expressed	No. of Named Soldiers who Expressed Apprehension	No. of Observers Reporting These Conversations[a/]	No. of Observers Reporting No Men Expressed Apprehension
Fear of Volunteering to remain in a forward area	7	7	14
Fear of Radiation and Radiation Sickness	7	5	16
Fear of Effects of Noise	4	4	17[b/]
Fear of Blast Effects	4	4	17
Fear of Danger from Flash or Burn	2	2	19
Fear of Sterility	1	1	20
Fear of Bombardier or Pilot Error	0	0	21[c/]
Fear of Permanent Harmful Effects	0	0	21
Total	25 men		

a/ Of the 21 observers, 5 reported no named individuals whom they had heard expressing anxiety; 9 observers reported one man each; five reported two men each; and 2 reported 3 men each.
b/ 8 of these 17 observers reported that some fear existed but were unable to supply individual names.
c/ 8 of these observers reported "joking about it" or "a lot of talk" but named no individuals who expressed a serious apprehension.

The participant observers, who were reporting on a total of 822 men, could name only 25 soldiers who were overheard to express apprehension about some aspect of the impending exercise. It is possible that some "joking" comments about possible dangers, were not reported by the observers; if that is the case, the question arises as to whether jocularity is the enlisted man's way of expressing latent apprehension in a manner acceptable in field and barracks conversation. In any case, the assumption can be made that actual anxiety exceeded expressed anxiety, since the social pressures of camp life would inhibit a free admission of such apprehension.

Conversations on D-day

Enroute to Test Position 6. On D-day, five Operations Analysts, accompanying five different sticks of the Battalion Combat Team, observed and recorded the conversations they overheard. The compilation of their reports provides the best available data on opinions openly expressed by the participants in the course of the test.

During the ride from Camp Desert Rock to Test Position 6, there was very little conversation among the men in the trucks, and what little there was tended to be desultory and non-bomb-centered. Only one analyst reported an exchange which had reference to the impending test. A soldier mentioned that he had been talking to a IIIrd Corps man who had witnessed the preceding detonation in the test series. "Those fellows who were out there said that thing really made a loud noise. They said it was plenty big." When asked by an ORO analyst whether he had heard that any of the men would have preferred a position nearer Ground Zero, he replied: "No, I didn't hear none of them that said they would. They said they'd just as soon have been further away. They said that noise was so loud it almost bursted your eardrums at seven miles. I don't believe I'd want to be up in my position this morning. I heard that other one in camp."

At Test Position 6 Before "Bomb Away." As the men marched from the trucks to their observation posts and Ground Zero was indicated by the orientation officer, one man exclaimed, "Hell, that don't look very far away!" Once they had broken ranks and mingled in groups, the level of noise of the troops' conversation became so high that it was impossible for the voice of the orientation officer to be understood.

As the three planes flew over the area an hour before the drop, two soldiers remarked that they hoped the pilot or bombardier would hit the target accurately. A majority of the conversation overheard by analysts in this waiting interval was non-bomb-centered. Remarks such as "Let's get it over with" and "This is what we suffered three weeks for —let's get it over and go home", however, were overheard.

Running through the typical soldier jocularity were comments indicating that the troops were giving some thought to the coming explosion. (1st e.m.): "I'm cold." (2nd e.m.): "You'll warm up when the bomb goes off." (3rd e.m.): "Yeah, when them gamma rays start running through you, you'll be plenty warm." In one group, some of the men conversed about going to town on passes afterwards in order to test their potency. Others in the same area held a discussion about whether the radiation monitoring equipment was unevenly distributed among the various sticks; a remark to the effect that one counter to a stick was sufficient seemed to settle the argument. Some speculated about the effects of the explosion upon the equipment they had left at their emplacements. Others mentioned the atomic cloud they had observed from Camp Desert Rock after the last detonation and wondered what interval of time would elapse before they would walk into the dust. Some spoke questioningly of the need for rigid security regulations in view of the accuracy of newspaper reports on the subject and the letters, phone calls and clippings about the maneuver which they had received from home.

After the order to fall in and the command "Rest" was given, troops continued to converse, though in more subdued tones. At H-3 minutes, one enlisted man exclaimed, "Boy, don't turn around and look at that flash!"

At Test Position 6 After "Bomb Away." In the interval between "Bomb away" and the flash, such remarks as "Hurry up," "It's dud," "Wait a minute — don't stand up," and "I hope that fly boy knows what he's doing," were made by various members of the Battalion Combat Team. Several men said "Bang" or "Pop" during the seconds of silence; these exclamations brought only mild laughter from a few soldiers nearby. One man began a long whistle to imitate the sound of a falling bomb, but was told to "cut it out" by another soldier.

The appearance of the flash called forth spontaneous exclamations about its intensity from many of the men. After the team

had turned toward Ground Zero and were able to look at the fireball, "Boy, that's beautiful!" and similar exclamations were overheard.

Once the shock waves had passed over, there ensued a barrage of comments upon the physical characteristics of the explosion: "That son of a bitch is really rumbling." "Man did you feel that heat!" "See that blue fizz they had been talking about?" "If you got your eyes in that flash, you wouldn't ever see again." "I forgot about the shock wave and it damned near knocked me over." "I could see them old gammas hopping around like crazy!"

Some troops convinced each other that they noticed a distinctive explosion odor, though observers said there was none. One man pointed out an icecap over the mushroom, although no real icecap formed. During the first rush of exclamations, one soldier remarked, "Back to the game — what was my point?" This comment provoked no responsive laughter and there was no effort made to resume the crap game.

During the interval prior to entrucking, the five Operations Analysts circulated among the groups of soldiers, listening for comments and asking questions. They heard considerable discussion about how it would have felt to experience the explosion at closer range. "Man, if I'd been up in them positions, I'd really have been digging when that thing went off!" was one soldier's observation. Three others, who had previously asked if they would be permitted to remain in their foxholes, said they would have stayed there, but would have been digging "like moles." Some soldiers stated that they would have preferred to view the explosion from their foxholes, provided they had been permitted to dig them in the form they wished. Several men said they'd wait to see the condition of their foxholes before giving any opinions about being nearer to Ground Zero during the explosion.

There were some soldiers, however, who expressed unqualified preference for remaining further forward. "I wish we were up in the foxholes to settle this once and for all!" "What I wanted to do, Lieutenant, was to be at Ground Zero and see what would happen --I don't think it would hurt." "I still think we should have jumped into the area."

A few expressed indifference to the experience, saying it wasn't worth the sweat and dust they had endured and that they wished they had remained at Fort Campbell.

Many men expected that, in the areas closer to Ground Zero, the explosion would have created considerable havoc. Several mentioned the heavy dust: "Gee whiz, how are we gonna find those damn roads in that dust?" "Hell, I'll have to dig my carbine out of the dust up there."

Among some members of the Team, there was serious speculation about the weapon. One wondered what the effect would be if a second bomb, two thousand feet higher, had been set off a few seconds after the first. Some inquired why the bomb could not be made into a shaped charge which would be more effective. One soldier remarked, "This is a weapon to be respected, not feared." "Christ!" another exclaimed, "it takes one of those SOB's just to set off the H-bomb."

Finally, there were those men who seemed impressed with their own roles in the unique experiment. "Well, we made history. My name will go in the history books." "What do you think the papers will say? 'A-bomb exploded with troops in the field?'"

At the Emplacements. At the emplacement area, analysts overheard many expressions of surprise and disappointment at the lack of visible damage to the positions. No comments were heard concerning the sheep in the area. Troops asked such questions questions about the bomb as: "Sir, can you tell me why there was so much more radiation at Bikini?" "Is this the same size bomb that was used at Nagasaki?" "How come it did so much damage at Hiroshima and so little here?"

The participant observers also reported hearing expressions of disappointment about the quantity of damage troops observed: "Expected to see more damage." "It didn't live up to its show." "I expected to find the tanks a molten mass of metal." "Not what it's cracked up to be." "Overrated."

One observer reported that he heard an officer state that a lot of people in the Atomic Energy Commission would lose their jobs for having "oversold the bomb."

When one soldier, after completing an examination of his position said he'd now volunteer to stay in the foxholes during an explosion, another commented, "Everybody in the company would." One soldier reproached a man who was sitting on the ground saying, "Get up. You're not supposed to sit down here — they told us that." The seated man replied, "They also told us that there wasn't a thing to worry about." He declined to get up.

In one small group, many of the men expressed the wish for another test during which they might be permitted to remain in their foxholes. Two in this group taunted the others with being "Tongue brave SOB's."

During the Foot Maneuver. The single-file advance toward Ground Zero was not conducive to conversation. A few men griped that they were obliged to walk while the official observers rode. One soldier ordered another to "pick up his feet." The little bomb-centered conversation which was overheard indicated that the troops were looking for the effects of the explosion and being disappointed in what they saw. When the order to turn was given, about 500 yards before Ground Zero was reached, there were groans and other exclamations of disappointment.

At Test Positions 1 and 2, troops inquired why buildings had not been erected in the area so that the effects of the explosion might have been better demonstrated. "When are we going to make history?" and "Why don't they let us make an air-drop right after an A-Bomb burst?" were questions posed by some of the men. Before entrucking at Test Position 2, one soldier urged the monitor checking him for radioactivity to hurry up so that he could get a seat in the truck.

Enroute from Ground Zero. During the ride back toward Test Position 5, one soldier was heard to complain that the Army had messed around with the battalion and made it take three weeks to do what a "bunch of cons" could have done in a week. Others questioned the need for the scheduled stop at Test Position 5. "Hell, it (the explosion) didn't do anything at two and a half miles. Why do we have to stop and look at stuff at four miles?" "Why are we stopping here? So we can see more stuff that wasn't damaged?" There was very little conversation among the men as they rode the last lap of the journey, from Test Position 5 back to camp. Those few soldiers who conversed discussed food, showers and the most probable date of their return to Fort Campbell.

Conversations after D-day

When participant observers were asked, on the two days following D-day, what the men in their units were saying about the exercise, several mentioned comments made by the men about disappointment in the level of bomb damage they had observed. According to one observer, "A lot thought it wasn't everything it was doped up to be; a few used their heads and figured out what

it would do to a city." Many of the observers reported statements among the men to the effect that they were not afraid of the bomb and that they had learned a lot about the safety afforded by foxholes. The observers had also overheard criticisms about the test, remarks to the effect that the troops could have been closer, that damage could have been better demonstrated, that the exercise wasn't sufficiently similar to an attack.

As indicated by their publicly expressed views, participants were interested in the Exercise, but unapprehensive for their safety. Their private responses to questions, which are described in the following section, revealed a somewhat larger degree of apprehension.

PRIVATELY EXPRESSED VIEWS

The majority of participants claimed to have prepared for the atomic maneuver in full confidence of their safety. Many later admitted, however, to feelings of tension, excitement, or both, at the time of the explosion and when advancing toward Ground Zero.

Information about the privately expressed views of participants was drawn from:

Periodic intensive interviews with 21 enlisted men who, though they were themselves serving as participant observers, revealed, in the course of their reports, many of their own reactions.

The verbal responses of subjects for whom polygraph readings were recorded.

Intensive interviews with 45 enlisted men after they had participated in the Exercise.

Answers to questionnaires administered to 86 enlisted infantrymen after they had participated in the Exercise on the relative excitement of various Exercise events.

Answers to a post-burst information questionnaire administered to 203 enlisted men.

This information has been divided into troops' reports on their reactions before D-day, on D-day and after D-day.

Troops' Reports on Their Reactions Before D-Day

Participant Observers Expressed Few Apprehensions. As noted above, the twenty-one participant observers frequently tended, in giving their reports, to generalize the feelings of the men in their units in terms of their own expressions of opinion. Such expressions, though they have limited value as reports upon the behavior of other men in the units, serve as data on the behavior of the observers themselves.

In reporting upon the pre-burst apprehensions of the men in their units, the participant observers commented, as well, upon their own feelings, claiming that, for the most part, they were unapprehensive about participating in the test. "Nothing to get panicky about." "Nobody's lost any sleep over this at all." "I don't think the government would risk the lives of the troops. It would be safe at five miles, because the government always overdoes things." "They wouldn't have us out there if they thought they were going to lose half the outfit in the operation."

A few observers, however, expressed doubt about some specific aspect of the test. In respect to radiation sickness, one reported: "I'm rather confused and they (the troops) are too. They don't really know the effects of gamma particles or whether they'll be there."

This "confusion" was not, however, typical. In discussing radiation sickness, most observers cited figures to prove that, at seven miles, the radiation produced by the explosion would be harmless. Specific distances were also quoted to prove that, at seven miles, troops would be safe from blast effects. The frequency with which facts and figures were introduced by the participant observers when referring to various "dangers" involved in the test seems to indicate that the indoctrination lectures had left a strong impression. Expressions of confidence in their personal safety were, in many cases, associated with references to the seven-mile stretch separating the troop observation positions from Ground Zero. In discussing the willingness of men in their units to stay in a forward area during the explosion, various observers remarked: "None of the men would volunteer." "A few fools might." "Some guys will do anything."

Though most participant observers said that it would probably be safe to witness the explosion from a distance closer than seven miles, 7 of the 21 specifically stated that they wouldn't volunteer for any such duty until they'd seen the effects of the detonation.

Seventeen of the 21 participant observers were paratroopers of which 14 were asked to compare their pre-burst fears with the fear they felt before a parachute jump. All 14 of these subjects claimed that their pre-burst fears were the same as or less than their fears before a jump.

Minority of Polygraph Subjects Admitted Anxiety. Polygraph readings were made for a small group of prospective participants before D-day at Desert Rock. Each subject was asked to give verbal answers to the questions in order that such responses as well as non-voluntary physiological reactions might be recorded and studied. Among the stimulus questions asked each subject were three dealing with personal safety in situations relating to the impending maneuver, one dealing with personal safety in a future combat situation, and one more general question about atomic warfare. The percentages of men who verbally admitted fear or apprehension in response to each question are listed in Table II.

TABLE II

VERBAL RESPONSES TO A-BOMB QUESTIONS BY PARATROOPERS BEFORE D-DAY AT DESERT ROCK

Question	No. of Cases	Admitting Fear or Apprehension	
		No.	Percent
Expect to black out or be hurt when A-bomb goes off?	29	1	(3%)
Feel safe in foxhole positions when A-bomb goes off?	27	5	(19%)
Afraid to handle equipment within 1-1/2 miles of the A-bomb burst before it is monitored?	28	11	(36%)
Feel will be unhurt in A-bomb attack if do what told to do here?	28	4	(14%)
Feel chances of coming out unhurt as good in atomic warfare as in regular warfare?	28	14	(50%)

In answer to the three questions relating to the impending maneuver, verbal expressions of apprehension become more frequent as the ideational contents of the questions move closer to Ground Zero. Thus, while only one subject stated that he expected to be personally affected while observing the explosion from his observation position, 19 percent said they would not feel safe if they were in the emplacement area during the detonation. The still higher percentage admitting apprehension about handling unmonitored equipment is probably a function both of the closer distance to Ground Zero mentioned in the question and of the implied reference to dangerous levels of radiation. A much smaller percentage of subjects admitted apprehension about their personal safety in a future A-bomb attack. Half the subjects expressed doubts of their personal safety in atomic warfare as opposed to regular warfare; whether such doubts can be called apprehensive or in any way emotional is highly questionable, since the stimulus question itself is one likely to invite an intellectual and relatively impersonal response.

In respect to the radioactivity question, it is interesting to compare the verbal responses of 28 participants at Desert Rock, before D-day, with the verbal responses of a control group of 29 soldiers at Fort Campbell, who were not participants and who had received no indoctrination lectures in atomic weapons. Though 10 (36 percent) of the participants verbally admitted apprehension about handling unmonitored equipment 1 1/2 miles from an atomic ground zero, 23 (79 percent) of the non-participants expressed this fear. This significant difference indicates either that the paratroopers tested at Desert Rock before D-day were less afraid of radiation dangers than the non-indoctrinated, non-participating troops at Fort Campbell, or that the paratroopers were less willing to express their fears than were the control subjects. 4/

4/ 23 of the participants who were asked the radiation question prior to D-day were asked the same question after D-day when they had returned to Fort Campbell. 8 (35%) verbally admitted apprehension in the first test; 11 (48%) in the second. Though this difference is not statistically significant, it may indicate a slight tendency for participants to express fear of atomic radiation more readily after the Exercise than before.

Participants Approached D-Day Confidently. Of the 45 participants who were interviewed after their return to Fort Campbell, 38 reported that, from the very start, they had approached the exercise with a high degree of confidence in their safety. Of the remaining 7, who reported that they had initially thought the exercise might involve personal danger, 4 claimed that they had been reluctant to participate; the other 3, however, said that they were eager to take part regardless of possible risks. The doubts of 5 of these 7 men were, they reported, removed by the indoctrination lectures. Forty-three of the 45, therefore, claimed that, by D-day, they were fully assured of their personal safety. Among these 38 men who enjoyed this confidence from the beginning, 8 gave as their reason, in effect: "I knew the Army wouldn't put us in any danger in a maneuver."

Troops Reports on Their D-Day Reactions

Several Participants Were Tense at Time of Explosion. Many of the interview subjects, however, reported feelings of diminished confidence on D-day itself. Five claimed that they were "a little worried" even before arriving at the test site. Two others remembered thinking, at the time, that seven miles was too close to the burst for safety.

In respect to the time of the burst, 8 men reported that they had been somewhat worried; 3 others described physiological reactions they had noticed, such as "goose pimples" or a pounding of the heart. In addition, 24 of the subjects reported what they called "excitement." Altogether, therefore, 35 of the 45 subjects later claimed that they had experienced an intense personal reaction just prior to and during the burst. Table III lists their own descriptions of these reactions.

TABLE III

PSYCHOLOGICAL REACTIONS EXPERIENCED AT THE TIME OF BURST

Description	No. of Subjects Reporting	
"Excited"	24	
"Scared"	4	
"Tense"	3	
(Described physiological reactions)	3	
"Worried"	1	
	35	Sub Total
(Described no particular reaction)	10	
	45	TOTAL

Nineteen of the 35 men who reported a definite personal reaction at the time of the explosion identified the period between "Bomb away" and the flash as the most exciting time. "It seemed like hours" and "Ages seemed to pass" were typical comments about this interval. Ten others extended the period from the order "Sit down and face south" until the flash; the remainder experienced a more intense reaction after the flash. Eleven men indicated that they had experienced feelings of startle or surprise at the two cracks of noise which followed the flash.

Two explanations can be advanced to account for the peak in tension which troops claimed to have experienced during the sixty to eighty second interval between "Bomb away" and the shock waves. After "Bomb away," participants had nothing to do but to sit waiting for the flash; anticipation of an intense experience plus the absence of distracting activity undoubtedly contributed to the level of tension. Furthermore, although the physical phenomena associated with the explosion were described to troops in their indoctrination lectures, it is doubtful whether any verbal description could have been sufficiently vivid to prepare them for the intensity of the flash, shock waves and noise.

Some Participants Worried About Radioactivity. All other instances of anxiety which the subjects claimed that they experienced in the course of the maneuver concerned a possible exposure to dangerous levels of radioactivity. Table IV indicates the numbers of men who reported apprehension about this risk during various phases of the total maneuver.

TABLE IV

APPREHENSION ABOUT RADIOACTIVITY
DURING VARIOUS PHASES OF THE MANEUVER

Phase of the Maneuver	Distances from Ground Zero	No. of Men Reporting Some Apprehension
While experiencing the shock waves	7 miles	2
While riding to the emplacements	7 - 2 miles	4
While inspecting the emplacements	2 miles	3
While on maneuvers forward of the emplacements	2 miles - 500 yds.	19
		28
(Did not report apprehension about radioactivity)		17
		45

As Table IV illustrates, only two men reported concern about radioactivity at the time of the shockwaves: one feared, as he later claimed, that the radioactivity would extend back 7 miles from Ground Zero; the other was anxious lest the dust over Ground Zero drift toward Test Position 6. Although 4 subjects reported feelings of apprehension during the ride toward the emplacements, the remaining 41 described their prevalent thoughts as eagerness to inspect the damage to their foxholes. Those 3 who were doubtful of their safety at the emplacements, stated that they were initially reluctant to pick up their weapons; all, however, did so. Table IV clearly indicates that, only forward of the emplacements, was an appreciable percentage of the subjects concerned about dangerous levels of radioactivity. These 19 men stated: that they were acutely conscious of and concerned about the dust in the air; that they avoided sitting on the ground, even though monitors were doing so; that they felt their feet getting warm; or that they checked frequently with the monitors. Only one subject, however, described himself as "scared" and followed by explaining that he had misunderstood a Geiger Counter reading and had assumed that the radiation level had passed the danger point.

A Small Minority Judged the Experience as Unpleasant or Dangerous. When these 45 subjects were asked, however, to sum up the entire experience, only 6 named something connected with the bomb as "the worst thing;" 14 of the 45 stated that, at some time during the maneuver, they felt they might actually be in danger. Table V identifies the stages of the exercise which provoked these feelings.

TABLE V

REACTIONS TO DESERT ROCK MANEUVERS

Q: "What was the worst thing about D-day to you?"		Q: "Was there any time when you felt you might be in danger?"	
Answers	No. of men responding	Answers	No. of men responding
Waiting for the burst	3	Between "Bomb Away" and the flash	6
Advancing to Ground Zero	2	Advancing to Ground Zero	6
Waiting for shock wave	1	Waiting for shock wave	2
Sub Total	6	Sub Total	14
(Something not directly connected with the bomb)	39	No Time	31
TOTAL	45	TOTAL	45

Participants Chose Waiting for the Flash as Most Exciting Event. In connection with the Critical Incidents study of troop performance, 86 enlisted participants were asked, 9 days after the maneuver, to list their first choices of the most exciting and least exciting of 15 specific events connected with the entire exercise. In Table VI, their choices are enumerated.

TABLE VI

THE MOST AND LEAST EXCITING OF 15 EVENTS EXPERIENCED
(First Choices of 86 EM)

Event	Most Exciting Event	Least Exciting Event
1. The news that you were going on an atomic maneuver	3	4
2. The lecture on the typical A-bomb given at Camp Desert Rock	0	2
3. Your first view of Yucca Flats	0	20
4. Digging your foxhole	0	39
5. Your first "dry run"	1	12
6. Your first pass to Las Vegas	10	0
7. Getting your pay	4	1
8. Leaving camp for Yucca Flats on D-day	1	1
9. Waiting for the command to turn away from the burst area	2	0
10. Waiting for the flash after hearing "Bomb away"	35	0
11. Waiting for the shock wave after the flash	6	1
12. Watching the mushroom cloud form	14	0
13. Seeing the damage done to your foxhole and equipment	1	1
14. Advancing into ground zero	1	0
15. Leaving Desert Rock for Ft. Campbell	8	2
(No choice made)	0	3
	86 TOTALS	86

Troops Disappointed in Bomb Damage. As Table VI indicates, 55 men selected "Waiting for the flash," "Waiting for the shock wave," or "Watching the mushroom" as the most exciting event; only one chose any of the three events as the least exciting. In contrast, one subject chose "Seeing damage" as most exciting and one other chose it as least

exciting; this is the only phase of the maneuver which, on the basis of questionnaire responses, emerged with a final score of zero or less for excitement. This contrast between intense reactions to the explosion itself and lack of response to the effects of the explosion is corroborated by the summaries which 21 participant observers made of their own and their troops' reactions to these two aspects of the maneuver. In Table VII their summaries are enumerated.

TABLE VII

REACTIONS OF "MOST TROOPS" TO THE BURST
(As Summarized by Participant Observers)

Degree of Reaction	To the Spectacle of Explosion (No. of Observers)	To Apparent Damage (No. of Observers)
Exceeded Expectations	16	1
About as Expected	5	3
Less than Expected	0	17
TOTALS	21	21

When 203 enlisted participants were requested, on D+1, to evaluate the damage they had observed in terms of their own expectations, 79 percent reported that the quantity of damage was less than they had anticipated.

Several factors might have produced the disappointment of troops in the bomb damage they were asked to observe. The intensity of the flash, shock waves and noise at the time of the explosion had greatly impressed them. As some soldiers' subsequent questions indicated, they expected to see signs of damage in keeping with the extent of damage at Hiroshima. This did not prove to be the case. No equipment which they later observed was completely demolished, the damages being partial, and, in some cases, not immediately obvious. The absence of structures or tall vegetation in the Ground Zero area precluded a visibly dramatic demonstration of the bomb's potential.

Troops' Reactions After the Exercise

Troops Stated They Would be Safe in Foxholes Still Closer to Ground Zero. These same 203 enlisted participants were asked, in a post-burst information survey, to report the closest distances to Ground Zero at which they would be willing to witness an explosion similar to that in Exercise DESERT ROCK if protected in the following ways:

1. Sheltered behind a tank
2. Sheltered under a truck
3. Crouched down in a foxhole
4. Lying flat on the ground
5. Standing up on the ground

In responses to the 2nd, 4th and 5th questions, a majority chose distances farther than 2,000 yards from Ground Zero, showing a preference for the most remote position if standing up on the ground. Sixty-seven percent, however, expressed a willingness to remain at 2,000 yards or less from Ground Zero during an atomic explosion either sheltered behind a tank or crouched down in a foxhole. Although the troops were well aware that their own emplacements had been 2 miles from Ground Zero, only 18 percent of them replied that 2 miles or more was the closest distance at which they would be willing to remain in their foxholes during an explosion.

It is not surprising that, after the completion of the Exercise, participants indicated a high level of confidence in the protection afforded by foxholes against the effects of an atomic explosion. Having observed damage which was apparently minor at their own emplacements, two miles from Ground Zero, they assumed that similar emplacements could have been dug further forward without presenting risks to personnel who would remain in them.

Troops Stated They Would be Willing to Have Atomic Support in Combat. Of the 45 participants who were interviewed after their return to Fort Campbell, 38 reported that they would like to have such a weapon as that which they had witnessed to support them in combat. Only 3 of the remaining 7 stated that they felt it would be too dangerous to our own forces. Table VIII enumerates the responses of all 45 men regarding their willingness to advance into an area of atomic burst in an actual combat situation.

TABLE VIII

WILLINGNESS TO ADVANCE INTO BURST AREA

Q: If you were going into an actual assault against enemy troops, preceded by an A-bomb burst over the enemy positions, how soon after such an explosion would you be willing to advance into the area?

Answers	No. of Men Replying
Immediately after burst	14
Immediately after burst (with gas masks)	2
After 30 minutes or after "dust had cleared away"	20
No answer	9
TOTAL	45

Participating troops who reported, through interviews and question schedules, their reactions to Exercise DESERT ROCK, revealed more apprehension for their safety than their public conversations indicated. The following section deals with a subject of primary concern to the Army, namely the performance of troops during the maneuver.

CONDUCT OF TROOPS

Troops performed adequately in the Exercise and gave visible indications of willingness to participate and of lack of apprehension about personal safety.

Information about the overt non-verbal behavior of troops was drawn from the reports of 21 participant observers; the "critical incidents" of effective and ineffective performance described by 14 officers and 86 EM of the Battalion Combat Team; the reports of 5 Operations Analysts; and the representative sample of the film record viewed by an ORO staff member. This information is divided chronologically into Conduct before D-day, Conduct on D-day and Conduct after D-day.

Conduct Before D-Day

In an effort to arrive at a continuous report on the behavior of participating troops from the time of their arrival at Camp Desert Rock, 21 carefully selected troop participants were

briefed and instructed to observe the men in their units, which had a total enlisted strength of 822. Each of the participant observers was intensively interviewed twice in the week prior to D-day. At none of these interviews was any non-verbal behavior reported which seemed to signify apprehension about Exercise DESERT ROCK or reluctance to take part in the test. The picture which the observers presented of the participants was of men bored with what they considered unnecessarily protracted preparations, badly organized work schedules and insufficient recreational arrangements, who passed their leisure time playing cards, having rock fights, and occasionally going into town on pass. Participant observers from the Medical Detachment and first sergeants reported that, during the time at Camp Desert Rock, sick call was unusually small. "Those who made it were really sick," one reported. The men went to the field for duty "where in Campbell they (those with minor complaints) would have plagued us on sick book."

Other data concerning non-verbal troop behavior prior to D-day were provided by the 14 rifle company officers of the Battalion Combat Team which was scheduled to participate. These officers were asked to describe examples they had observed, during the period of preparing for maneuvers, of men doing their jobs with unusual efficiency or inefficiency. These 14 officers, responding to questions on D-3, and D-2, described 24 incidents of effective behavior and 33 incidents of ineffective behavior which they had personally observed. In all cases, behavior incidents were described in terms of job efficiency or inefficiency and no attempt was made to interpret them as signifying reactions to the Exercise.

Conduct on D-Day

Participants Described No D-Day Incidents Suggesting Fear.

After such preliminary experience in observing and reporting on the behavior of men in their units, these officers were asked to use the same technique for transmitting information about troop behavior on D-day. For D-day they reported a total of 4 behavior incidents (3 ineffective and 1 effective), approximately the same number as the daily average for the period of advance preparation. Eighty-six infantrymen of the Battalion Combat Team were also asked to describe in writing behavior incidents which they had observed on D-day. Fifty-two of these men reported a total of 55 non-verbal incidents, forty-six of which

were described as examples of ineffective behavior and nine as effective behavior performed by officers and men of the Battalion Combat Team. In all, then, a total of 49 ineffective non-verbal behavior incidents were observed on D-day by infantry officers and men participating in Exercise DESERT ROCK.

As Table IX indicates, 38 such incidents referred to a lack of regard for the safety precautions specifically prescribed for this atomic maneuver in the indoctrination lectures. There was, actually, some basis for confusion in respect to these precautions. For example, troops had been advised before D-day not to sit on the ground in the forward areas. During the maneuver however participants received constant assurances that the amount of radioactivity was far below the critical level. Official observers and even monitors sat down in previously proscribed areas, and their example was followed by some of the participants who were tired with walking. It is probable that the men who reported carelessness about safety precautions as ineffective behavior were themselves meticulous in observing these precautions because of obedience to indoctrination instructions or because of apprehension about radioactivity or both. The distribution of incidents in Table IX suggests that large numbers of participants were confident that they ran no risk from radiation after they had been in the forward area for some time.

Analysts' Observations at Test Position 6. On D-day, five Operations Analysts accompanied five different sticks of the Battalion Combat Team in the field so as to observe their behavior during the various stages of the maneuver. The reports of these analysts provide additional information about overt, non-verbal behavior during the test.

After boarding the trucks at Camp Desert Rock, most of the troops attempted to settle into comfortable positions. During the ride to Test Position 6, many of them slept. Upon their arrival at Test Position 6, the various groups of soldiers marched to their observation positions. As they were taking their places, several looked toward the point which the orientation officer identified as Ground Zero, and attempted to locate the spot for themselves. After taking their positions, the men broke ranks and mingled, for the most part, in small casual groups for talking, gambling, sharing the lunches with which some of the men had been supplied at camp, and smoking. There was some solitary behavior during this waiting interval.

TABLE IX

TYPES OF INEFFECTIVE BEHAVIOR OBSERVED BY OFFICERS AND ENLISTED MEN

Description of Behavior	No. of Incidents Reported
Lack of regard for atomic-maneuver safety precautions	
Picking up souvenirs	11
Sitting on the ground in the "area of burst"	11
Standing up before the shock wave had passed	9
Improper use of monitoring equipment	2
Opening rations exposed to possible radiation	2
Looking at the burst	1
Avoiding having clothes monitored for radiation	1
Halting a formation in a possibly contaminated area	1
Sub Total	38
Lack of regard for ordinary safety precautions	
Jumping off a moving truck	1
Driving a truck too fast	1
Sub Total	2
Lack of interest in the Exercise	
Not observing the damage done to equipment	3
Lack of concern about condition of foxhole	3
Sub Total	6
Work inefficiency, etc.	
Difficulty in locating stake	1
Losing rifle	1
Pestering the sheep	1
Sub Total	3
TOTAL	49

Those men who stayed alone munched on sandwiches, smoked or read. Some of the men had pocket-size books and magazines; at least one soldier was observed to be reading a New Testament. Scarcely any of the troops appeared to be attending to the voice of the orientation officer which was amplified by loudspeaker. When the three planes first appeared over the test site at about an hour before the drop, however, many of the men interrupted their activities to listen to the orientation officer's explanation.

After the troops were ordered to fall in and the command "rest" was given, they returned to their observation positions and many men ceased talking. At H-6 minutes, several soldiers were observed to be sitting on the ground, facing south, although

the order to do so had not yet been issued. Upon the order, all troops sat down and faced south, to await the burst.

Troops remained seated until the order to turn, which was issued three seconds after the flash. Several then rose to a kneeling or standing position, although they had been previously instructed to remain seated until the shock waves had passed over. They were immediately ordered to sit down and complied without hesitation. After the first few seconds, all participants were able to look steadily at the fireball. As soon as the shock waves had passed over, most troops stood up and mingled together in casual groups. The Operations Analysts who circulated among the men at this time observed only one soldier who was trembling. The film sequence viewed later by an ORO staff member showed no soldier giving physical evidence of fright.

EM Reports on Their Activities at Test Position 6. After D-day, 86 infantrymen of the Battalion Combat Team were asked to describe the activities they were pursuing immediately prior to and immediately after the detonation. Table X lists the results of this inquiry. As the list indicates there was a significant rise in bomb-centered activity after the explosion. Prior to the bomb run, only 20 percent had been engaged in some activity associated with the Exercise; the remaining 80 percent disported themselves in other ways. After the burst, however, 62 percent of the respondents reported that they were doing something associated with the explosion or the maneuver to follow.

The descriptions of troop conduct at Test Position 6 suggest that, prior to falling in just before the detonation, participants were rather nonchalant about the Exercise, with only a minority showing interest in the impending explosion. The confusion evident in those soldiers who stood up prior to the shock waves, the degree of attention with which participants contemplated the fireball and the increase in numbers engaging in bomb-centered activities after the shock waves indicate that the physical manifestations of the explosion captured the interest of most participants. Indoctrination lectures had, of course, described these manifestations. It is unlikely, however that verbal descriptions were sufficient to prevent the surprise of troops for the first time experiencing an explosion of such magnitude.

TABLE X

ACTIVITIES BEFORE AND AFTER WITNESSING THE ATOMIC DETONATION

Type of Activity	Before	After
Bomb-centered Activities		
Talking to buddy (ies) about the bomb	9	40
Discussing the spirit of the troops	2	0
Looking for or talking about the plane	2	0
Being interviewed	1	3
Talking to photographers or being photographed	3	3
Preparing for maneuver	0	7
Sub Total	17	53
Non Bomb-centered Activities		
Talking to buddy (ies) about "non-Exercise" topics	28	8
Playing cards	6	1
Shooting craps	12	6
Matching coins	4	3
Eating	13	8
Smoking and thinking	3	2
Reading	3	1
Going to the latrine	0	1
Sub Total	69	30
"Don't remember"	0	3
TOTALS	86	86

Analysts' Observations During the Advance and Return. En route from Test Position 6 to the emplacements, there was considerable conversation and horseplay among the men in the trucks. Several of the troops, however, looked intently in the direction of various test positions as though attempting to see what damage had been done. On arrival in the emplacement positions, the troops quickly detrucked and moved in orderly fashion to the briefing point. After briefing, they proceeded to their foxholes, where they readily handled their weapons, including the one badly damaged rifle. While waiting for the sticks to form for a further advance toward Ground Zero, several men sat down to relax in the emplacement area. Some troops began crap games and others read during the waiting interval.

During the single-file advance toward Ground Zero, the troops were quiet and orderly. A few ate candy bars. Some of the men stopped to examine the steel fragments with which the area was littered. When the jack rabbit appeared, about 500 feet from Ground Zero, a few troops attempted to catch it, but were restrained by the monitors. As the Battalion Combat Teams approached Test Position 1 in order to inspect the equipment there, the files began to break up. By the time they had arrived at Test Position 2, there was scarcely any semblance of the original formations. While many held at this position in "dismissed" formation for orientation comments over the loudspeaker, several men sat down on the ground in this area while listening, though they had been instructed before the maneuver not to do so. Before the command to entruck was given, the troops, for the most part, had already ceased to examine the exhibits. There was little laughter, talking, and activity in the trucks on the route back to Test Position 5. At that position, very few of the men attempted to examine the exhibits. Instead, most troops after being dismissed from their briefing muster by Colonel Tully, began to take positions in their trucks. The ride back to Camp Desert Rock was quiet and many of the men slept.

The Observations of Participant Observers. Prior to D-day, participant observers had named in their interviews certain individual soldiers, who, *they thought*, judging from comments they had overheard, would not perform the D-day maneuver adequately because of anxiety. Observers were, accordingly, instructed to watch these participants closely. During their interviews after D-Day, however, no observer was able to report that he had witnessed any failure in performance on the part of any one of these "suspect" participants.

Conduct After D-day. After D-day, arrangements for returning the troops to Fort Campbell were immediately pushed forward. There was, therefore, little opportunity for detailed observation of overt, non-verbal behavior in the days following. None of the observers or Operations Analysts, however, noted anything beyond the usual behavior of soldiers in breaking up a camp and getting ready for transportation.

The conduct of troops in Exercise DESERT ROCK was, in general, orderly and efficient and suggested no reluctance to participate in any phase of the maneuver. The involuntary physiological responses described in the following section, however, indicate the presence of tension and excitement in the subject participants.

PHYSIOLOGICAL RESPONSES

Although relatively few of the participants verbally expressed fear or apprehension concerning the forthcoming Desert Rock maneuver, these troops showed a higher level of general physiological tension and excitement, as measured by initial heart rate and blood pressure reactivity, at Desert Rock before D-day than after D-day at Fort Campbell. They gave significant emotional responses before D-day to questions pertinent to real or hypothetical danger situations involved in the atomic test and maneuvers. The physiological responses of these airborne troops to the question involving danger of atomic radiation did not differ significantly from their physiological responses to a question pertaining to a known stress situation – making a parachute jump from a plane.

In order that the reactions of troops to the A-bomb maneuvers might be probed beyond the level of the subjects' voluntary responses, their involuntary physiological reactions were studied in an experiment making use of a form of polygraph. The instrument used made a continuous record of each subject's respiratory and circulatory changes as he answered various questions presented by the examiner. From the polygrams, it was possible to derive approximate measurements of heart rate, pulse amplitude, rate and depth of respiration, and changes in relative systolic and diastolic blood pressure in response to specific stimuli. In the present study certain of these measures (heart rate and relative systolic blood pressure rise) were subjected to quantitative treatment in order to provide objective data concerning the emotional reactions of troops to various aspects of the atomic burst and the maneuvers at Desert Rock.

Findings from the polygraph study will be presented and discussed in the following order: (1) evidence of tension and excitement in troops at Desert Rock, (2) physiological responses to bomb and non-bomb questions, (3) physiological responses to bomb questions as compared with responses to a standard non-bomb question, (4) comparison of verbal and physiological responses to A-bomb questions, and (5) comparison of reactions to A-bomb and jump questions.

Evidence of Tension and Excitement in Troops at Desert Rock

Twenty-seven of the paratroopers participating in Exercise Desert Rock were given the polygraph test twice – once prior to D-day at Desert Rock, and again after D-day upon their return to Fort Campbell. In an attempt to determine whether or not there were differences in the level of tension and excitement

shown by participants before and after D-day, a comparison was made of the subjects' heart rate [5] at the beginning of each of the two tests.

Higher Heart Rate at Desert Rock than at Fort Campbell. On the test before D-day at Desert Rock, heart rates for the 27 subjects ranged from 68 to 132, with 9 subjects showing a rate of 100 or more. On the retest after D-day at Fort Campbell, no subject's initial heart rate was as high as 100, the range being from 52 to 92. The mean heart rate for the subjects in their first test was 95, whereas the mean heart rate in their second test at Fort Campbell was 76. [6] This difference is highly significant (beyond the .001 level of confidence) and strongly suggests that participation in the maneuvers and A-bomb test at Desert Rock increased the level of physiological tension and excitement in the troops studied. [7]

5/ The number of pulse beats occurring within the 15-second interval immediately following the asking of the first question (in all cases a question presumed to have little or no emotional loading, usually relating to the subject's name) was determined for each of the 27 subjects on each test. In every case, this figure was multiplied by 4 to obtain a value corresponding to heart rate per minute.

6/ There is a difference in altitude above sea level between Fort Campbell (C. 500 feet) and Camp Desert Rock (C. 3,000 feet). According to oral information supplied by W. E. Consolazio, formerly engaged in altitude studies conducted by The Fatigue Laboratory, Harvard University, this degree of altitude change, unless achieved with extreme suddenness, would cause no significant heart or blood pressure reactions.

7/ An attempt was made to measure the physiological responses of troops under conditions of known tension and stress by administering a polygraph test to paratroopers in a plane immediately before they were to make a parachute jump. Although tests were obtained on only three subjects under such conditions, the heart rate of each subject when tested in the plane was found to be higher than when he was retested three days later on the ground. One subject showed only a slightly higher heart rate in the plane stress situation -- 84 as compared to 80 on the ground; the others showed very marked increases: 124 as compared with 84, and 108 compared with 78. Parachute jumps in training are made at altitudes of 800 to 1,500 feet, usually at approximately 1,000 feet after cruising at the jump altitude for approximately one hour. For the effect of such altitudes upon heart rate and blood pressure, see Footnote 6.

Heart Rate Differences Not Due to First Experience with Polygraph. In order to determine whether or not the higher mean heart rate of participants before D-day could be a function of their initial experience with the polygraph test itself, a study was made of differences in heart rate on two polygraph tests by a group of 17 male civilians who were approximately the same age as the paratrooper sample. Although the polygraph tests were used for security purposes with the civilian sample, test procedures and instructions were similar to those used with the paratroopers. It was assumed that if the test itself elicited anxiety and tension in the subjects, this effect would decrease on the second test. Such a decrease was not evident. As measured after the initial non-critical question, the mean heart rate, on the first test for the civilian group was 88; for the second test with the same group it was 86. This lack of marked decline is in sharp contrast to the heart rate findings for the paratrooper sample. A control group, 29 members of the 11th Airborne Division who did not participate in the Exercise and received no indoctrination on atomic weapons, was found to have a mean initial heart rate of 81. This is significantly lower than the mean initial heart rate of participants tested before D-day. Mean heart rates for these various groups of subjects are summarized in Figure 2.

Greater Initial Blood Pressure Reaction at Desert Rock than at Fort Campbell. Another method of assessing the level of tension and excitement of participants before D-day is to compare the magnitude of their blood pressure responses to the initial question on the polygraph test at Desert Rock with their initial responses on their second test at Fort Campbell. For this comparison, the rise in relative systolic blood pressure shown in each subject's polygram following the first question on each of the two tests was measured. [8] On the test before D-day, 19 of the 21 men tested responded to the first question (Is your name _____?) with a blood pressure rise; these rises ranged from 1 to 16 mm.

8/ This is a measure of relative change in blood pressure, expressed in terms of the greatest millimeter deflection of the recording pen during the interval following the asking of the specific question. It is not a measure of absolute blood pressure rise expressed in millimeters of mercury.

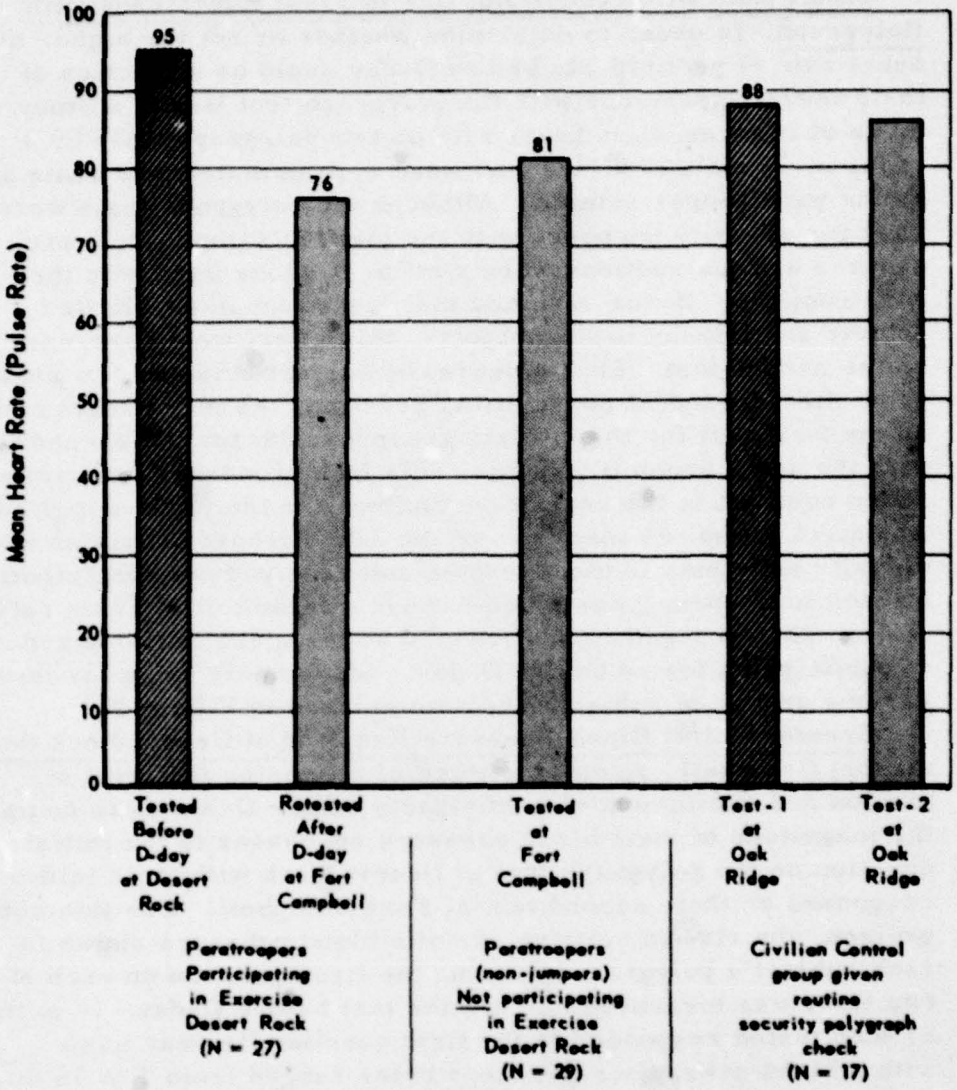

FIGURE 2.—Comparison of Mean Heart Rates for Various Groups of Subjects on Initial Polygraph Test Question

The mean blood pressure response of the entire group was 4.1 mm. On the test after D-day, 13 of the 21 paratroopers showed a blood pressure rise in response to the first question (Did you eat any breakfast today?); these rises ranged from 1 to 4 mm. The mean response for the group of 21 subjects on this test was 1.1 mm. The difference between the mean blood pressure response on these two tests is significant beyond the .01 level of confidence, [9] indicating a higher level of physiological tension in paratroopers before D-day at Desert Rock than after D-day at Fort Campbell. The mean blood pressure response of 27 non-participant control subjects at Fort Campbell to the first question on their only polygraph test was found to be 1.9 mm. This mean is significantly lower (beyond the .001 level of confidence) [10] than that of the participants tested prior to D-day; the difference in initial blood pressure reaction on the first polygraph tests for these two groups indicates that the increased initial blood pressure reactivity shown by participants before D-day was not a function of the test itself, but was related in some way to the Desert Rock situation.

Possible Significance of Tension and Excitement Shown by Troops at Desert Rock. On the basis of a study of initial heart rate and blood pressure reactivity, therefore, a higher level of tension and excitement was exhibited by troops prior to D-day at Desert Rock than by the same troops after D-day at Fort Campbell, or by the non-participant control subjects. These general physiological reactions may reflect the men's specific anxieties and apprehensions concerning the impending atomic burst and subsequent maneuvers; or they may denote an overall emotional response to the Desert Rock situation as a whole. In an attempt to determine more precisely the nature of the situational stimuli, the troops' physiological responses to specific questions on the polygraph test were analyzed.

Physiological Responses to Bomb and Non-Bomb Questions

In order to provide a basis for evaluating the significance of troops' physiological responses to questions pertaining to

9/ A t-test of the significance of a difference in the means of related measures was used.

10/ A t-test of the significance of a difference in the means of independent small samples was used.

the A-bomb, a number of questions unrelated to the A-bomb were included in the various polygraph tests administered both before and after D-day to the various groups of subjects. Among the irrelevant items in these tests were certain questions which, although unrelated to the A-bomb, might be expected to have some emotional significance to the subject (e.g., "Do you think your outfit is a good one?" "Do the fellows in your outfit think you may let them down in combat?") One question concerning a fear which most airborne troops claim to experience, namely the fear of making a parachute jump, was included in the tests administered to the paratroopers after D-day and to the control subjects. These latter subjects, although members of the 11th Airborne Division, were non-jumpers as well as being non-participants in Exercise DESERT ROCK.

Using this "jump question" and all bomb and non-bomb questions which were administered both to the participants tested before and after D-day and to the control subjects, a study was made of the magnitude of relative systolic blood pressure responses to these various questions by these groups of subjects.

Desert Rock Participants Showed Greater Response to Specific A-Bomb Question Before than After D-Day. Results of a comparison of physiological responses to the three questions used in polygraph tests both before and after D-day are presented in Table XI. For each question, differences in mean blood pressure response by the same men tested before and after D-day are given, and results of a test of the significance of these differences are shown. 11/

Although for each question the subjects' mean blood pressure reaction before D-day at Desert Rock was greater than after D-day at Fort Campbell, this difference is statistically significant in the case of only one question, i.e., the specific question pertaining to danger of atomic radiation. There is no appreciable difference in mean blood pressure response before and after D-day to the non-bomb question pertaining to the men's opinion of their outfit. Although the atomic warfare question elicited somewhat greater blood pressure reactions from men before D-day than after D-day, this difference too lacks statistical significance. The question which was most closely and

11/ A t-test of the significance of a difference in the means of related measures was used.

directly associated with the A-bomb maneuver at Desert Rock did elicit significantly larger blood pressure responses in the participants before D-day than after D-day. Troops before D-day, then, when asked about their willingness to handle equipment exposed to an A-bomb burst before such equipment was monitored, showed greater emotional disturbance than when asked this question after D-day upon their return to Fort Campbell.

TABLE XI

MEAN RELATIVE SYSTOLIC BLOOD PRESSURE RESPONSE TO POLYGRAPH QUESTIONS BY DESERT ROCK PARTICIPANTS TESTED BEFORE AND AFTER D-DAY

QUESTION	NO. CASES	BEFORE D-DAY Mean Response in mm[a]	AFTER D-DAY Mean Response in mm[a]	DIFFERENCE IN mm[a]	t RATIO	LEVEL OF SIGNIFICANCE
Radiation (Afraid to handle equipment within 1-1/2 miles of A-bomb burst before it is monitored?)	23	5.5	2.8	2.7	2.60	.02
Atomic warfare (Chance of coming out unhurt under atomic warfare as good as under regular warfare?)	22	5.1	3.8	1.3	1.35	(Not significant at .05 level)
Outfit (Think your outfit is a good one?)	20	3.3	2.4	.8	1.27	(Not significant at .05 level)

a/ Expressed in millimeters deflection of the recording pen, not in millimeters of mercury.

TABLE XII

MEAN RELATIVE SYSTOLIC BLOOD PRESSURE RESPONSE TO POLYGRAPH QUESTIONS BY DESERT ROCK PARTICIPANTS AND BY NON-PARTICIPANT CONTROL SUBJECTS

QUESTION	PARTICIPANTS		CONTROL SUBJECTS		DIFFERENCE IN mm[a]	t RATIO	LEVEL OF SIGNIFICANCE
	No. Cases	Mean[b] Response in mm[a]	No. Cases	Mean Response in mm[a]			
Radiation (Afraid to handle equipment within 1-1/2 miles of A-bomb burst before it is monitored?)	28	5.2	29	2.4	2.8	6.42	beyond .001
Atomic Warfare (Chance of coming out unhurt under atomic warfare as good as under regular warfare?)	27	4.4	29	5.2	.8	1.73	(Not significant at .05 level)
Outfit (Think your outfit is a good one?)	26	2.9	29	2.8	.1	.55	(Not significant at .05 level)
Jump (Have complete control of senses as jump out door of plane?)	25	4.9	29	3.8	1.1	3.14	beyond .01

a/ Expressed in millimeters deflection of the recording pen, not in millimeters of mercury.

b/ These are mean responses to questions on the test administered at Desert Rock before D-day except in the case of the jump question which was included in the after D-day test only.

Desert Rock Participants Showed Greater Response to Specific A Bomb Question than Non-Participants. Results of a comparison of physiological responses to four questions used in polygraph tests administered to participants and to non-participants are presented in Table XII. Differences in the mean blood pressure responses by these two groups of subjects, and the significance of differences, 12/ are shown for each question.

12/ A t-test of the significance of the difference in the means of independent small samples was used.

Troops studied at Desert Rock before D-day did not differ from the non-participating control subjects in their mean blood pressure response to the non-bomb question concerning their unit, nor did they show any statistically significant difference in their physiological response to the rather general question concerning the chances of being hurt in atomic versus conventional warfare. There was, however, a marked and highly significant difference in the physiological responses of participants and non-participants to the specific bomb-oriented question; significantly greater emotional disturbance concerning atomic radioactivity was shown by participants prior to D-day than by the control subjects who did not participate in the A-bomb maneuvers at Desert Rock.

Greater Response to Jump Question by Jumpers than Non-Jumpers. Another question included in this comparison was one pertaining to making a parachute jump from a plane. It might be expected that paratroopers, most of whom admit experiencing a certain amount of anxiety and apprehension before making a jump, would show a greater physiological response to this question than would the control subjects — members of the 11th Airborne who did not have jump experience. This was found to be the case; paratroopers tested at Fort Campbell gave a significantly larger mean blood pressure response to the jump question than did the control subjects who were non-jumpers.

Physiological Responses to Bomb Questions as Compared with a Standard Non-Bomb Question

Another method of studying the significance of physiological responses to bomb-oriented questions by troops participating in Exercise DESERT ROCK is to compare the blood pressure responses of the same subjects to different questions on the polygraph test. Using the standard question pertaining to the men's unit ("Do you think your outfit is a good one?") as a basis of comparison, a study was made of the differences in mean blood pressure response to this question and to the A-bomb and jump questions. These results are shown in Table XIII. Differences in mean blood pressure response to the standard (outfit) question and to other questions are given for participants tested before D-day, participants tested after D-day, and for the control subjects. Results of a test of the significance of these differences are also shown.[13/]

13/ A t-test of the significance of a difference in the means of related measures was used.

TABLE XIII

COMPARISON OF MEAN RELATIVE SYSTOLIC BLOOD PRESSURE RESPONSES TO STANDARD (OUTFIT) QUESTION AND TO BOMB AND JUMP QUESTIONS BY PARTICIPANTS AND NON-PARTICIPANTS

QUESTION	PARTICIPANTS				NON-PARTICIPANTS	
	Before D-day		After D-day			
	No.	Mean Response in mm[a]	No.	Mean Response in mm[a]	No.	Mean Response in mm[a]
Chance of coming out unhurt under atomic warfare as good as under regular warfare?	26	4.3	21	3.9	29	5.2
Standard question		2.9		2.3		2.8
Difference		1.4		1.6		2.4
t ratio =		1.74		2.10*		4.77***
Feel will be unhurt in A-bomb attack if do what told to do?	26	3.8				
Standard question		2.9				
Difference		.9				
t ratio =		1.79				
Afraid to handle equipment within 1-1/2 miles of A-bomb burst before it is monitored?	26	4.7	21	2.8	29	2.4
Standard question		2.9		2.3		2.8
Difference		1.8		.5		.4
t ratio =		2.90**		.80		.75
Feel safe in being in foxhole positions when A-bomb goes off?	26	4.3				
Standard question		2.9				
Difference		1.4				
t ratio =		2.60*				
Expect to black out or be hurt when A-bomb goes off?	26	4.5				
Standard question		2.9				
Difference		1.6				
t ratio =		2.68*				
Have complete control of senses as jump out door of plane?			21	5.0	29	3.8
Standard question				2.3		2.8
Difference				2.7		1.0
t ratio =				3.10**		2.56*

a/ Expressed in millimeters deflection of the recording pen, not in millimeters of mercury.

***Significant beyond .001 level of confidence.

**Significant beyond .01 level of confidence.

*Significant beyond .05 level of confidence.

Participants Tested Before D-Day Showed Greater Responses to A-Bomb Questions. It is seen that the troops tested prior to D-day at Desert Rock showed significantly larger blood pressure responses to specific bomb-oriented questions than to the standard question concerning their unit. These questions were directly pertinent to specific situations, either real or imaginary, which the troops might face on D-day. The thought of blacking out or being hurt at the time of the burst, the idea of being in their foxholes in the forward area when the A-bomb was dropped, and the possibility of handling unmonitored equipment within several miles of ground zero — all these might be expected to have had considerable meaning for the troops involved in the A-bomb maneuver. Therefore it is not surprising to find that the participants before D-day gave significantly larger blood pressure responses to these questions than they gave to the irrelevant question pertaining to their outfit.

To the more general and hypothetical questions concerning an A-bomb attack and atomic warfare, the physiological responses of these subjects are greater than their responses to the standard question, but not significantly so.

Participants Tested After D-Day and Control Subjects Did Not Show Greater Responses to Specific A-Bomb Questions. The non-participant control subjects and the participant troops tested after D-day at Fort Campbell showed a pattern of physiological response to these questions which differs from that shown by the participants before D-day. On the specific question concerning willingness to handle exposed and unmonitored equipment 1 1/2 miles from an atomic burst, blood pressure responses by both participants after D-day and control subjects did not differ significantly from their responses to the standard outfit question. It may be assumed that to the troops back from the Desert Rock maneuvers, as well as to troops which were never involved in these maneuvers, this question had little immediate emotional significance, and elicited physiological responses which were not greater than those elicited by the non-bomb question concerning men's opinions of their unit.

On the other hand, both participant troops after D-day and non-participant troops showed significantly larger blood pressure reactions to the general atomic warfare question than to the standard question, and both groups also gave significantly larger blood pressure responses to the parachute jump question than to

the unit question. The question pertaining to chances of being hurt in atomic warfare and the question concerning making a parachute jump from a plane were, for Desert Rock participants (jumpers) after D-day and non-participants (non-jumpers), of greater emotional significance than the standard question regarding the men's unit.

The significance of troops' physiological responses before D-day to specific questions pertaining rather directly to the impending A-bomb burst and maneuvers thus becomes apparent when these responses are compared with the physiological responses of the same troops after D-day, the responses of non-participant control subjects, and the responses of these troops to other questions.

Comparison of Verbal and Physiological Responses to A-Bomb Questions

Data presented in the preceding sections of this report have indicated that, prior to D-day, the troops participating in Exercise DESERT ROCK verbally manifested a rather high degree of confidence in their personal safety during the impending D-day events. Of the troops given a polygraph test at Desert Rock before D-day, only one man out of 29 verbally expressed a fear of blacking out or being hurt at the time of the burst; only 19 percent of the men said they would not feel safe in their foxhole positions when the A-bomb went off; and approximately one third of the men admitted that they would be afraid to handle equipment within 1-1/2 miles of the A-bomb burst before the equipment was monitored.

The physiological data, however, seem to indicate a rather widespread emotional reaction to specific A-bomb questions on the part of participants before D-day. In order to examine more closely the apparent disparity between these two types of data, the verbal and physiological responses of participants tested before D-day and of non-participant control subjects to two bomb-oriented questions were studied. These responses are shown in Figure 3.

Differences in Meaning of General and Specific A-bomb Questions to Participants Before D-Day and to Non-Participants. It has been shown that the physiological responses of paratroopers before D-day to the general atomic warfare question did not differ significantly from the responses of non-indoctrinated and non-participant troops, whereas the participants before D-day showed

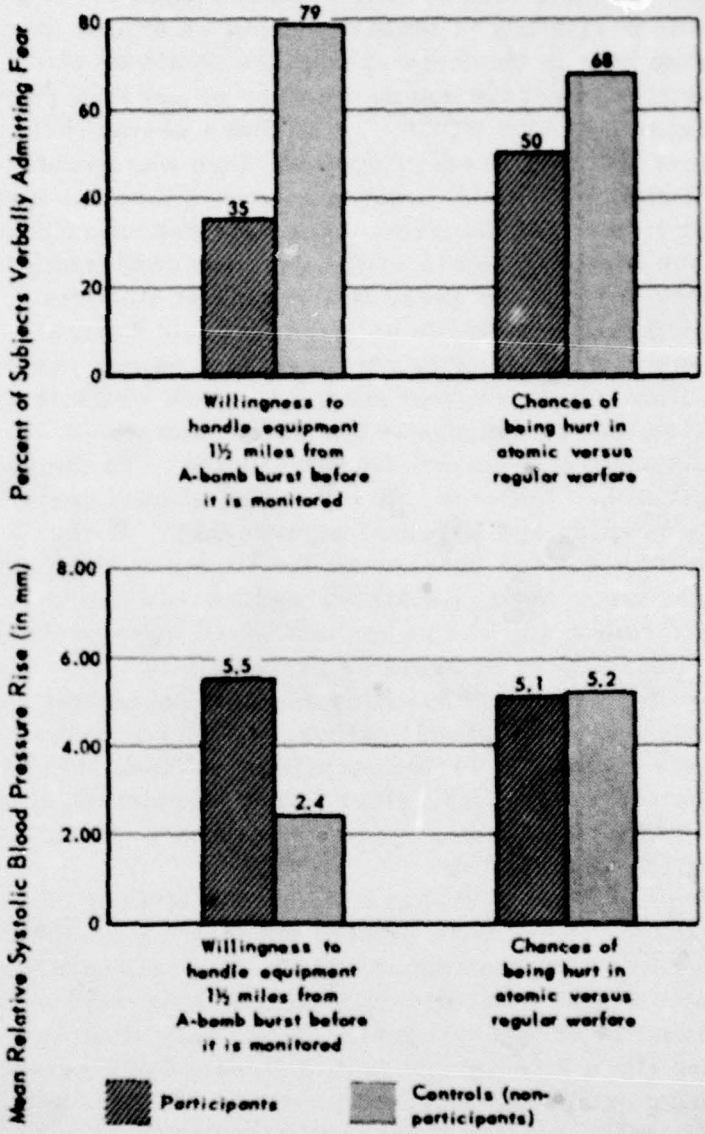

FIGURE 3.—Verbal and Physiological Responses by Participants before D-day and by Nonparticipant Control Subjects to Two A-bomb Questions.

significantly larger blood pressure responses to the radiation danger question than did the control subjects. It may be assumed that the possibility of involvement in an atomic war and the chances of being hurt in this type of warfare would be of concern to Airborne troops regardless of whether or not they participated in Exercise DESERT ROCK. Also there seems little reason to suspect that the threat of such warfare was greater for troops participating in the A-bomb maneuvers than for troops not participating in these maneuvers. There is reason to believe, however, that the meaningfulness of the question concerning atomic radioactivity differed for these two groups of subjects. The handling of equipment exposed to an A-bomb burst before such equipment was monitored probably represented a rather remote and hypothetical hazard to the control subjects — one which they would be likely to recognize as dangerous but which they would not perceive as immediately and personally threatening. To the paratroopers at Desert Rock, however, this question almost certainly had much more meaning and personal significance. Within a day or two these men were to witness an atomic burst and then to advance into the burst area, handle weapons which had been exposed to atomic radiation, and in various other ways personally face the potential dangers of residual radioactivity. For these troops, then, the question of handling exposed equipment was far from hypothetical and remote; rather, it represented a real and immediate threat. It is not surprising to find, therefore, that troops at Desert Rock before D-day were more disturbed emotionally by this question than were the non-participating troops at Fort Campbell. 14/

Significance of Verbal Admissions of Fear Concerning Atomic Radiation. It has been pointed out that the emotional disturbance concerning radiation danger shown by participants tested before D-day was not generally reflected in their verbal responses. On the basis of verbal testimony alone, only about one-third of the troops given a polygraph test at Desert Rock revealed fear of handling equipment exposed to atomic radioactivity, whereas a significantly greater number (three-fourths) of the non-participant subjects admitted such fear. 15/ If such testimony is

14/ This interpretation is supported by the finding that, after D-day there was no significant change in the mean blood pressure response of participants to the general atomic warfare question, whereas there was a significant decrease in their mean physiological response to the specific radiation danger question.

15/ Chi-square = 11.11; significant beyond the .001 level of confidence.

accepted at face value, this would indicate that fear of atomic radiation was far more prevalent among the non-participating troops than among the troops involved in the A-bomb maneuvers at Desert Rock, and it might be inferred that Army A-bomb indoctrination lectures had reduced anxiety concerning radiation dangers on the part of the Desert Rock participants. Such an explanation, however, fails to account for the marked and highly significant difference in the physiological responses of participants and non-participants to this question. If troops tested at Desert Rock were actually less disturbed about the danger of atomic radiation than were the control subjects, it is difficult to see why their blood pressure responses to this specific question were so much larger than those of the control subjects.

The Validity of Verbal Responses. The validity of verbal testimony concerning affective and emotional reactions is, however, open to some question. Unlike the physiological reactions of the individual, verbalization is a form of behavior subject to conscious control, and, as such, may undergo a considerable amount of screening influenced by the needs of the individual and the demands of the situation. It is also possible that individuals may be unable to verbalize emotional reactions because they themselves may not be aware of such reactions, or are unable to convert them into words. Thus it is possible that paratroopers at Desert Rock denied feeling afraid of handling exposed weapons while at the same time experiencing a certain amount of apprehension at the thought of radiation danger. It seems more likely, however, that a majority of these troops, after intensive indoctrination, were persuaded on an intellectual level that it would be safe to handle equipment exposed to an atomic burst at a given distance from Ground Zero. But they were not emotionally convinced of such safety; residual anxiety and apprehension showed up in their involuntary physiological reactions to this question. The non-participating, non-indoctrinated control subjects, in contrast, were not so emotionally disturbed about atomic radiation, since they faced no immediate exposure to such danger; and on an intellectual level most of them shared the popular stereotype concerning the hazards of atomic radioactivity and admitted this verbally. 16/

16/ After D-day there was a slight but non-significant increase in the number of participants who verbally admitted fear of handling exposed weapons. Thirty-five percent of the men admitted such fear before D-day, and 48 percent after D-day.

Verbal and Physiological Responses to General Atomic Warfare Question. The verbal responses of participants before D-day to the general question concerning atomic warfare did not differ significantly from the verbal responses of control subjects to this question.[17] Half of the participants and approximately two-thirds of the non-participants said that their chance of being hurt would be greater in atomic warfare than in conventional warfare. Verbal responses to this question are thus in accord with physiological responses which reveal no significant difference between the mean blood pressure reaction of participants and control subjects. A-bomb indoctrination lectures and participation in the Desert Rock maneuvers apparently had little or no influence on troops' attitudes and emotional reactions to the general question of atomic warfare.[18]

Comparison of Reactions to A-Bomb and Jump Questions

In a further attempt to evaluate troops' physiological and verbal responses to the specific A-bomb questions on the polygraph test administered before D-day, responses by both participant and control subjects to the parachute jump question[19] were studied. The reason for including this question in the polygraph test was to obtain data concerning a known fear (almost all paratroopers admit being apprehensive and fearful before making a jump), in order to facilitate the interpretation of data concerning a hitherto unknown fear (witnessing an A-bomb burst and participating in maneuvers in the burst area).

It has been shown that the mean blood pressure response to the jump question by paratroopers tested at Fort Campbell was

17/ Chi-square = 1.78; fails to reach significance at the .05 level.

18/ After D-day there was no change in the verbal responses of participants to the atomic warfare question; 50 percent of the men both before and after D-day said that their chances of coming out unhurt under atomic warfare would not be as good as their chances under regular warfare.

19/ The question as administered to paratroopers was: "As you jump out the door of the plane do you have complete control of all your senses?" It was rephrased for the control subjects (members of the 11th Airborne who did not have jump experience) as follows: "If you were to jump out the door of the plane would you have complete control of all your senses?"

significantly higher than their mean response to a non-critical question relating to their opinion of their unit; also, the mean blood pressure response of control subjects to the jump question was significantly greater than their response to the standard unit question. For both jumpers and non-jumpers, then, the question concerning making a parachute jump from a plane elicited a greater degree of physiological disturbance than was elicited by the unit question. The paratroopers, however, showed more physiological disturbance in response to this question than did the non-jumpers. It has been shown (see Table XII) that the mean blood pressure response to the jump question by paratroopers tested at Fort Campbell was significantly larger than the mean blood pressure response of the control subjects who were non-jumpers. Also, a verbal response presumed to indicate fear (a negative answer to the jump question) was given by a somewhat greater number of jumpers (60 percent) than non-jumpers (50 percent); this difference is not, of course, statistically significant.

Non-Participants (Non-Jumpers) Showed Greater Response to Jump Question than to Radiation Danger Question. It is possible to make a direct comparison of the control subjects' physiological responses to the jump question and to the question relating to atomic radioactivity. As was shown in Table XII, the mean blood pressure response by these subjects to the jump question was 3.8, as compared with a mean response of 2.4 to the radiation danger question. This difference in means is significant beyond the .01 level of confidence. Thus the control subjects — troops who did not receive A-bomb indoctrination, did not participate in the A-bomb maneuvers at Desert Rock and did not have jump experience — gave smaller physiological reactions when questioned about the possible danger of atomic radioactivity than when asked how they would feel if they made a parachute jump from a plane. If it is assumed that these troops were equally inexperienced in these two types of possible danger situations, then these data suggest that the emotional stimulus of the idea of jumping from a plane is inherently stronger than that of handling radioactive equipment.

Responses of Participants (Jumpers) to Jump and Radiation Danger Questions Did Not Differ. On the basis of paratroopers' reports of pre-jump fears, and the finding that paratroopers gave larger mean blood pressure response to the jump question than did non-jumpers, it might be assumed that the jump question on

the polygraph test would have an even greater emotional stimulus value for jumpers than for non-jumpers. It then becomes of interest to compare the physiological responses to the jump question and to the atomic radiation question given by experienced paratroopers who had received A-bomb indoctrination and were soon to witness an A-bomb burst and participate in maneuvers in the burst area. The mean blood pressure response of 25 paratroopers before D-day to the question concerning fear of handling exposed and unmonitored weapons after an atomic burst was 5.5; the mean blood pressure response of these same men after D-day [20] to the jump question was 4.9. This difference is not statistically significant.[21]

There is evidence, then, that paratroopers with jump experience showed larger blood pressure responses to the jump question than did control subjects without jump experience; that paratroopers participating in the A-bomb maneuvers at Desert Rock showed larger blood pressure responses to the radiation danger question than did the non-participating control subjects; and that the physiological responses of these paratroopers to the jump question after D-day did not differ significantly from their physiological responses to the atomic radiation question on the polygraph test administered at Desert Rock shortly before the atomic burst and the subsequent maneuvers were scheduled to take place.

That paratroopers' pre-jump and pre-burst fears were possibly comparable was suggested verbally by the participant observers; the physiological evidence from the polygraph test on another sample of paratroopers gives further support to the validity of such a comparison.

Physiological data collected from subject participants in Exercise DESERT ROCK revealed more emotional disturbance than their verbal responses indicated. Such disturbance was not, however, sufficient to impede adequate performance.

20/ Since the jump question was included only on the polygraph tests given after D-day, a more direct intra-test comparison of the responses to these two questions cannot be made.

21/ ($t = .59$, $p = .50$).