TECHNICAL
MEMORANDUM
ORO-T-41(FEC)

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The Johns Hopkins University
Operating Under Contract With The
DEPARTMENT OF THE ARMY

In Cooperation With

ONR
OFFICE OF NAVAL RESEARCH
and
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OFFICE OF THE SURGEON GENERAL
US ARMY

A STUDY OF COMBAT STRESS

KOREA 1952

(Preliminary Report)

by

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HEADQUARTERS
UNITED STATES ARMY FORCES, FAR EAST
APO 343

AG 461 GC-PO

4 September 1953

SUBJECT: Evaluation of Technical Memorandum ORO-T-41 (FEC)

TO: The Adjutant General
Department of the Army
Washington 25, D. C.
ATTENTION: Assistant Chief of Staff, G3
Research, Requirements and Special Weapons

1. References: a. Letter, G3 040 ORO (6 Feb 1952), Department of the Army, 7 February 1952, subject: Distribution of Publications of the Department of the Army Operations Research Office (ORO).

b. Letter, G3 040 ORO (9 Jun 53), Department of the Army, 21 July 1953, subject: Technical Memorandum ORO-T-41 (FEC), "A Study of Combat Stress Korea 1952."

c. Letter, AG 461 GC-PO, Headquarters, United States Army Forces, Far East, 17 April 1953, subject: ORO Technical Memorandum ORO-T-41 (FEC).

2. Two hundred forty-two (242) copies of this letter, incorporating the comments of Headquarters, United States Army Forces, Far East, are forwarded for attachment to the technical memorandum cited in paragraph 1c, in compliance with references 1a and b.

3. Technical Memorandum ORO-T-41 (FEC), "A Study of Combat Stress Korea 1952 (Preliminary Report)", is a study to determine the physiological and psychological changes that occur in combat infantrymen as a result of combat stress. As specified in the memorandum, the report is a preliminary one meant to describe the activities of the team and to present the bulk of the data obtained for the team's series of measures. The study discloses the problems encountered in controlling adequately in experiments of this type such important variables as time and place of measurement, and activity and food intake of the subjects.

4. The memorandum unquestionably has achieved the objective of presenting a detailed description of the activities of the research team and the data obtained by the team. With reference to the contents of the memorandum, concur with the general conclusions cited in referenced paragraph 1b to the effect that:

a. Research in this field is just starting and much work remains to be done before definitive conclusions can be reached.

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b. Continued research in this field may eventually establish usable criteria for use by commanders in lessening the effects of combat stress.

5. Comments on specific conclusions, recommendations and other portions of the technical memorandum are presented in Inclosure 1 for consideration by the Director, Operations Research Office, in the preparation of the final report. It is realized that all the conclusions and recommendations advanced in the study are tentative and subject to change after further analysis.

6. Copies of this letter and comments of lateral and subordinate commands and staff sections of Headquarters, United States Army Forces, Far East, have been furnished the Director of Operations Research Office, Far East Command, for his information.

FOR THE COMMANDING GENERAL:

Owen Elliot

1 Incl
Comments on TM ORO-T-41 (FEC)

OWEN ELLIOT
Colonel AGC
Asst AG

COMMENTS ON TECHNICAL MEMORANDUM
ORO-T-41 (FEC)

The following paragraphs cover comments of Headquarters, United States Army Forces, Far East on Technical Memorandum ORO-T-41 (FEC), "A Study of Combat Stress Korea 1952 (Preliminary Report)."

1. General:

a. Regarding the conclusions with reference to the physiological findings (pages 154-156): The blood cellular changes described (leukopenia, eosinophilopenia, etc.) are not felt particularly significant. A leukopenia found at certain examinations is no guarantee that this is a constant finding, especially when one considers the normal diurnal variation that occurs. The alleged finding of dehydration under stress does not agree with previous work on this topic done by members of a Surgical Research Team in Korea. It is considered that the research conducted by the Research Team was more extensive and better controlled than that of the ORO Team. The findings reported in this current ORO study were based on only five subjects. There is inconclusive data on the electrolyte balance as well as on total plasma cholesterol. It is further felt that there are no significant findings on the plasma carbon dioxide, urine uric acid, urine creatinine, blood and urine urea, blood and urine sugar and on the reactivity of the autonomic nervous system. In the latter case the findings are again based on groups of four people only. It is considered that more is already known about the nutritional aspect of combat stress than is pointed up in Technical Memorandum ORO-T-41 (FEC).

b. Regarding the conclusions with reference to the psychological findings (pages 154-156): The same general criticisms can be made in regard to insufficient numbers of samples tested. Further it is considered that all the variables that are present should have been taken into consideration in the study. An example is the problem of individual differences in intelligence. Most of the psychological tests used in the study, for example the Similarities, Identical Forms, Cattell Culture Free, Gottschaldt, etc., are highly correlated with over-all intellectual ability (and are often used to evaluate intelligence). Differences among the subjects as a group before and after combat stress could possibly be explained on the basis of native differences in intelligence. Without controlling this factor the differences which might have been obtained after combat could have been nullified by the existing differences in IQ prior to combat. Knowledge does not currently exist concerning the differential influence of combat upon persons with higher or lower intelligence so that, again, different subjects may have been influenced in different ways. There is no way of determining this without some idea of the native endowment of the subjects and the inclusion of control groups of high and low intelligence.

2. The following comments pertain to specific conclusions and recommendations:

a. Conclusion 16 (page 155) and recommendation 5 (page 151): The conclusion indicates that the tests of higher mental function demonstrate decrement in response to combat stress. As outlined in recommendation 5, research should be implemented to develop additional objective tests which would be more amenable to field use. It would appear that the testing was valuable in indicating that a higher mental function, if indeed it undergoes a decrement under stress, quickly returns to its normal, and that in devising any research scheme this fact should be borne in mind so that tests of parallel nature and timing should be discarded. Concur in general with recommendation 5 with the provision that the objective measures mentioned are indeed additional and not a parallel type which has proved ineffective.

b. Conclusion 23 (page 156): It is believed that this is an overstatement. The factors which tend to modify the experience of combat stress are so great in number, so inter-related and carry so many different meanings to different examiners, that it is believed in the present state of our knowledge and understanding adequate interview fails to provide complete knowledge of the factors involved.

c. Conclusion 25 and 26 (page 156): If the obvious implementation was made of the concepts expressed, it is believed that the psychiatric casualty rate would increase tremendously, including the "observable changes in overt behavior." It is true that experienced line and medical officers within the confines of their own unit, with knowledge of their own personnel and of the particular situation confronting the group, can develop an operational formula specific for that time and group which is most useful. It is considered, however, that the formula for one group cannot be applied to the next, nor can it be taught to any specificity beyond the fact that it happens. Symptomatologyof individuals under stress is most reactive to the patient's concept of what comprises useful symptomatology. If the "changes in overt behavior" were specified and a matter of common knowledge, experience tends to show that the specified changes would occur with increasing frequency.

d. Conclusion 28 (page 156): This conclusion could be misleading. It may have been true during the limited series of engagements that the ORO team observed that no instances of psychiatric casualties occurred while the individual was actively engaged in a fire fight. It is known, however, that during combat acute "breakdown", "freezing", fugue states, etc. may occur.

e. Recommendation 1 (page 156): Continued research, if designed so as to insure that there is a reasonable expectation of an addition to our present knowledge, should be carried on. Research should not be done merely for its own sake or to exhaust the list of parallel types of tests which have been tried. Any continued research should be held in abeyance until suitable research design is devised.

f. Recommendation 2 (page 156): Further studies in the field should be preceded by field trials of equipment and procedures to be used under environmental conditions as near like those of the actual study area as possible. All procedure should be standardized and adequate control data secured. As was maintained in this report, the results obtained may have been considerably modified by delayed testing or by the environment of the testing site. Use of aircraft (helicopter or light plane) to evacuate study subjects to a properly located and equipped laboratory might be well worth while and provide the expected results which this study failed to do in a convincing way.

g. Recommendation 3 (page 156): Concur.

h. Recommendation 4 (page 157): The implication appears to be that procedures are not being devised for the reduction of combat stress. Such innovations as armored vests and shorts, new types of winter clothing, and the continuous effort to provide the combat soldier with the best in weapons and support, all point up that procedures to reduce combat stress is a continuing effort.

i. Recommendation 6 (page 157): Concur.

j. Recommendation 7 (page 157): The research design is again emphasized. It would be worthless to attempt the objective as outlined without a firm and promising plan to implement.

THIS IS A WORKING PAPER
Presenting the considered results of study by the ORO staff members responsible for its preparation. The findings and analysis are subject to revision as may be required by new facts or by modification of basic assumptions. Comments and criticism of the contents are invited. Remarks should be addressed to:

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

ORO abstract

A STUDY OF COMBAT STRESS KOREA 1952
(Preliminary Report)

by

Operations Research Office
Office of Naval Research, Unit No. 1
Naval Medical Research Institute
Office of the Surgeon General US Army

What are the physiological and psychological changes that occur in combat infantrymen as a result of combat stress? This question is important in evaluating and predicting combat effectiveness and in determining measures for relieving combat fatigue and stress. This report presents a preliminary examination of data gathered by a field team composed of physiologists, psychologists, and one psychiatrist. Physiological and psychological tests were conducted on a group of 23 soldiers at Camp Omiya, Japan; on 24 infantrymen in Korea who were in reserve behind the MLR; on 39 men from an infantry company which led a major assault; and on 13 men from another company that had just returned from five days active combat. Preliminary findings, pending final treatment of the data, show these general conclusions:

- Analysis of blood and urine specimens show definite physiological changes occurring as a result of combat.

- Physiological disturbances resulting from the effects of psychological stress were found to be dehydration and an almost total absence of certain types of adult white blood cells.

- The adrenal gland, particularly the adrenal cortex, functions normally in the front-line infantryman not in active combat, but shows a high level of adrenal activity following severe combat stress.

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Technical Memorandum ORO-T-41 (FEC)

A STUDY OF COMBAT STRESS
KOREA 1952

(Preliminary Report)

by

OPERATIONS RESEARCH OFFICE
OFFICE OF NAVAL RESEARCH, UNIT NO. I
NAVAL MEDICAL RESEARCH INSTITUTE
OFFICE OF THE SURGEON GENERAL US ARMY

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SUMMARY

PROBLEM

To examine the kinds and degree of physiological and psychological changes that occur as a result of the stress placed on the infantryman by combat.

FACTS

A symposium was held at the Operations Research Office in January, 1952, to aid in planning an experimental approach for assessment of the deterioration of the infantryman's effectiveness in combat.

The symposium concluded that objective data have been lacking on the physiological and psychological changes which occur in men in combat.

The recommendation was made that a team of physiologists and psychologists obtain such data as the first step in determining deterioration due to the stresses of combat.

The work reported herein represents the findings of the team which examined, tested, and interviewed over one hundred infantry soldiers in a variety of combat and non-combat situations.

DISCUSSION

With the ever-increasing technological advancements being made in the production of weapons and in the solving of logistical problems, the tempo of warfare is increasing. It is becoming more and more evident that the human organism is one of the primary limiting factors in determining the success or failure of a military operation. In order to employ combat personnel most effectively, it becomes essential to determine the rate of deterioration in their effectiveness in battle. In other words, the problem becomes one of assessing the combat effectiveness of the infantryman under the stress of battle.

Combat imposes many stresses on the soldier -- fear of being killed or wounded, fear of not performing satisfactorily in the eyes of his fellow soldiers or his superiors (with consequent social or official disapproval), and the actual physical exertion required are some of these stresses. When stresses such as these act on the individual, they give rise to a great many changes in his physiological and psychological

functioning. Some of these manifestations can be measured, and when properly interpreted provide clues to how severe the stress was, how long it acted, and which soldiers were more severely stressed.

There are many factors present in any military situation which serve to modify the effects of stress on the individual. The quality of leadership and training, the extent of the soldier's combat experience, his attitudes, and the military task are some of the many factors which can mitigate or intensify the effects of stress.

These modifiers of stress are the factors which the Army can control in varying degrees. One of the ultimate goals of studies of stress, therefore, is to evaluate the effectiveness of various kinds of leadership, or training, in lessening the stressing experiences of combat. It would also be desirable to evaluate the condition of men so that their immediate future effectiveness can be better predicted. It is possible that future research may disclose some means of relieving the adverse effects of stress directly.

To accomplish any of these goals it is necessary first to determine what happens to men as a result of combat stress. This study was, therefore, devoted primarily to determining these physiological and psychological changes.

A secondary aim of the study was to obtain information pertaining to the basic causes of stress, and the modifiers of the stress.

In view of the restricting conditions of field testing, the choice of methods of study was limited. Hence tests were selected for their practicability, except in a few instances where it was feasible to obtain specimens which, after preliminary processing, could be shipped to more complete laboratories for final analysis.

The physiological tests consisted largely of obtaining samples of blood, urine, and saliva and examining them for various constituents. Changes in these constituents reflected changes in the level of activity of the adrenal gland which, through the intermediation of the pituitary gland, is a primary agent of the body in adapting to stress situations. One other type of physiological test was used to determine whether changes occurred in the reactivity of the autonomic nervous system (the part of the nervous system which is of prime importance to the individual in adapting to stress). The test consisted essentially of measuring the blood pressure and pulse rate response following the injection of the vasodilator drug, Mecholyl.

The psychological tests were of two general types. One group of tests was directed at measuring the changes in the sensitivity of the response of the individual to accurately definable visual and auditory stimuli. It is believed that the response is a reflection of the sensitivity of special areas of the cortex of the brain. The other group of psychological tests measured aspects of integrated higher mental function by determining such abilities as digit span retention, color naming, digit substitution, word similarities, series completions, figure recognition, and time estimation.

In addition to these objective measures, the behavioral characteristics of the combat soldier were defined through the use of interviews. Both psychiatric and general interviewing were carried out in the various combat situations examined.

The pattern of application of these procedures was essentially one of comparing soldiers immediately after exposure to combat stress with themselves before battle or after a recovery period, and with other troops in non-combat situations. It was possible to make control studies on a total of 23 soldiers and airmen at Camp Omiya, Japan, and on 24 infantrymen in Korea fresh from Corps reserve in a battalion in blocking position behind the MLR. Detailed studies were also made on a total of 33 men from an Infantry Company that was engaged in active combat for five days. Finally, tests were carried out on a group of five psychiatric casualties, and on one individual, a member of the team, who participated in an ambush patrol. Interviews were held at Sasebo, Japan, with 32 experienced combat soldiers awaiting return to the United States.

The tests in Korea for the large part were carried out at a Mobile Army Surgical Hospital located about one hour by jeep from the active combat area. The laboratory for the biochemical analyses was located at this MASH in a separate, pre-fabricated tropical shell. In many cases, however, the blood and urine specimens were obtained on the MLR, where it proved feasible to carry out simple preparative procedures such as the centrifugation of the blood samples to separate the plasma.

The thirteen members of the team were physiologists, psychologists, or psychiatrists.

The conclusions are to be regarded as preliminary and tentative pending final treatment of the data which mush await completion of the laboratory analysis of certain of the samples and further statistical analysis.

CONCLUSIONS

(The following are generalized conclusions. Technical conclusions and recommendations will be found in the memorandum proper.)

1. Analysis of blood and urine specimens disclosed definite physiological changes occurring as a result of combat.

2. Physiological disturbances were found which are considered to be new findings in that they have not been noted previously in investigations of the effects of psychological stress. They are: (a) dehydration, and (b) almost total absence of certain types of adult white blood cells. (The decrease in adult white cells has been found by others in the severely burned, and the acutely infected. Finding these changes in cases of combat stress may indicate how severe that stress is.)

3. Further indication of the severity of the combat stress is denoted by the fact that, in general, physiological function had not returned to normal four days after exposure to combat.

4. The function of the adrenal gland, particularly the adrenal cortex, in front-line infantrymen not in active combat, is normal, while following severe combat stress, there is a prolonged, high level of adrenal activity.

5. The psychological tests of higher mental function used in this research failed to demonstrate a significant change in response to combat stress.

6. The administration of complex physiological and psychological tests to front-line infantrymen who had just been engaged in major combat proved feasible under conditions existing in Korea during the fall of 1952.

7. Through proper indoctrination, it is possible to obtain the complete cooperation of both officers and enlisted men designated as subjects for this type of experimentation despite their lack of complete understanding and considerable physical discomfort to themselves.

8. In this study it was found to be particularly difficult and at times impossible to control adequately such important variables as time and place of measurement, activity of the subjects, and food intake of the subjects.

9. During interviews with combat veterans, effective leadership was cited as one of the most important factors in lessening the stressful experiences of combat.

A PRELIMINARY INVESTIGATION
OF COMBAT STRESS

INTRODUCTION

As a part of research on the larger problem of infantry effectiveness, the Operations Research Office has a continuing interest in research on infantry tactics and infantry weapons systems. Research in these areas cannot be fully accomplished without adequate knowledge of the effectiveness of the individual infantry soldier and the factors which increase or decrease this effectiveness.

One major problem in evaluating combat effectiveness is a lack of knowledge of the effects combat itself has on the ability of the soldier to perform effectively as he continues in the combat situation. How far a soldier can go, how much he can carry, how long he can remain in combat, are all problems which need answering. There are additional questions which can be raised and for which more complete answers are needed: whether or not there are certain individuals who are better able to withstand the rigors of combat and if so how they can be identified; the ways in which training can be improved to enable a combat soldier to better withstand combat and its ensuing effects.

The basic knowledge needed to investigate these problems is a definition of the changes which occur in the combat soldier as a result of being exposed to combat. Only with this knowledge can research be accomplished which will permit anticipation of the failure of individuals in combat so cogently described by Brig. Gen. S.L.A. Marshall. 1/ This knowledge is necessary to formulate training programs which will minimize the effects of combat. The setting of reasonable combat objectives and planning the tactics to take these objectives require additional knowledge of the effects of combat on the soldier.

In an attempt to obtain expert background knowledge and advice on these and related problems, the Operations Research Office sponsored a symposium held in January of 1952. (The proceedings of this symposium are at present being readied for publication.) Eight leading physiologists and psychologists, together with representatives of interested Army, Navy, and Air Force agencies, attacked the problem of how fatigue and stress affect the combat soldier.

1/ ORO-R-13 "Analysis of Infantry Operations and Weapons Usage in Korea During the Winter" S.L.A. Marshall (SECRET)

It was their opinion that the first task was one of defining what physiological and psychological changes occur in the combat soldier as a result of combat. They suggested that a team composed of representatives of the various scientific fields interested in the problem of fatigue and stress go to a combat zone. There they were to evaluate qualitatively and quantitatively the changes which occurred.

ORO immediately set about organizing such a team to go to Korea to make this evaluation. It was ORO's opinion that one major phase of this evaluation involved an accurate description of the behavioral and personality changes which occurred as a result of combat. A second major phase was determined to be a description of the underlying changes of a physiological and biochemical nature. These changes, theoretically should be concommitant with the general behavioral changes.

The Fatigue and Stress Team organized to implement this preliminary study was made up of 13 individuals, and included five Operations Research Office representatives, two Surgeon General Representatives, and five Office of Naval Research representatives and one representative of the Naval Medical Research Institute. The scientific disciplines involved included psychiatry, psychology, physiology, biochemistry, medicine and nutrition.

What follows is a preliminary report of the activities, findings, and recommendations of this team. Additional data will be provided when analysis of some of the samples, forwarded to laboratories in the United States, is completed. Complete interpretation of the results must await further evaluation in light of the tremendous volume of stress and fatigue literature. For these reasons, this report is a preliminary one meant to describe the activities of the team, and to present the bulk of the data obtained for our series of measures. The conclusions and recommendations presented are tentative. They will be elaborated upon in the final report which will be prepared after all the data are assembled and evaluated.

GENERAL DESCRIPTION

METHODOLOGY

One of the fundamental objectives of the team was to attempt an integrated investigation in the field on the problem of acute fatigue and stress in the combat infantryman, employing the techniques of the disciplines listed above. In view of the difficulties associated with field studies generally, certain limitations were imposed on the methodology which could be used. On the other hand, recent major research achievements suggested new measures which heretofore had not been applied in field studies on the effects of stress. For example, the development in the past few years of a purified adrenocorticotrophic hormone (ACTH) preparation suitable for injection into human beings has resulted in a rapid expansion of our understanding of the physiological changes occurring with the heightened pituitary-adrenal activity that is concommitant with stress situations. Similarly, the studies of the Columbia Greystone Associates on the effects of lobotomy and lobectomy have suggested new techniques for examining higher mental function objectively.

A battery of measures was devised, therefore, which could be applied under field conditions to assess the physiological and psychological effects of the acute stress of combat on an individual soldier. Briefly, these tests may be summarized as follows.

Physiological Tests

The physiological tests fall into two basic categories: the bulk of them were aimed at estimating the level of pituitary-adrenal activity, and one other test was designed to examine the reactivity of the autonomic nervous system. The former category comprised: (a) total white blood cell count, total eosinophil count, and differential white cell count from which the absolute lymphocyte count was determined; (b) hematocrit values and total blood volume; (c) electrolyte studies including sodium, potassium, chloride and total carbon dioxide on the blood plasma; sodium, potassium and chloride on the urine; and sodium and potassium on the saliva; (d) plasma total cholesterol level; (e) uric acid and creatinine in the urine; (f) blood and urine urea nitrogen; and (g) blood and urine sugar. In addition, an attempt to measure the adrenal cortical reserve was made by the use of a modified ACTH test, suggested by Dr. Peter Forsham, which involved the administration of a dose of an ACTH-gel preparation followed by a period of urine collection. Both the ordinary urine samples and those from the ACTH test were extracted and concentrated for subsequent 17-ketosteroid and corticoid analysis, to be done by the Worcester Foundation for Experimental Biology and the Metabolic Institute of the University of California. The test of the reactivity of the autonomic nervous system consisted essentially of measuring the blood pressure and pulse rate responses to an intramuscular injection of the parasympathomimetic drug Mecholyl.

Psychological Tests

The psychological tests likewise may be subdivided into two categories: those aimed at an objective measure of higher mental function and those attempting to evaluate sensory-cortical sensitivity. The tests selected to assess cortical function included measures of digit span retention, digit substitution, color naming, word similarities, series completions, figure recognition, time estimation, and task preferences. Two tests were used to determine sensory-cortical sensitivity: the measurement of visual flicker fusion frequency and of auditory flutter fusion frequency.

In addition to these objective psychological measures, both psychiatric and general interviews were conducted in order to obtain the broadest possible evaluation of each individual.

OPERATIONAL PROCEDURES

In preliminary meetings of the team, held in Berkeley, California in August, 1952, a tentative experimental plan was devised with the assistance of Lt. Col. D.E. Munson and Dr. Ralph W. Gerard. It was concluded during these meetings that an approach to the actual combat situation would not be practicable for two reasons; first that the Korean War was at that time in a quiescent state, and second that during active combat the fluidity of the military situation made personnel sampling extremely difficult. Consequently, it was decided to employ the ambush and combat patrols as the stress entity to be examined. These would have a further advantage in being susceptible to subjective ranking in terms of severity. It was planned to examine the men to be committed on patrol a few days before the patrol, immediately upon return from the patrol, a few days after the patrol, and finally a few weeks later. Comparison of these data for several patrols would be expected to reveal the effects of a moderately acute, readily definable, combat stress situation on typical groups of infantrymen.

Preliminary Work: Tokyo and Korea

The team arrived at the Tokyo Operations Research Office on 1 September, and arrangements were made through the 406 Medical General Laboratory to set up a squad tent (12 feet by 20 feet) in a motor pool lot to simulate the expected field conditions for the laboratory. Power was furnished from a gasoline generator and water from a tank trailer. Portable ion exchange resin water purifiers were used to purify water for chemical purposes. The laboratory methods were successfully set up and tested under these conditions.

In the meantime, an advance echelon of the team visited Korea to set the exact location for the studies, and visualize more exactly the details of both working conditions and experimental design. It was decided to establish the laboratory at the 8063 Mobile Army Surgical Hospital (MASH) Unit, which was supporting the Infantry Division with which the study was to be made. Through the kind agency of the EUSAK Surgeon, a pre-fabricated tropical shell (20 feet by 54 feet) was made available at the MASH for the laboratory studies. It is clear after the experience with the squad tent in Tokyo that the provision of this semi-permanent type building greatly extended the effectiveness of the team in its work. Although the laboratory work could have been done in a squad tent, both the quantity and quality of the date obtained would have been lower.

The MASH was located no further than one and a half hours by jeep from any point on the MLR of the sector concerned in these tests. This was a factor of no little importance because of the labile nature of some of the blood and urine constituents to be examined. In fact it later became apparent that there would have been some additional advantage gained had the laboratory been set up at Division Headquarters. There would have been no problem in quartering the female members of the team, liaison with Division Operations would have been facilitated, and travel time to and from the MLR would have been reduced.

Preliminary arrangements were also made at Division, Regiment, and Battalion levels to work with specific patrols. In view of the dual responsibility involved in this study, the test plan was presented for approval to both the Operations and Medical Officers at all three levels. It may be stated unequivocally that complete cooperation was obtained throughout the study at all levels, including Company level and from the combat soldiers themselves.

In accordance with the observations and arrangements made in Korea, it was decided to set up in Tokyo the type of test pattern to be applied to the patrols. The purpose was two-fold, one to perfect the timing of the tests and the laboratory techniques, and two, to obtain control values for the various measures in the absence of combat stress. Consequently, arrangements were made to study two groups of twelve men each at Camp Omiya, located about one hour by car from the laboratory tent. These two groups, termed Group I and Group II, were made up of soldiers and airmen who were in the late stages of convalescence from accidental and battle injuries, and who at the time of the tests were undergoing regular physical training as part of their rehabilitation.

The general plan involved the testing of each group two days apart, allowing one day between tests to complete the laboratory determinations. Thus each group could be repeated every fourth day on an alternate two day cycle. It was hoped to apply this pattern to patrols in Korea so that a pre-patrol determination could be run four days before the patrol, a second test could be administered immediately after the patrol, and a post-patrol run carried out four days after the patrol. Thus two patrol groups could be studied every two weeks, and a total of six patrols examined during the stay in Korea.

On this basis, by the end of September Group I from Camp Omiya had been examined three times, the runs being designated as I-A, I-A', and I-A''. Group II was studied twice, and these runs were termed II-A and II-A'.

The plan for each run was as follows. After explaining briefly to the group of men the purpose of the study, they were asked to void and the time was noted. This served as the zero time for the urine collection period. Some of the psychological battery was given next as a group test to all the men simultaneously. These tests included the digit substitution, series completion and figure recognition. Immediately following the psychological group tests 15 ml blood samples were drawn and partitioned equally between three tubes, two of which were oxalated. The blood in the third tube was allowed to clot for serum collection. One of the oxalated tubes was spun down as soon as possible, usually within one hour, for plasma collection, and the other was kept for the determinations involving whole blood. Later in the study, after arrival in Korea, this procedure was much simplified by using a heparinized syringe to draw the blood and using plasma exclusively instead of serum.

After the blood sampling the subjects were tested individually for auditory flutter and visual flicker fusion frequencies, followed by saliva collection. The latter was accomplished by asking the individual to chew paraffin for ten minutes, and then collect the saliva through a funnel into a 15 ml vial while continuing to chew the paraffin. The individual psychological tests, administered usually by two observers, were given next, and these included the digit span retention, color naming, word similarities, time estimation, and task preferences. Urine collections were usually made at the end of the individual psychological tests, and the time was noted.

Finally the so-called special tests were performed. These were called special tests primarily because no individual received more than one of them. Generally each of the three special tests was given to four individuals of the group. These three tests were the measurement of blood volume, the Mecholyl autonomic reactivity test, and the ACTH adrenal cortical reserve test.

The entire battery could be administered in two and a half to three hours, except for the urine collections following the administration of the ACTH-gel which were made over-night in practically all instances. No psychiatric interviews were conducted on the Camp Omiya subjects.

In Korea

The team arrived at the 8063 MASH on 28 September, and final plans were set to make pre-patrol studies on a group of combat infantrymen on 7 October, who were scheduled for an ambush patrol on the night of

10 - 11 October. In the meantime one member of the team went to Sasebo, Japan to interview veteran troops just relieved from combat who were being returned to the United States after acquiring the necessary number of points. By this method a much broader survey of the nature of the combat stress problem in patrols could be made than by work with a few isolated groups alone. This member rejoined the team in Korea later in October.

On 6 October the Chinese Communist Forces started their limited Fall offensive, and the patrol schedules were suspended. As a result, the experimental plan had to be modified. It was ascertained that an assault on a high piece of ground in front of the Division sector was being planned for the near future, and permission was received to work with the troops making the initial attack.

In the interim period before the assault, blood and urine specimens were obtained from two psychiatric casualties and one battle casualty at a Regiment Collecting Station on the night of 8 - 9 October. These individuals were made part of miscellaneous Group VII, and follow-ups were made on the psychiatric casualties on 12 October.

On 13 October a limited test battery, including blood and urine collection, was run on 24 infantrymen from one of the Rifle Companies some thirteen hours before being committed to the initial assault on the following day. This was designated as Group III-A. It should be pointed out that the group knew they were being committed as the point company of a major attack. Therefore, there was present in the individuals a high degree of anticipatory tension, and there is little doubt that some of the test measures were influenced. Consequently, interpretations based on these as control data must be made carefully. On the other hand, the data are of considerable value in giving information concerning the anticipatory state itself.

It was not possible to run the complete test battery because of the short notice that the troops were moving out of the rear collecting area. With more experience on the part of the team in the details of military operations it would have been entirely practicable to run the full test battery before the assault. It is in this connection where close and continuous liaison with Operations at Division, Regiment, and even Battalion level is essential, largely because of the rapidity with which the final decisions on troop commitments are made. This point cannot be over-emphasized, as the only limiting factor in the study of combat stress is the speed with which the testing team can keep up with the situation, and in no wise is it the degree of cooperation obtainable from the military operations groups.

The assault began on the morning of 14 October, and three members of the team were located at the Battalion Aid Station supporting the rifle company being followed, one team member was located at the Regiment Collecting Station, and three others were located at the Medical Clearing Platoon. The purpose of this distribution, which was only partially successful, was to attempt to follow the casualties from the Group III-A subjects.

During the course of the battle it was possible to obtain blood samples, included in Group III-B, from five of the group who had been wounded, and from one of them a urine specimen was also obtained somewhat later. It was also possible to get blood samples from three psychiatric casualties being evacuated from the Company, but who were not of the original 24 subjects. Urine specimens were obtained from two of the psychiatric casualties. These three men were placed in miscellaneous Group VII, and a follow-up was made on one of them five days later, after he had been returned to duty. The plasma samples in all cases were separated immediately after blood drawing in a clinical centrifuge operated from a small gasoline generator carried in a jeep trailer.

A note may be interposed here concerning the convention adopted for designating the conditions under which the individuals were examined. The individuals themselves were identified by the first letter of their last names followed by the last four numbers of their Army Serial Number. Following the numbers were the letters A, B, C, or D indicating respectively that the test was run either some time before the specific stress situation, immediately after the stress, four to ten days after the stress, or more than two weeks following the stress. In the case of the control groups who were not exposed to a major stress, tests and retests were designated by A, A', or A''.

The Group III company was withdrawn from the assault approximately 16 hours after it began because the tactical situation became untenable; however, because of communications and transportation lags it was not possible to start tests on the men until the following day, 16 to 18 hours after they had left the acute combat area. Blood and urine samples were obtained from 20 survivors of the assault, five of whom were repeats from the original group of 24. All of these 20 men were termed Group III-B, although no A samples had been taken on 15 of them. Shortly after the blood sampling, twelve of the III-B men were taken to the MASH laboratory for the psychological tests, psychiatric interviews, and the special physiological tests (four men each for blood volume, Mecholyl and ACTH respectively).

The assault by this rifle company, which lasted approximately sixteen hours, represents an intensely acute combat operation. It was conducted in the face of strong, well-prepared enemy positions which were supported in depth from higher ground, and in the course of the action the men were subjected to artillery concentrations and numerous grenade and small-arms duels throughout the entire period. When they withdrew under cover of darkness it was to a collecting area within a mile of the MLR, where they spent the remainder of the night in the open. They were trucked back to the Division reserve area the next morning, 15 October, arriving about noon. Throughout this period before the tests were run the men subsisted on "C" rations, and the blood samples were taken at approximately 1400, before the men received their lunch "C" rations.

When first seen by the team at the reserve area the men as a group gave a clear clinical impression of an extremely fatigued group. Their features were drawn and gaunt making them appear older than their actual ages. There were essentially no spontaneous expressions of amusement, either verbal or facial. Their responses to conversation were depressed and dulled, and their actions were lethargic although they were quite tractable. On being called up for formation they responded gradually with a slow and unenthusiastic obedience, and they received the congratulations of the new Company Commander on the action just completed with utter and complete apathy. Altogether, they were a very tired group of men who had been through a severe physical and emotional ordeal. In spite of this, the 12 men who were taken directly to the MASH with very little time to rest were extremely cooperative for the tests and gradually became more and more verbal during the remainder of the afternoon, so that they were even voluble in their thanks for the hot supper and shower with which they were provided after the tests.

Blood and urine specimens were obtained from the same 20 men comprising Group III again on 19 October, five days after the assault, and the same 12 were retested at the MASH. This run was designated as Group III-C. In the interim period between B and C the men had been returned to a quiet sector of the MLR. Although there was some measure of stress present, it was in marked contrast to that of the assault, and represented the typical environment of the combat infantryman in Korea.

It was learned that another rifle company, which was occupying the same combat area that Group III had assaulted, was to be relieved after five days in position. Consequently, arrangements were made to obtain blood and urine samples at the Division reserve area from 13 individuals about 0500 on 21 October, within seven hours after leaving the combat area. These same individuals, after a brief rest, were transported by truck to the MASH for the psychological tests, psychiatric interviews and special physiological tests, starting at 1000. This run was designated as Group IV-B because although this was the first test on Group IV it was made immediately after the stress situation.

During most of the five day period that Group IV was in combat position, the military situation was relatively stable, although enemy artillery was active. The major combat episode occurred on 19 October, the day before the group retired, when an enemy company-size counterattack was repulsed successfully after intensive artillery action and hand-to-hand fighting. On the whole, the combat stress experienced by Group IV, while severe, was less intense but more prolonged than that experienced by Group III, a conclusion substantiated by the much lower casualty rate of Group IV than Group III. Furthermore, from a military point of view the Group III Rifle Company had essentially failed to reach and hold its objective whereas the Group IV Rifle Company was more successful in its assigned task.

When Group IV was first seen, about three hours after leaving the combat area, they gave the impression of marked fatigue but were considerably more alert and cheerful than Group III had been. In contrast to Group III, laughter and spontaneous talk were occasionally evident. The men volunteered help with the sample collecting, and generally showed a lack of the phlegmatic dejection of Group III. It is not intended to minimize the severity of the stress undergone by Group IV, but rather to point out the obvious behavioral difference between the two groups shortly after combat.

Arrangements were made with another Division, which had been in Corps Reserve for a few weeks, to test 24 men in two groups of 12 men each. These were designated Group V-A and Group VI-A. The tests were run at the MASH laboratory starting at 0900 on 26 and 27 October respectively. These individuals were drawn in equal number from three rifle companies that had just been assigned to a blocking position immediately behind the MLR. The purpose of studying Groups V and VI was two-fold: to provide better control data for the Korean combat infantryman than was provided by Groups I and II, and in the expectation that some of the men in Groups V and VI would be committed in acute combat so as to increase the number of individuals on whom both pre-stress and post-stress data was obtained. Actually, only the former objective was met because none of the men had been committed by the end of the stay of the team in Korea.

It was possible, however, to obtain retest data on Groups V and VI at the same time of day on 6 and 7 November, some eleven days after the first test. The retests were designated as Group V-A' and Group VI-A'.

In the meantime a repeat set of tests was performed on 12 of the original 13 men of Group IV approximately ten days after their first tests. During the ten day period the Group IV Rifle Company had been assigned to a quiet sector of the MLR and had resumed normal activity, including patrols. One of the FAST Team members, Lt. John Kilbuck, participated in an ambush patrol on the night of 29-30 October, and his evaluation of this phase of combat stress forms a part of the report. On 30 October Kilbuck and six of the Group men were tested at the MASH, on 31 October three more were tested, and on 2 November the remaining three were tested. This run was termed IV-C, except for Kilbuck who was placed in the VII-B category. A repeat test was performed on Kilbuck eight days after his patrol, and was designated as his C run.

It was also possible to repeat the test procedures on 10 of the 12 men in Group III on 5 November, 22 days after the severe combat experience. Blood and urine samples were also obtained from 17 of the 20 sampled previously in this group. This run was designated as III-D. During the time intervening between III-C and III-D the Company had been in Regiment Reserve, had engaged in a limited combat action involving an outpost position, and had occupied positions on the MLR. At the time of the last retest, the group had been occupying their old positions in a quiet sector of the MLR for five days, and in general the group seemed to have recovered completely from the assault of three weeks previously.

The team left Korea on 11 November and returned to Tokyo to prepare the report.

Listed in Table 1 are the mean values for height, weight, and age, and the age range of the various groups studied. It will be noted that they are quite uniform in this respect, and close to the mean values for combat infantrymen generally.

TABLE 1

MEAN VALUES FOR HEIGHT, WEIGHT, AGE, AND AGE RANGE, OF THE GROUPS EXAMINED

Group	Mean Height (in.)	Mean Weight (lbs)	Mean Age (yrs)	Minimum Age (yrs)	Maximum Age (yrs)
I	67.6	152.9	23.4	21	31
II	69.2	152.4	21.8	19	25
III	68.8	151.8	22.5	18	31
IV	68.5	157.5	22.7	21	26
V	69.4	162.0	a/	a/	a/
VI	68.8	154.0	a/	a/	a/

a/ These data will be presented in the final report.

The results obtained with each of the test measures are presented separately in the following sections. They are grouped under two broad sections: the physiological findings and the psychological and psychiatric findings. These findings as a whole, and their relation to the general problem of fatigue and stress, are then summarized in a discussion section.

While preliminary treatment of the data has led to the construction of some developed tables and figures which appear in the text, all of the original data have been preserved in Appendix A so as to be available for future critical evaluation.

For convenience, a generalized description of the various groups examined in this study is presented in Table 2. A more detailed description of the composition and time of study of the groups is given in Appendix A.

TABLE 2

GENERALIZED DESCRIPTION OF THE GROUPS EXAMINED

Group	Run	Time of run	Description of group	Total Individual in group
I	A	0	Camp Omiya, Japan control.	11
	A'	4 days after A.		
	A''	4 days after A'.		
II	A	0	Camp Omiya, Japan control.	12
	A'	4 days after A.		
III	A	13 hrs before assault.	Part of point Co in major assault. Stayed in active combat area 16 hrs. Also includes some wounded individuals.	39
	B	17 hrs after leaving assault area.		
	C	5 days after leaving assault area.		
	D	22 days after leaving assault area.		
IV	A	Not run.	Part of Co occupying assault area for 5 days.	13
	B	7 hrs after leaving assault area.		
	C	10 days after leaving assault area.		
V	A	0	Korea combat infantrymen in Regimental reserve position.	12
	A'	11 days after A.		
VI	A	0	Korea combat infantrymen in Regimental reserve position.	12
	A'	11 days after A.		
VII	A	Not run.	Miscellaneous group comprising psychiatric casualties, one wounded and one man from combat patrol.	7
	B	Shortly after the stress.		
	C	Several days after the stress.		
			TOTAL	106

PHYSIOLOGICAL FINDINGS

PITUITARY ADRENAL FUNCTION

Hematology

From the whole blood samples (either oxalated or heparinized) the white blood count (WBC) and differential count were determined. Eosinophils were determined from the same samples by direct count in a Fuchs-Rosenthal Chamber. The determinations were made, at the latest, 18 to 24 hours after sampling. The smears for differential counts were stained in Wrights Stain and two slides were made on each sample. Two hundred cells were counted on each slide.

Two main groups of controls were sampled. Data for the two groups from Camp Omiya (Japan), Group I and Group II, are presented in Fig. 1. Data for groups V and VI, who served as the Korean controls, are presented in Fig. 2.

It may be seen that Group I is peculiar in regard to the presence of a definite lymphocytosis. The explanation for this is not as yet available. The lymphocyte counts of Group II and of Groups V and VI are quite comparable. The eosinophils of Groups I, and II and Groups V and VI are comparable and not significantly different from one another.

Figure 3 presents the data for the five subjects of Group III, one of the stress groups. Taken as a group it may be noted that there were, after combat, the following changes in blood count from the before combat measures: (a) a definite leucopenia accompanied by (b) a neutropenia, and (c) a lymphocytopenia, and (d) an eosinopenia. Figure 4 shows the breakdown of each individual with regard to lymphocyte count, and it should be noted that all show definite drops in count. However, it should also be noted that in the eosinophil picture as seen in Fig. 5, subject H-4808 shows a rise from the A to the B measurement while M-0305 shows no change. The explanation probably lies in the anticipatory tension state of the individuals. As for M-0305, the low count indicated throughout may be due to a continuous tension state of the individual. Psychiatric evaluations of individuals are needed, however, to reinforce these tentative explanations.

The tendency of this group of five subjects to return to normal by the time of the fourth sampling is apparent; however, there are wide variations from individual to individual. The lymphocyte counts of

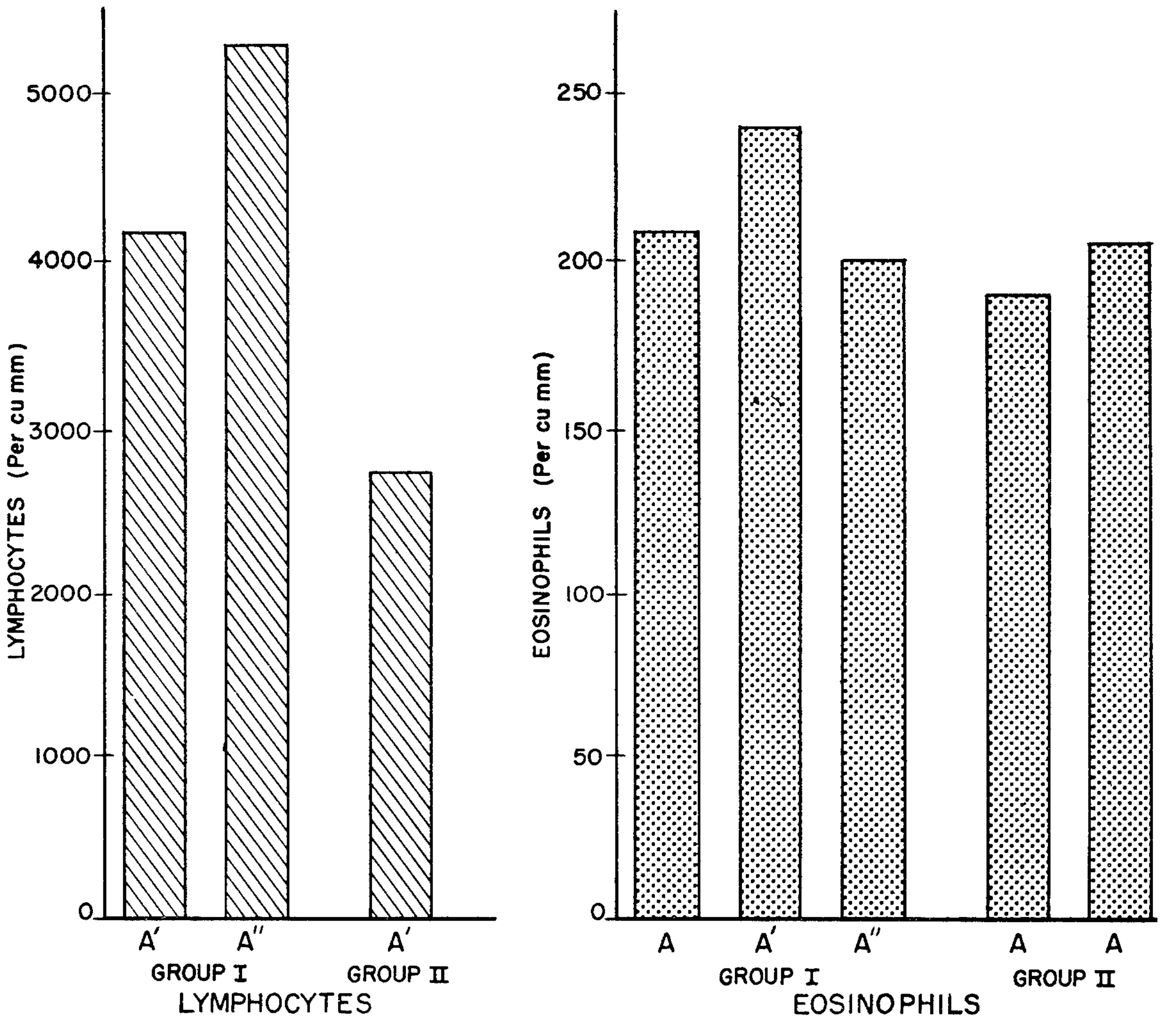


Fig. 1 - Mean Blood Lymphocyte and Eosinophil Levels, Control Groups I and II

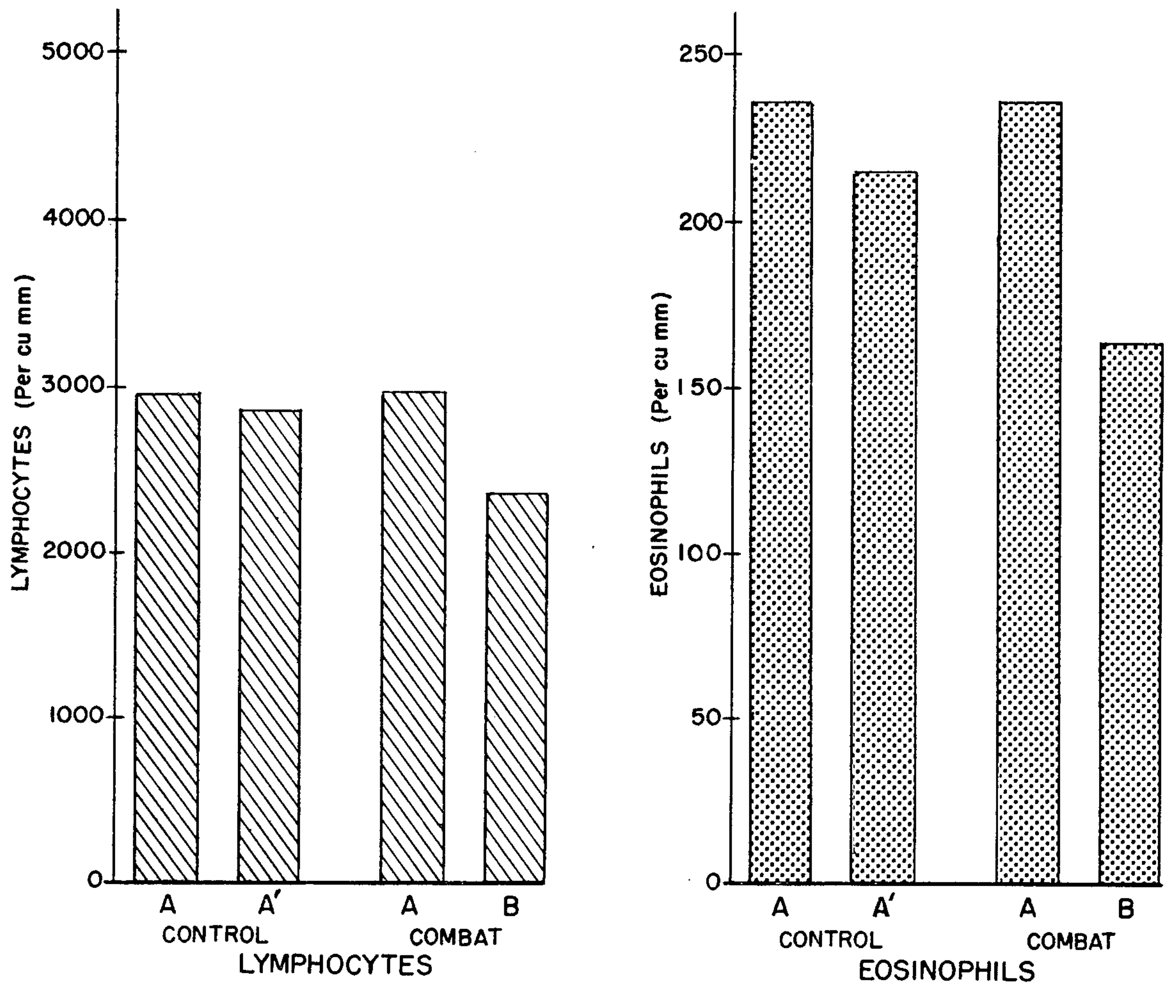


Fig. 2 - Blood Lymphocyte and Eosinophil Levels, Control Groups V and VI, Combat Groups III and IV[a/]

a/ Mean values of combined groups V and VI are shown for the controls. For the combat groups, A is the mean pre-stress value of Groups, III, B is the mean post-stress value for combined Groups III and IV.

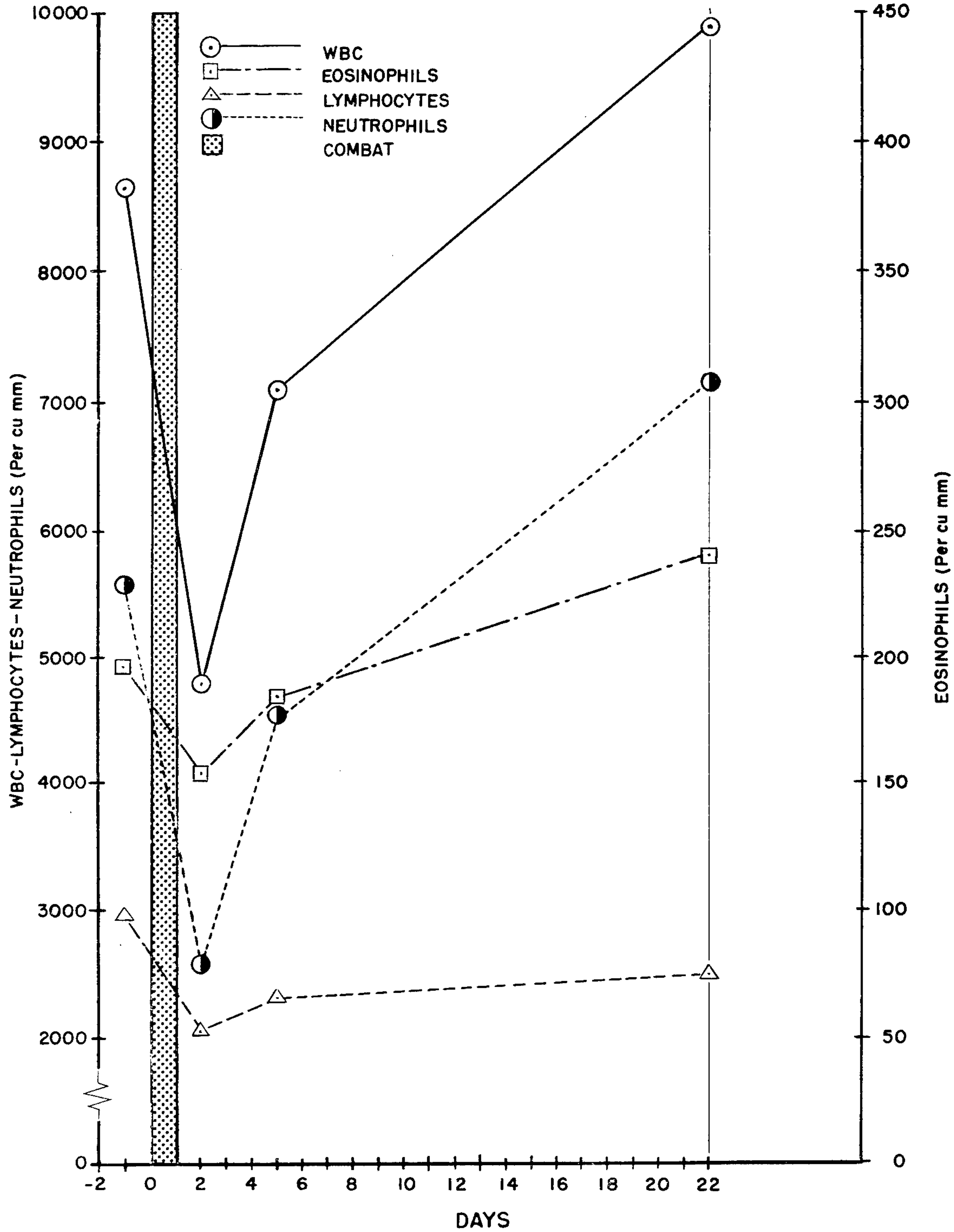


Fig. 3 - Mean Blood Count of Individuals, Group III, on whom Serial Data was Available

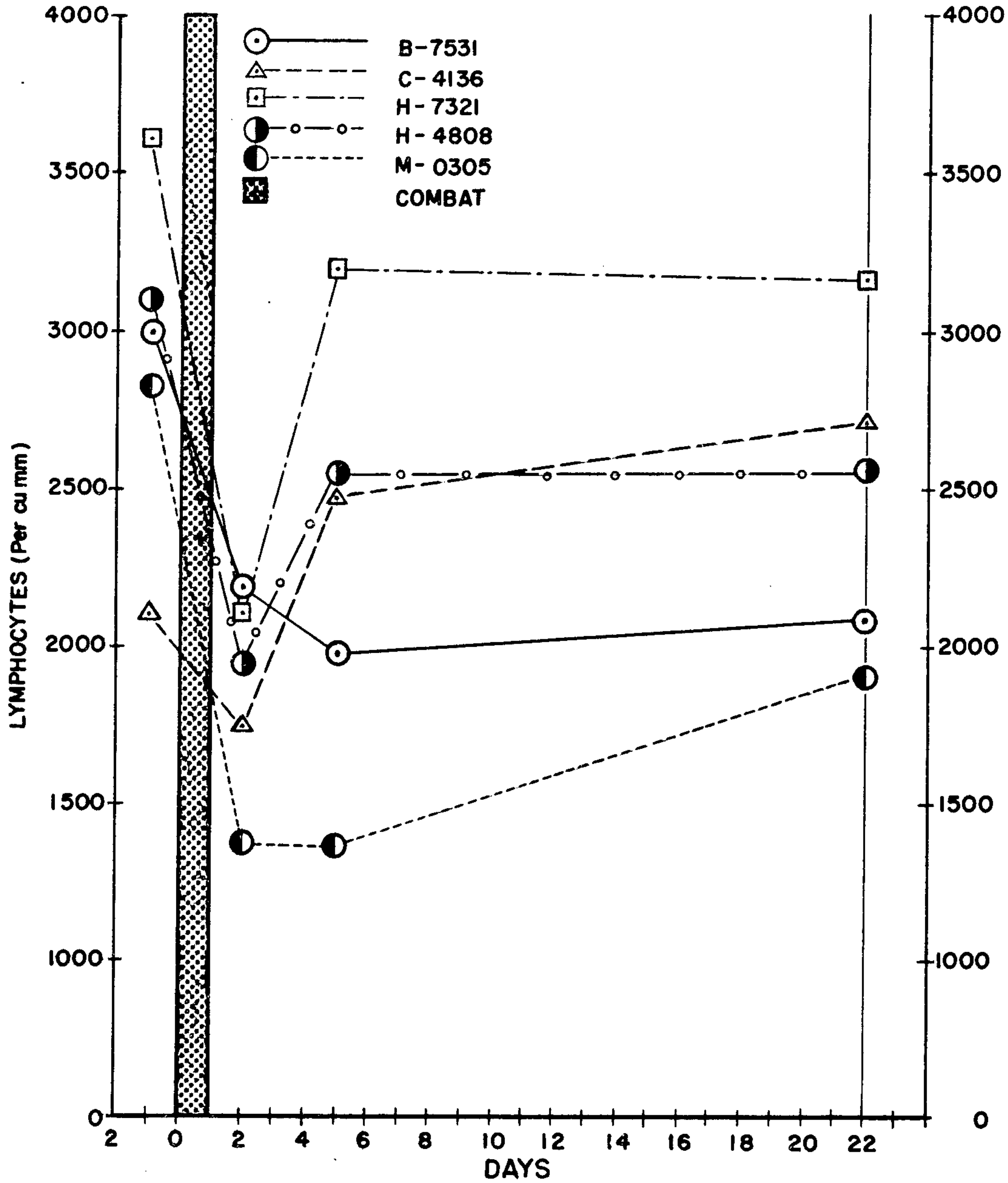


Fig. 4 - Lymphocyte Counts of Individuals, Group III, on whom Serial Data was Available

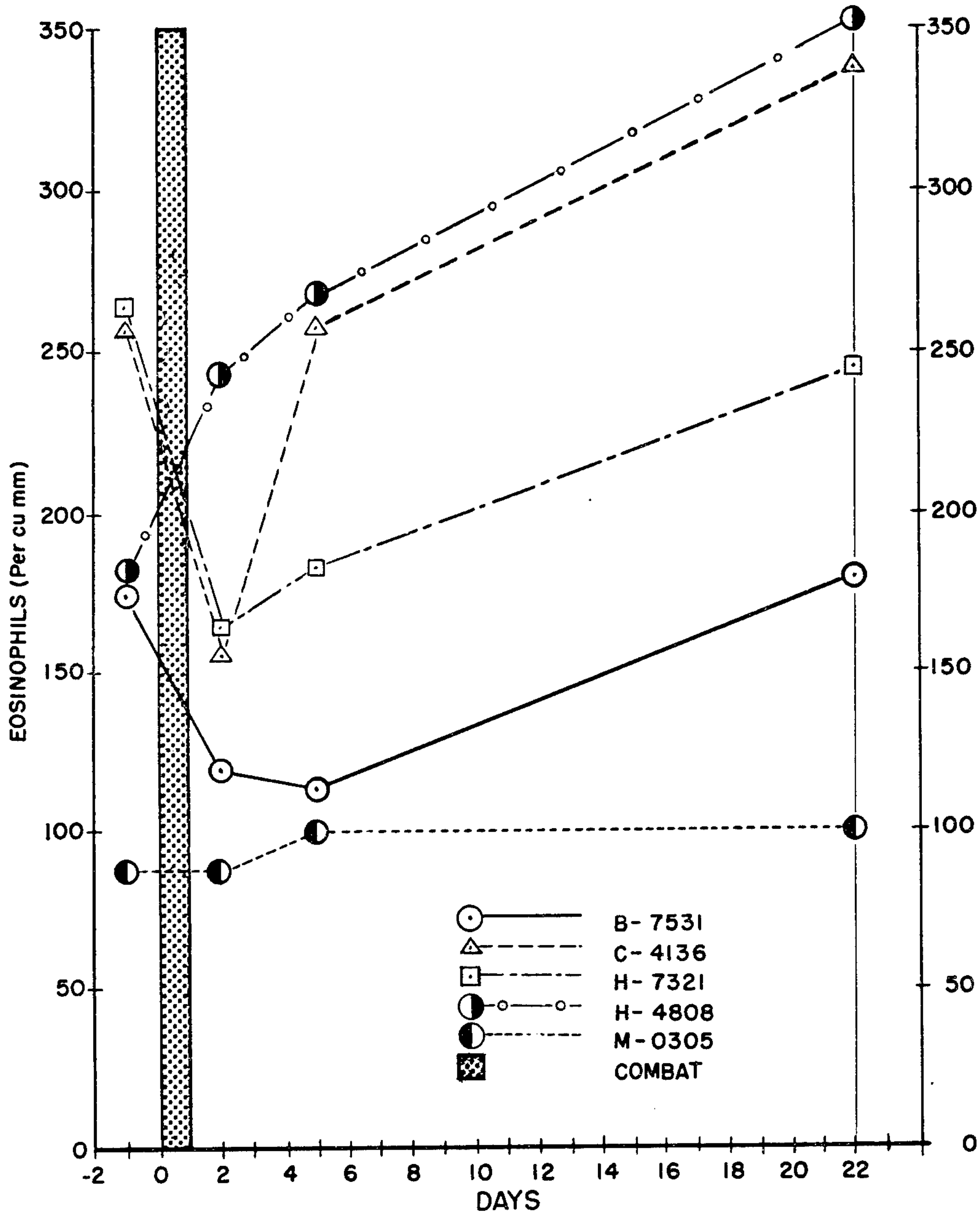


Fig. 5 - Eosinophil Counts of Individuals, Group III, on whom Serial Data was Available

C-4136, H-4808, and H-7321 come right back toward normal, while M-0305 remains down and B-7531 shows a slight decrease from the B to the C measurement. These individual differences may be better understood when the data is interpreted with psychiatric findings.

Figure 6 presents the A, B, C, and D findings for Group III. There are 18 to 20 subjects in each group. Groups B, C, and D are serial samples on the same individuals; however, A includes only five subjects which are included in B, C, and D. The others, though of the same group, are different individuals. From Fig. 6 it may be noted that taken as groups there is a definite leucopenia. On examination of the B samples of Group III, there was noted (a) a definite decrease in polymorphonuclear leucocytes, and (b) the presence of a large percentage of immature polymorphonuclear leucocytes and practically a total absence of mature cells. In the D measurement of this group there was a return to normal values for polys and a reappearance of mature polys in large numbers. A more detailed study of these smears is to be made. The presence of immature polys was also noted in Group IV B, the other post-combat group studied, and further reports on this group will be made later.

The Korea control group of 24 men, Groups V and VI, were sampled twice at intervals of ten days. In Fig. 2 the test and re-test are designated as A and A'. No significant differences in lymphocytes and eosinophils were found. When the post combat data (B) of Groups III and IV are combined and compared with Groups V and VI A, a significant lymphopenic response at $<.01$ confidence level and a eosinopenia of the $.02 < .05$ level were evident.

In examining the recovery rate from B to D of Group III, there was no significant rise toward normal with regard to lymphocytes; however, the eosinophils rose from 150 at B to 235 at D which was significant at the .001 level of confidence. (See Fig. 7) Furthermore the eucocytes (WBC) returned toward normal from B to D, and the number of immature cells, noted in B, were markedly reduced with the reappearance of mature polymorphonuclear leucocytes.

The combat casualties fall into two groups: (a) those who had physical wounds and (b) those classified as "combat fatigue" or who were unable to conduct their duties due to psychological disturbances.

As may be seen from Fig. 8, there is a marked lymphocytopenia and eosinopenia in the wounded men. The descriptions of the wounds are as follows.

SCHOW: simple fracture right humerus; superficial shell fragment wounds left thigh and hip; superficial gun-shot wound of scalp; slight loss of blood; possible shock.

SMITH: multiple shell fragment wounds of left leg and thigh; moderate blood loss; no shock.

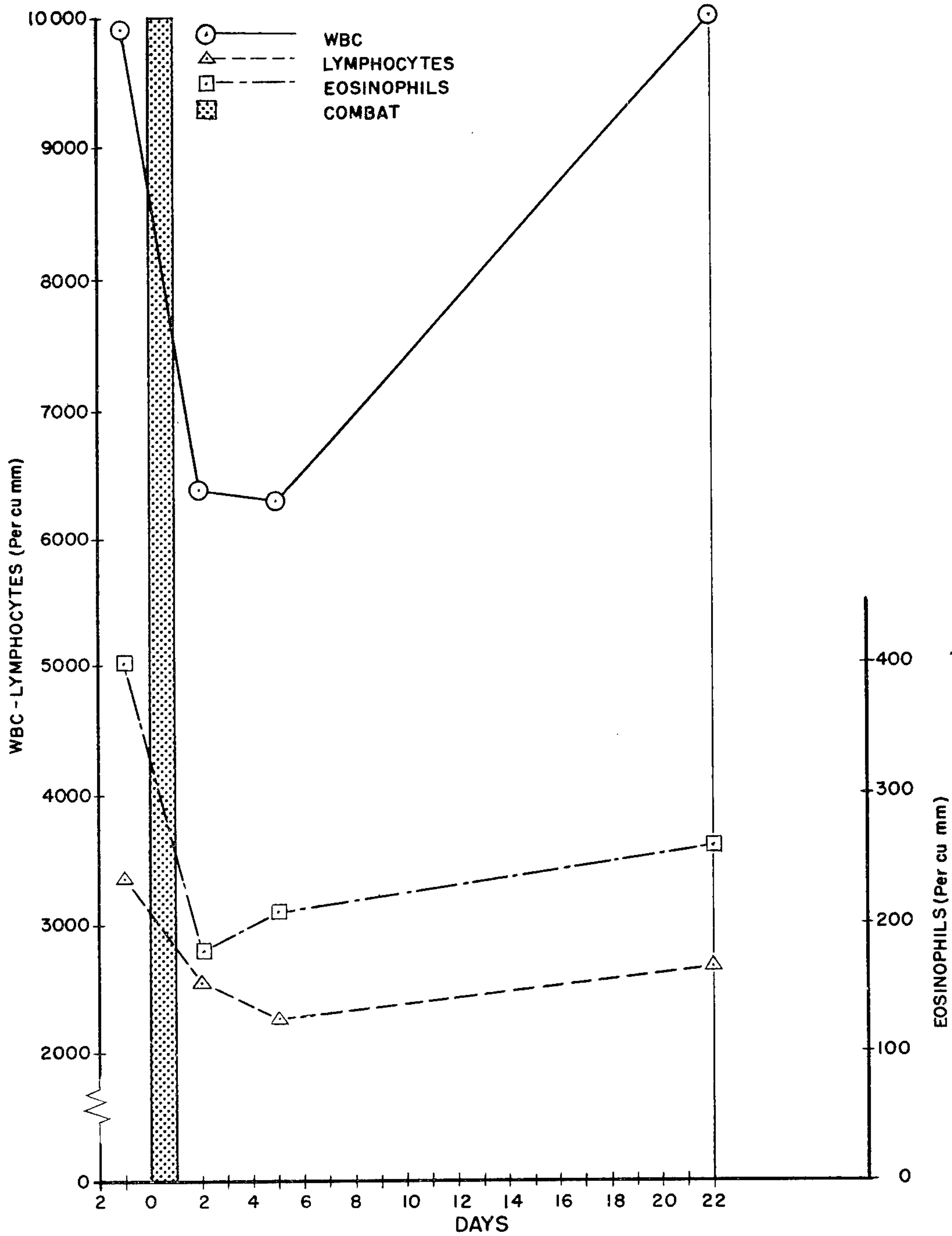


Fig. 6 - Average Blood Count Values of Group III

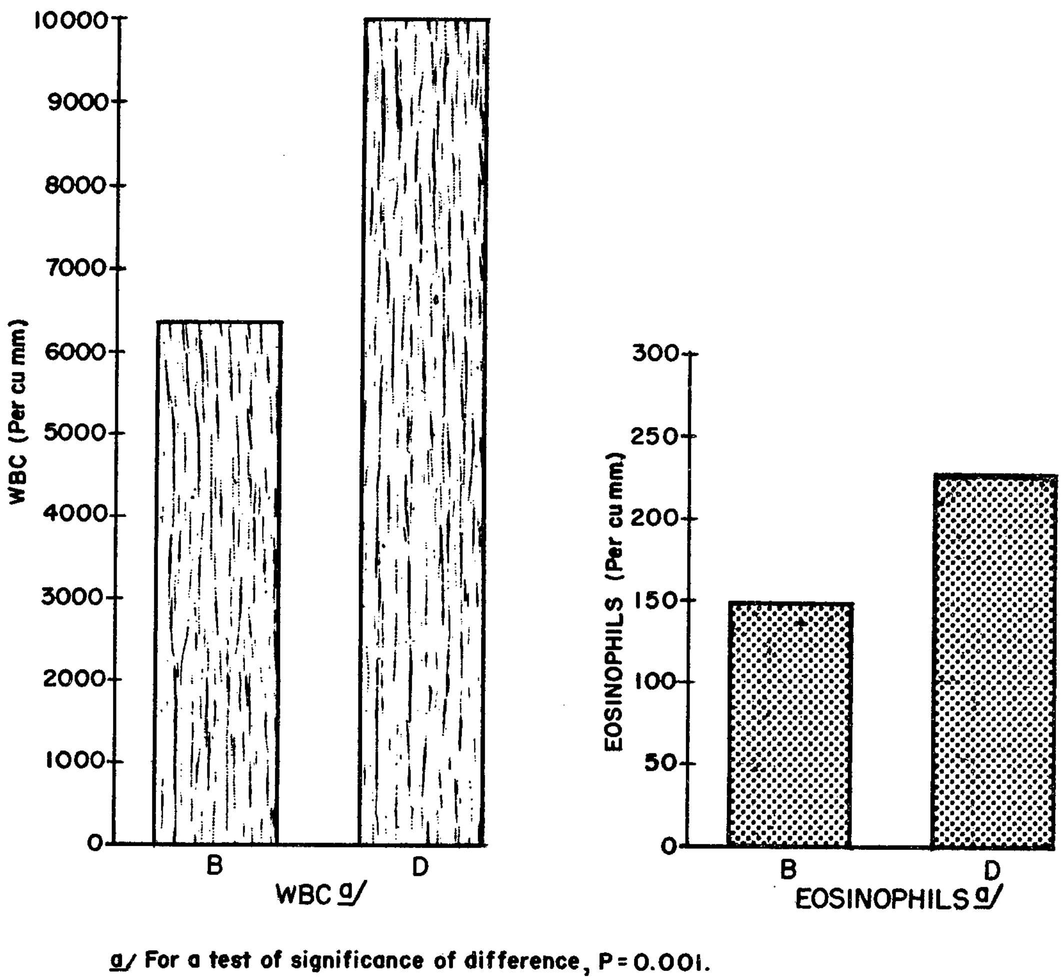


Fig. 7 - Mean Values of WBC and Eosinophils, Group III
Post-stress (B), and 20 Days Later (D)

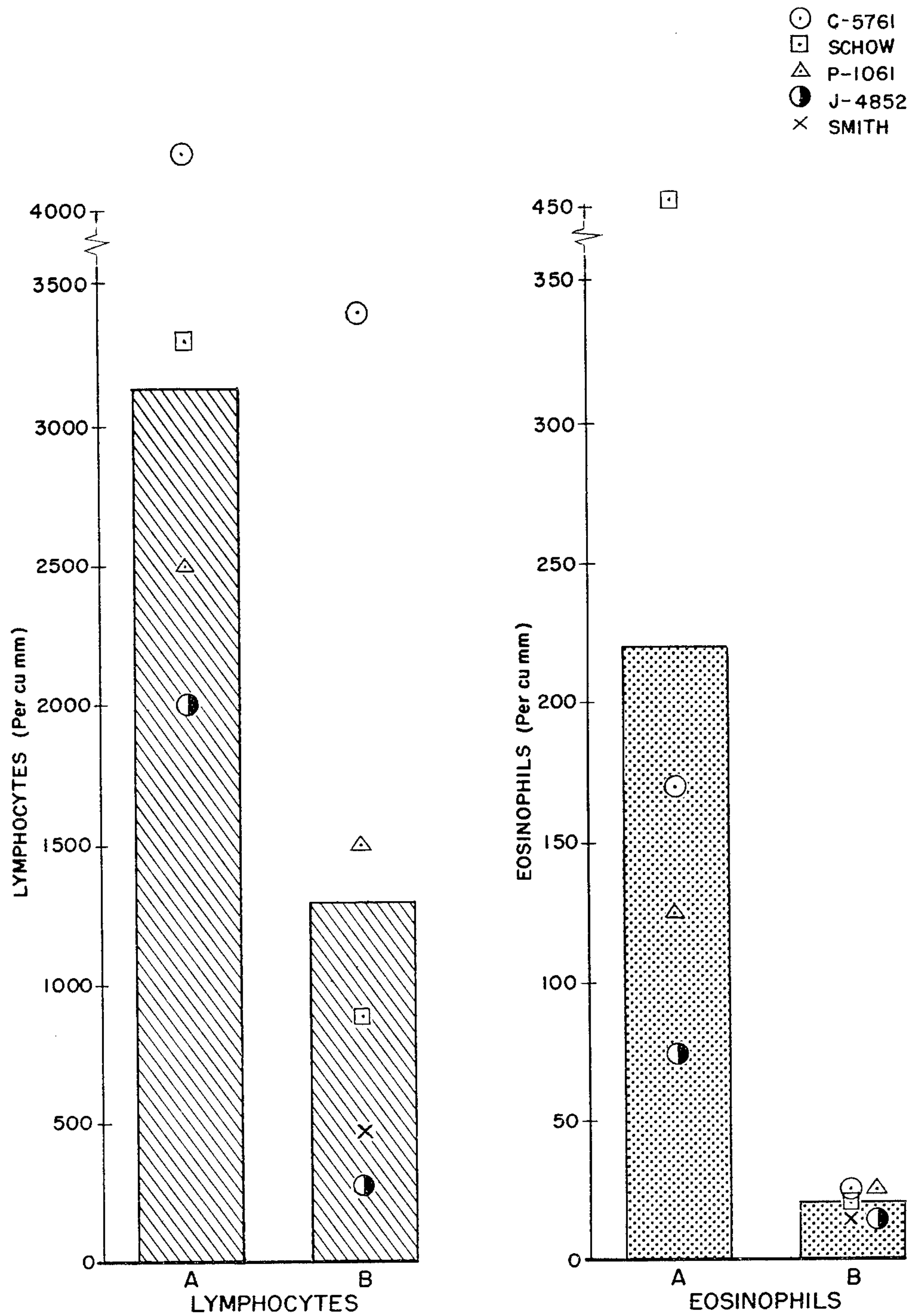


Fig. 8 - Lymphocyte and Eosinophil Counts of Casualties, Group III Before (A) and After (B) Wounding (Blocks Indicate the Means)

G-5761: shell fragment wounds of both lower extremities; moderately severe blood loss with shock at time of blood sampling.

J-4852: superficial shell fragment wounds of the extremities; no significant blood loss; no shock.

P-1061: shell fragment wound of upper right arm with possible fracture of humerus; slight blood loss; no shock.

The second group of casualties, which may be described as psychologic or psychiatric in character, comprises Group VII and consists of four subjects who were not treated and two who received sodium amytal. The psychiatric evaluation of these casualties is as follows.

W-4352. This nineteen year old soldier was seen at Clearing Company within twenty-four hours after admission. He was evacuated after an incoming artillery round had landed only a few feet away from him. He is assigned to a heavy mortar company and has been on the line for six months. He is small, thin, and shows some hostility and defensiveness to cover his quiet for being evacuated without physical injury. There are no signs of more than average anxiety. He is well motivated, proud of his unit, and anxious to return to duty. This man would come under the heading of normal combat reaction. There was no need for evacuation to Clearing level.

P-4360. This twenty-three year old soldier was admitted to Clearing Company after six months on the line and two days of enemy offensive. He had seen several of his friends killed. When first seen he was disoriented, retarded, showed no change of facial expression and no affect. He is very passive and dependent. He is unable to speak - makes only unintelligible noises. Periodically his body is shaken by generalized muscular contraction. During five days observation, he became oriented, ate, and slept well. He continued to have absent affect and could not speak. This is true combat exhaustion - combining conversion and dissociative mechanisms. He required further hospitalization beyond Division level.

S-7571. This twenty-three year old soldier was admitted to Clearing Company after four months on the line. He was a member of the assault company of a friendly offensive action. During the middle of the night prior to the attack he was reported as speaking irrationally and refused to get out of his sleeping bag. On the following day he showed some tremulousness and fear. He claimed amnesia for the time of his evacuation. There were no objective signs of psychiatric illness. It is felt that this man's illness was largely conscious and the primary difficulty was unwillingness. When seen again some days later on the line he was making a good attempt to regain his self esteem and acceptance by the platoon.

P-5803. This twenty-two year old soldier was first seen at the Battalion Aid Station. He was crying uncontrollably and was quite oblivious to his surroundings. Absolutely no contact could be made. He had been with his unit only five weeks and had fought well on the initial assault. His acute break came after carrying a seriously wounded friend off the hill and finding that his friend had died on the way down. He repeated over and over again, "Why did they do it...Why did they do it." After twenty-four hours hospitalization he continued to cry continuously but was oriented and answered questions. He was returned to his company after two days where he rigidly controlled himself. He refused the relatively safe job of jeep driving and accepted the position of squad leader to prove himself in combat. This man cannot be classified as a true psychiatric casualty. His reaction was acute and strictly situational.

G-0442. This twenty-four year old sergeant was first seen at the Battalion Aid Station. He had fainted after walking only a few yards beyond the MLR on the company assault. He was depressed, retarded and could neither hear nor speak. This man had served approximately 20 months in Korea, this being his second tour of duty here. This was the result of disciplinary action. He had previous conversion reactions in the form of anaesthias of the hands and feet. He showed no improvement after two days and was evacuated beyond Division. Throughout his stay at Clearing Company he was cooperative and helpful. This is an example of conversion reaction precipitated by combat stress but not a combat exhaustion.

It may be noted from Fig. 9 that S-7571 and W-4352 are quite separate from the others both in lymphocyte count and eosinophil count; these two subjects received sodium amytal. The other four show a definite eosinopenia and quite an extensive lymphopenia. Since no precombat data were available on these subjects they are compared in Fig. 9 with normal Korean values as obtained from Groups V and VI.

Hematocrit Value and Blood Volume

The hematocrit determinations (percent erythrocytes in the blood) were made in Wintrobe tubes centrifuzed at full speed for 30 minutes in an International clinical centrifuge. They were usually carried out on the blood samples within six hours after obtaining them, and in no instance were they done later than 24 hours.

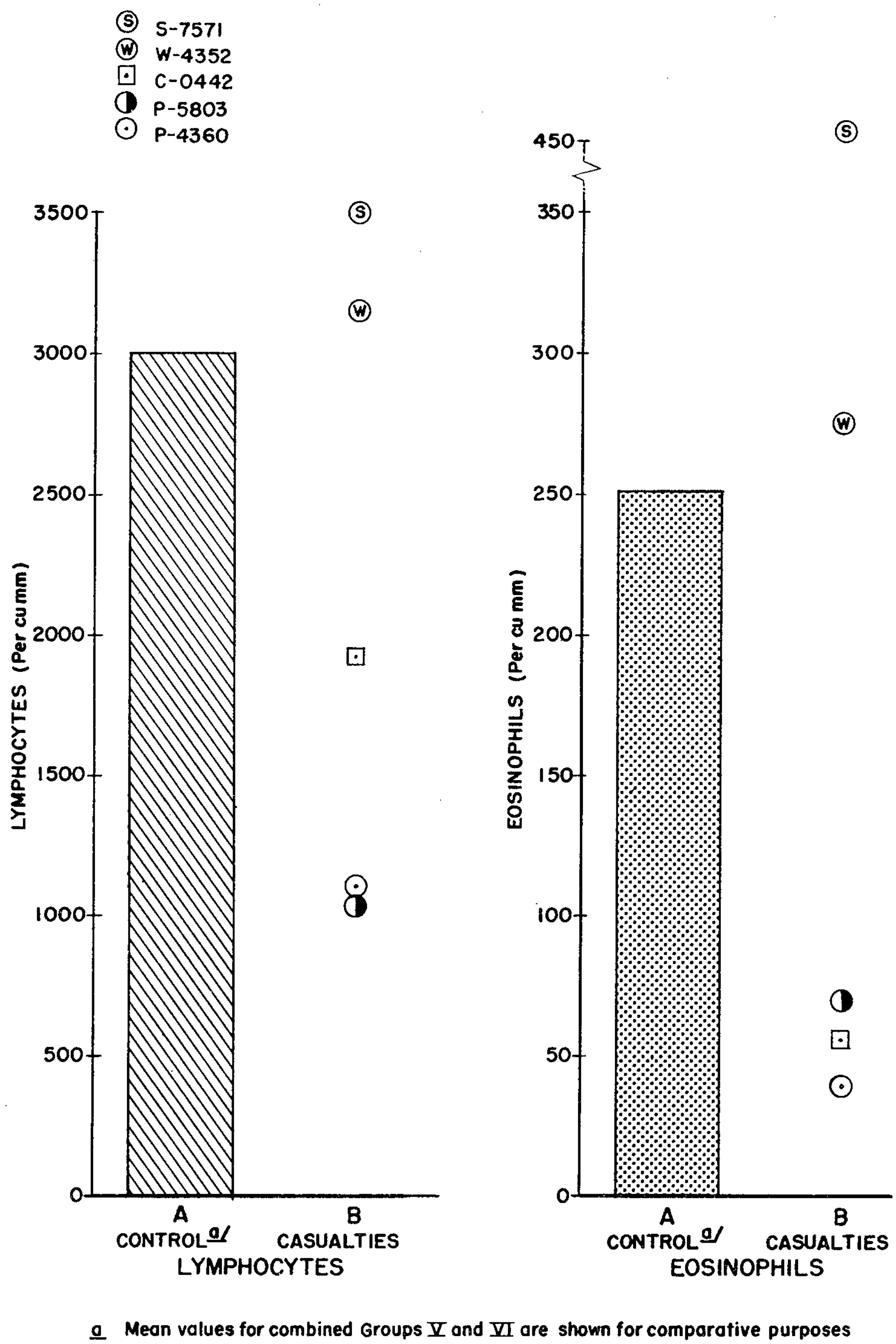


Fig. 9 - Lymphocyte and Eosinophil Counts, Psychiatric Casualties

TABLE 3

NORMAL HEMATOCRIT VALUES (PERCENT RED BLOOD CELLS)
FOR COMBAT INFANTRYMEN IN THE ABSENCE OF ACUTE COMBAT STRESS

Group I-A

Individual	Hematocrit value % RBC
B-4833	48.2
F-4293	45.5
G-1884	44.4
G-3336	46.2
J-9670	47.0
M-7856	51.0
R-5249	48.5
W-0689	46.8
W-9926	50.0
V-4828	49.5
V-1030	40.7
N = 11	Mean = 47.07

Group V-A

Individual	Hematocrit value % RBC
A-5075	39.7
C-5107	48.5
H-3136	49.5
H-8421	48.3
H-9329	46.8
K-3195	46.0
M-3285	51.6
M-7371	47.5
S-6942	48.3
W-4130	47.8
W-7018	50.0
W-9893	48.0
N = 12	Mean = 47.67

Group III-A

Individual	Hematocrit value % RBC
A-8537	40.8
C-4136	46.5
C-5898	46.8
E-3096	47.0
G-5761	45.8
P-1061	47.0
SCHOW	52.7
S-5171	47.0
A-4492	46.6
B-7531	47.8
H-7321	51.8
J-4852	44.5
M-3290	44.8
B-2003	44.3
H-4808	46.0
M-7579	47.0
M-1604	44.3
M-0305	45.1
N = 18	Mean = 47.67

Group VI-A

Individual	Hematocrit value % RBC
B-8787	48.2
B-9350	43.8
C-6378	44.5
C-9358	45.8
F-0536	48.8
G-2474	49.0
G-6497	49.0
K-4360	44.0
M-5261	47.3
O-7035	48.5
S-1495	44.3
W-1009	47.0
N = 12	Mean = 46.68

Total N = 53 Mean = 46.90 Range is from 39.7 to 52.7

TABLE 4

A COMPARISON OF REPEAT HEMATOCRIT DETERMINATIONS A FEW DAYS APART IN COMBAT INFANTRYMEN IN THE ABSENCE OF COMBAT STRESS

Individual	(A) Test hematocrit % RBC	(A1) Retest hematocrit % RBC
Group I		
B-4833	48.2	46.8
F-4293	45.5	50.0
G-1884	44.4	45.6
G-3336	46.2	49.0
J-9670	47.0	49.0
R-5249	48.5	49.1
W-0689	46.8	44.5
W-9926	50.0	51.0
V-4828	49.5	48.4
V-1030	40.7	44.1
Group II		
B-2258	41.7	43.8
E-4332	53.0	51.5
H-4815	39.0	39.8
J-1789	41.7	42.6
J-7455	40.8	42.1
M-2878	44.2	44.0
M-7056	39.8	39.8
P-9139	47.3	51.8
R-0897	46.3	47.1
R-2312	36.8	45.4
S-0746	38.1	44.8
S-6143	45.8	45.0
Group V		
A-5075	39.7	42.7
C-5107	48.5	48.0
H-3136	49.5	50.0
H-8421	48.3	45.8
M-3285	51.6	49.0
M-7371	47.5	48.0
S-6942	48.3	49.8
W-4130	47.8	49.5
W-7018	50.0	53.5
Group VI		
B-8787	48.2	48.8
B-9350	43.8	50.3
C-6378	44.5	45.8
C-9358	45.8	48.5
F-0536	48.8	48.8
M-5261	47.3	49.0
O-7035	48.5	48.7
S-1495	44.3	45.5
W-1009	47.0	50.0

TABLE 5

HEMATOCRIT VALUES FROM GROUP III COMBAT INFANTRYMEN

Individual	Hematocrit value % RBC			
	A a/	B b/	C c/	D d/
C-4136	46.5	48.0	47.3	47.1
B-7531	47.8	47.3	49.3	51.0
H-7321	51.8	51.0	49.5	50.5
H-4808	46.0	48.7	44.6	47.0
M-0305	45.1	45.5	47.3	44.8
Mean (N = 5)	47.44	48.30	47.60	48.08
A-8639	-	48.3	47.5	49.8
H-1864	-	44.9	43.3	51.8
H-1296	-	47.3	49.5	49.7
J-4226	-	43.2	43.3	51.8
M-9987	-	44.4	43.0	44.8
P-4185	-	45.1	43.4	46.5
S-4171	-	50.4	52.2	52.4
S-4917	-	47.5	49.3	47.8
T-9985	-	46.0	42.1	45.8
W-0218	-	50.5	46.7	48.3
W-1083	-	42.8	45.3	44.6
Mean (N = 16)		46.99	49.28	50.77

a/ 13 hours before active combat.
b/ 17 hours after combat
c/ 5 days after the attack.
d/ 22 days after attack.

The results obtained by measuring the normal hematocrit of several groups of combat infantrymen in the absence of acute combat stress are presented in Table 3, and their distribution is plotted in Fig. 10. The data for Group II-A from Camp Omiya is omitted from this treatment because the values for the group are low, and it is possible that a degree of anemia may have been present. No information is available concerning the medical history of these men, other than that they were in a stage of convalescence. Group IV does not appear because pre-stress (A) samples were not obtained.

It may be seen that the mean value, distribution, and range for each group and for all the individuals is within the normal limits for the population as a whole.

The reliability of the hematocrit determinations under the present conditions of measurement was tested by repeating them on a number of individuals a few days apart. The results are listed in Table 4. The coefficient of correlation r, was found to be 0.78, and the standard error of estimate was $\pm$ 3.2 percent. It is evident from these data that only a large change in the hematocrit value would be significant.

Table 5 gives the results of hematocrit determinations on the Group III combat infantrymen at various times before and after an acute combat situation lasting approximately sixteen hours. It is clear that the blood hematocrit values did not change significantly as a result of combat stress in this group.

TABLE 6

HEMATOCRIT VALUES FOR GROUP IV COMBAT INFANTRYMEN

Individual	Hematocrit Value % RBC	
	B a/	C b/
F-8596	43.0	43.6
B-5392	49.3	43.8
H-4368	45.8	47.3
J-4476	45.8	46.8
L-0624	51.8	51.0
M-2280	43.7	46.7
P-4431	48.5	46.5
P-0411	48.5	47.5
R-0371	47.0	45.1
S-4749	47.8	45.7
T-1483	46.0	45.8
W-7805	49.5	50.5
Mean (N = 12)	47.23	46.83

a/ 7 hours after prolonged combat.
b/ 10 days later.

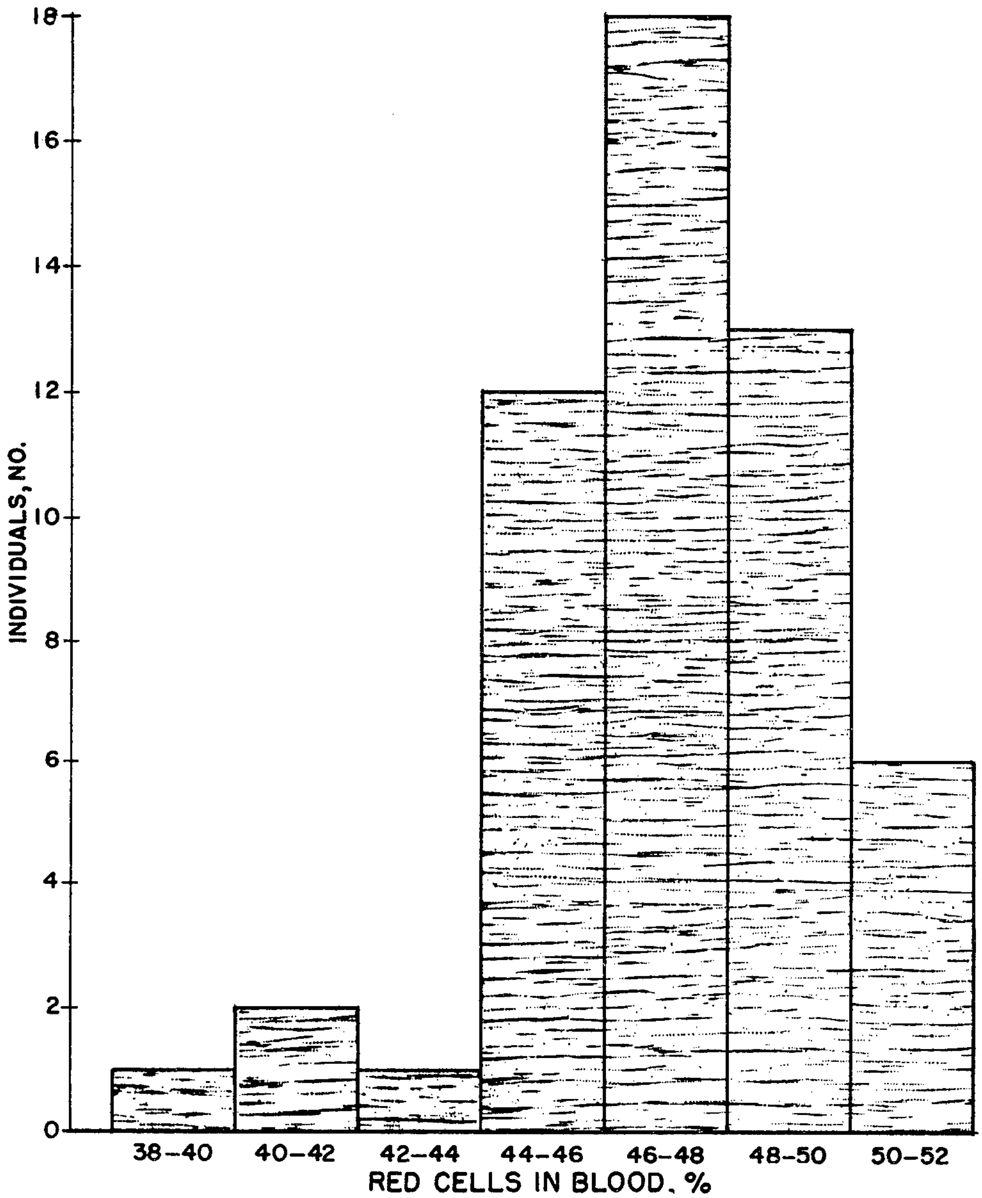


Fig. 10 - Distribution of Normal Hematocrit Values for Combat Infantrymen in the Absence of Acute Combat Stress

Table 6 lists the hematocrit values of the combat infantrymen seven hours after a prolonged exposure to moderately severe combat, and again ten days later. In this case, as in the previous one, the hematocrit values showed no significant change from the immediate post-combat levels to the levels some days later.

It must be concluded that in the combat groups studied here, the blood hematocrit value did not change detectably as a result of combat stress.

On the other hand, from Table 7 it may be seen that a significant decrease in hematocrit values occurred as a result of wounding and the attendant hemorrhage. These four individuals from Group III were seen when brought into the Battalion Aid Station from the battlefield, and a blood sample was obtained immediately on arrival before administration of fluids. Blood samples had been obtained from these same individuals the day before the assault began. The degree of depression in the hematocrit level appears to correlate well with the clinical impression of the severity of the wounds.

Blood volumes were determined on a selected number of individuals using P^{32} labeled red blood cells. This method of measurement was chosen in preference to the carbon monoxide or T-1824 methods, since these latter give high values, probably owing to some degree of extravascular distribution of these materials. The method used was basically that of Berlin, Lawrence, and Gartland[2/], a modification of the original technique of Hevesy and Zerahn[3/] for labeling erythrocytes. Further changes in the method were initiated by this group to adapt the technique to problems encountered in the field. Two principal changes were made: (1) type O blood (universal donor) was obtained from a laboratory group member, prepared, and given to all the subjects; and (2) incubation was accomplished in a Dewar flask with manual rotation every ten minutes during the incubation period.

The complete preparative technique was as follows. Using a heparinized syringe, sufficient blood was withdrawn from the O-type donor to allow for one ml injections to each subject, plus a margin of two ml for preparation of a standard and for leakage. The blood was then placed in a sterile twelve ml centrifuge tube capped with a rubber serum bottle stopper. If four subjects were being run, approximately three millicuries of P32 as Na_2HPO_4 were added, and the tube was incubated at 37° C. in the Dewar flask for an hour, with manual rotation every ten minutes. At the end of this period, the tube was centrifuged, the supernatant fluid was removed by means of a long needle and air vent (consisting of a #20 hypodermic needle to which was attached, by means

2/ Berlin, N. I., Lawrence, J. H., and Gartland, J.: Blood Volume in Polycythemia as determined by P^{32} labelled red blood cells, AM. JOUR. MED. 9: 747, 1950.

3/ Hevesy, G. and Zerahn, K. Determination of red corpuscle content. ACTA PHYSIOL. SCANDINAV. 4: 376, 1942.

TABLE 7

EFFECT OF WOUNDING ON HEMATOCRIT VALUES
FROM FOUR GROUP III COMBAT INFANTRYMEN

Individual	Hematocrit value 13 hours before combat % RBC	Hematocrit value immediately after combat % RBC	Clinical impression of injury
G-5761	45.8	39.0	Shell fragment wounds of both lower extremities; moderately severe blood loss with shock at time of sampling
P-1061	47.0	44.6	Shell fragment wound of upper right arm with possible fracture of humerus; slight blood loss; no shock
SCHOW	52.7	45.3	Simple fracture of right humerus; superficial shell fragment wounds left thigh and hip; superficial gunshot wound of scalp; slight loss of blood; possible shock
J-4852	44.5	45.1	Superficial shell fragment wounds of the extremities; no significant blood loss; no shock

of rubber tubing, a short piece of glass tubing containing a cotton plug), and isotonic saline solution was added to fill the tube. The cells were gently but thoroughly resuspended and again centrifuged; this step was repeated for a total of three times. The cells were finally resuspended in an equal volume of isotonic saline for injection. All the preceding steps were carried out while maintaining sterile conditions.

For the blood volume determination, an injection of one ml of the labeled cell suspension was made into an antecubital vein of each of the subjects. Immediately following the injections a standard solution was prepared by diluting 0.1 ml of the cell suspension in two hundred ml of water. Twenty minutes after the injection, to allow for complete mixing throughout the vascular system, a three ml sample of blood was obtained from each subject, from a different vein than that into which the injection was made.

Determination of the activity of the blood samples was made in the following manner. One ml of blood was pipeted onto lens paper rectangles on aluminum foil and dried in an oven. The dried blood was covered with cellophane, and the preparation was wrapped around a thin-walled aluminum Geiger-Muller counter tube (Victoreen 1B85 Throde Tube) for counting. The scaler circuit was a Berkeley Model 2000, run from a separate dental field x-ray unit generator to maintain constant voltage. A minimum of 20,000 counts was measured on each sample, and duplicate plates were made for each blood.

The standard was measured in duplicate by plating and counting 0.5 ml of the 1:2000 dilution of the donor blood in the same fashion. The total blood volume was computed according to the simple dilution principle, $C_1V_1 = C_2V_2$, and was expressed in ml. The blood volume was calculated as a fraction of the total body weight, and the red cell volume per unit body weight and plasma volume per unit body weight could then be obtained from the hematocrit value and blood volume per unit body weight.

It proved possible to test the reliability of the various blood measures in six normal combat infantrymen, and the results are shown in Table 8. It may be seen that blood volume measurements show a high degree of variability. How much of this is true individual variation and how much is due to technical inaccuracies cannot be determined at present. The mean values agree quite well with those in the literature as determined by the same method.4,5,6/

4/ Berlin, Lawrence, and Garland, Op. cit.

5/ Berlin, N. I., Hyde, G. M., Parsons, R. J., Lawrence, J. H., and Port, S. Blood volume of the normal female as determined with P^{32} labeled red blood cells. PROC. SOC. EXP. BIOL. & MED., 76:831, 1951.

6/ Hyde, G. M., Berlin, N. I., Parsons, R. J., Lawrence, J. H., and Port, S. The blood volume in portal cirrhosis as determined by P^{32} labeled red blood cells. J. LAB. & CLIN. MED. 39:347, 1952.

TABLE 8

COMPARISON OF REPEAT BLOOD VOLUMES ON SIX NORMAL COMBAT INFANTRYMEN[a/]

Individual	Group	Blood volume ml/kg body wt		Red cell volume ml/kg body wt		Plasma volume ml/kg body wt	
		A	A'	A	A'	A	A'
G-1884	I	67.1	64.1	27.4	29.2	34.3	34.8
J-9670	I	60.1	79.3	29.4	36.8	30.0	42.4
V-4828	I	70.4	63.3	34.8	30.5	35.6	32.6
V-1030	I	72.3	59.8	29.5	26.4	42.8	33.5
F-0536	VI	88.2	98.7	43.0	47.7	45.0	50.0
M-5261	VI	70.6	89.6	33.4	43.9	37.2	45.8
Mean (N = 6)		70.55	75.80	32.92	35.75	37.48	39.85
r		0.56		0.74		0.26	
Standard error of estimate		11.81		5.29		3.68	

a/ Measures were done in the absence of stress, several days apart

The effect of combat stress on the blood volume was examined in five combat infantrymen on whom it was possible to measure the blood volume shortly after combat and again a few days later. Four of these men were from Group III and the other was from Group IV. The results are listed in Table 9, and it is quite apparent that by this technique the blood volume did not change significantly.

On the other hand, the body weight exhibited a significant ($P<0.01$) increase following combat, amounting to a mean gain of about 2.5 kilos per man. It is probably correct to assume that this increase in weight is largely attributable to rehydration of the body, as is further indicated in the section on Urinary Creatinine by the characteristically concentrated urine excreted immediately following exposure to combat situations. This apparent change in body water, however, does not seem to be sufficiently severe to result in either hemoconcentration or a decrease in blood volume.

Electrolytes[7/]

Studies of electrolytes were included in this project because of the well-known effects of the adrenals upon electrolyte metabolism and the relation of the adrenals to stress. Sodium and potassium were determined in plasma (or serum), saliva, and urine. Plasma carbon dioxide was also determined and the results are reported in the next section. Frawley and Thorne[8/] have shown that the ratio of Na to K in the saliva is inversely proportional to adrenal activity. Although wide differences between individuals were noted in their reports, the changes in the ratio for a given individual were sensitive indicators, and perhaps a better index of adrenal activity than urinary Na and K.

Plasma and urine chloride concentrations were determined by a modification of the method of Sendroy[9/]. To adapt the method for large numbers of determinations under field laboratory conditions, a reduction in all volumes employed was made and centrifugation was substituted for filtration. To 0.5 ml of plasma or urine in a 15 ml centrifuge tube, 10 ml of phosphoric-tungstic acid solution, followed by 0.15 to 0.25 gm of silver iodate were added. The tube was covered with Parafilm, and after shaking, was centrifuged 5 to 10 minutes. Recentrifugation was employed if a clear solution did not result. An aliquot of 5 ml of the supernatant fluid was removed from below the surface, and any adhering precipitate was wiped from the pipet. Immediately after the addition of 0.5 ml of sodium iodide solution to the aliquot in a small erlenmeyer

7/ The determination of urine plasma and saliva sodium and potassium was accomplished by the 406 Medical General Laboratory, Tokyo, Japan and by the 8228 MASH, Korea. Their work is gratefully acknowledged.

8/ Frawley, T. F. and Throne, G. W. The relation of the salivary sodium-potassium ratio to adrenal cortical activity. Proc. 2nd. Clinical ACTH Conf. Vol. I. Blakiston, New York, 1951, pp. 115-122.

9/ Hawk, P. B., Oser, B. L., and Summerson, W. H. Practical Physiological Chemistry. 12th Ed. Blakiston, Philadelphia, 1947. pp 575-577.

TABLE 9

BLOOD VOLUMES AND BODY WEIGHT DETERMINATIONS ON FIVE COMBAT INFANTRYMEN IMMEDIATELY AFTER SEVERE COMBAT STRESS

Individual	Group	Body weight kg			Blood volume ml/kg body wt			Red cell volume ml/kg body wt			Plasma volume ml/kg body wt		
		B[a]	C[b]	D[b]	B	C	D	B	C	D	B	C	D
H-7321	III	73.7	75.5	75.0	72.3	79.1	72.3	36.9	39.2	27.0	35.5	39.9	35.9
J-4426	III	63.2	66.3	-	86.0	87.1	-	37.1	37.7	-	48.9	49.3	-
P-4185	III	72.3	73.7	73.7	74.6	76.6	72.8	33.6	33.3	33.9	41.0	43.4	38.9
T-9985	III	64.6	67.8	69.6	78.0	89.8	84.8	35.9	37.8	38.8	42.2	51.9	45.9
M-2280	IV	59.1	61.8	-	76.1	74.2	-	33.3	33.3	-	42.8	40.8	-
Mean (N = 5)		66.58	69.02	-	77.40	81.36	-	35.36	36.26	-	42.08	45.06	-

a/ Immediately after combat stress.

b/ Some days later.

flask, titration was performed with 0.03 N sodium thiosulfate using a starch as the indicator. The thiosulfate was standardized against 0.100 N potassium iodate.

Saliva, urine, and plasma sodium and potassium levels were determined by flame photometry. These analyses were very kindly performed by the 406th Medical General Laboratory, Tokyo, and by the laboratory of the 8228 MASH, Korea. Saliva collections were commenced after having the subjects chew paraffin for approximately ten minutes.

All blood samples obtained in Japan, and those in Korea obtained prior to 14 October 1952, i. e. prior to Group III-B, were drawn into dry syringes. A portion of the blood was treated with potassium oxalate, and the plasma was used for the chloride determination. Another portion was allowed to clot, and the serum was used for the determination of Na and K. Frequent hemolysis occurred, and high K values resulted. For this and other technical reasons, all subsequent blood samples were drawn into heparinized syringes. Although a preparation of sodium heparin in isotonic saline was employed, the quantity in the syringe was too small to be of consequence in the sodium and chloride analyses.

With only two exceptions, all plasma chloride determinations fell within a normal range of 100 to 110 milliequivalents per liter. A high value of 113 meg/l was noted in subject H-4368 of Group IV after being in combat five days. Upon recovery, a value of 105 meg/l was observed. In the same subject an increase in plasma CO_2 from 57 to 60 vol % was noted. A low chloride value of 98 meg/l was observed in a psychiatric casualty, P-4360. A retest three days later showed a value of 101 meg/l. In this subject, low CO_2 values of 54 and 55 vol % were observed.

The mean values for plasma chloride determinations of the various groups are shown in Table 10, and the individual values in Appendix A. The increases in plasma chloride of Group III upon 'recovery' (B to C) from a severe short term stress was found to be statistically significant at the 0.1 percent level upon testing the differences for the individuals. The decreases noted with further recovery time (C to D) were similarly significant. This may be due to a rebound following stress. On the other hand the slight mean decrease in plasma chloride of Group IV was not significant. It must be noted that the recovery period (B to C) of this group was ten days, as compared with the four day recovery period for Group III in which an increase was noted. Thus, possible changes in the plasma chloride of Group IV would have been missed.

The results of the analyses for urinary chloride are given in Tables 11 to 15. The creatinine levels were used as a basis for comparative studies rather than time because of the constancy of creatinine excretion and the difficulty of obtaining valid data on the collection time of the samples. Large variations in chloride excretion are to be expected from subjects in whom no control over salt intake is maintained. Such variations are seen in the controls in Japan (Table 11) and Korea (Table 12). Low urine chloride excretion was observed with Group III (Table 13) after combat, with increasing

TABLE 10

MEAN PLASMA CHLORIDE CONCENTRATION OF COMBAT INFANTRYMEN[a]

Controls	Individuals No.[b]	A	A'	A''	
Group I	11	104.0	105.2	105.1	
Group II	12	105.7	105.2	-	
Group V	9	105.5	105.2	-	
Group VI	8	105.3	104.2	-	
Combat Groups		A	B	C	D
Group III	5 12	106.0 -	106.8 104.8	108.2 107.8	105.2 105.3
Group IV	12	-	105.8	104.1	-

a/ Values expressed as milliequivalents Cl/liter.

b/ Only the individuals retested are included.

TABLE 11

URINARY CHLORIDE EXCRETION OF JAPAN CONTROLS[a]

Group I	A	A'	A''
B-4833	56	186	165
F-4293	101	102	143
G-1884	119	140	185
G-3336	116	109	158
J-9670	44	104	94
M-7856	179	262	154
R-5240	68	203	187
W-0689	202	156	249
W-9926	87	179	222
V-4828	76	91	215
V-1030	139	143	172
Mean	153.4	152.3	176.7
Group II			
B-2258	225	122	-
E-4332	134	175	-
H-4815	208	136	-
J-7455	205	205	-
J-1789	132	265	-
M-2878	132	139	-
M-7056	122	178	-
P-9139	255	98	-
R-0897	173	343	-
R-2312	68	107	-
S-0746	140	115	-
S-6143	185	258	-
Mean	164.9	178.4	-

a/ Values expressed as meg Cl/gm creatinine.

TABLE 12

URINARY CHLORIDE EXCRETION OF KOREA CONTROLS[a]

Group V	A	A'
A-5075	51	95
C-5107	131	259
H-9329	202	-
H-8421	199	130
H-3136	207	235
K-3195	172	-
M-3285	168	151
M-7371	124	136
S-6942	290	222
W-4130	194	158
W-9893	180	-
W-7018	202	64
Mean, N = 12	176.7	-
Mean, N = 9	174.0	161.1
Group VI		
B-9350	112	115
B-8787	240	168
C-9358	203	202
C-6378	175	135
F-0536	174	197
G-2474	113	-
G-6494	84	-
K-4360	138	-
M-5261	189	128
O-7035	124	137
S-1495	70	184
W-1009	125	185
Mean, N = 12	145.6	-
Mean, N = 9	156.9	161.2

a/ Values expressed as meg Cl/gm creatinine.

TABLE 13

URINARY CHLORIDE EXCRETION OF GROUP III INDIVIDUALS[a]

Individual	A	B	C	D
A-8537	94	-	-	-
C-4136	97	37	204	208
C-5898	162	-	-	-
E-3096	127	-	-	-
G-5761	113	-	-	-
P-1061	147	-	-	-
SCHOW	91	-	-	-
SMITH	150	-	-	-
S-5171	97	-	-	-
A-4492	117	-	-	-
B-7531	57	51	142	73
H-7321	60	31	178	219
J-4852	81	-	-	-
M-3290	103	-	-	-
O-4697	137	-	-	-
R-2423	182	-	-	-
B-2003	135	-	-	-
H-4808	66	23	184	158
J-0703	73	-	-	-
M-7579	90	-	-	-
M-1604	168	-	-	-
M-0305	125	65	70	105
MOSS	96	-	-	-
W-3173	91	-	-	-
A-8639	-	133	126	162
H-1864	-	16	291	82
H-1296	-	69	91	196
J-4426	-	105	126	155
J-8455	-	83	91	-
L-6206	-	32	106	-
M-9987	-	312	96	207
P-4135	-	21	259	146
S-7808	-	221	123	-
S-4171	-	93	88	165
S-4917	-	30	230	40
T-9985	-	31	264	310
W-0218	-	22	53	108
W-2990	-	24	76	276
W-1093	-	26	370	270
Mean, N = 5	81.0	41.4	155.8	152.6
Mean, N = 12	-	73.5	172.5	176.4
Mean, all individuals	110.7	71.2	158.4	169.4

a/ Values expressed as meg Cl/gm creatinine excretion during the following four days. Tested statistically, the mean increase for 20 individuals (B to C) was 86.6 meg Cl/gm creatinine. This was significant at the 1 percent level (t = 2.88). For 18 Korean controls a mean decrease of 4.3 meg Cl/gm creatinine (A to A') was found, which was not significant (t = 0.27). These findings indicate a chloride retention in the men immediately after combat, which is in accord with present ideas on stress physiology. However, it must be kept in mind that the intake of food, water, and salt by these individuals was limited during the combat period.

The changes in chloride excretion in Group IV (Table 14) cannot be considered significant. This may be an indication of a chloride excretion phase in a prolonged stress situation; or perhaps the stress was not as severe as in the Group III subjects.

TABLE 14

URINARY CHLORIDE EXCRETION OF GROUP IV INDIVIDUALS[a/]

Individual	B	C
F-8576	37	261
B-5392	72	58
H-4368	203	89
J-4476	176	69
L-0624	200	165
M-2880	75	146
O-8834	306	-
P-4431	41	160
P-0411	86	123
R-0371	76	83
S-4749	42	98
T-1483	117	143
W-7805	300	93
Mean, N = 13	133.2	-
Mean, N = 12	118.8	124.0

a/ Values expressed as meg Cl/gm creatinine.

The data for the wounded and psychiatric casualties (Table 15) appear to be similar to the chloride excretion data of combat Group III.

The chloride excretion values for the subject of the ACTH test are shown in Table 16. Decreases in urinary chloride were generally observed in the controls after ACTH administration, while increases were generally observed with the post-combat subjects. This finding suggests a depletion of adrenal reserve in the men after combat. However it must be noted that increases were observed in nearly all cases, control or combat, when the pre-ACTH chloride excretion was low (less than 100 meg Cl/gm creatinine). Decreases were observed with higher

TABLE 15

URINARY CHLORIDE EXCRETION OF MISCELLANEOUS INDIVIDUALS[a/]

Wounded	A	B	C
R-1552	-	89	-
SCHOW	91	41	-
Psychiatric Casualties			
W-4352	-	24	197
P-4360	-	31	41
S-7571	-	45	97
G-0442		73	-
Ambush Patrol			
K-7440	-	92	72

a/ Values expressed as meg Cl/gm creatinine.

pre-ACTH values. Since most of the post-combat values were low, prior to ACTH administration, the interpretion of the data is difficult.

The pattern of plasma chloride levels and urinary excretion in the five individuals studies throughout Group III are shown in Figure 11.

The results for sodium and potassium analyses were only partially available at the time of this report. The sodium to potassium ratios for urine, saliva, and plasma, where available, are shown in Tables 17 to 21. No values are included for plasma obtained before 14 October 1952 because of the frequent hemolysis. The expression of the Na and K values as ratios eliminates the necessity of taking the large variations in absolute levels into account in the cases of urine and saliva, and facilitates comparisons between the various body fluids.

The salivary Na/K ratios for the controls (Tables 17 and 18) were in accord with the normal values in the literature previously cited. There were wide variations among the individuals but highly significant correlation ($r = 0.86$) upon retest of the individuals. The salivary ratios for Group IV (Table 19) were generally lower than the controls, which would be expected in stressed subjects. However an evaluation cannot be made until the retest data is available.

The urine Na/K ratios for Group I and Group II controls (Table 17) show a great deal of variability. However, upon retesting the individuals a statistical correlation significant at the 1 percent level was found ($r = 0.56$), thus making possible studies using the individual as

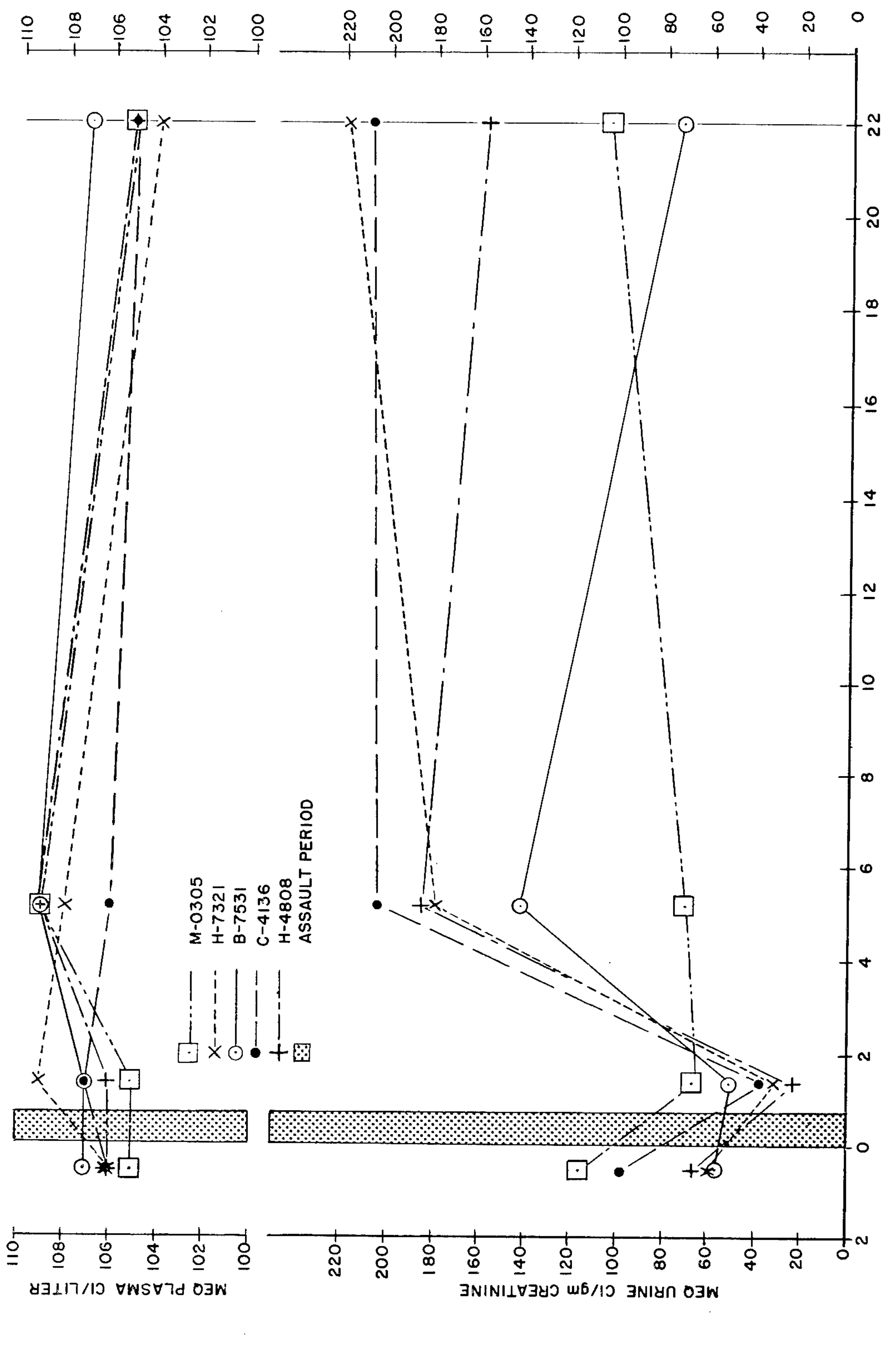


Fig. 11 - Plasma Chloride Level and Urinary Chloride Excretion of 5 Individuals Before and After a Combat Assault

TABLE 16

URINARY CHLORIDE EXCRETION BEFORE AND AFTER ACTH ADMINISTRATION[a]

Controls	A		A'		A''	
Group I	Before	After	Before	After	Before	After
M-7856	179	101	262	112	154	186
R-5249	68	110	203	92	197	103
W-9926	87	107	179	100	222	137
Group II						
J-1789	132	107	265	132		
M-2878	132	67	139	86		
M-7056	122	105	178	145		
P-9139	255	96	-	-		
Group V						
H-9329	202	203	-	-		
H-8421	199	178	130	57		
H-3136	207	204	235	30		
M-7371	124	95	136	114		
W-4130	194	72	158	48		
W-7018	202	52	-	-		
Group VI						
S-1495	70	85	184	83		
W-1009	125	156	185	126		
Combat Groups	B		C		D	
Group III						
H-4808	23	155	184	99	159	85
M-0305	65	69	70	128	105	64
S-4171	93	87	88	180	165	101
W-1083	26	148	370	240	270	93
Group IV						
R-0371	76	79	83	85		
S-4749	42	82	98	129		
T-1483	117	88	143	115		
W-7805	300	85	93	77		
Group VII						
W-4352	24	77	-	-		
P-4360	31	31	41	79		
S-7571	161	83	-	-		
G-0442	73	124	-	-		

a/ Values expressed as meg Cl/gm creatinine

TABLE 17

URINE AND SALIVA NA/K MOLAR RATIOS OF JAPAN CONTROLS

Group I	Urine			Saliva		
	A	A'	A''	A	A'	A''
B-4833	5.4	7.6	4.1	-	0.7	0.6
F-4293	5.4	7.2	1.7	-	3.0	2.2
G-1884	5.6	1.9	3.6	-	1.5	1.5
G-3336	3.3	2.1	1.4	-	3.0	1.8
J-9670	6.0	3.1	3.8	-	1.6	0.9
M-7856	7.7	3.5	1.4	-	0.7	0.5
R-5249	3.6	7.2	2.6	-	2.1	1.9
W-0689	4.9	3.0	4.1	-	0.9	1.0
W-9926	3.2	4.7	2.5	-	1.1	0.7
V-4828	3.6	7.5	3.3	-	0.2	0.3
V-1030	11.1	3.8	3.0	-	0.3	0.5
Group II	**A**	**A'**		**A**	**A'**	
B-2258	3.2	2.2		1.6	1.2	
E-4332	3.7	1.7		0.9	0.7	
H-4815	5.4	4.7		0.5	0.3	
J-7455	3.4	1.3		1.4	2.0	
J-1789	2.4	3.8		0.9	0.6	
M-2878	2.6	3.6		1.1	1.0	
M-7056	4.9	3.6		0.7	1.7	
P-9139	5.1	1.8		2.1	1.2	
R-0897	3.8	3.7		1.7	1.3	
R-2312	2.9	2.3		0.6	0.7	
S-0746	5.3	2.5		4.0	2.9	
S-6143	4.2	3.6		0.6	0.4	

TABLE 18

SALIVA AND PLASMA NA/K RATIOS OF KOREA CONTROLS[a/]

Group V	Saliva		Plasma	
	A	A'	A	A'
A-5075	1.9	x	33	x
C-5107	1.0	x	32	x
H-9329	1.9	-	35	-
H-8421	1.0	x	35	x
H-3136	2.0	x	32	x
K-3195	1.9	-	33	-
M-3285	2.3	x	36	x
M-7371	2.0	x	29	x
S-6942	1.3	x	33	x
W-4130	1.1	x	32	x
W-9893	1.2	-	31	-
W-7018	0.6	x	36	x
Group VI				
B-9350	1.2	x	36	x
B-8787	0.4	x	34	x
C-9358	1.9	x	34	x
C-6378	0.8	x	x	x
F-0536	0.9	x	36	x
G-2474	0.5	-	x	-
G-6494	0.9	-	x	-
K-4360	0.3	-	37	-
M-5261	2.0	x	x	x
O-7035	1.4	x	x	x
S-1495	1.8	x	49	x
W-1009	0.4	x	27	x

a/ Urine results were not available. The symbol 'x' indicates data yet to be reported.

TABLE 19

URINARY, SALIVARY, AND PLASMA NA/K MOLAR RATIOS IN GROUP IV

Group IV	Urine		Saliva		Plasma	
	B	C	B	C	B	C
F-8576	3.1	x a/	0.6	x	33	x
B-5392	1.7	x	-	x	28	x
H-4368	5.5	x	1.1	x	x	x
J-4476	7.5	x	0.4	x	34	x
L-0624	7.4	x	0.4	x	x	x
M-2880	3.9	x	3.1	x	48	x
O-8834	7.7	-	0.5	-	x	-
P-4431	1.4	x	0.5	x	40	x
P-0411	6.6	x	1.4	x	x	x
R-0371	3.3	x	0.6	x	38	x
S-4749	3.8	x	0.9	x	x	x
T-1483	8.2	x	0.3	x	34	x
W-7805	6.9	x	0.3	x	x	x

a/ The symbol 'x' indicates data yet to be reported.

his own control. A decrease in the ratio was always noted after ACTH administration (Table 20), which was to be expected.

The urine ratios for the individuals subjected to acute combat stress (Table 21) were generally low, showing increases during the four day "recovery" period. Such findings are in accord with the present views of stress physiology. After ACTH, small decreases in the ratio were noted in three post-combat subjects, while an increase was observed in the fourth (Table 20). Such findings would indicate a depleted adrenal reserve. With Group IV, the individuals subjected to less severe but more prolonged combat (Table 19), the ratios were generally higher than for the intense combat group. A decreased ratio was always noted after ACTH administration (Table 20). Such results may indicate a more stable electrolyte balance during prolonged stress. The results from the combat casualties (Group VII, Table 20) were similar to those of Group III. Full interpretation cannot be made from the urine Na/K ratios until all the results are available. Even then the possible effects of limited and uncontrolled intake of food,water, and salt must be borne in mind.

Changes in the plasma Na/K ratios are primarily reflections of changes in the plasma K level, since the K level of plasma is much lower than the Na level and the ratio is therefore sensitive to small changes in the K value. In the subjects suffering acute combat stress (Table 21), there is an indication of a slight decrease in the plasma Na/K ratio during the four days following combat.

The results of the analyses completed thus far indicate that changes in electrolyte metabolism occur in men subjected to combat stress, indicating the involvement of the adrenal cortex in combat situations. This is borne out by the relative increase in potassium excretion and sodium retention with chloride excretion similar to that of sodium. Interpretation of the data is complicated because of the lack of control of the intake of salt and water (which would be virtually impossible in combat) and variations in the time of sampling. As noted elsewhere in these studies, dehydration was observed in the men exposed to severe combat situations even 18 hours after withdrawal from combat. In comparisons between the two combat groups with regard to changes in electrolyte metabolism, the differences in the duration of stress and the time between sampling must also be considered.

For field studies involving electrolyte metabolism, the relative simplicity of the urine chloride determination is an advantage. However, a reliable period of collection of urine, or a creatinine determination is necessary also. If a flame photometer is available (not necessarily at the site of the study), valuable information can be gained from the ratio of sodium to potassium in urine or saliva, without accurate collection data or other analyses. The collection of saliva involves only slightly more time and inconvenience to the subject. The relative values of saliva and urine Na and K as indicators of stress and adrenal function cannot be assessed from this study with the data available at this time.

TABLE 20

URINARY NA/K MOLAR RATIOS BEFORE AND AFTER ACTH ADMINISTRATION[a]

	A		A'		A''	
	Before	After	Before	After	Before	After
Group I						
M-7856	7.7	1.2	3.5	0.7	1.4	0.4
R-5249	3.6	1.3	7.2	2.2	2.6	0.6
W-9926	3.2	1.7	4.7	2.0	2.5	0.7
Group II						
J-1789	2.4	0.8	3.8	0.8	-	-
M-2878	2.6	1.4	3.6	1.6	-	-
M-7056	4.9	2.4	3.6	2.3	-	-
P-9139	5.1	2.9	1.8	1.0	-	-
Group III	B		C		D	
H-4808	1.4	0.4	4.9	x	x	x
M-0305	2.1	1.5	2.9	x	x	x
S-4171	2.7	0.7	2.8	x	x	x
W-1083	1.0	1.4	4.6	x	x	x
Group IV						
F-8576	3.1	1.7	x	x		
R-0371	3.3	1.3	x	x		
S-4749	3.8	1.4	x	x		
T-1483	8.2	2.0	x	x		
W-7805	6.9	1.7	x	x		
Group VII						
R-1552	2.1	0.3	-	-		
W-4352	1.0	0.2	1.8	0.6		
P-4360	x	0.5	1.0	0.2		
S-7571	2.2	0.7	3.6	0.7		
G-0442	2.1	1.0	-	-		

a/ This table is incomplete due to the fact that the results of the analyses have yet to be obtained on parts of Groups III, IV, and VII, and all of Groups V and VI for Na and K. The symbol 'x' in the above table represents such missing data.

TABLE 21

URINE AND PLASMA NA/K MOLAR RATIOS IN GROUP III

Individual	Urine				Plasma		
	A	B	C	D	B	C	D
A-8537	1.2	–	–	–	–	–	–
C-4136	1.7	1.4	5.9	x a/	43	41	x
C-5898	1.9	–	–	–	–	–	–
E-3096	1.8	–	–	–	–	–	–
G-5761	1.8	–	–	–	–	–	–
P-1061	2.0	–	–	–	–	–	–
SCHOW	0.9	–	–	–	–	–	–
SMITH	2.1	–	–	–	–	–	–
S-5171	3.7	–	–	–	–	–	–
A-4492	3.0	–	–	–	–	–	–
B-7531	1.4	2.8	3.2	x	38	39	x
H-7321	1.7	1.4	3.8	x	37	37	x
J-4852	3.7	–	–	–	–	–	–
M-3890	3.5	–	–	–	–	–	–
O-4697	1.5	–	–	–	–	–	–
R-2423	3.4	–	–	–	–	–	–
B-2003	3.0	–	–	–	–	–	–
H-4808	1.3	1.4	4.9	x	x	37	x
J-0703	1.4	–	–	–	–	–	–
M-7579	0.9	–	–	–	–	–	–
M-1604	1.6	–	–	–	–	–	–
M-0305	2.4	2.1	2.9	x	37	35	x
MOSS	1.2	–	–	–	–	–	–
W-3173	1.8	–	–	–	–	–	–
A-8639	–	3.7	2.1	x	34	x	x
H-1864		0.4	3.6	x	x	33	x
H-1296	–	5.1	1.7	x	x	35	x
J-4426	–	3.6	4.4	x	42	34	x
J-8455	–	3.4	4.8	–	36	26	–
L-6206	–	3.3	5.6	–	x	39	–
M-9987	–	2.3	3.2	x	x	34	x
P-4135	–	1.2	2.9	x	42	x	x
S-7808	–	1.1	2.2	–	39	38	–
S-4171	–	2.7	2.8	x	38	39	x
S-4917	–	1.2	1.3	x	35	36	x
T-9985	–	0.7	4.9	x	49	34	x
W-0218	–	0.8	2.4	x	x	37	x
W-2990	–	0.6	2.9	x	34	x	x
W-1083	–	1.0	4.6	x	43	x	x

a/ 'x' represents data for which laboratory analysis is incomplete.

Studies of blood electrolytes are complicated by greater difficulty in obtaining and preparing the sample and by the relative constancy of blood constituents making high analytical accuracy necessary to detect small changes. However in the case of certain psychiatric and battle casualties blood is the only fluid readily obtainable. For thorough studies of the electrolytes, pH, phosphate, and possibly other determinations should be included. Because of the nature of field operations a study including dietary control is not practical.

Plasma Carbon Dioxide

Owing to the fact that under stress one of the reactions of an individual may be hyperventilation, it was decided to run blood carbon dioxide determinations on the stressed combat infantryman. The supposition was that after prolonged hyperventilation the bicarbonate level of the blood would be lowered sufficiently to compensate for the alkalosis which occurs in hyperventilation. It was also possible that in view of the electrolyte shifts known to occur with altered adrenal cortical activity, there might be shifts of plasma CO_2 in the opposite direction.

Because of the difficulties encountered under field conditions, a simple, yet accurate, method was required. For this reason, a slightly modified version of the Scholander-Roughton microgasometric estimation of plasma total carbon dioxide[10,11] was chosen. The equipment needed is minimum, primarily consisting of the Scholander-Roughton syringe analyzer in which a very small amount of plasma, less than 0.03 ml, is vacuum extracted in the syringe. The volume of gas formed is measured before and after absorption of carbon dioxide with an alkali. The method, as described by Scholander and Roughton, recommends the use of blood collected anaerobically, but since this was difficult under field conditions, the principle of the Van Slyke and Cullen plasma carbon dioxide combining capacity method[12] was used.

The blood samples were centrifuged in nearly all cases within an hour after withdrawal, and in no case longer than three hours. The plasma was removed from the cells immediately and stored in plastic tubes, the carbon dioxide determinations being run the day of collection whenever possible. It was found in preliminary studies of Groups I and II at Camp Omiya that the bicarbonate level of stored plasma drops

10/ Scholander, P. F. and Roughton, F, J. W. Micro Gasometric Estimation of the Blood Gases. IV. Carbon Dioxide. J. B. C. 148: 573-580, 1943.

11/ Lilienthal, J. L. and Riley, R. L., On the estimation of arterial carbon dioxide from samples of cutaneous (capillary) blood. J. Lab. and Clin. Med. 31: 99-104, 1946.

12/ Van Slyke and Cullen, Plasma carbon dioxide combining capacity. Peters and Van Slyke, Quantitative Clinical Chemistry; Methods; 251-257, Table 15, p. 129.

slightly after 12 hours. The plasma was equilibrated with alveolar air immediately before analysis in order to restore carbon dioxide which had escaped during and after centrifugation.

In order to establish a normal base-line, plasma carbon dioxide determinations were run on 12 of the 24 infantrymen comprising Groups V and VI, already described as being on a relatively quiet sector of the MLR. The results of these analyses, shown in Table 22, establish a mean normal carbon dioxide level of 59.5 vol, %, that is 59.5 cc carbon dioxide per 100 ml plasma.

TABLE 22

PLASMA CARBON DIOXIDE VALUES ON GROUP V AND GROUP VI INFANTRYMEN IN A NON-COMBAT SITUATION

Individual	Plasma CO_2 vol %
A-5075	61
C-5107	62
H-9329	57
H-8421	58
H-3136	61
K-3195	60
G-6497	60
K-4360	57
M-5261	59
O-7035	59
S-1495	58
W-1009	62
Mean (N = 12)	59.5
S. D.	± 1.7

Determinations were made on Group III, consisting of individuals exposed to a severely acute combat stress situation of approximately 16 hours duration. It was possible to obtain data on the same five individuals 13 hours before the attack began, again 17 hours after leaving the active combat area, and finally five days after combat. It was also possible to obtain data on 15 other individuals during the same two post-combat periods. These results are listed in Table 23.

It appears that the plasma total carbon dioxide is significantly lower in the pre-assault (A) samples than in either of the post-combat samples. The difference between A and B for the five individuals had a $\underline{t}$ value of 2.49, which is significant at P = 0.08. On the other hand the two post-combat samples (B and C) for either the five men or or the additional 15 on whom this comparison could be made, did not differ significantly from each other, or from Groups V and VI (Table 22)

TABLE 23

PLASMA CARBON DIOXIDE VALUES FROM GROUP III INFANTRYMEN

Individual	Plasma CO_2 vol %		
	A[a]	B[b]	C[c]
C-4136	62	62	61
B-7531	50	61	62
H-7321	57	64	62
H-4808	56	60	57
M-0305	55	57	58
Mean (N = 5)	56.0	60.8	60.0
A-8639	-	59	57
H-1864	-	59	53
H-1296	-	58	56
J-4226	-	57	60
J-8455	-	56	57
L-6206	-	60	58
M-9987	-	52	55
P-4185	-	57	59
S-7808	-	50	59
S-4171	-	58	58
S-4917	-	56	56
T-9985	-	54	56
W-0218	-	56	58
W-2990	-	63	60
W-1083	-	59	58
Mean (N = 20)		57.9	58.0

a/ 13 hours before beginning an assault.
b/ 17 hours after the assault.
c/ 5 days after the assault.

From this it may be concluded that combat itself does not seem to alter the carbon dioxide carrying capacity of the blood; however, the lowered plasma carbon dioxide shortly before combat may be indicative of a hyperventilation associated with the anticipatory tension which was undoubtedly present in Group III when the A samples were taken.

The third group analyzed comprises Group IV, which experienced a less intense but greater duration combat situation. The first blood samples were obtained from 13 men seven hours after withdrawl of the unit from five days of combat, the second set of samples was obtained ten days later from 12 of the same individuals. These data are given in Table 24 and again, on an individual as well as group basis, there is no evident increase or decrease in the plasma carbon dioxide level. The mean values in this group compare within 0.5 vol % with the mean normal value of Groups V and VI. In both cases analyses were carried out within twelve hours after collection of the blood samples.

TABLE 24

PLASMA CARBON DIOXIDE ON GROUP IV INFANTRYMEN
EXPOSED TO SEVERE LONG TERM COMBAT STRESS

Individual	Plasma CO_2 vol %	
	B	C
F-8576	60	61
B-5392	59	61
H-4368	57	60
J-4476	62	61
L-0624	59	59
M-2880	61	61
P-4431	58	60
P-0411	60	60
R-0371	64	61
S-4749	60	56
T-1483	62	60
W-7805	59	60
Mean (N = 12)	60.1	60.0

Table 25 includes a group of seven individuals in two other categories. Four of these were men from Group III who were wounded and from whom samples were obtained shortly thereafter during the assault. Each one of these exhibited a lower plasma carbon dioxide value after being wounded than their pre-assault level, two of which are markedly lower. The other three were psychiatric casualties from whom blood samples were drawn at the time of disturbance and again several days later, after partial or complete recovery. Of these, no change in plasma carbon dioxide was noted, with the exception of one who may have shown a slight increase.

It is concluded, therefore, in these data, that in neither an acute, short term combat stress situation nor a less severe but longer lasting combat stress situation is there any apparent change in the carbon dioxide carrying capacity of the blood. On the other hand, it may be that the anticipatory state before combat may lead to a small but significant lowering of plasma carbon dioxide, perhaps as a result of hyperventilation. The Scholander-Roughton microgasometric method of analysis was found to be a very satisfactory field method, provided determinations were carried out within twelve hours after collection of the blood samples

TABLE 25

PLASMA CARBON DIOXIDE ON INFANTRYMEN IN SPECIAL CATEGORIES

Individual	Plasma CO_2 vol %	
	13 hours pre-assault	Wounded
G-5761	61	47
P-1061	60	47
SCHOW	59	55
J-4852	57	55
	Psychiatric casualty	Post-psychiatric casualty
W-4352	52	56
P-4360	54	55
S-7571	62	61

Plasma Total Cholesterol

In recent years the adrenal cortex has been shown to contain a large amount of cholesterol, and under various conditions of cortical activity the cholesterol content may drop markedly. It has been postulated that cholesterol may be precursor of the cortical hormones and when demands are made on the adrenal cortex, as in stress or during administration of the pituitary adrenocorticotrophic hormone (ACTH), the stored cholesterol of the gland is depleted in the rapid synthesis of cortical hormones.

More recently, Conn, et al.,13/ have demonstrated clearly that the cholesterol level of the blood plasma also falls if the period of

13/ Conn, J. W., Vogel, W. C., Louis, L. H., Fajans, S. S. Serum cholesterol: a probable precursor of adrenal cortical hormones. J. Lab. Clin. Med., 35: 504-517, 1950.

cortical activity is prolonged. Thus, in experiments with normal human subjects receiving daily doses of 26 to 100 mg of purified ACTH per day they showed that the plasma cholesterol level began to fall after the first day. It reached a minimum value about 32 percent below the normal level approximately six days after the start of the ACTH administration, and some four days were required for the original plasma level to be restored following the discontinuation of the injections. The effect was almost entirely on the esterified cholesterol rather than the free fraction; however, the changes were reflected well in the total cholesterol values. Administration of 200 mg of cortisone daily for ten days in two other normal individuals had no effect on plasma cholesterol levels.

In the present study plasma total cholesterol levels were determined as an index of the magnitude of adrenal cortical activity in the stress of combat. The method of Saifer and Kammerer[14] was used and was found to be entirely satisfactory under the field laboratory conditions obtaining in this instance. It should be noted, however, that a somewhat wider range of normal values, 130 mg % to 280 mg %, and a slightly lower mean normal value, 197.3 mg %, were obtained in the group of 92 young combat soldiers examined in this connection than were found by Saifer and Kammerer. These values are presented in Table 26, and their distribution is plotted in Fig. 12.

The blood samples were obtained at all hours during the day without respect to time after meals. In most instances the plasma was removed within an hour after the blood sample was drawn, and in no case was the time longer than three hours. Although the plasma was kept refrigerated it was found in the preliminary studies with Groups I and II at Camp Omiya that the cholesterol level began to fall appreciably after standing 24 hours; consequently, all analyses were performed within this period after blood sampling.

In order to test the reliability of cholesterol determinations on the same individual at different times under these field conditions, a group of 18 combat infantrymen (comprising Groups V and VI) was studied in a relatively quiet sector of the MLR on two occasions 10 days apart (A and A'). As may be seen in Fig. 13, a high degree of correlation, r = 0.91, exists between the test (A) and retest (A') values, all of which are listed in Table 27. The standard error of estimate of A' from A was calculated to be ± 16.9 mg %, and the difference between the two means was found to have no statistical significance. Thus the normal plasma cholesterol level of the combat soldier may be regarded as being fairly stable within these limits, with respect to such factors as diet, time of day, and physical activity, for the purpose of field studies such as this one. It also appears that while the cholesterol level of the blood may vary widely from individual to individual, it is relatively constant over a period of time for each individual.

14/ Saifer, A., and Kammerer, O. F. Photometric determination of total cholesterol in plasma or serum by a modified Liebermann-Burchard reaction. J. Biol. Chem., 164: 657-677, 1946.

TABLE 26

PLASMA TOTAL CHOLESTEROL VALUES IN COMBAT INFANTRYMEN DURING QUIESCENT PERIODS OF COMBAT ACTIVITY

Group I-A		Group III-A		Group III-D		Group V-A	
Individual	Cholesterol mg %	Individual	Cholesterol mg %	Individual	Cholesterol mg %	Individual	Cholesterol mg %
B-4833	147	A-8537	183	A-8639	193	A-5075	157
F-4293	153	C-4136	176	H-1864	176	C-5107	212
G-1884	230	C-5898	226	H-1296	218	H-9329	188
G-3336	197	E-3096	224	J-4226	184	H-8421	138
J-9670	210	G-5761	272	M-9987	197	H-3136	173
M-7856	219	P-1061	194	P-4185	280	K-3195	194
R-5249	157	SCHOW	231	S-4171	257	M-3285	179
W-0689	170	S-5171	217	S-4917	182	M-7371	258
W-9926	203	A-4492	240	T-9985	217	S-6942	169
V-4828	179	B-7531	145	W-0218	260	W-4130	209
V-1030	197	H-7312	182	W-2990	169	W-9893	209
		J-4852	247	W-1083	174	W-7018	182
N = 11	Mean = 187.5	M-3290	194	N = 12	Mean = 208.9	N = 12	Mean = 189.0
Group II-B		B-2003	179	Group IV-C		Group VI-A	
		H-4808	212				
		J-0703	185				
		M-7579	217				
B-2258	181	M-1604	172	F-8576	195	B-9350	279
E-4332	206	M-0305	184	B-5392	208	B-8787	232
H-4815	145	MOSS	260	H-4368	169	C-9358	199
J-7455	193	W-3173	246	J-4476	147	C-6378	151
J-1789	270	N = 21	Mean = 208.9	L-0624	191	F-0536	209
M-2878	196			M-2880	216	G-2474	185
M-7056	130			P-4431	153	G-6497	237
P-9139	159			P-0411	237	K-4360	159
R-0897	183			R-0371	197	M-5261	174
R-2312	146			S-4749	258	O-7035	191
S-0746	197			T-1483	187	S-1495	214
S-6143	197			W-7805	175	W-1009	159
N = 12	Mean = 183.6			N = 12	Mean = 194.4	N = 12	Mean = 199.1

Total N = 92 Mean = 197.3 mg % cholesterol Range is from 130 mg % to 280 mg %

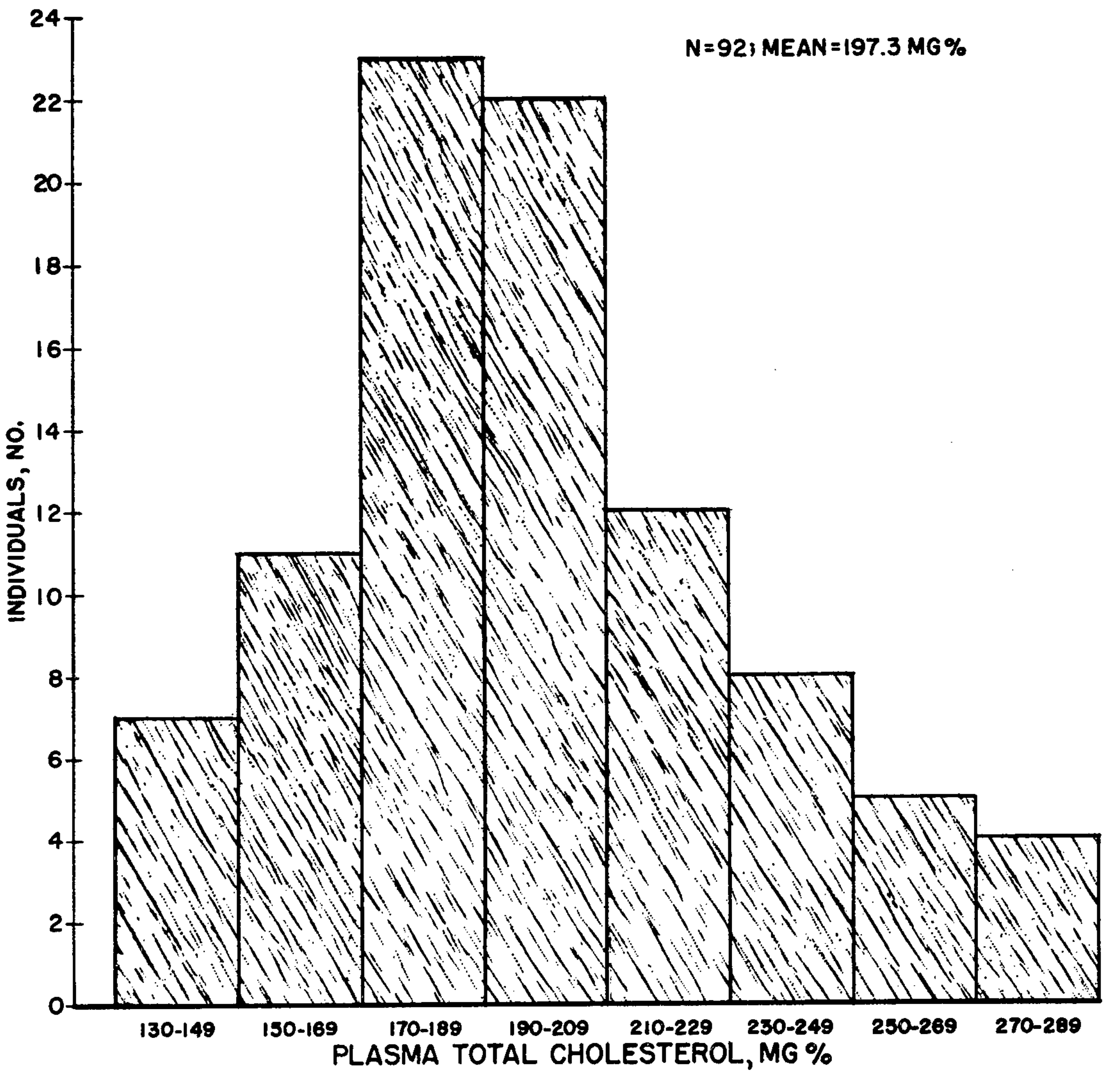


Fig. 12 - Distribution of Plasma Total Cholesterol Values in Group of Combat Infantrymen During Quiescent Periods of Combat Activity

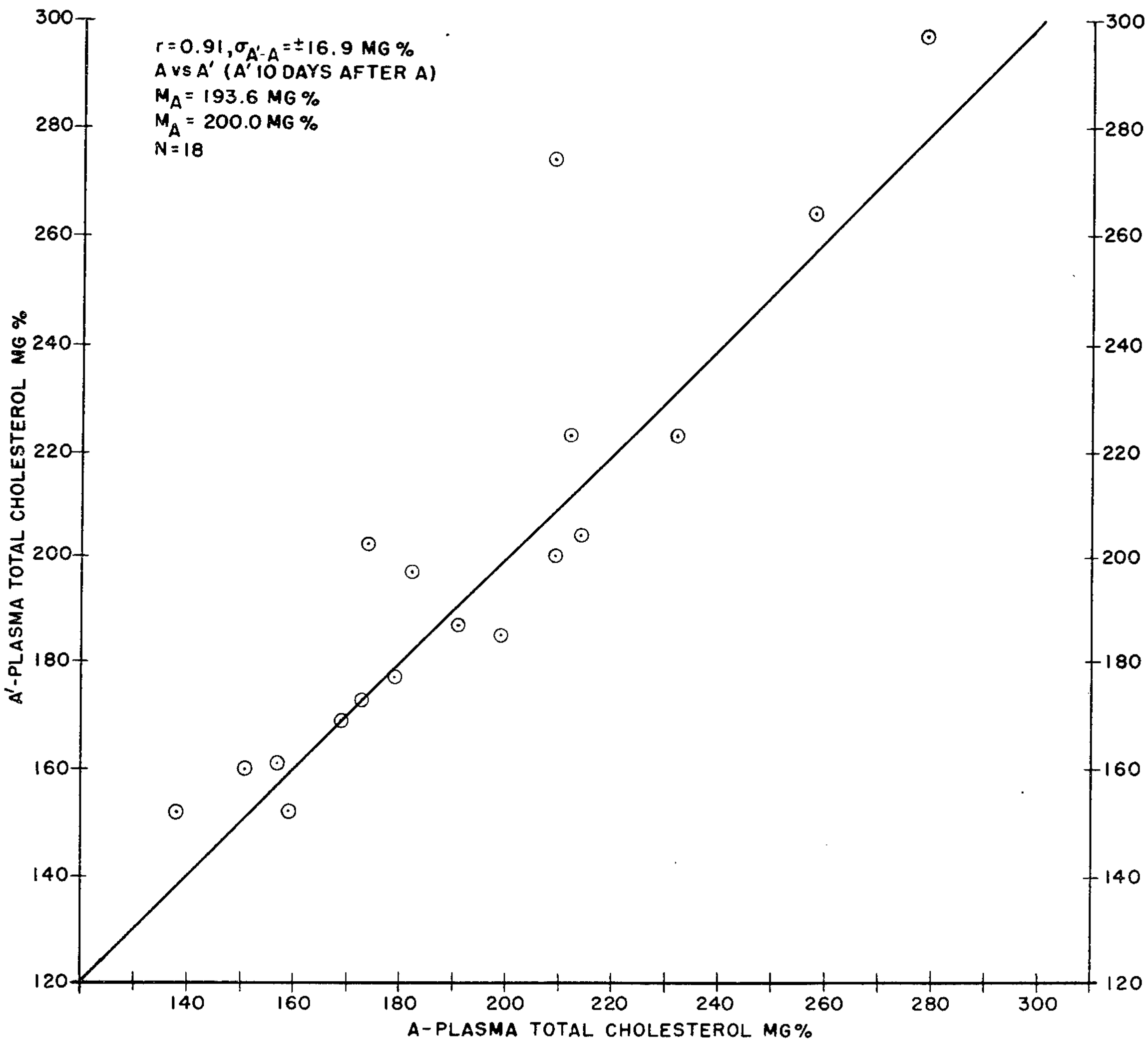


Fig. 13 - Test-retest Reliability of Plasma Total Cholesterol Values in Group of Infantrymen - Stable Combat Situation

The effect of an intensly acute combat assault situation of relatively short duration, i.e. about 16 hours, on the plasma total cholesterol level of five individuals is shown graphically in Fig. 14. The mean for the group is also plotted on the same graph. Blood samples were obtained from these individuals about 13 hours before the assault began (A), again about 17 hours after they withdrew from the active combat area (B), a third time five days after the assault (C), and finally 22 days after the attack (D). As explained previously, this group was exposed to other combat situations in the intervening periods between samples; however, none of the succeeding situations was apparently as severe as the first one.

TABLE 27

A COMPARISON OF PLASMA TOTAL CHOLESTEROL VALUES
(GROUPS V & VI)

Individual	(A) Original Cholesterol mg %	(A') Cholesterol After 10 days mg %
A-5075	157	161
C-5107	212	223
H-8421	138	152
H-3136	173	173
M-3285	179	177
M-7371	258	264
S-6942	169	169
W-4130	209	274
W-7018	182	197
B-9350	279	297
B-8787	232	223
C-9358	199	185
C-6378	151	160
F-0536	209	200
M-5261	174	202
O-7035	191	187
S-1495	214	204
W-1009	159	152
Mean	193.6	200.0
N = 18	r = 0.91	

The data are also given in Table 28, Part A, together with data on 12 other men of the same combat unit from whom samples were obtained on all the occasions listed above, except the first one just before the assault. This entire group is referred to as Group III.

It can readily be seen that in all five individuals the plasma total cholesterol level is lower shortly after the assault than it was before.

TABLE 28

PART A

PLASMA TOTAL CHOLESTEROL VALUES FROM GROUP III COMBAT INFANTRYMEN

Individual	Plasma Total Cholesterol mg %			
	A[a]	B[b]	C[c]	D[d]
C-4136	176	140	168	157
B-7531	145	140	139	173
H-7321	182	166	165	197
H-4808	212	200	176	191
M-0305	184	169	168	172
Mean (N = 5)	179.8	163.0	163.2	178.0
A-8639	-	212	200	193
H-1864	-	167	161	176
H-1296	-	212	234	218
J-4226	-	175	192	184
M-9987	-	192	200	197
P-4185	-	267	264	280
S-4171	-	179	202	257
S-4917	-	212	199	182
T-9985	-	218	178	217
W-0218	-	244	244	260
W-2990	-	164	172	169
W-1083	-	168	176	174
Mean (N = 17)	-	189.7	190.5	199.8

a/ 13 hours after active combat.
b/ 17 hours after the combat period.
c/ 5 days after the attack.
d/ 22 days after the attack.

TABLE 28

PART B

SIGNIFICANCE OF THE DIFFERENCE BETWEEN THE VARIOUS CHOLESTEROL MEANS FOR ABOVE SITUATIONS

N	A vs. B		B vs. C		B vs. D		A vs. D	
	t	P	t	P	t	P	t	P
5	3.24	5%	0.02	10%	1.86	10%	0.18	10%
17	-	-	0.19	10%	1.68	10%	-	-

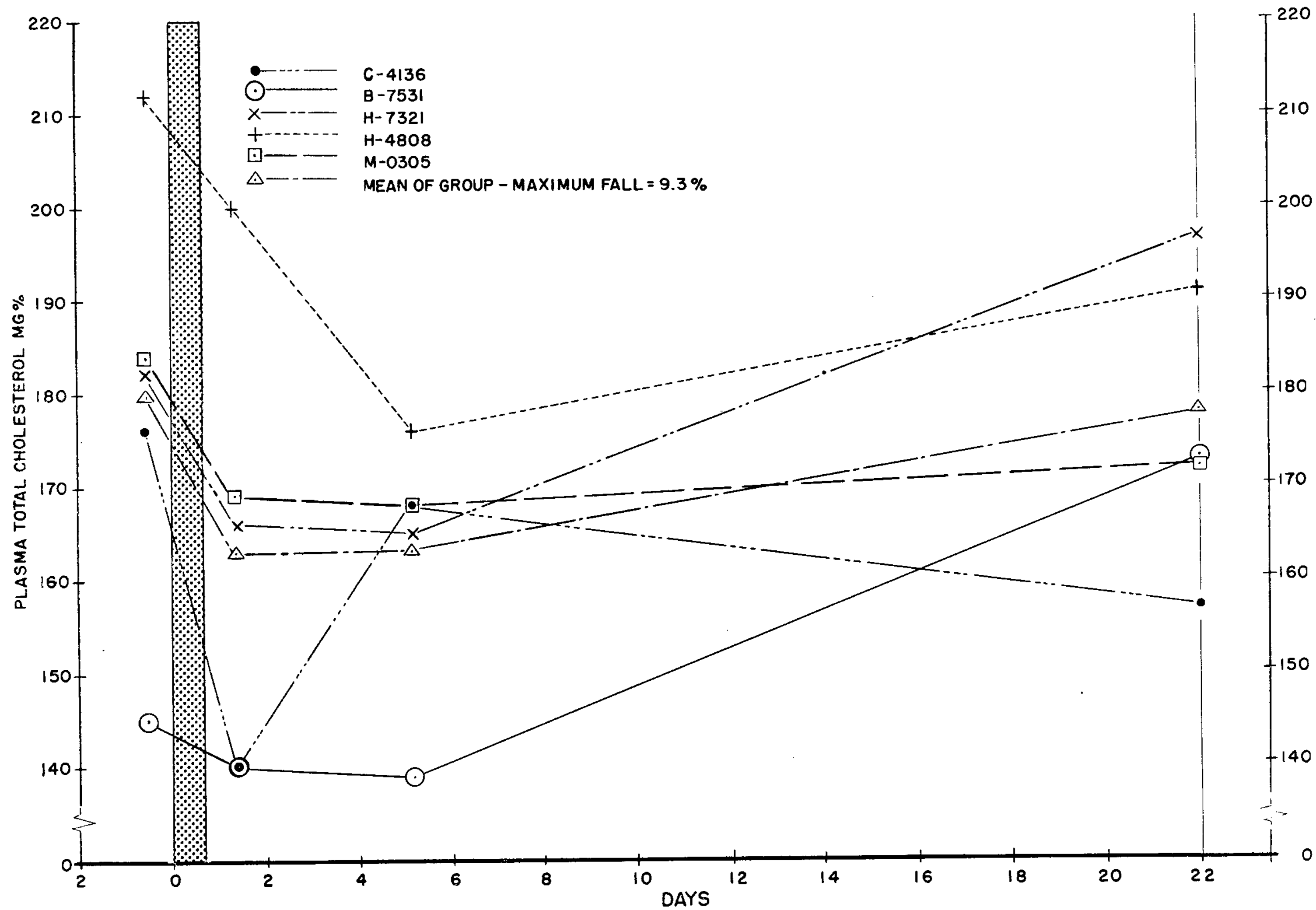


Fig. 14 - Plasma Total Cholesterol Values in Group of Infantrymen 13 Hours Before Active Combat, 17 Hours After Combat Period, 5 Days After the Attack, and 22 Days After

As indicated in Table 28, Part B, the difference in the two means is significant at the 5 percent level, and amounted to a drop of 9.3 percent (16.8 mg %) in total cholesterol level. It may also be noted that only one of the five individuals had recovered his previous cholesterol level five days after the assault, and that there was no significant difference between the mean for the group at this time and that shortly after the assault. The latter was also true of the entire group of 17 individuals on whom this comparison could be made. On the other hand, most of the individuals showed a practically complete recovery on the twenty-second day after the assault, and although the difference between this mean and that shortly after the assault, is not quite significant at the 10 percent level (see Table 28, Part B), the change is clearly evident. This recovery occurred in plasma cholesterol level apparently in spite of the continuing intermittent stress to which the individuals were exposed during the recovery period, in some cases as recent as the night before the final sampling. There was no significant difference between the mean on the day before the assault and that on the twenty-second day after the assault.

These changes are consistent with the finding of Conn, et al., 15/ on normal men receiving daily injections of ACTH, particularly with respect to the time relationship mentioned earlier. The fact that the drop in plasma cholesterol level was not as great in the combat soldiers may have been due in part to the relatively short duration of the stress situation and partly to the lag of 17 hours between the end of the stress and the drawing of the blood samples.

The effects of a more prolonged, though less intense, combat situation were examined in another infantry rifle unit, Group IV, that was exposed to the stress for over five days. Blood samples were obtained in this instance from 13 individuals within seven hours after withdrawl of the unit from the active combat area (B), and another set of blood samples was obtained ten days later from twelve of the same individuals (C). A comparison of the plasma total cholesterol levels in these two instances is presented in Table 29 and reveals an even greater effect than in the previous group. The mean cholesterol level for this group immediately after five days of active combat is seen to be 15.5 percent (30.1 mg %) lower than it was ten days later after a general recovery period. This difference between the two means is significant below the 1 percent level.

In order to test further the significance of the drop in plasma total cholesterol level in Group IV, a comparison was made of the distribution of the differences between Group IV immediately after combat (B) and ten days later (C), with the distribution of the differences between the test (A) and retest (A') values for Groups V and VI. The value of $\underline{t}$ for the difference between these two sets of differences was found to be 2.53, indicating a probability of significance at the 2 percent level. On the other hand, the homogeneity of Group IV ten days after the combat stress situation (C) with Groups V and VI was indicated by testing the significance of the difference in means between the former and the retest (A') values of the latter. In this case $\underline{t}$ was

15/ Conn et al., op. cit.

found to be equal to 0.39, indicating no confidence at the 10 percent level. Thus, the lowering of plasma total cholesterol as a result of acute combat stress appears to be real, and indicates a prolonged and high level of adrenal cortical activity under these conditions, probably as a result of an increased production of ACTH by the pituitary gland.

TABLE 29

PLASMA TOTAL CHOLESTEROL VALUES
FOR GROUP IV COMBAT INFANTRYMEN

Individual	Plasma Total Cholesterol mg %	
	B a/	C b/
F-8576	184	195
B-5392	201	208
H-4368	136	169
J-4476	124	147
L-0624	184	191
M-2880	131	216
P-4431	189	153
P-0411	206	237
R-0371	146	197
S-4749	218	258
T-1483	120	187
W-7805	132	175
Mean (N = 12)	164.3	194.4
	$t = 3.25$ $P < 1\ \%$	

a/ 7 hours after leaving an active combat situation of 5 days duration.
b/ 10 days later.

Table 30 lists plasma total cholesterol values for a few individuals in several other categories. It was possible to obtain blood samples from four individuals in Group III shortly after they were wounded during the assault, and from whom blood samples had been taken 13 hours before the assault. As may be seen in the table, three of the four exhibited a fall in plasma cholesterol level, and the mean difference for all four before and after was quite comparable in magnitude with that exhibited by the unwounded members of the group tested. How much of the decrement in plasma cholesterol was due to the stress of being wounded, and how much to the previous stress of combat cannot be determined; however, in view of the time relationships involved it appears more likely that the latter was the more important contributory factor.

TABLE 30

PLASMA TOTAL CHOLESTEROL VALUES IN VARIOUS STRESS SITUATIONS

Individual	Plasma total cholesterol mg %			Stress condition
	A	B	C	
G-5761	272	211	-	Seriously wounded
P-1061	194	183	-	Lightly wounded
SCHOW	231	246	-	Seriously wounded
J-4852	247	234	-	Lightly wounded
Mean (N = 4)	236.0	218.5	-	
W-4352	-	241	248	Acute anxiety
P-4360	-	241	223	Combat exhaustion (conversion hysteria)
S-7571	-	140	138	Mild combat exhaustion
Mean (N = 3)	-	207.3	203.0	
K-2270	-	197	247	Night ambush patrol

Plasma total cholesterol levels were also measured in three individuals suffering psychiatric disturbances as a result of combat situations. Repeat samples were obtained from the same individuals several days later when the disturbance had abated. In no case did the cholesterol change appreciably, nor was any trend evident. These data are included in Table 30.

Listed in Table 30 are two plasma total cholesterol values obtained from a member of the team 11 hours after returning from a night ambush patrol of six hours duration, and again after a recovery period of eight days. The latter is clearly higher than the former, which is consistent with the change to be expected in acute stress.

On the whole, it would appear that plasma total cholesterol level is influenced by severe degrees of combat stress, but in order to be useful in estimating the degree of stress it requires either control values on the same individual if it is to be applied to one individual, or fairly large numbers of individuals if a single group determination is to be made. In any event, the importance of investigating further the relationship of cholesterol to the physiologic changes induced by stress is emphasized by the present findings.

Urine Uric Acid

An increase in the urinary uric acid-creatinine ratio has been described as one effect of ACTH administration[16]. To determine whether such a change occurs in men subsequent to a period of combat stress, uric acid was included in the general biochemical study. The direct colorimetric method of Benedict and Franke[17] was used with the following modifications: two ml of urine, diluted 1:25, was placed into a 50 ml volumetric flask. One ml of the 5 percent sodium cyanide reagent was added, followed by 2 ml of water. The contents of the flask were mixed and allowed to stand for five minutes. At this time, 0.4 ml of the arseno-phosphotungstic acid reagent was added, the contents mixed occasionally, and allowed to stand exactly five minutes before adding water to the 50 ml mark.

Readings with a Coleman Junior Spectrophotometer were made against a blank prepared in parallel with the samples. A wave length setting of 700 mμ was used. A calibration curve was constructed with uric acid standards covering a range up to the equivalent of 1.0 mg/ml of original urine. To avoid high readings it was important to maintain uniform time periods for the reactions, and to read the samples soon after the final dilutions.

Urinary uric acid determinations were made on all urine samples from each of the seven major groups and the ACTH special test groups.

16/ Forsham, P. H., Thorn, G. W., Prunty, G. F. T., and Hills, A. G., J. Clin. Endocrinol., 8: 15, 1948.

17/ Hawk, P. B., Oser, B. L., and Summerson, W. H., "Practical Physiological Chemistry," 12th Ed., Blakiston, Philadelphia, 1947, pp. 844-46.

Although hourly uric acid outputs have been calculated for each individual test, these data deserve less emphasis than the uric acid-creatinine ratios, since hourly outputs depend on accurate urine collections which in some instances were proved unreliable.

In 24 control subjects (Group V-A and VI-A) in which urine collections were well controlled, the mean hourly uric acid output was 37.76 mg with a standard deviation (S. D.) of 9.4 mg. In these same two groups the mean uric acid-creatinine ratio was 0.476 with a S. D. of 0.088.

In Group III-B the mean uric acid-creatinine ratio was 0.462. On the first retest four days later the uric acid-creatinine ratio was 0.500 (III-C). On the final retest 22 days after combat the value was 0.479 (Group III-D). The difference between III-B and III-C was found to be significant at the 5 percent level.

In Group IV on the first test soon after combat (Group IV-B) the uric acid-creatinine ratio was 0.488 and ten days later (Group IV-C) the ratio was 0.418. Applying the "t" test one finds that this difference is significant, but only at the 10 percent level. A similar degree of difference was found between the first and second tests on the control groups.

In the case of Group III-B the mean uric acid-creatinine ratio for the ACTH test subgroups was less than the mean for the entire group or for the subgroup itself before ACTH. This was true also on the first and second retests (Groups III-C and III-D).

In case of Group IV-B the mean uric acid-creatinine ratio for the ACTH subgroup rose when compared with the same group before ACTH. In the Group IV-C test, on the contrary, the mean ratio in the subgroup fell after ACTH.

In Group V-A the mean uric acid-creatinine ratio in the subgroup rose after ACTH and in Group V-A' the ratio fell.

The changes in the uric acid-creatinine ratio failed to reveal consistent changes either with stress or after ACTH administration.

It is apparent that in these studies uncontrollable factors have led to unexplainable changes in this ratio. It was expected that stress would increase the output of uric acid relative to creatinine. In Group III this ratio was actually lower on the first test than on the second or third. In Group IV the ratio fell on the retest ten days after combat. This is in the predicted direction but was of a low order of significance.

Similarly ACTH is said to increase the uric acid-creatinine ratio. Our findings with ACTH, however, failed to show a consistent change in this direction. As a matter of fact, the ratio fell after ACTH twice as often as it rose.

Of the factors other than stress and ACTH which may have led to the observed changes, perhaps the most important is the known diurnal variation in uric acid output. Thus, Toussky, et al[18] have shown that the uric acid-creatinine ratio may increase as much as 240 percent between the periods 0600 to 0800 and 0900 to 1200. In the ACTH special tests the majority of urine specimens were collected between 1600 on the one afternoon and 0630 the following morning, thus including the period of low uric acid excretion. This may have masked the tendency of ACTH to increase the uric acid output.

Other uncontrolled factors of importance are those of food, particularly the proportion of high purine foods in the diet, and of fasting[19]. Diet and eating schedules are obviously difficult to control in men subject to a changing military situation. It would appear, therefore, that the uric acid-creatinine ratio is not a reliable index of adrenal cortical activity in men under field conditions.

Urine Creatinine

The total daily urinary excretion of creatinine is relatively constant. Hence the concentration of this constituent in the urine serves as ajuseful reference in studying changes in the output of other excretory products. Such a reference is valuable when question exists regarding the rate of urinary secretion during a given period. In these studies the ratios of uric acid:creatinine, chloride:creatinine, and of urea N:creatinine have been calculated for all urine samples. Urinary creatinine concentrations per se have been compared in some groups as an index of dehydration

The method used was that of Folin[20]. In most analyses 0.5 ml of urine was used. In case the specific gravity values indicated a highly concentrated urine, the volume was reduced to 0.25 ml.

Urinary creatinine determinations were made on all subjects. In two control groups of 12 subjects each tested in Korea (Groups V-A and VI-A), the collection of urine was well controlled. In this group the mean creatinine output was 80.2 mg per hour with a S. D. of 17.5. In other test groups, individual samples showing an apparent excretory rate well outside this range were regarded as indicating unreliable collection data. This conclusion was usually confirmed on retesting these individuals. As a rule a second test yielded values falling within the normal range.

18/ Toussky, Hertha M., Swan, R. C., and Shorr, E., "An Inquiry into the Specificity of the uric acid-creatinine ratio as a measure of adrenal cortical responsiveness," Proceedings of the Second Chemical ACTH Conference, Vol. I pp. 273-281, Blakiston, New York, 1951.

19/ Ibid.

20/ Hawk, et al., op cit., pp. 838-842.

No apparent correlation was found to exist between creatinine excretion rates and combat stress. On the other hand inspection of the data seems to indicate a reduced rate of creatinine excretion following ACTH administration. This is not in the anticipated direction and is probably explained on the basis that the ACTH urine was collected overnight, at a time when creatinine output would normally be low.

High values for urinary specific gravity were observed in samples collected from Group III between 15 and 17 hours after retiring from the assault. The mean urinary specific gravity for this group of 20 subjects was 1.025. After four days of recovery (Group III-C) the mean value dropped to 1.020 and on the final retest 22 days after the assault (Group III-D) the specific gravity was 1.021. The difference between the first two values is significant at less than the 1 percent level of reliability.

These data suggest that men recently subjected to acute combat stress are in a state of dehydration. To validate this assumption further a statistical evaluation of urinary creatinine concentrations was made on samples collected on Group III 15-17 hours after combat and retested again four days later. The mean concentration in the former test was 2.40 mg/ml compared with 1.57 mg/ml in the latter. This difference also was found to be significant at less than the 1 percent level. It might be added that the mean value for urinary creatinine concentration in four psychiatric casualties (Group VII) observed within 24 hours after combat was 3.05 mg/ml which would indicate a degree of dehydration in these four subjects greater on the average than in the larger group

These data are further substantiated by the rather consistent increase in body weight that occurred during the recovery from combat stress already noted in the section on Hematocrit Value and Blood Volume.

Although dehydration from urinary water loss can occur in spite of adequate water intake in acidosis, such as that occurring in diabetes and starvation, there is no evidence that any such metabolic disturbance existed in these subjects. In fact the CO_2 combining power of the plasma was normal. Therefore, to explain the dehydration observed here one must assume that the water intake was inadequate. It is quite possible that the water supply was short not only during combat but also during the period of movement from the scene of combat to the battalion area in the rear. To what extent the sensation of thirst may have been in abeyance during this period is a matter for speculation. Adolph[21] has described progressive dehydration in soldiers under desert conditions even though the water supply was unlimited. Whatever its cause, dehydration in the combat soldier may be a factor of importance not only from the standpoint of the surgical treatment of battle casualties but also in the more general problem of stress physiology.

21/ Adolph, Edward F., Physiology of Man in the Desert, N. Y. Interscience, 1947, Series Monographs in the Physiological Sciences, Vol. I.

Blood and Urine Urea

The level of blood urea and urinary urea excretion were studied in this project in an effort to measure the effects of battle-induced stress upon nitrogen metabolism. It is generally accepted that stress or ACTH administration induces a negative nitrogen balance in man and animals. Engle[22] has postulated that although this effect is not directly due to the adrenal cortical hormones, the presence of such hormones is necessary for the changes in nitrogen metabolism, which may be part of the defense mechanism of the organism.

Urea was studied rather than non-protein nitrogen because of the greater ease of determination. Little or no additional information would be obtained from non-protein nitrogen values.

Both urine and blood urea were determined by the method of Conway[23] with certain modifications. A bromcresol green-methyl red mixed indicator (5:1) was used with the boric acid. The final titration was performed with 0.01 N HCl. In the determination of urine urea, a few milligrams of double strength urease powder was added to a convenient quantity of diluted urine (containing not over 0.5 mg N). In the determination of blood urea, two drops of a digitonin suspension (approximately 10 mg/ml) were added to one ml of whole blood. The digitonin served to hemolyse the red cells.

At room temperature at least 20 minutes were allowed for the hydrolysis of urea, and for the diffusion of ammonia at least two hours were allowed with urine and ten hours with blood. The ammonia of the urine was not determined independently. Consequently, the values for urine urea all include a small component from ammonia nitrogen. Blood ammonia levels are too low to be of significance.

The individual values for blood urea nitrogen are shown in Appendix A and the mean values in Table 31. For technical reasons Groups I-A' and II-A are not included in Table 31. It may be noted that the samples taken after an intense combat situation of short duration, Group III-B, were generally high in urea, with several values above 20 mg % N and one value of 35.7 mg % N.

The differences for the individuals in certain groups were tested statistically, the results being shown in Table 32. The decrease in blood urea from immediately after combat (Group III-B) to four days after (Group III-C) and 21 days after (Group III-D) was considered to be significant.

Since nearly significant differences were obtained on retest in Groups V and VI, the distribution of differences of those groups as

22/ Engle, Frank L. Comparative effects of ACTH and stress in nitrogen metabolism. Proceedings, 2nd. Clinical ACTH Conf., Vol. I, pp. 235-241.

23/ Hawk, et al., *op. cit.*, pp. 826-827.

TABLE 31

LEVELS OF BLOOD UREA IN COMBAT INFANTRYMEN[a]

Controls	A		A'		A''			
	N	Mean	N	Mean	N	Mean		
Group I	11	13.38	-	-	11	14.01		
Group II	-	-	12	12.41	-	-		
Group V	12	14.58	9	13.42	-	-		
Group VI	12	12.67	9	11.97	-	-		
Combat Groups	A		B[b]		C		D	
	N	Mean	N	Mean	N	Mean	N	Mean
Group III	20	13.88	19	19.33	20	13.26	17	14.69
Group IV	-	-	13	13.93	12	13.52	-	-

a/ Values expressed as mg % Nitrogen. N = number of individuals.
b/ Wounded individuals were not included.

TABLE 32

STATISTICAL TESTS OF DIFFERENCES IN BLOOD UREA NITROGEN

Controls	Difference tested	N	Difference[a] mg % N	t	P
Group I	A''-A	11	0.68	1.28	>0.1
Groups V & VI combined	A - A'	18	1.03	1.88	< 0.1
Combat Groups					
Group III	B - A	b/	6.29	1.75	<0.1
Group III	B - C	19	5.96	4.84	<0.001
Group III	B - D	16	4.52	3.32	< 0.01
Group IV	B - C	12	1.88	1.96	< 0.1

a/ The mean of the differences upon retest for N individuals was used except in Group III - B - A where the difference of the means of independent samples was treated.
b/ $N_1 = 15$, $N_2 = 14$.

compared to the differences in Group III was tested and found to be significant at the 5 percent level.

No significant change was found in Group IV, the infantrymen that suffered a less severe combat situation for several days. The results with this group are probably complicated by the fact that several of the men participated in an ambush patrol the night prior to obtaining the "recovery" samples. Each of these individuals showed a small increase in blood urea over the post-combat values.

The blood urea levels of miscellaneous subjects are shown in Table 33. No conclusions can be drawn from the urea changes in the individuals suffering wounds. It is interesting to note that all the psychiatric casualties fell well within the normal range, except subject W-4352 whose blood urea level increased during the three days between samples. The team member who participated in an ambush patrol showed a post-stress decrease in blood urea nitrogen.

The results of the analyses of urine urea are presented in Tables 34 to 38. The results are expressed as based upon the urinary creatinine level rather than upon the hourly excretion because of the lack of reliability regarding the elapsed time in collection of many of the samples. Considerable variability was shown with the control samples taken in Japan (Table 34), while the Korean controls (Table 35) less variability was apparent. A tendency toward increased urea excretion following combat with a decrease during "recovery" is shown in Tables 36 to 37. The miscellaneous subjects are shown in Table 38.

The results of statistical tests of differences shown by the individuals in certain groups are shown in Table 39. The decrease in urinary urea excretion upon recovery (Group III-B versus III-C) is significant at the 5 percent level. Testing the distribution of differences as compared to those of the combined Korean controls (Groups V and VI), the significance was only at the 10 percent level. The differences shown by the individuals in Group IV cannot be considered significant.

Following ACTH administration, variable changes in urea excretion were found, as is seen in Table 40. The controls studied in Japan generally showed a decrease after ACTH, while those in Korea generally showed an increase. In the subjects observed following an intense combat situation of short duration (Group III), large increases in urea excretion were noted. This finding is contrary to what would be expected if the situation were merely that of a depleted adrenal cortical reserve; other mechanisms are undoubtedly involved. Because of the wide variation in response to ACTH and the small number of samples, conclusions cannot be drawn from the effects of ACTH upon nitrogen metabolism.

The data indicate correlation of blood and urinary urea levels in some individuals but not in others. Undoubtedly, the lack of control of conditions such as dietary intake and time of day of urine collection influenced the changes observed.

TABLE 33

LEVELS OF BLOOD UREA IN MISCELLANEOUS SUBJECTS[a]

Psychiatric casualties	B	C
W-4352	14.7	21.0
P-4360	13.5	12.9
S-7571	13.9	15.8
G-0442	10.1	-
P-5803	13.3	-
Wounded	**A**	**B**
G-5761	17.0	16.4
P-1061	10.6	16.2
SCHOW	15.3	17.8
SMITH	-	19.7
J-4852	13.0	10.1
R-1552	-	13.4
Ambush patrol	**B**	**C**
K-2270	21.3	13.1

a/ Values expressed as mg % N.

TABLE 34

URINARY UREA EXCRETION OF JAPAN CONTROLS[a]

Group I	A	A'	A''	Group II[b]	A'
B-4833	6.3	6.7	6.4	B-2258	5.9
F-4293	6.3	5.2	6.3	E-4332	8.0
G-1884	9.6	5.7	6.2	H-4815	5.0
G-3336	7.0	5.8	6.1	J-7455	13.2
J-9670	5.6	4.3	4.2	J-1789	6.6
M-7856	10.0	12.0	8.5	M-2878	6.4
R-5249	6.5	7.3	6.4	M-7056	4.5
W-0689	7.7	6.3	6.5	P-9139	4.8
W-9926	9.6	6.8	7.7	R-0897	7.5
V-4828	6.6	6.7	6.5	R-2312	4.7
V-1030	8.7	4.3	5.7	S-0746	4.5
				S-6143	6.9
Mean, 11 subjects	7.63	6.46	6.41	Mean, 12 subjects	6.50

a/ Values expressed as mg urea N/mg creatinine.
b/ Group II-A was not included for technical reasons.

TABLE 35

URINARY UREA EXCRETION OF KOREA CONTROLS[a]

Group V	A	A'	Group VI	A	A'
A-5075	6.6	5.2	B-9350	4.4	6.3
C-5107	7.0	6.8	B-8787	6.5	4.8
H-9329	6.6	-	C-9358	7.5	6.7
H-8421	7.6	9.2	C-6378	8.0	6.5
H-3136	8.8	8.6	F-0536	6.4	7.1
K-3195	6.4	-	G-2474	5.1	-
M-3285	6.2	6.3	G-6497	1.6	-
M-7371	5.4	5.6	K-4360	6.0	-
S-6942	10.6	6.7	M-5261	5.6	5.2
W-4130	6.1	5.2	0-7035	7.5	6.6
W-9893	6.8	-	S-1495	5.1	5.5
W-7018	2.6	4.8	W-1009	4.6	6.6
Mean, N = 12	6.72	-	Mean, N = 12	5.69	-
Mean, N = 9	6.78	6.49	Mean, N = 9	6.18	6.14

a/ Values expressed as mg urea N/mg creatinine.

TABLE 36

URINARY UREA EXCRETION OF INDIVIDUALS IN GROUP III (SHORT INTENSE COMBAT)[a]

Individual	A	B[b]	C	D
A-8537	7.6	-	-	-
C-4136	7.7	7.2	7.5	8.8
E-3096	8.3	-	-	-
G-5761	7.8	-	-	-
P-1061	4.9	-	-	-
SCHOW	9.4	-	-	-
SMITH	5.6	-	-	-
S-5171	6.2	-	-	-
A-4492	5.7	-	-	-
B-7531	13.4	7.9	6.3	7.3
H-7531	5.0	7.0	5.0	5.4
J-4852	4.2	-	-	-
M-3290	6.0	-	-	-
O-4697	6.2	-	-	-
R-2423	8.3	-	-	-
B-2003	16.1	-	-	-
H-4808	6.2	5.6	3.3	6.0
J-0703	5.7	-	-	-
M-7579	6.7	-	-	-
M-1604	7.1	-	-	-
M-0305	5.8	7.1	5.5	7.0
MOSS	6.7	-	-	-
W-3173	3.6	-	-	-
A-8639	-	6.5	5.5	7.1
H-1864	-	7.6	7.9	4.2
H-1296	-	6.1	6.3	7.9
J-4426	-	9.2	7.1	6.8
J-8455	-	6.9	5.8	-
L-6206	-	7.2	6.2	-
M-9987	-	19.6	7.3	7.6
P-4185	-	8.4	7.5	7.9
S-7808	-	9.3	6.4	-
S-4171	-	7.5	8.1	9.6
S-4917	-	5.4	4.1	4.0
T-9985	-	7.4	7.3	11.7
W-0218	-	6.7	4.4	6.0
W-2290	-	5.5	3.5	6.5
W-1083	-	7.1	11.0	9.0
Means				
All individuals	7.17	7.76	6.30	7.22
5 individual in ABCD	7.59	6.97	5.53	6.91
12 individuals in BCD	-	8.10	6.69	7.38

a/ Values expressed as mg urea N/mg creatinine.
b/ Wounded individual was not included.

TABLE 37

URINARY UREA EXCRETION OF INDIVIDUALS IN GROUP IV (PROLONGED MODERATELY SEVERE COMBAT) a/

Individual	B	C
F-8576	6.3	8.9
B-5392	6.8	6.1
H-4368	7.3	8.0
J-4476	7.8	4.3
L-0624	8.4	7.2
M-2880	7.7	4.1
O-8834	9.9	-
P-4431	6.0	10.5
P-0411	8.2	5.9
R-0371	6.3	5.5
S-4749	5.3	4.6
T-1483	6.9	7.9
W-7805	12.0	6.6
Mean, N = 13	7.60	-
Mean, N = 12	7.42	6.64

a/ Values expressed as mg urea N/mg creatinine.

TABLE 38

URINARY UREA EXCRETION OF MISCELLANEOUS INDIVIDUALS IN GROUP VII a/

Wounded	A	B	C
SCHOW	9.4	2.9	-
R-1552	-	7.0	-
Psychiatric Casualties			
P-4360	-	5.2	4.7
W-4352	-	3.2	7.0
S-7571	-	3.7	7.4
G-0442	-	7.2	-
Ambush Patrol			
K-2270	-	6.8	5.2

a/ Values expressed as mg urea N/mg creatinine.

TABLE 39

STATISTICAL TESTS OF DIFFERENCES IN URINE UREA NITROGEN UPON RETEST

Controls	Difference Tested	N	Difference mg N/mg Creatinine	t	P
Groups V & VI combined	A - A'	18	0.16	0.44	>0.1
Combat Groups					
Group III	B - C a/	19	1.47	2.12	0.05
Group IV	B - C	12	0.77	1.00	>0.1

a/ Wounded individual was not included.

TABLE 40

URINE UREA EXCRETION BEFORE AND AFTER ACTH ADMINISTRATION[a]

	A		A'		A''	
Japan Controls	Before	After	Before	After	Before	After
M-7856	10.0	5.4	12.0	6.2	8.5	6.5
R-5249	6.5	5.3	7.3	4.2	6.4	4.7
W-9926	9.6	11.0	6.8	5.2	7.7	5.8
J-1789	-	-	6.6	5.4	-	-
M-2878	-	-	6.4	5.3	-	-
M-7056	-	-	4.5	5.2	-	-
P-9139	-	-	4.8	5.1	-	-
Mean change		-1.47		-1.69		-1.87
Korea Controls						
H-8421	7.6	8.2	9.2	8.3		
H-3136	8.8	8.4	8.6	11.0		
M-7371	5.4	5.7	5.6	7.4		
W-4130	6.1	5.4	5.2	6.3		
W-7018	2.6	8.5	-	-		
S-1495	5.1	8.2	5.5	10.6		
W-1009	4.6	5.7	6.6	6.6		
Mean change		1.41		1.59		
	B		C		D	
Group III	Before	After	Before	After	Before	After
H-4808	5.6	10.4	3.3	6.2	6.0	8.7
M-0305	7.1	8.8	5.5	6.8	7.0	7.3
S-4171	7.5	8.0	8.1	8.0	9.6	5.7
W-1083	7.1	10.3	11.0	7.9	9.0	6.4
Mean change		2.55		0.25		-0.88
Group IV						
F-8476	6.3	7.5	8.9	10.0		
R-0371	6.3	8.0	5.5	7.6		
S-4749	5.3	7.6	4.6	7.9		
T-1483	6.9	7.7	7.9	10.0		
W-7805	12.0	6.8	6.6	9.6		
Mean change		0.36		2.32		
Psychiatric Casualties						
P-4360	5.2	6.2	4.7	5.3		
W-4352	3.2	4.2	7.0	9.0		
S-7571	3.7	8.1	-	-		
G-0442	7.2	9.4	-	-		

a/ Values expressed as mg urea N/mg creatinine.

The results of this study indicate that changes in nitrogen metabolism occur in combat-induced stress, which was to be expected from previous studies in experimental stress. Changes in blood urea nitrogen are clear-cut, while urinary changes are only suggestive. Figure 15 shows the blood and urinary levels of urea in the five individuals studied from the pre-stress through the recovery period.

The variation in response to combat stress from individual to individual was quite marked, some showing no indication of changes in nitrogen metabolism, whereas others exhibited a large change. On the whole however, the data are in accord with the hypothesis that a negative nitrogen balance exists during stress and is followed by a return to normal balance during recovery. In other words, a high level of blood and urine urea would be expected during and immediately after the stress. This was observed despite the fact that combat is usually accompanied by a low nitrogen intake. There was also indication of a temporary nitrogen retention during recovery. Carefully controlled conditions would be necessary to afford more definite support of this hypothesis.

The use of ACTH as an adrenal function test cannot be evaluated by the urinary nitrogen excretion in uncontrolled conditions such as in these studies.

Blood and Urine Sugar

It has been previously observed that under some conditions of stress, the urinary sugar output increases. Likewise the sugar output is sometimes increased when ACTH is administered over a several day period, especially when the sodium intake is low. It may be postulated that the effect of ACTH on urinary sugar results from either a hyperglycemia above the renal threshold value and then sugar is spilled over into the urine, or alterations in kidney function leading to decreased reabsorption. The latter possibility is the generally accepted one[24/].

This study is basically concerned with the variations within the normal urinary sugar output range caused by stress of battle.

The method used was that of Green and Wade[25/] which is specific for carbohydrates, in contrast to the methods which measure reducing substances. Minor modifications of this method were made for both blood and urinary sugar.

In the blood sugar determinations the blood-trichloracetic acid mixture was centrifuged instead of being filtered. Because the optical density of both the standard and the samples was found to reach a

24/ Earle, D. P. et al, "Observations on the Relation of Renal Function Changes to the Electrolyte and Glycosuric Effects of ACTH," PROC. 2nd. Clinical ACTH Conf., Vol. I, Blakiston, New York, 1951, pp. 139-147.

25/ Green and Wade, Determination of true blood sugar using anthrone. Can. Med. Assn. J., 66: 175, 1952.

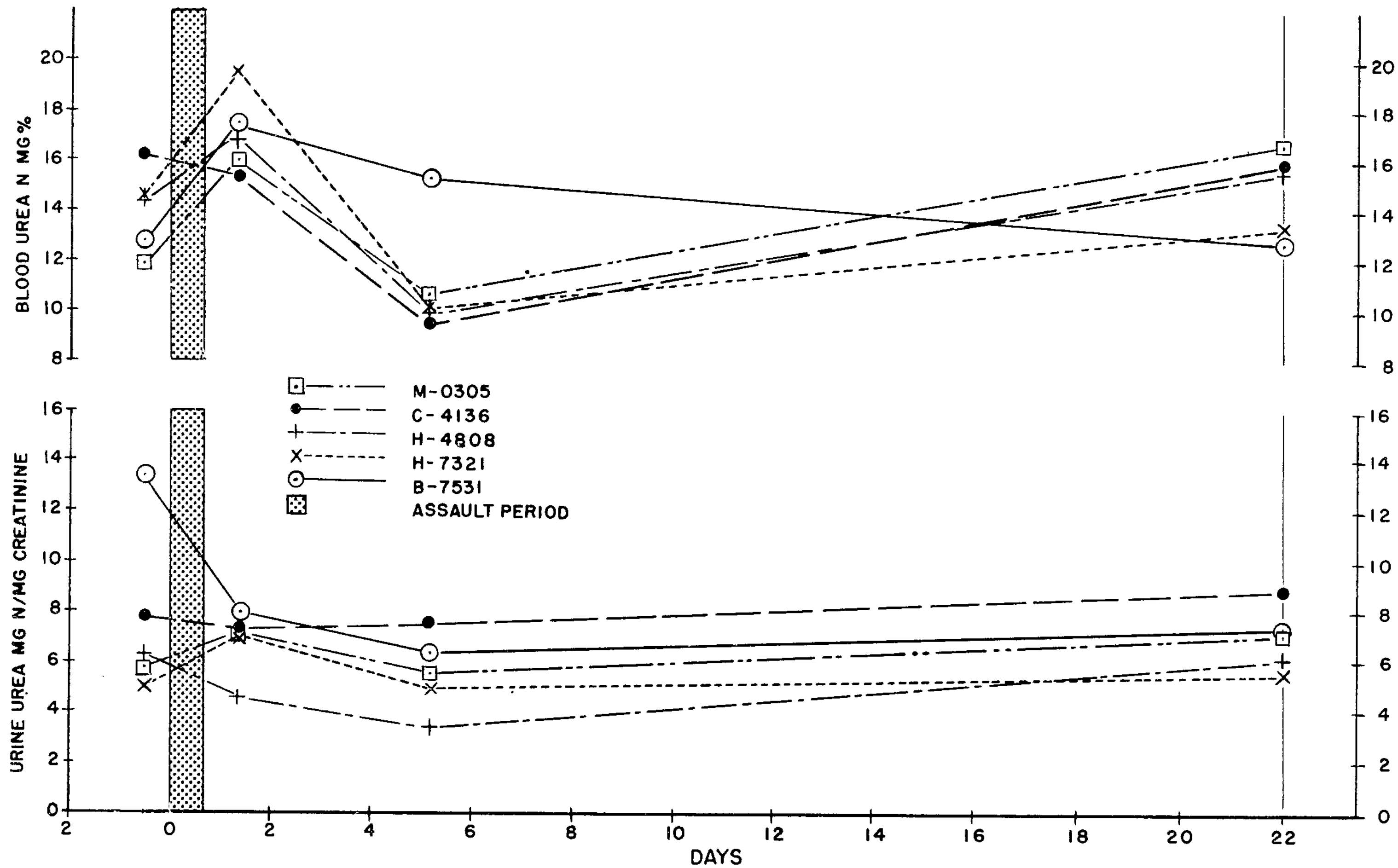


Fig. 15 - Blood Urea Levels and Urinary Urea Excretion of
5 Individuals Before and After an Assault

maximum after seven minutes in a boiling water bath, this was used as the heating time instead of ten minutes as specified.

In the determination of urinary sugar the only modification was that 1.0 ml of diluted (usually 1:25) urine was used instead of the trichloracetic acid mixture. Standards were made up for each set of samples and no calibration curve was used.

Blood sugar was also determined on some of the subjects and the values obtained were within the normal blood sugar range. No significant correlation was found between the urinary and blood sugar levels in either the normal subjects (Groups V and VI) or the samples taken from the soldiers (Group IV) immediately following the moderate long term combat stress.

Urine samples were collected over varying periods of time, usually two to four hours. Sugar determinations were made within 24 hours and if there was more than a 12 hour delay in analysis the samples were held under refrigeration.

Control urine samples were obtained from 23 soldiers in Japan (Groups I and II) and 24 combat infantrymen in Korea who had not been subjected to stress for a considerable period of time (Groups V and VI). The distribution of individual urinary output values for these two groups combined is shown in Fig. 16. The predominant range of output is between 20-60 mg/hr, with a mean of 35.0 mg/hr (0.84 g/day).

The urinary sugar output of stressed men was determined on combat infantrymen (Group III): after they knew they were to engage in a major assault within 13 hours (A), 17 hours after they had withdrawn from this intense stress which had lasted about 16 hours (B), five days after the severe combat stress (C), and 22 days after the assault (D). Distribution of sugar output for these subjects under these conditions is shown in Fig. 17. The range of values of Group III prior to this acute stress (A) is considerably wider than the control samples shown in Fig. 16 even though Group III is made up of fewer subjects. Shortly after this acute stress (B) the range is still the same, whereas five days later (C) there are no extremely high values and 22 days post-stress (D) the distribution curve is similar to the normal distribution curve.

The difference between the means of the acutely stressed subjects (B) and these subjects retested five days later (C) showed a significant drop in urinary glucose output during this period. Mean values for these four tests are 68.3, 63.2, 32.8, and 47.3 mg/hr respectively. The value for t was significant between the 5 percent and 1 percent level of confidence.

Another group of combat infantrymen (Group IV) was tested for urinary sugar output after several days of moderately severe stress and then again ten days after withdrawal from this stress situation to one much less severe on the MLR (Fig. 18). This group does not show a statistically significant difference in the means of their urinary sugar output immediately following stress (55.8 mg/hr) and ten days later

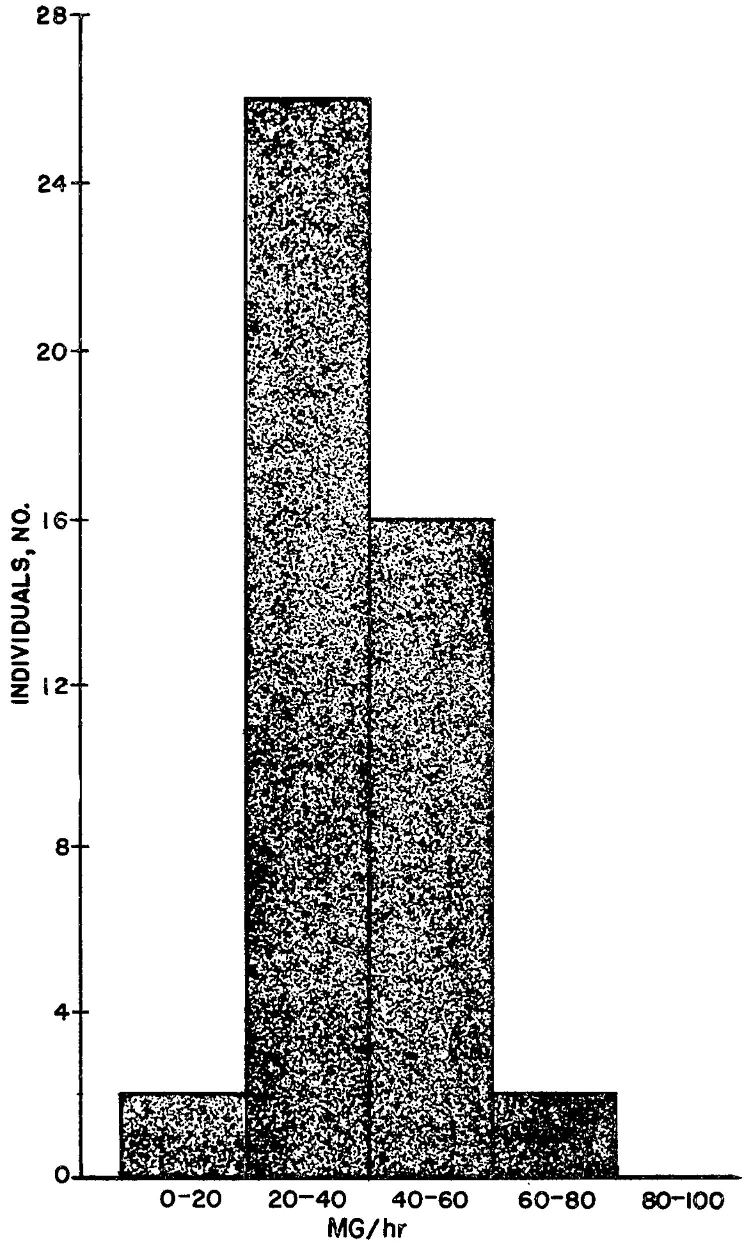


Fig. 16 - Distribution of Sugar Output in Urine of Normal Individuals

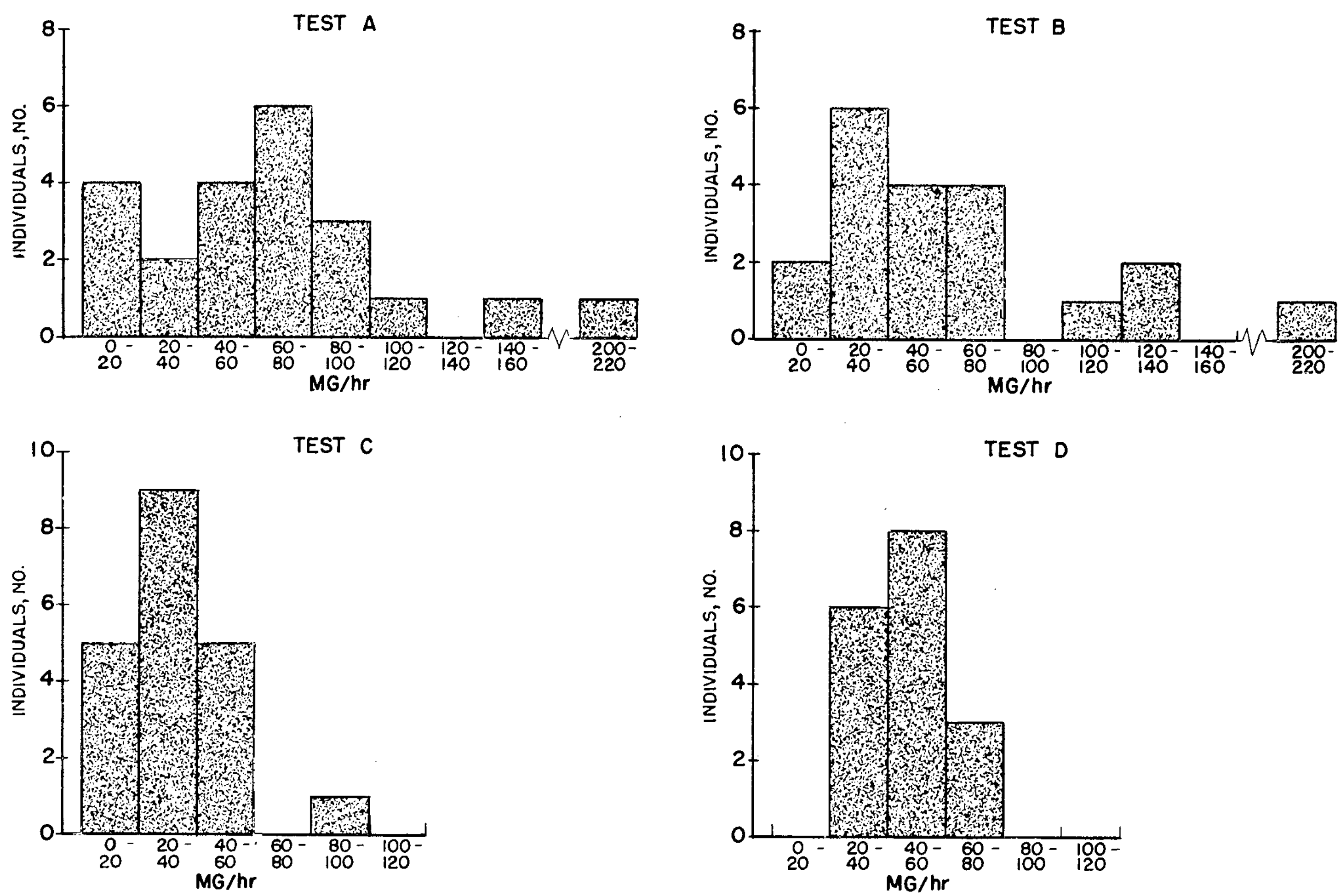


Fig. 17 - Distribution of Urinary Sugar Output in Acutely Stressed Individuals, Group III a/

a/ B, C, and D represtent same individuals, 5 of the individuals in A are included in B, C, and D.

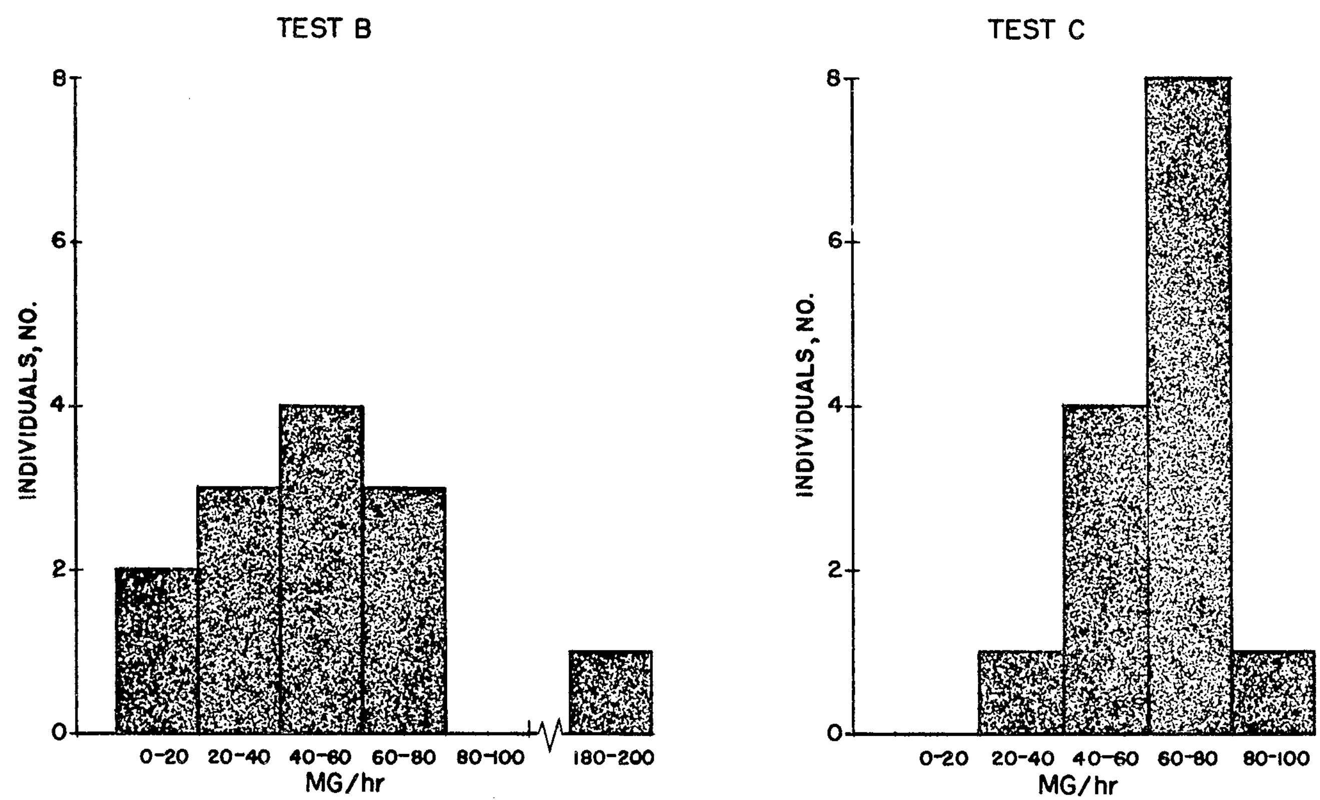


Fig. 18 - Distribution of Sugar Output in Urine of Moderately Stressed Individuals, Group IV[a]

[a] Same individuals used for Tests B and C.

TABLE 41

URINARY SUGAR OUTPUT IN NORMAL INDIVIDUALS BEFORE AND AFTER ACTH ADMINISTRATION[a]

Individual	Group	A		A'		A''	
		Before	After	Before	After	Before	After
M-7856	I	-	-	30.6	20.4	40.5	52.7
R-5249	I	-	-	44.0	21.2	26.1	20.9
W-9926	I	-	-	20.6	194.0	27.1	101.3
J-1789	II	33.0	27.8	35.0	23.0	-	-
M-2878	II	55.2	44.6	54.2	198.0	-	-
M-7056	II	21.0	54.0	34.9	16.5	-	-
P-9139	II	27.9	41.7	10.6	23.6	-	-
H-9326	V	34.8	31.5	-	-	-	-
H-8421	V	28.6	46.0	41.7	42.8	-	-
H-3136	V	24.4	19.5	44.3	27.8	-	-
M-7371	V	21.8	16.9	40.5	60.9	-	-
W-4130	V	52.4	35.6	40.5	72.2	-	-
W-7018	V	43.5	24.4	-	-	-	-
S-1495	VI	36.3	42.4	41.9	58.4	-	-
W-1009	VI	45.2	55.1	57.1	34.6	-	-

a/ Measures expressed in mg/hr.

TABLE 42

URINARY SUGAR OUTPUT IN ACUTELY STRESSED INDIVIDUALS BEFORE AND AFTER ACTH ADMINISTRATION[a/]

Individual	Group	B		C		D	
		Before	After	Before	After	Before	After
H-4808	III	77.0	3.1	86.0	29.6	47.6	110.0
M-0305	III	23.8	6.1	19.7	77.4	36.3	30.3
S-4171	III	46.0	22.9	30.4	37.2	45.2	53.4
W-1083	III	121.0	21.5	15.1	24.3	36.0	28.0

a/ Measures expressed in mg/hr.

TABLE 43

URINARY SUGAR OUTPUT IN MODERATELY STRESSED INDIVIDUALS BEFORE AND AFTER ACTH ADMINISTRATION[a/]

Individual	Group	B		C	
		Before	After	Before	After
F-8578	IV	19.0	27.0	66.6	63.4
R-0371	IV	32.2	50.2	61.2	58.6
S-4749	IV	27.6	44.4	36.7	109.3
T-1483	IV	46.2	88.6	53.4	23.4
W-7805	IV	7.1	54.0	67.8	72.5

a/ Measures expressed in mg/hr.

(62.1 mg/hr). The immediate post-stress range is greater, however, than the range of values obtained ten days after stress.

Urinary glucose determinations were also made on samples from subjects receiving ACTH (2.0 ml ACTH-gel Armour preparation). In normal subjects (Table 41) the urinary sugar decreased in nine subjects and increased in six subjects the first time they were given ACTH. After several days they were given another injection and at this time five decreased while eight increased from their original values. The glycosuria level was arbitrarily set at 150 mg of sugar output per hour (ca. 4 grams per day). In the normal subjects only two showed glycosuria following ACTH injection--one following his first injection and one following his second injection.

The acute stress group (Table 42) received the ACTH shortly following the stress, and in all four subjects the urinary sugar level was lowered. After five days the glucose output increased in three of the four subjects following ACTH injection, after 17 days the glucose level in two subjects increased, and in two subjects it decreased after injection. In no case did the sugar output reach the glycosuria level.

A similar procedure was followed on the group which had undergone a prolonged moderate stress (Table 43). In this group the urinary sugar increased slightly in all subjects following ACTH administration immediately following their stress period. After nine days of mild stress three subjects had lower glucose output following ACTH while two subjects increased their glucose output. There was no evidence of glycosuria in these subjects following either ACTH injection.

In Table 44 the sugar output values for the psychiatric casualties are shown. After the first ACTH injection three had a lower urinary sugar output and one had a higher glucose output. Only two subjects were available for retest but both showed very high sugar output and were definitely excreting excessive quantities of sugar.

TABLE 44

URINARY SUGAR OUTPUT IN PSYCHIATRIC CASUALTIES BEFORE AND AFTER ACTH ADMINISTRATION a/

Individual	Group	B		C	
		Before	After	Before	After
W-4352	VII	32.4	125.6	6.7	335.0
P-4360	VII	28.5	14.7	6.8	1688.0
S-7571	VII	30.6	18.7	-	-
G-0442	VII	51.7	36.2	-	-

a/ Measures expressed in mg/hr.

Evidence has accumulated showing the relationship between the effect of ACTH and the electrolyte balance[26]. In the present investigations it was observed that in each case of glycosuria following ACTH injection the urinary sodium output was low (below 44.5 meq/liter). However, the converse did not occur since there were cases of low sodium output and only moderate sugar output. On the other hand, it must be remembered that only four cases of glycosuria was observed following ACTH injection, which does not represent a large group of samples for correlation with sodium output.

There was no apparent correlation between sodium and sugar excretion in subjects who did not receive ACTH.

It is realized that by the nature of this project there are many unavoidable uncontrolled variables of importance. Subjects were sampled at different times of the day and night, although an attempt was made to standardize the time of day on the retest with the time of collecting the initial sample. Diet was not controlled and some of the results on the ACTH subjects may have been influenced by variations in salt intake.

In spite of these variables this study has shown several interesting phenomena:

a. There was a wider range of urinary sugar in samples from stressed groups than in the normals or after the stressed soldiers had returned to approximately normal condition. This increase in range included decreases in sugar output in some individuals, but was largely due to an increase in sugar output.

b. Decreases in sugar output have not been previously reported following injection of ACTH. In the most severely stressed individuals (Tables 42 and 44) the sugar output was lower after the injection of ACTH than before it was given in seven out of eight subjects.

c. In all cases of glycosuria after ACTH injection the urinary sodium output was low but there was not necessarily a high sugar output accompanying each low sodium output.

<u>Urine Steroids</u>

Under the influence of ACTH from the pituitary, the cortex of the adrenal gland secretes into the blood a hormone-complex which is generally believed to consit largely of compound "F," an 11-oxysteroid substance. The cortical hormone affects a large number of the physiological processes of the body, and its action is most obviously manifested as changes in electrolyte, carbohydrate and nitrogen metabolism and the white blood cell level. Some of these changes, observed as a result of combat stress, have already been described in the preceding sections.

26/ Ransohoff, W. et al, The effect of sodium and potassium in the metabolic and physiological responses to ACTH, <u>Proc. of the 2nd. Clinical ACTH Conference</u>, I, 160-171, Blakiston Co. New York, 1951.

The cortical hormone is also excreted by way of the urine, in part as unchanged compound "F." An attempt was made in this study to estimate this fraction of the urine by means of a procedure suggested by Dr. Peter Forsham of the Metabolic Institute of the University of California Hospital, San Francisco. The method is essentially a butanol extraction procedure which is not completely specific for compound "F," and hence is also referred to as a neutral lipid determination.

Briefly, the procedure for obtaining this extract consisted of shaking five ml of acidified urine with five ml of normal butanol. Separation was accomplished by centrifugation for three minutes, and pipeting off the butanol layer. The aqueous residue was extracted again with another three ml of butanol, and the combined extracts were evaporated to dryness under vacuum at 45° to 60° C. These dried extracts have been sent to the Metabolic Institute for final spectrophotometric analysis, and the results will be reported later.

Another portion of the cortical hormone is apparently changed as it goes through the tissues of the body, and a number of characteristic metabolic derivatives, known as 17-ketosteroids, appear in the urine. The level of these may be determined chemically and serves as a valuavle index of adrenal cortical activity. Preliminary extraction of 17-ketosteroids from the urine samples obtained in this study has been carried out, and the dried extracts have been sent to the Worcester Foundation for Experimental Biology in Massachusetts for detailed analysis.

The procedure consisted in adding to the urine 15 percent of its volume of concentrated HCl and boiling the mixture vigorously for seven minutes. The hydrolyzed urine was extracted with ethyl ether, and the ether extract was washed successively with sodium carbonate, sodium hydroxide, and water. The washed extract was evaporated to dryness and transferred to test tubes with ethyl alcohol. The alcohol was evaporated off and the dried residue was sent to Worcester.

At the Worcester Foundation this extract will be separated into ketonic and non-ketonic fractions with the Girard Reagent. The ketonic fraction will be measured by two color reactions: The dinitrophenol or Zimmerman reaction, and the antimony trichloride or Pincus reaction. Selected ketonic fractions will be chromatographed. The chromatographs will give concentration patterns of the 17-ketosteroids in the original urine. All of these results will also be reported later.

ACTH Test

The purpose of this test was to compare the adrenal cortical reserve of soldiers immediately after combat stress with that in the same subjects after a stress-free period considered adequate for physiological recovery. The test consisted in subjecting the adrenal to be prolonged stimulus with ACTH. Urine samples collected immediately before and after ACTH were analyzed for 17-ketosteroids, neutral lipids (Compound "F"), and for electrolytes, nitrogenous products, and glucose. The extent of the changes in these various components after ACTH then served as a measure for the adrenal cortical response. Thus large changes should indicate a large adrenal reserve and small changes a low adrenal reserve. By the same token, if stress depletes the adrenal, the ACTH test should result in less corticoid excretion and less secondary effect on electrolytes, nitrogen and carbohydrate metabolism than in the same subject after recovery.

In order to produce a long lasting stimulus to the adrenal each subject was given a standard dose of 2.0 ml ACTH in gel (Armour) administered intramuscularly into the gluteus maximus. The subject voided just before the injection and this time was recorded. He was told to collect all of his urine from then on in a liter bottle containing 5 ml of 3 percent thymol in glacial acetic acid. As a rule the period of collection extended from 1600 on the afternoon of the day the ACTH was given until 0630 the following morning. The subject himself recorded on the bottle the last time of voiding. The total period of collection was calculated from the difference between the initial and the final times of voiding.

The total number of subjects receiving ACTH was 30. Of this group, 16 were in the control category (Groups I, II, V, and VI) and 14 were in the combat stress category(Groups III & IV). Table 45 indicates the number of ACTH test and follow-ups in each group.

TABLE 45
DISTRIBUTION OF SUBJECTS USED
FOR THE ACTH SPECIAL TEST

Group	Test					
	A	A'	A''	B	C	D
I	4	4	4			
II	4	4				
III				4	4	4
IV				5	5	
V	6	4				
VI	2	1				
VII				5	2	
Total	16	13	4	14	11	4

Studies in Groups I and II served to establish the extent, if any, of residual ACTH effects after four days. As noted in the introduction, the subjects for each special test were kept separate. Thus none of the ACTH subjects was used in the other special tests.

The urine samples collected following ACTH were measured for volume and specific gravity. An aliquot of 30 ml was removed for sodium, potassium, chloride, glucose, ammonia, urea, creatinine, and uric acid determinations using the methods described above. The remaining portion of each sample was then carried through the preliminary stages of the extraction procedures for 17-ketosteroids and for Compound "F" (neutral lipids). These latter data will not be available until the final report is made.

REACTIVITY OF THE AUTONOMIC NERVOUS SYSTEM

The autonomic nervous system is integrated in its functions with the skeletal motor system on the one hand, and with the endocrine system on the other. In this capacity the sympatho-adrenal division of the autonomic nervous system served to mediate those physiological changes which rapidly adapt the organism for "fight-on-flight." One effect of fatigue and stress, therefore, might conceivably be an alteration either in tonic activity or in excitability of the autonomic centers.

In the case of the cardiac and vasomotor centers, the systolic blood pressure and heart rate serve as convenient indices of tonus. Reactivity of these same centers can be tested using the depressor effect of Mecholyl[27] as a stimulus leading to reflex vasoconstriction, adrenal medullary stimulation, and cardio-acceleration. This method of studying autonomic excitability was adopted because of the relative ease with which it can be applied in the field.

The Mecholyl test used in these studies is essentially that described by Funkenstein, Greenblatt, and Solomon[28] but was modified to meet our needs. Systolic blood pressure by the auscultatory method, and heart rate by radial artery palpation were measured in the resting recumbent subject at 30 second intervals for a preliminary period of approximately five minutes, at which time an intradeltoid injection of 0.8 ml of saline was given. Blood pressure and pulse rate measurements were then continued until the values had stabilized, usually within a period of ten minutes after saline administration. Ten mg of Mecholyl Chloride in 0.8 ml normal saline were injected by tuberculin syringe through a one and a half inch 22 gauge needle into the deltoid muscle. Blood pressure readings were made at short intervals (every 15 to 20 seconds) for two minutes, at 30 second intervals for the next 13 minutes, and at one minute intervals for the last ten minutes. Thus, systolic pressures were measured for 10 to 15 minutes before Mecholyl, and for 25 minutes after the drug was given. Pulse rates were taken at frequent intervals during the depressor and recovery phases. When possible, the subjects were fasting; however, true basal conditions were not achieved under the conditions of these tests.

The usual pattern of the blood pressure and pulse rate response to intramuscular Mecholyl shows the following phases: a control period before injection; a depressor phase; a phase of recovery to the initial pressure level; a hypertensive phase (or period of over-compensation); and final recovery. Figure 19 shows these phases in a test of a typical control subject. The individual pattern of response is reproducible to satisfactory degree on retesting the same subject. Funkenstein and co-workers classify individuals into six categories, depending on the pattern of the blood pressure response to Mecholyl. In this limited

27/ Acetyl-beta methyl choline; Merck.

28/ Funkenstein, D. H., Greenblatt, M., and Solomon, H. C. Autonomic changes paralleling psychologic changes in mentally ill patients. J. Nervous and Mental Diseases, 114: 1-18, 1951.

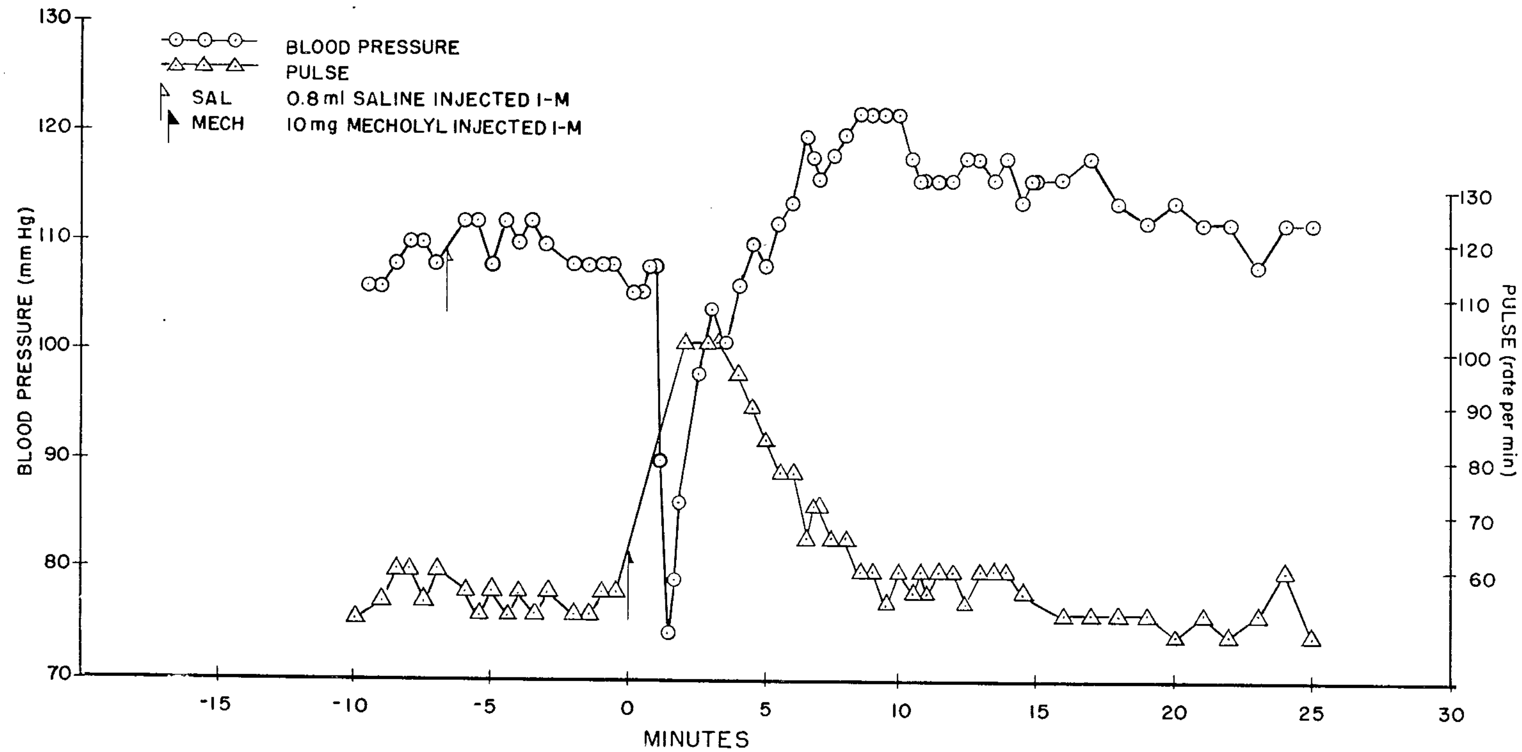


Fig. 19 - Mecholyl Test - A Typical Blood Pressure and Pulse Record (Individual H-4368, 30 Oct 52)

series such a classification would not be possible. Some of the responses described as typical by Funkenstein et al., have not been observed in the groups tested here.

The pulse rate pattern is essentially a mirror image of the blood pressure response. It is likely, therefore, that the chief factor in altering the heart rate is the blood pressure itself. Hence, heart rate is less useful as an index to the Mecholyl response than is the blood pressure.

The side effects of Mecholyl are those of generalized parasympathetic stimulation and include flushing, salivation, broncho-constriction and broncho-secretion (sometimes leading to coughing), profuse sweating, and myosis. Intermittent shivering beginning about four minutes after Mecholyl is not infrequent, especially in subjects of the fatigue groups, and is probably of reflex origin resulting from a combination of two factors: evaporation of sweat and cutaneous vasconstriction, both of which lead to a fall in skin temperature. No residual effects of the Mecholyl response were apparent after 25 minutes.

A total of 25 subjects was tested. Of these, eight were from Groups I and II in Japan. Six of these subjects were retested at least once. Eight additional subjects from Groups V and VI were tested and retested after several days without having been subjected to combat stress. These subjects constitute the Korean control group.

The nine remaining subjects were in the combat stress category. Four were from Group III and may thus be designated as the acute combat stress group. Another four were from Group IV, representing a group subjected to less intense but more prolonged combat stress. Each of these eight subjects was retested at least once following an interval of four to ten days. In addition, three of the individuals from Group III were retested a second time. The ninth individual, K-2270 of Group VII was tested 15 hours after having participated in his first ambush patrol, and then again eight days later.

In order to make a preliminary comparison of the results of the Mecholyl test, the blood pressure data from the four subjects in each of the combat stress groups (III and IV) and from four subjects in Control Groups V and VI were expressed as the mean for each group. The average blood pressures were calculated from the individual graphic records for each 30 seconds beginning ten minutes before the Mecholyl, each 15 seconds for two minutes after Mecholyl, at 30 second intervals for the next 13 minutes, and at one minute intervals for the final ten minutes.

Figure 20 presents composite graphs for the four men of the control group tested and retested without being subjected to combat. Similar composite graphs were constructed for each combat stress group (III and IV), and are presented in Figs. 20 and 22. The latter compare the findings shortly after combat with those after several days of recovery.

It is evident that this treatment in no sense constitutes a critical analysis of the data. However, at the risk of obscuring individual

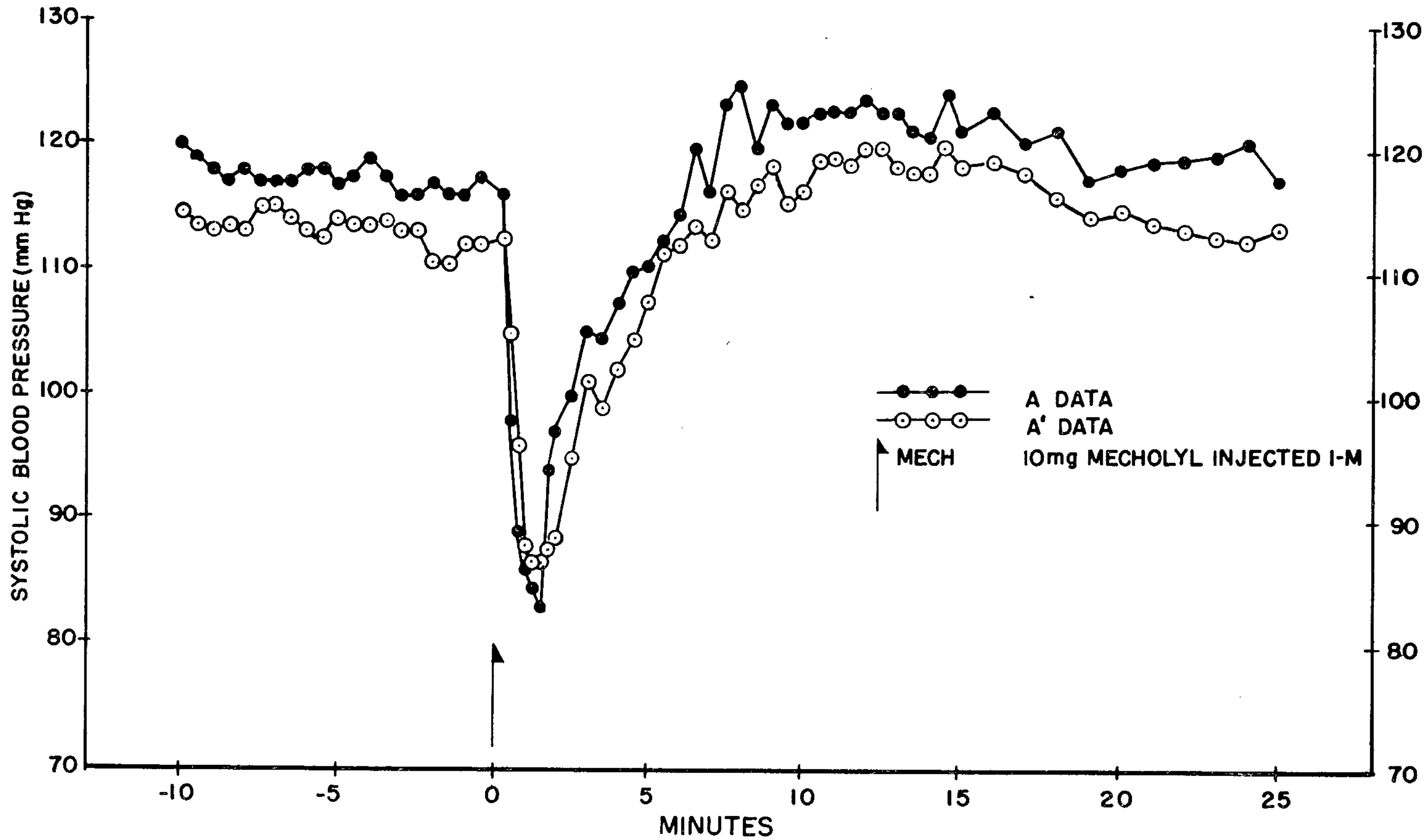


Fig. 20 - Mecholyl Test - Composite Record of Individuals A-5075, B-9350, C-5107, S-6942 (Control Groups V and VI)

differences, it was hoped that general trends would become more evident. The following evaluation is based largely on the composite graphs.

In considering the control group (Fig. 20) the following differences between the two tests are observed. The initial systolic pressure level is two to four mm Hg lower in the second test than in the first. This may mean that the subjects were less apprehensive the second time. The fall in blood pressure is somewhat greater in the first test; however, this is not considered important since the depressor effect of Mecholyl is transitory and the lowest point can easily be missed. The rate of recovery and extent of overshoot are closely similar in the two tests. From these data it can be assurred that the Mecholyl test is reproducible in the same group of subjects, as well as in the individual subject.

The composite graph of Group III subjects, constructed from data obtained approximately 17 hours following severe combat stress, is shown in Fig. 21. In form it differs from the curve constructed from data obtained four days later, chiefly in the relatively high initial pressure level (125 mm Hg as compared with 116 mm Hg). It is believed that this is a significantly greater degree of hypertension than was seen in the first test on the control group. Except for this initially higher pressure level, however, the two curves, including time for return to normal, extent and duration of overshoot, and final level, are closely comparable.

In comparing the two curves obtained from the four subjects in Group IV (Fig. 22), the "stress" curve differs from the "recovery" curve in three principal ways. First, the control pressure level in the former curve fails to reach a plateau but falls slowly at an almost constant rate amounting to five mm Hg per ten minutes. Second, the degree of fall and rate of recovery are similar to those in the curve obtained after recovery, but the extent and duration of the overshoot are less. Comparing the areas under those portions of the curves in which the systolic pressure exceeds the initial pressure level, one observes that the area of the curve after recovery is over four times that of the stress curve. No such difference is seen in the other comparable groups of data. Thirdly, the final pressure level is below the initial pressure to an extent not seen in either of the other groups.

The data obtained in this portion of the study are too meager to permit rigid statistical analysis. However, by comparing each group of four subjects with itself it was hoped that changes appearing as a result of fatigue might become apparent. As indicated above, certain differences have been noted in each stress group when that group was compared with itself after recovery. These differences exceed those seen in a comparable group of controls. In the group subjected to acute stress (Group III) the only apparent finding was a mild degree of hypertension existing in the resting subject prior to the actual test. Emotional excitement and muscular effort are both well-known factors in producing transitory hypertension. In our study the hypertension was found to exist in individuals as long as 15 to 20 hours after leaving the scene of combat. Autonomic excitability, on the

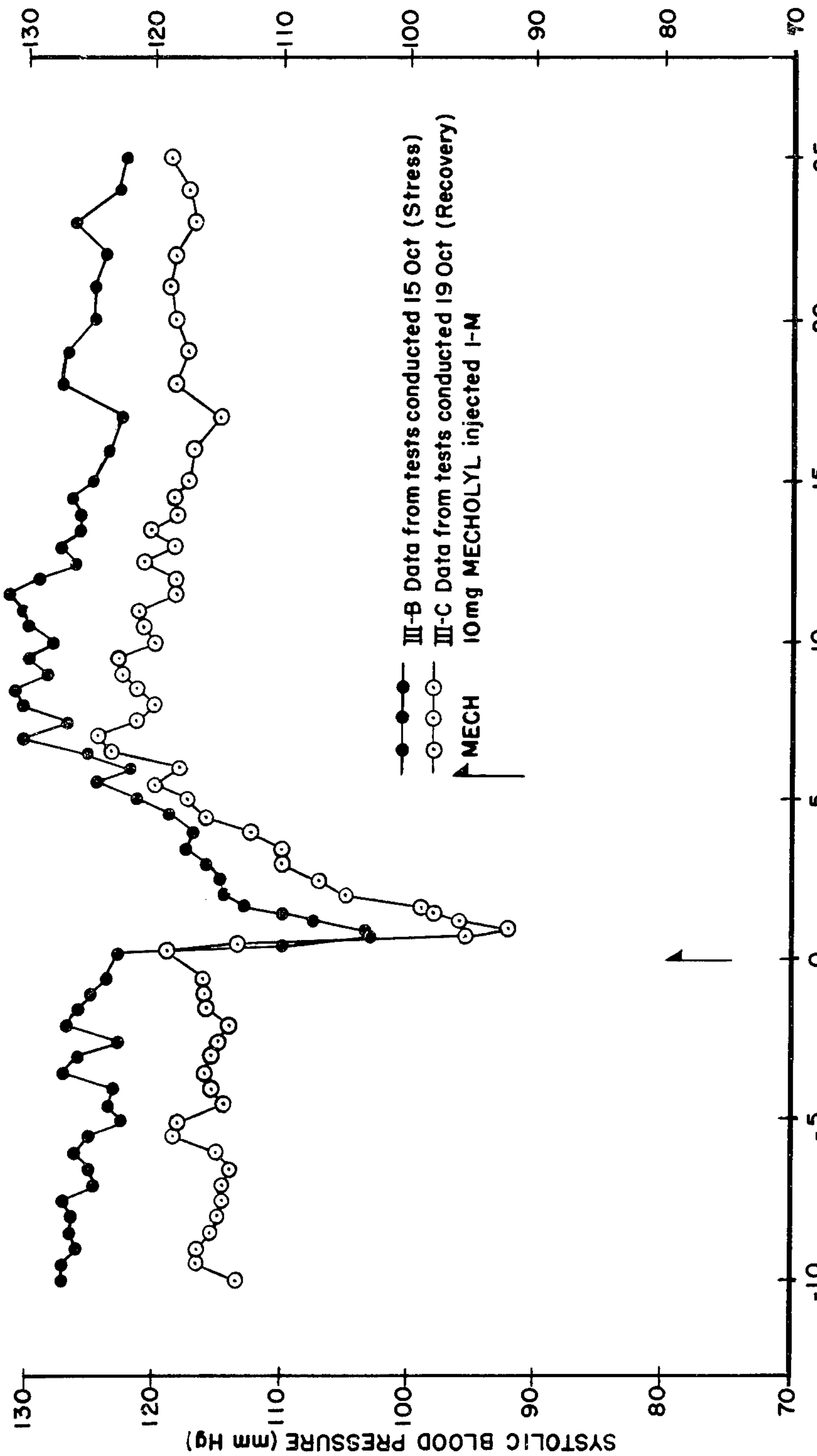


Fig. 21 - Mecholyl Test - Composite Record of Individuals C-4136, H-1864, L-6206, S-4917 (Group IV)

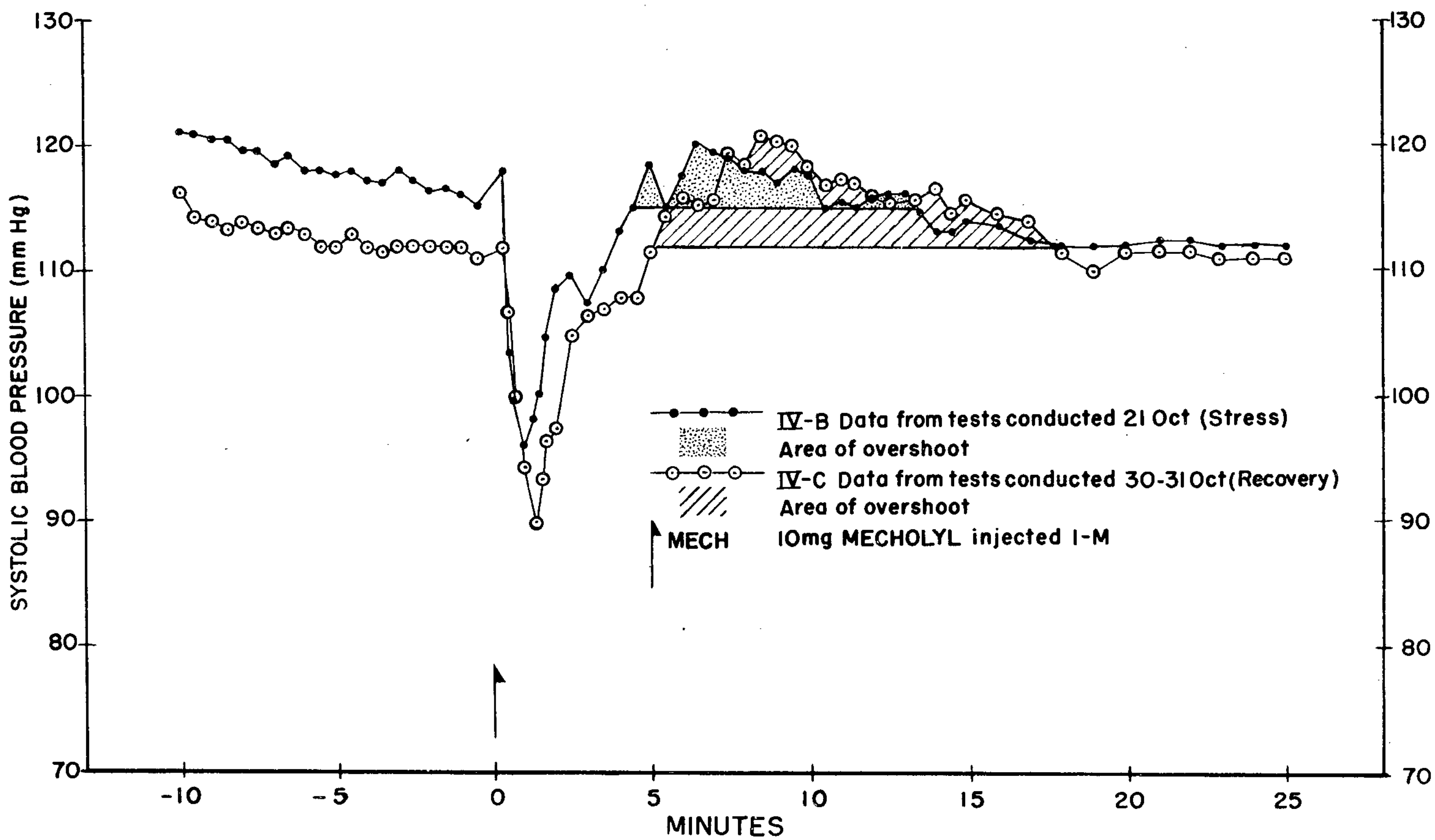


Fig. 22 - Mecholyl Test - Composite Record of Individuals
B-5392, H-4368, J-4476, L-0624 (Group IV)

other hand, as demonstrated by the response to Mecholyl was not appreciably different than in the same group after a four day period of recovery.

In Group IV subjects the data would suggest a lower excitability of those autonomic centers concerned in compensating for a fall in blood pressure. Tonus of the vasomotor center also appeared disturbed in that a uniform blood pressure level was not maintained in the resting recumbent subject.

It should be pointed out, however, that the groups studied here were small, and that the test conditions were not uniform. The tests were carried out in a squad tent in which the air temperature and air movement varied greatly. Extraneous noises from low-flying aircraft, heavy motor traffic nearby, and occasional artillery practice in the vicinity introduced disturbing and uncontrollable factors. On the other hand, the control group, which showed no apparent differences on test and retest, was subject to these same adverse influences.

It is believed that the data are of sufficient interest and promise to warrant further pursuit along these lines. It is recommended that future tests should be run sooner after the termination of the fatigue situation. This may require testing the man at a site closer to the front lines, e. g. at a battalion aid station or perhaps in a bunker on the MLR.

In acute stress, simple measurement of the blood pressure level in the resting subject may be more important as an index of autonomic tonus than the more elaborate test with Mecholyl. Blood pressure measurements alone could be applied to larger groups of subjects than is possible with the Mecholyl test.

In chronic stress the major need is for more subjects. To supplement the Mecholyl test other related techniques such as the tilt-table test of autonomic stability should be considered. To gain a more complete picture of the status of the autonomic centers as a whole, tests of other autonomic functions such as salivary and gastric secretion should be included.

It is further recommended that the extent to which parallel changes occur in men under training in the US, and also in fatigue states produced under laboratory conditions should be determined. In the laboratory, methods for the continuous recording of blood pressure and heart rate, as well as related vasomotor indices, would facilitate conducting the Mecholyl test and would improve its accuracy.

NUTRITIONAL ASPECTS OF COMBAT STRESS

Probably never before in all military history has the combat soldier been confronted with the great variety of relatively well prepared food as he is at the present time on the front lines in Korea. This is the result of several important factors:

a. The realization by those in command that the nutritional status of the combat soldier is of greatest importance in maintaining highest combat effectiveness;

b. The relative stability of the MLR which allows the supply and preparation of food, often within 1000 yards of the front lines; and

c. Tremendous technological and scientific advances made in the preservation and preparation of rations.

In spite of this there are still improvements to be made in present troop feeding. The medical officers who were interviewed reported no cases of malnutrition among our soldiers, and this might be interpreted as a compliment to our troop feeding program. On the other hand, stress can result either from sub-clinical deficiencies of essential nutrients or from an imbalance of their intake, absorption, or utilization. Similiarly, compounds which can be formed in the processing of foods may lead to physiological and pyschological stresses and decreased appetite.

It is only reasonable to expect the food available for the combat soldier to be as free as possible from these nutritional stress factors, rather than to accept them as an added stress to the emotional and physiological stress of battle. Before this can be accomplished, however, it is necessary to evaluate accurately the changes that occur in food during processing, storage, cooking, and the period of holding for several hours at high temperatures prior to serving. It is not impossible that essential nutrient imbalance could occur since these differ greatly in lability, varying from the relative instability of vitamins to the stable minerals. Likewise, other detrimental changes which might easily occur, such as alteration of amino acids and/or their linkages from excessive heating, need further study to determine their relationship to time, temperature, and pH.

It was observed that the men who were actually doing the fighting complained less about the quality and variety of rations being served than the soldiers in rear areas. This was in spite of: (a) the same ration being served on the front lines as in the rear areas twice a day, but with the noon meal being the "C" ration as compared with three hot meals a day in the rear areas; (b) food at the front being usually not as warm as that served in the rear areas; and (c) the food being eaten under more unpleasant conditions at the front-usually out-of-doors with the men sitting on rocks or on the ground experiencing some anxiety about harrassing mortar fire which the enemy occasionally throws into the messing area about meal time.

Under severe combat conditions the men observed in this study lost their appetites almost completely. Although the physiological and psychological basis for appetite is not clearly understood, the gastrointestinal tract, which is under the control of the autonomic nervous system, is subject to a host of functional disturbances and is probably as good a mirror of stress as any body system. Even though the men who made the shock attack on an enemy stronghold carried Assault rations with them, only a few ate any part of them during the 16 hours of the assault. The reasons given were that they were too busy to eat, they were not hungry, or their stomachs were "weak." A few complained of nausea.

Even under less severe stress situations the combat soldier rarely maintains body weight while he is subject to enemy fire and some men experience considerable weight loss, indicating that they are either on a diet deficient in calories and/or their metabolic efficiency is lowered. Some men in dug-in positions on a hill top did not have enough interest in hot food to walk down the hill 300 yards to the messing area, but rather stayed in their bunkers and nibbled on "C" rations.

Each individual is able to withstand only a certain amount of stress and if the soldier is not well nourished during severe combat his physical well-being decreases with a corresponding decrease in his ability to withstand the emotional stress of battle.

The main problem in maintaining nutritional well-being of our combat soldier appears to lie in the lack of knowledge of the factors which affect the appetite of severely stressed individuals and the possible changes this stress brings about in the digestion and utilization of ingested food. It becomes necessary, therefore, to develop a more complete understanding of the factors which affect appetite, digestion, and utilization of food in severe stress situations.

We also need to know more about the ration as it is ingested with respect to the stress it may add to the soldier by virtue of deteriorative changes as a result of processing, storage, preparation, and serving.

Basic information on these two problems is of paramount importance if further advances are to be made in attaining and maintaining the greatest possible resistance to stress of our combat troops.

PSYCHOLOGICAL AND PSYCHIATRIC FINDINGS

OBJECTIVE PSYCHOLOGICAL TESTS

The use of objective psychological tests was an attempt to quantify the effect of stress upon the overt behavior of the combat soldier. Whether his reactions are slowed; his perception is dulled; his ability to see and recognize details is impaired; his capacity to orient what he sees with what he knows is in some way reduced; whether his ability to make quick and accurate decisions is diminished or disappears; these questions are of major import to a complete definition of the effects of combat stress.

In the preliminary ORO symposium, the "background experience" of psychology was asked to provide or suggest techniques for the measurement of psychological changes accompanying the stress and fatigue of combat exposure. Certain areas of psychological function were selected as most susceptible of measurement.

Tests of Higher Mental Function

The tests used to evaluate the changes within this area are listed below. (Samples of these tests may be found in Appendix B.)

Identical Forms (IF47- Thurstone). The testee is required to choose from five numbered figures the one which is exactly the same as the first figure in the line.

Digit Symbol (Wechsler-Bellevue). A key is provided by which the subject associates unfamiliar symbols with familiar digits. In the test proper the digits are given and the subject is required to reproduce the appropriate symbol from the key.

Cattell Culture-Free (Extract). The instructions ask the testee to observe a series of three figures. He is then asked to select from six additional figures, one which will complete the series of three to make a logical sequence of four figures.

Shipley-Hartford Institute of Living Scale (Extract). This test presents sequences of letters or digits. The task is to add the letters or numbers which most logically complete the sequence.

Gottschaldt Figures (GF47). Here the subject is presented with a geometrical figure. He is then required to identify which of the more complicated figures which follow contain the same figure.

Similarities (Wechsler-Bellevue). The testee is asked to relate in what way each of a series of paired items is alike. For example, he is asked "In what way are a banana and an orange alike?" His response is scored on the basis of superficial or essential likeness.

Memory Span for Digits (Wechsler-Bellevue). A series of digits is read slowly to the testee. He is then asked to repeat the digits in the order presented. Upon correct repetition he is presented with another series to which an additional digit has been added. This is continued until he fails two successive series. His score is the number of digits he can repeat without error. The second part of the test requires the subject to repeat other digit series backward. Total score (forward and backward) is recorded.

Stroop Ratio. The subject is shown a 6"x12" card on which are several lines of large words printed in different colors on a black background. The words themselves are names of colors; however, no word is printed in the color it names. After reading the words aloud as rapidly as possible, the subject is required to go through the card again naming the colors in which the words are printed. His score is a ratio of the time taken to recite the colors to the time taken to read the words. Errors are also recorded.

Time Estimation (Adapted from Halstead). The subject watches ten seconds go by on a stopwatch, then is asked to estimate ten seconds without reference to the watch. Three trials are made to obtain a better estimate of his accuracy in estimating the passage of time.

Card Sort. The subject is presented with a set of eight cartoons, each representing some common military duty, none of which is considered to be particularly pleasant. Examples are: watching training films, listening to lectures on infantry weapons, performing sentry duty, and going on combat patrol. The subject is instructed to set the cards on the table in the order in which he would prefer to perform the duties. With a subject who has difficulty in understanding, the instructions are reworded, explained, and acted out, with due care not to influence the subject's choice. After the subject has made the arrangement according to his own choice and the order has been recorded, the cartoons are shuffled and the subject is asked to arrange them again, but this time according to how he thinks the men in his squad (or headquarters section, etc.) as a group would arrange them.

The soldier-subjects were assembled for the tests after the initial voiding of urine, and usually after the initial blood sample was taken. The subjects were seated at tables and given some background information on the nature of the project, along with general instructions that these tests were to be considered neither as tests of "intelligence," nor as evaluative or competitive with their companions; "We simply wish to measure how well you can perform now as against how well you can perform at other times."

The group tests were administered in the following sequence: Identical Forms, two minutes; Digit Symbol, one and one-half minutes; Cattell Culture Free, Shipley-Hartford, and Gottschaldt Figures, all two minutes each. Instructions for each test were read aloud and supplemented liberally; an attempt was made to see that each subject did the sample items of each test correctly, although there is no doubt that the subjects generally were reluctant to respond when asked if there were any questions.

These group tests took approximately a half hour to administer, after which all but the first two subjects were released to other procedures.

One psychologist administered the Similarities, Digit Span, and Card Sort to the first subject, while the other psychologist was administering the Stroop Ratio and Time Estimation tests to the second subject. Then the first two subjects exchanged places to complete the individual tests. In this manner two subjects were given the individual psychological tests every 15-20 minutes. The combined score sheets, used for the individual tests, also provided space for pertinent information, such as amount of sleep the previous night, expected patrol activity, or more specific individual notes.

In selecting tests of such a nebulous term as "higher mental function," it was somewhat inevitable that the area under investigation by the psycho-surgeons should be tried. If the frontal lobes of man are indeed the "latest" development of the brain and nervous system, and if the retentivity and similar associative functions of anxiety and cumulative 'mental' tension are involved in this area, they could logically be the functions most sensitive to, and first to be reduced by, fatigue. In addition to retention, another function which appears to be uniquely man's is the ability to abstract, especially to higher levels. Perhaps this one ability is closest to the common denominator sought in the tests selected.

The Identical Forms was selected as a simple recognition of a form from among similar forms; the Cattell Culture-Free steps up to the next level, the recognition of a sequence or principal of change, with the next stage to be identified from a choice; the Shipley-Hartford being a similar sequence analysis, with the next stage to be filled in by the subject himself; and the Gottschaldt Figures, a return to the recognition and identification of an identical geometrical pattern, this time complicated by additional and distracting lines.

Of the individual tests, the Similarities is a pretty direct test of the subjects ability to detect the level of abstraction at which the stimulus words are related, yet, as administered (and despite a claimed absence of linguistic handicap) the lack of ability to express relationships was clearly handicapping many of these soldiers. The Memory Span for Digits and Time Estimation are pretty clearly just what they appear, tests of retention and possibly attention.

The Stroop Ratio represented an attempt to get at what may be a slightly different type of abstraction: the separation of the less familiar task of color naming from the more habitual task of word reading. If fatigue were to have an effect on a soldier's abilities, the more habitual should have held up, and the 'newer', less common task should have been much more affected. This would show up as an increase in the Ratio (CNW/WNC); in these tests it did not.

Through the use of the Card Sort, two things were sought. One was some indication of group solidarity which it was hoped could be obtained through comparison of a subject's order of likes with his idea of the order of likes of his squad-mates. It is necessary to assume that a person who accepts and is accepted by a group must have some likes and dislikes in common with it. The other thing looked for was position or shift in the rank assigned the Combat Patrol cartoon with increased nearness to combat.

Preliminary examination of the data appears almost completely negative between "stressed" and "control" subjects, as far as statistically significant objectifiable psychological effects are concerned. On all the psychological tests used, the experimental subjects did as well as, or better than, the controls whether obtained in Japan or Korea. Certainly if any <u>impairment</u> of "higher mental functioning," or ability to handle perceptual or conceptual abstractions, was expected, the present form of the data does not show any such decrement (see Figs. 23-31).

In examining the figures, the one additional trend which may occasionally be noted is the <u>improvement</u> in the B series scores for Group III. This suggests previous findings in psychological literature on psycho-motor tests in which performance improves under mild stress.

To get a measure of the community of attitudes as determined by the Card Sort, rank-difference correlation coefficients (Rho's) were calculated for each man based on the difference between the rank he assigned to each job for himself and the rank he assigned for his squad. The Median values below (see Table 46) are from the first administration of the test. The three groups represent three different distances from the MLR. Groups I and II were tested in Japan; Groups V and VI comprise the Korea control group who had been in reserve for approximately one month; Groups III and IV were actively engaged in combat.

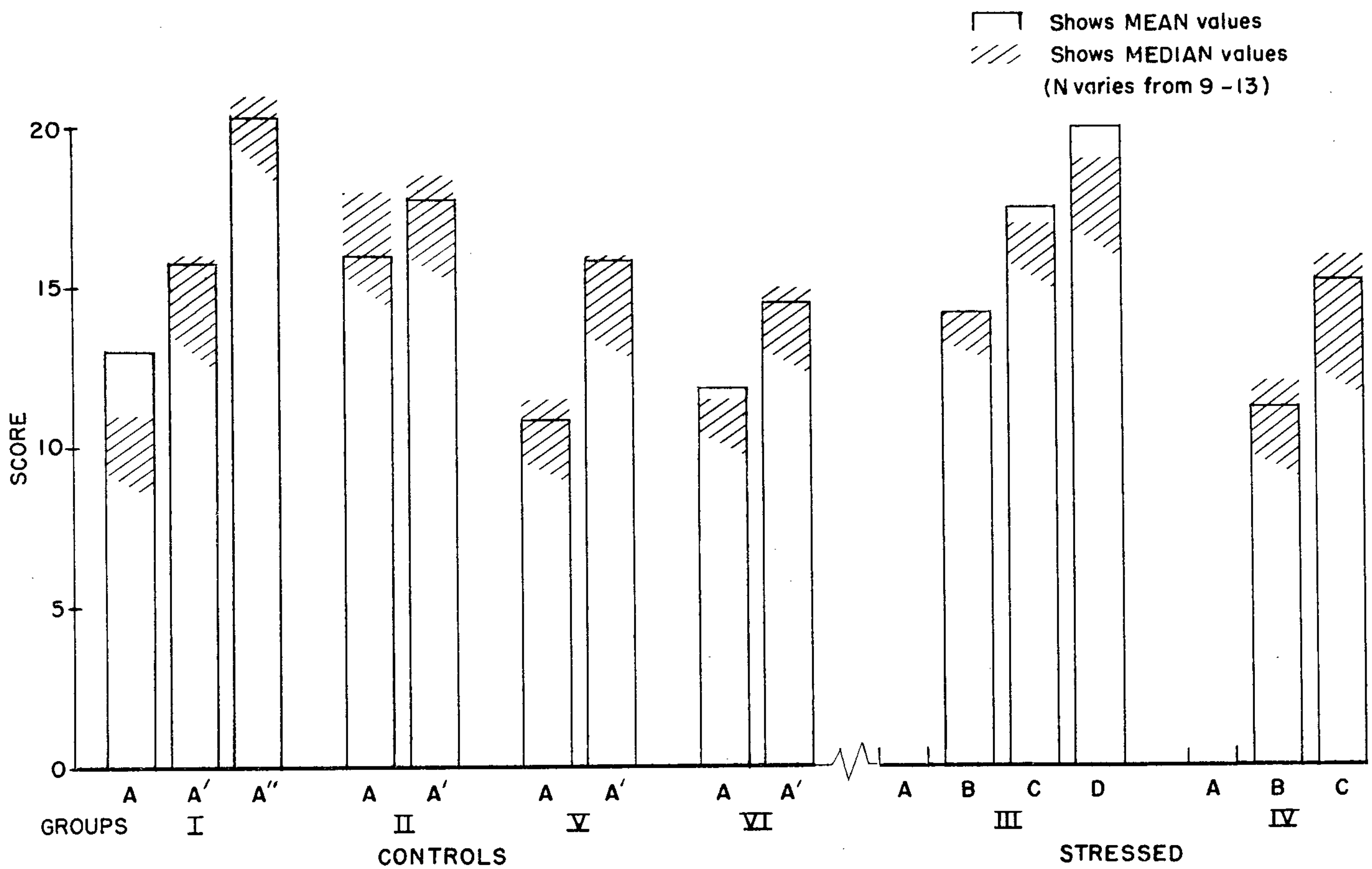


Fig. 23 - Identical Forms Test[a]

[a] Figures 23 through 31 show raw data mean and median comparisons between control and stressed groups as compiled from the psychological tests used in this study.

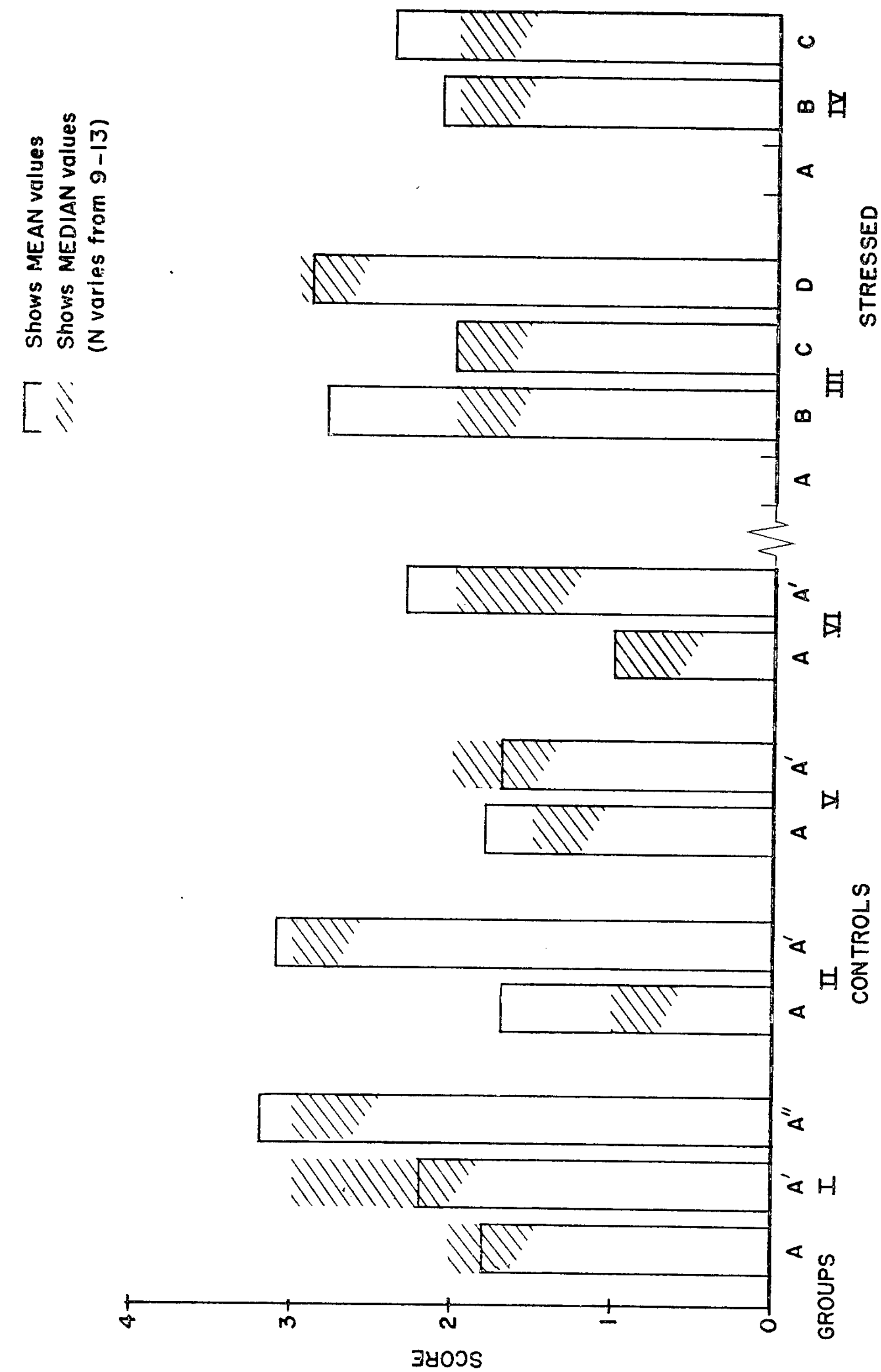


Fig. 24 - Cattell Culture Free Test

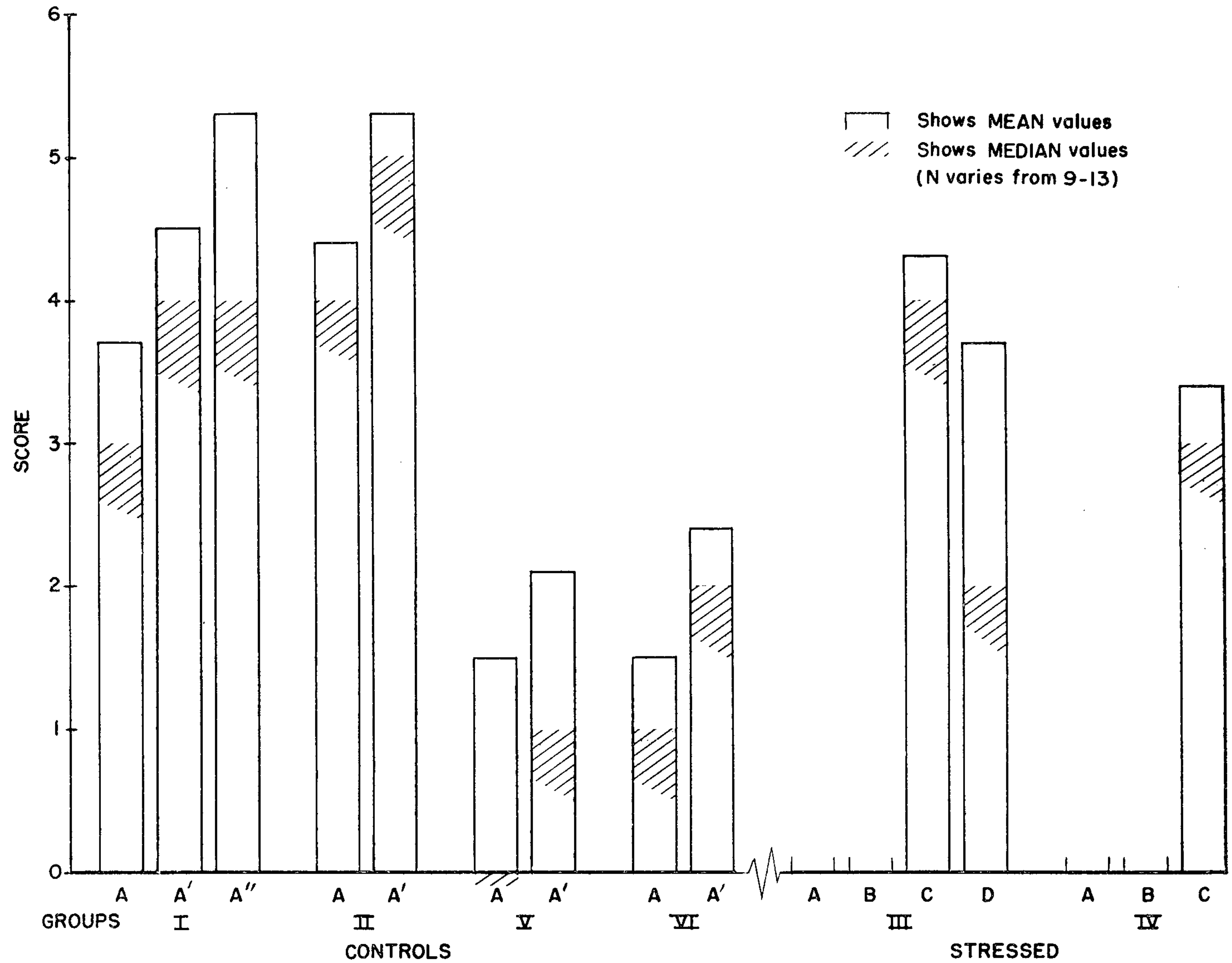


Fig. 25 - Shipley-Hartford Test

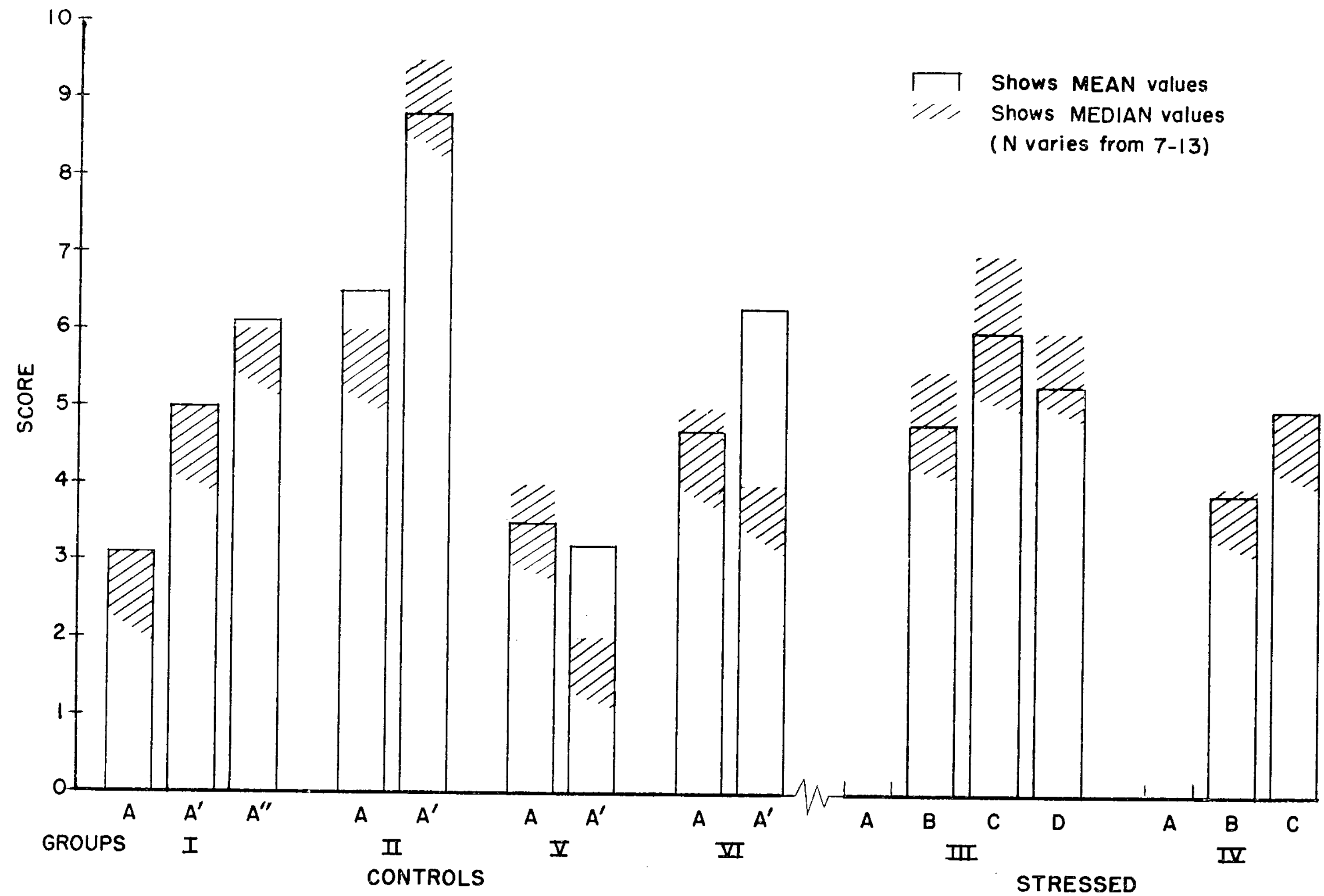


Fig. 26 - Gottschaldt Figures Test

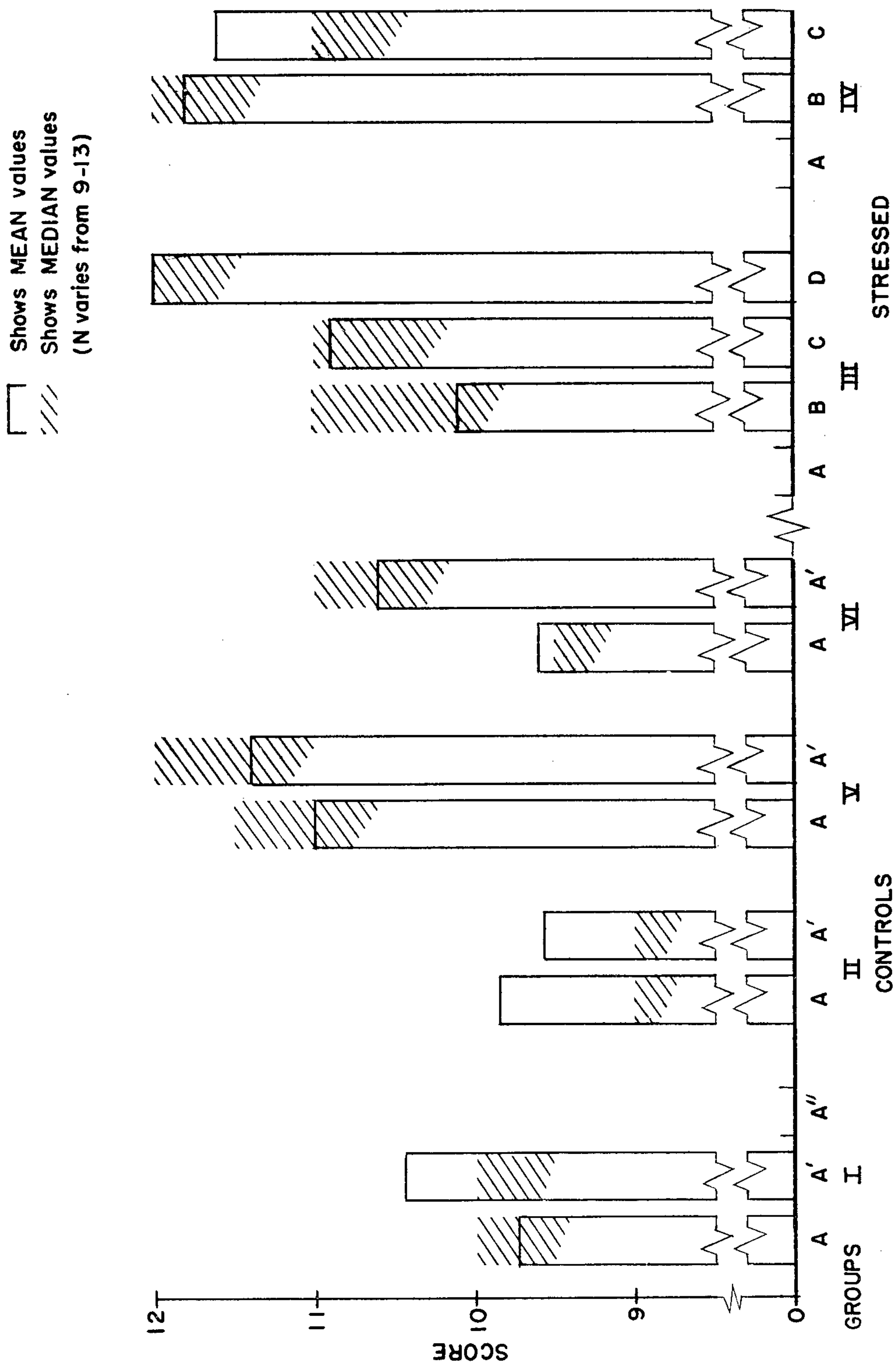


Fig. 27 - Similarities (W-B) Test

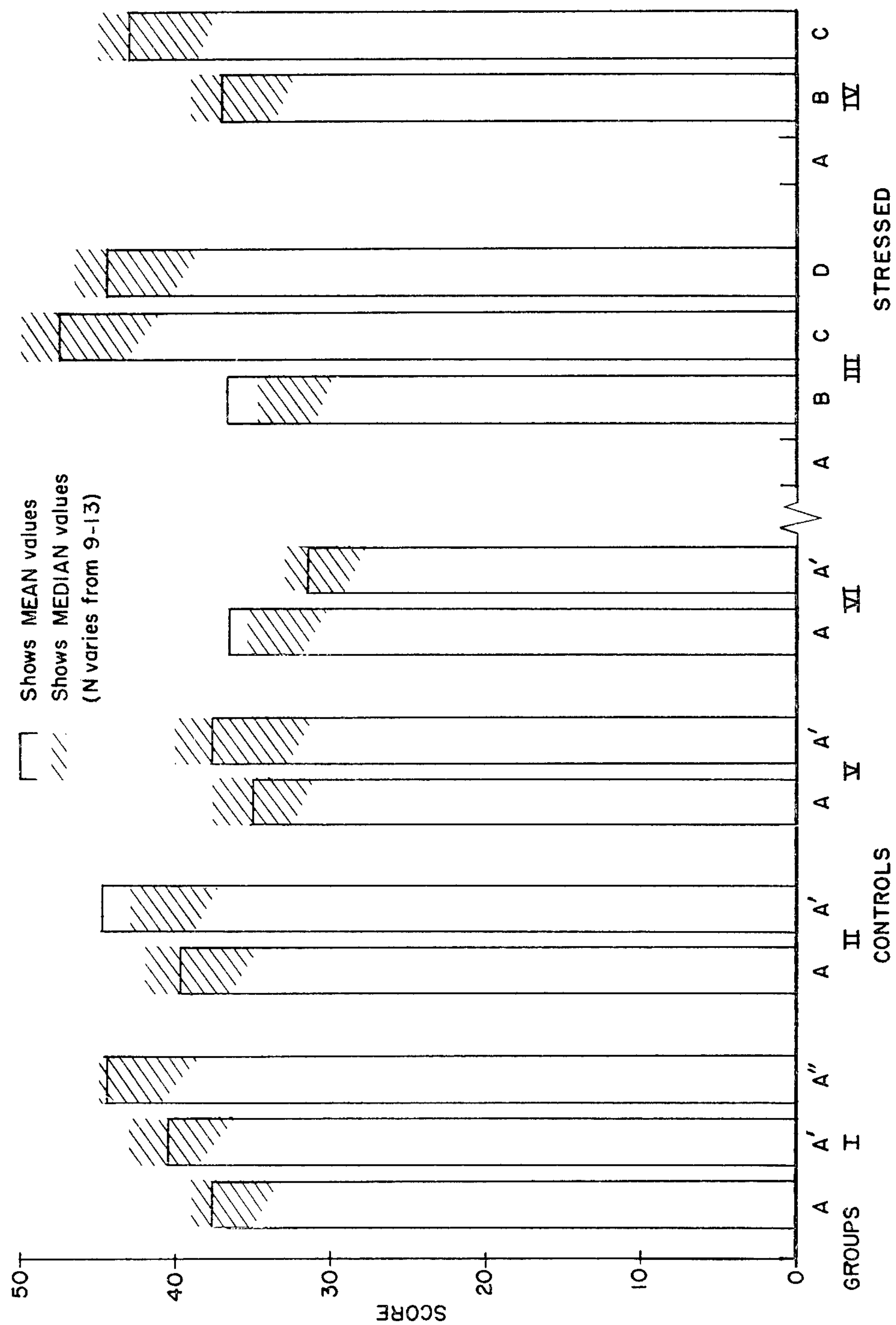


Fig. 28 - Digit Symbol (W-B) Test

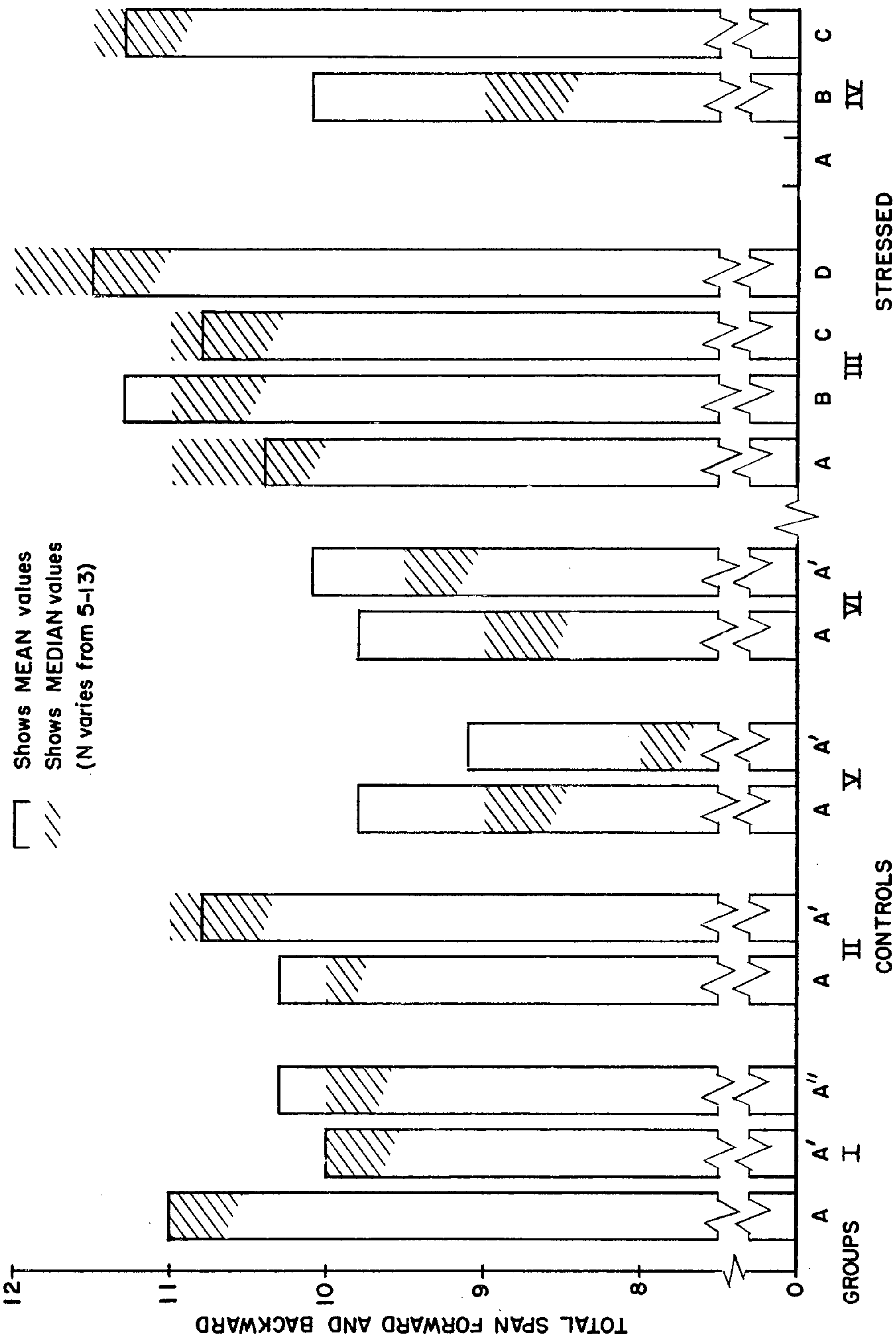
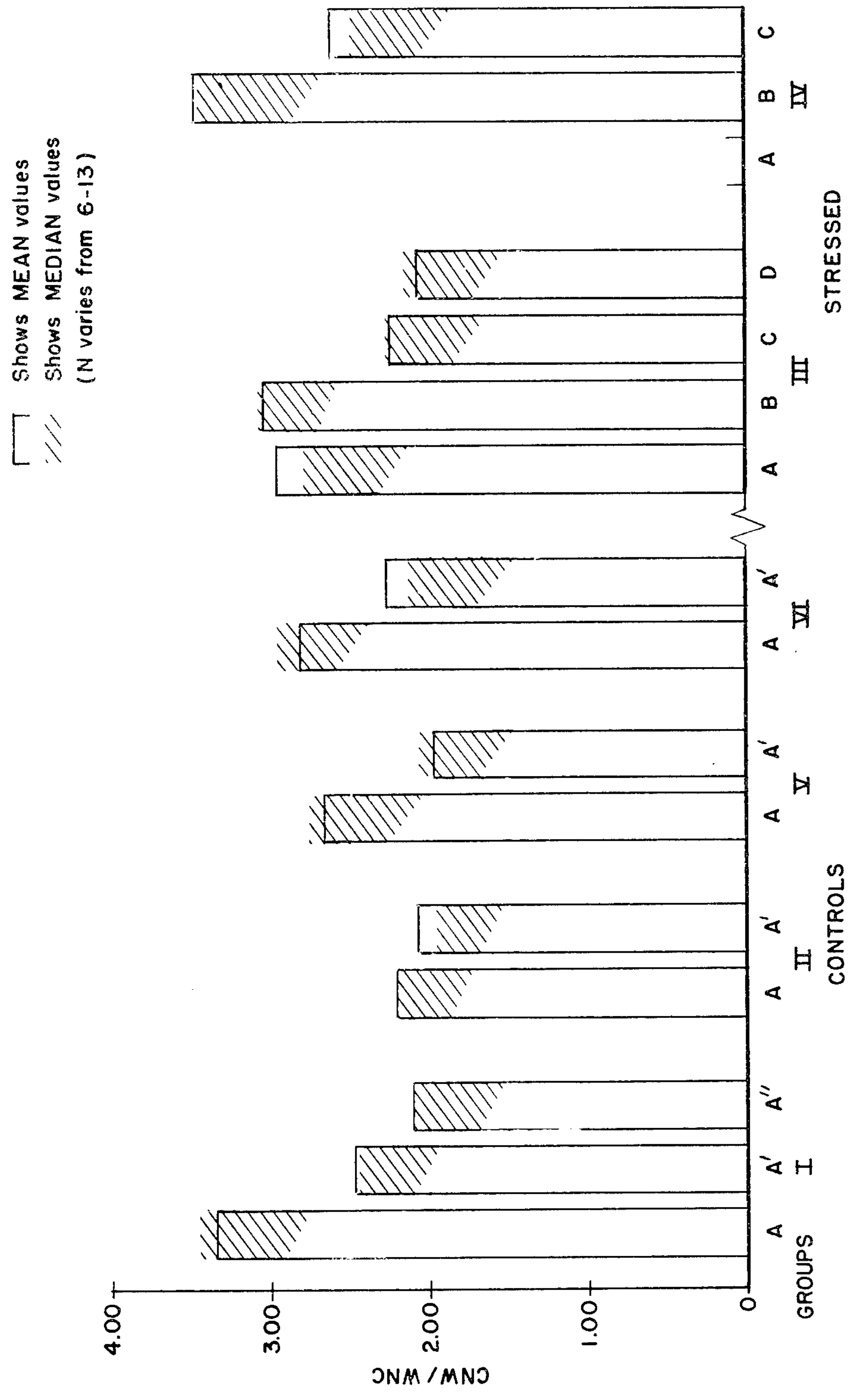


Fig. 29 - Digit Span (W-B) Test



Shows MEAN values
Shows MEDIAN values
(N varies from 6-13)
CNW / WNC
4.00
3.00
2.00
1.00
0
GROUPS
A
A'
A''
I
A
A'
II
CONTROLS
A
A'
V
A
A'
VI
A
B
C
D
III
STRESSED
A
B
C
IV

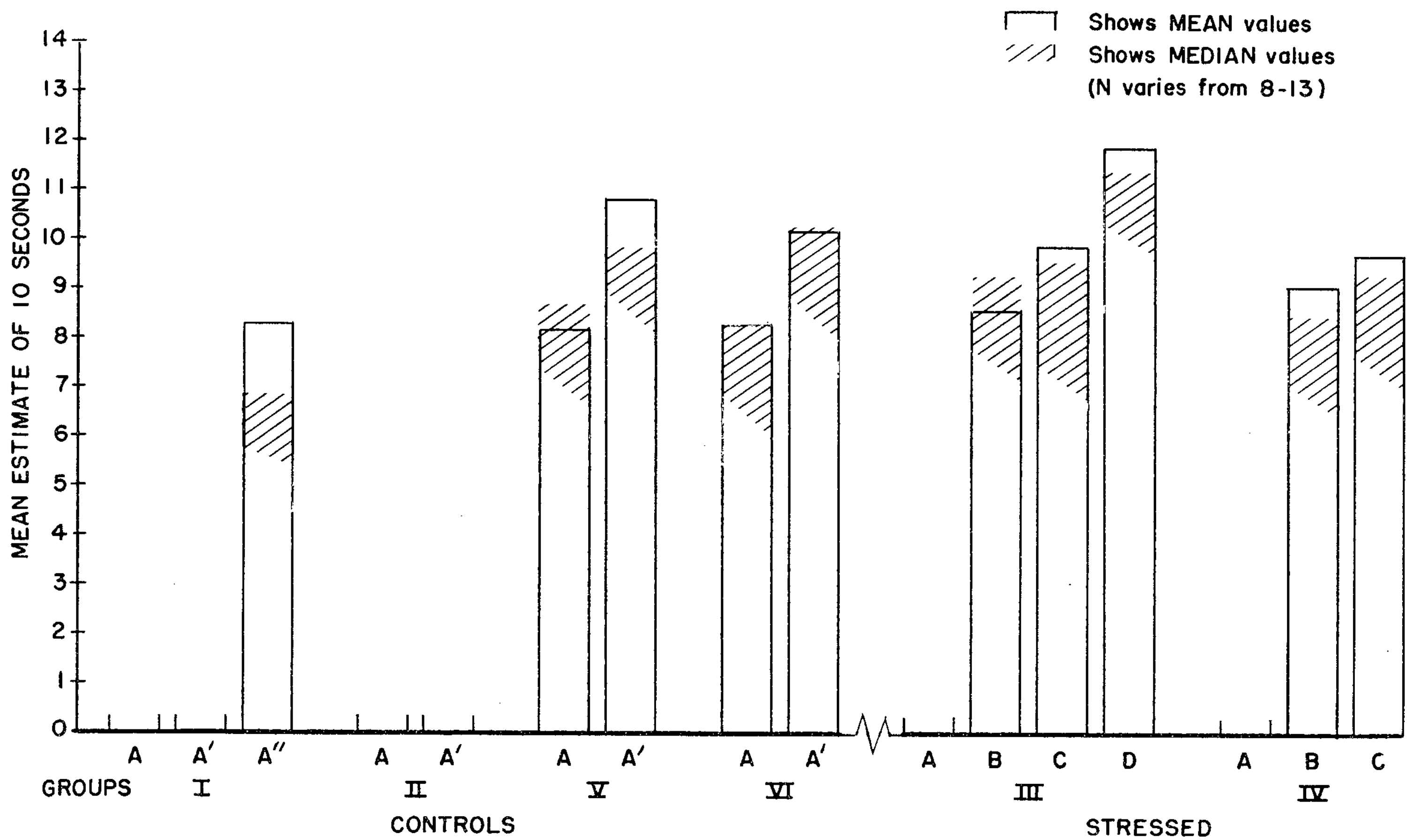


Fig. 31 - Time Estimation Test

TABLE 46

MEDIANS OF THE RANK-DIFFERENCE CORRELATION COEFFICIENTS OF THE SELF VS. SQUAD ARRANGEMENTS, FIRST ADMINISTRATION

Groups	N	Median
I & II	23	+ 0.75
V & VI	22	+ 0.78
III & IV	28	+ 0.88

Analysis of the Card Sort data to determine the presence of a shift in the Combat Patrol cartoon with increased nearness to combat failed to disclose any pronounced shift. These data are presented in Table 47.

TABLE 47

PROPORTION OF MEN IN EACH GROUP PREFERRING COMBAT PATROL CARD TO AT LEAST TWO OTHERS, FIRST ADMINISTRATION

Groups	N	Proportion
I & II	23	0.18
V & VI	22	0.17
III & IV	29	0.18

The failure of all these tests to show significant data may be attributed to any one or all of the following factors: (a) fatigue does affect abstraction (retention and attention), but the selection of tests was not adequate, either in kind or in sensitivity, to demonstrate these effects; (b) the conditions under which testing was accomplished were not adequate; light, temperature, time of day, and distractions were uncontrollable to a large degree, and while remarkably uniform for field conditions, may have confounded the results; (c) the tests were never run as promptly after the stress occurred as had been originally planned; perhaps the time lag permitted considerable recovery in performance; the difference between one or two hours and the 12 hour minimum actually obtained could easily be significant for these psychological functions; (d) the practice effects, greater than expected from the literature, may have obscured whatever sensitivity the tests have for the functions under observation.

The use of the Card Sort for making Self-Squad comparisons does show some promise. Soldiers closer to combat appeared to demonstrate a greater group solidarity. There is little doubt however, that a modified set of cartoons might improve greatly the sensitivity of this index. As an index of attitudes toward combat, the measure failed completely. Had there been more duties of a degree of unpleasantness more comparable to Combat Patrol, group differences might have appeared.

It was suggested that projective techniques would be extremely pertinent in studying the effects of stress. The biggest reason for not using projective measures was that they all take more time than it was expected to have available with the subjects, and even the ones that may be modified to a shorter form, such as the Rorschach, would take more individual time than was generally available. Nevertheless, from the results presented, this area should receive considerable emphasis in any further work on fatigue and stress. A psychological or psychiatric rating-scale of some sort would also seem indicated, both from the results of a very short one [29] used by the psychiatrist assigned to this team, and previous experience at the Worcester, Massachusetts State Hospital and the Columbia-Greystone Project.

Another area of psychological measurement which was omitted from our test battery, primarily for practical reasons, was the measurement of psycho-motor function. These tests generally involve considerable apparatus and in the stress literature have failed to show as large changes as tests of mental functions. It should be pointed out, however, that in the laboratory work on stress, the subjects were probably not as severely stressed as those in this investigation. The fact that changes in motor performance were observed in the men after combat, indicates the possibility that formal measurement of psycho-motor function would be a profitable area for future research. Prior work should be accomplished, however, to develop tests using simple apparatus which would be adaptable to field use.

Measurement of Visual Flicker and Auditory Flutter Fusion Frequencies

The visual flicker fusion frequency, or v.f.f. of our subjects was measured under the various experimental conditions by means of a Krasno-Ivy Flicker Photometer. This apparatus presents to the subject an interrupted, white, light source, the rate of interruption of which may be varied over a wide continuum. When first presented, the light is interrupted at such a rate that the subject perceives it to be continuous. The rate of interruption is then gradually decreased. The subject is instructed to press a switch when he first thinks the light is no longer steady. When the switch is depressed it turns off the light source and stops the apparatus. The experimenter then determines the rate of interruption at which flicker was first perceived by reading a Rate of Interruption indicator on the apparatus. The intensity of the light source is constant, as is the 50 percent on-off ratio. (The on-off ratio refers to the percentage of time the light is on to the time it is off in each cycle.) A 50 percent on-off ratio thus means that in each cycle the light is on 50 percent or half of the time.

In a similiar fashion, the auditory flutter fusion frequency, or a.f.f., was measured. The apparatus used was designed and constructed to our specifications by the Grason-Stadler Corp., Cambridge, Massachusetts. It presents a "white" noise to the subject via earphones. A white noise contains all frequencies within the audible range and is therefore analagous to the white light used in measuring the v.f.f..

[29] Sample shown in Appendix B.

The apparatus provides a wide range of frequencies of interruption. The intensity of the sound and the on-off ratio may also be varied. With the exception of the trial runs at Camp Omiya, Japan, the intensity was a constant 72 decibels (d.b.), and the ratio of time ON to OFF was always 90 percent. The procedure for determining the a.f.f. was identical to that used in measuring the v.f.f.. When first presented, the sound was interrupted at such a rate that it appeared to be continuous. The rate of interruption was then gradually decreased. The subject was instructed to signal the experimenter when he first thought the noise was no longer steady. When this point was reached, the experimenter recorded the rate of interruption.

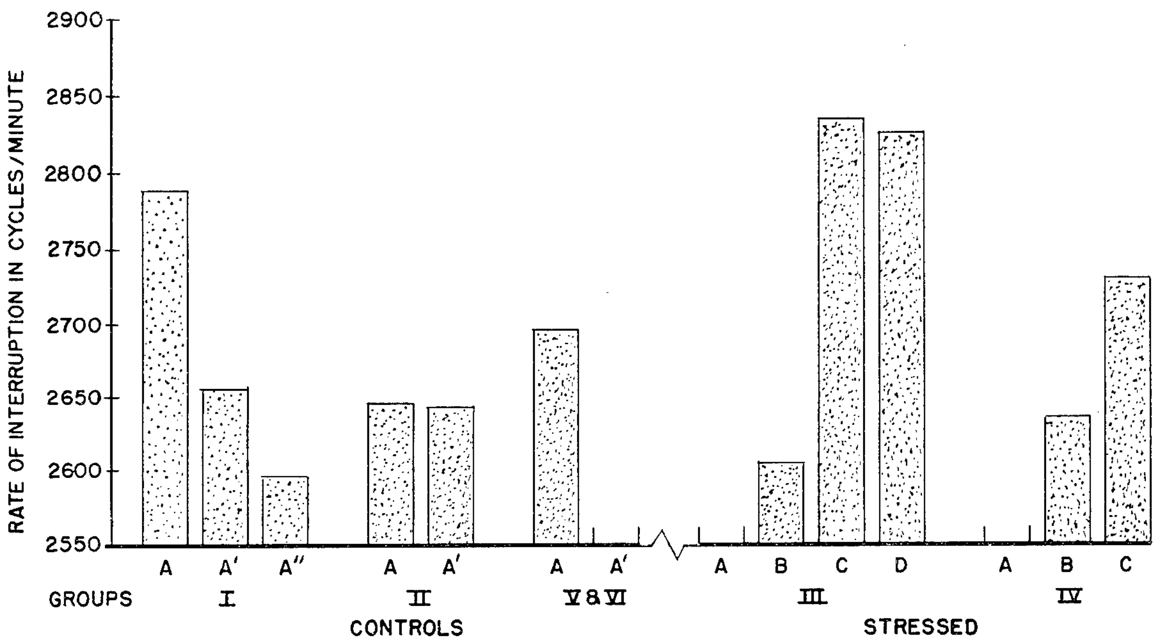


Fig. 32 - Visual Flicker Fusion Frequency Test

In order to measure the v.f.f. accurately it is necessary to obtain a series of successive judgements. It was anticipated that the work in Korea would require an absolute minimum of time with each subject. Accordingly, an attempt was made in the Omiya series to determine the minimum number of successive judgements necessary for reasonably accurate measures. For series A, Group I, each individual v.f.f. was computed by taking the mean of a series of five judgements. For series A', four judgements determined the mean, and for series A'' three judgements. As can be seen from Fig. 32, there were differences in the means of the three series. In Group II, however, the procedure was reversed, the mean of three judgements providing the measure for series A, and four judgements for series A'. There was almost no difference between the means of these two series. (Fig. 32) Considering the time saved and the small differences, it was decided to base all subsequent v.f.f. measures on series of three judgements.

With reference to the measurement of the a.f.f., the individual means based on only three judgements appeared to show little change over those based on a longer series of judgements (see Fig. 33). All subsequent measures of a.f.f. were based on three judgements. One other exception is found in series A, Group II. In this instance, the experimenter lowered the intensity of the noise source to 64 d.b. in an attempt to decrease the intra-individual variability in the serial judgements. This intensity so lowered the a.f.f. that the experimenter was afraid that stress induced changes might be lost entirely. All other measures of a.f.f. were made with an intensity level of 72 d.b..

For purposes of statistical analysis the experimental Groups, III and IV, were combined. The stress sample (B) was subtracted from the post-stress measure (C) for each individual. This was done for both the a.f.f. and v.f.f. Values of "t" were then computed from these distributions of differences. Reference to Table 48 shows that the stress sample (B) was significantly lower than the post-stress recovery sample (C), for both the a.f.f. and v.f.f..

TABLE 48

STRESSED GROUPS

Measure	Mean of "B"s	Mean of "C"s	Mean Difference	"t"	Significance Confidence Level
Visual	2622 cpm	2781 cpm	169 cpm	3.2	.01
Auditory	24.8 cps	31.3 cps	6.5 cps	4.30	.001

For the Korea Control Group only a.f.f. data are available. The flicker photometer broke down while running the second or A' series on this group and sufficient replacement parts were not available. With reference to the auditory data, Groups V and VI served as the Korea control data. They were combined for purposes of statistical analysis in the same fashion that the stress groups were combined. Figure 33 shows the means for both A and A' to be in the same range as the means of the other series of determinations. The significance of the difference between the means of A and A', was determined statistically by subtracting the A value from the A' value for each individual. A value for "t" was then computed from this distribution of differences. Table 49 shows the results of these computations.

TABLE 49

CONTROL GROUPS

Measure	Mean Gp V & VI A	Mean Gp V & VI A'	Mean Difference	"t"	Significance Confidence Level
Auditory	31.5 cps	36.17 cps	5.2 cps	2.06	.06

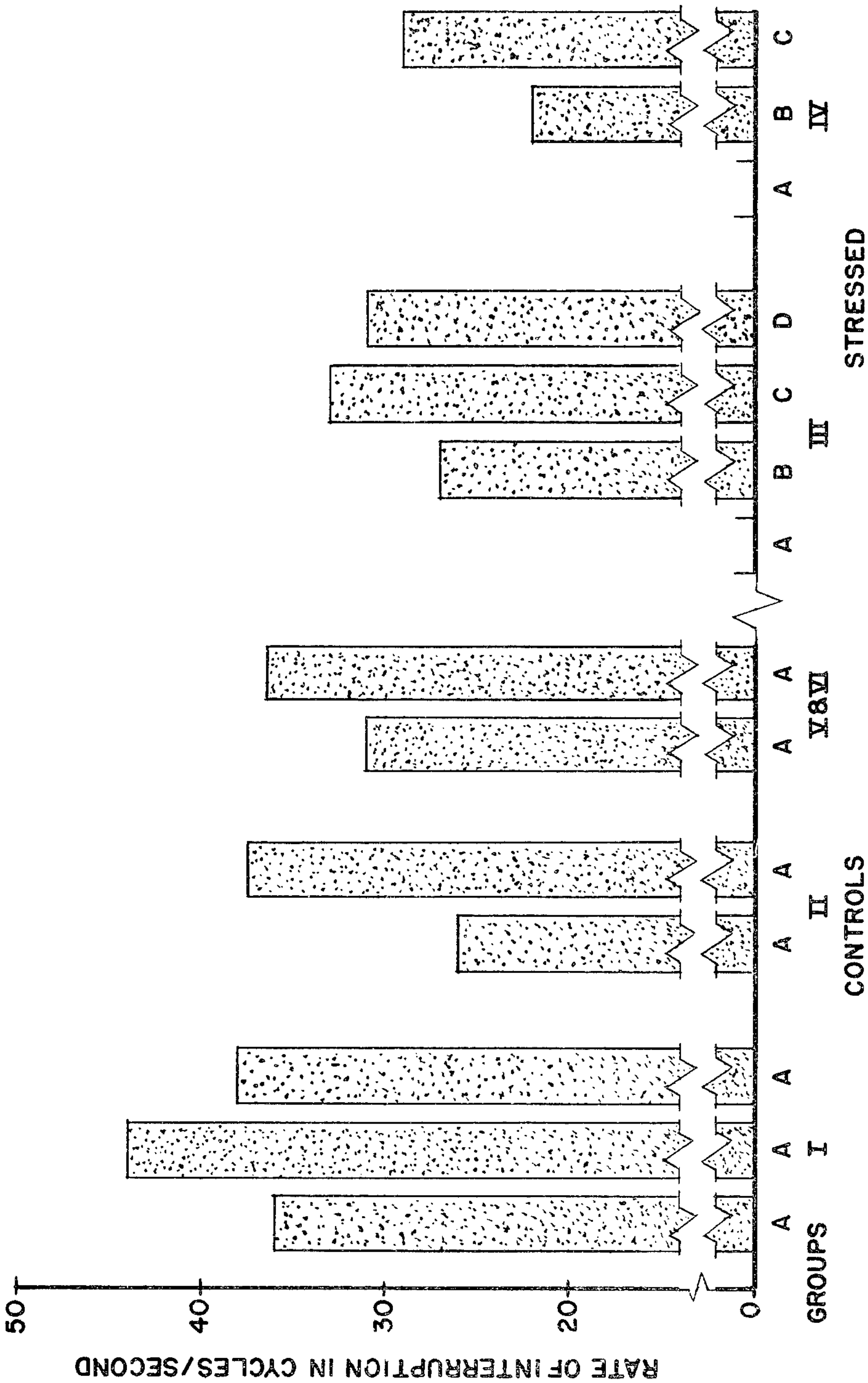


Fig. 33 - Auditory Flutter Fusion Frequency Test

Since a serial comparison for v.f.f. could not be made on the Korean control group, the data obtained at Camp Omiya was analysed statistically to see if there was a significant shift in the v.f.f. for a non-stressed group. The results of this comparison, computed for the combined Omiya groups in the same manner used in the previous comparisons, are shown in Table 50.

TABLE 50

CONTROL GROUPS

Measure	Mean Gp I & II A	Mean Gp I & II A'	Mean Difference	"t"	Significance Confidence Level
Visual	2711 cpm	2651 cpm	-60 cpm	-1.2	Not Significant

Considerable research has been done using changes in the v.f.f. as indicators of brain damage, fatigue states, and various other physiological states such as hypertension. Although the mechanisms which underlie the reflection of these states by the v.f.f. are not completely understood, it is generally considered that the v.f.f. reflects changes in the sensitivity of the cortex and the retina, either because of oxygen lack or because of a direct neurological or bio-chemical desensitization of the visual area of the cortex. From this it is reasonable to assume that the study of the effects of combat would be enhanced by the determination of the effects of combat stress on the v.f.f..

One of the major difficulties involved in these measures was securing apparatus suitable for field use. This difficulty was adequately overcome for v.f.f. through the use of the Krasno-Ivy Flicker Photometer. This device was engineered specifically for use outside of the laboratory. It is relatively small, convenient to carry, and is almost completely automatic in its operation. It survived rough field usage in Korea without major operational difficulty. The failure that occurred was minor, it was unfortunate that a suitable replacement part was not available. The fact that significant changes in the v.f.f. as a result of combat stress were obtained, combined with the fact that the instrument can be used successfully, even under rough field conditions, indicate that further research with this instrument should be continued.

The measurement of the a.f.f. is new as compared to the v.f.f.. There is little research literature with regard to its use. Theoretically, however, it is analagous to v.f.f. and should show similar changes. Practically, it has large advantages over the use of v.f.f.. By making use of the auditory sense modality rather than the visual, the experimenter need not be concerned with problems of adaptation or of contrast effects. The v.f.f. is seriously affected by the state of adaptation of the eyes, 10 to 15 minutes being required to make sure the subjects have adapted to the surrounding brightness. In measuring v.f.f. it is also desireable to maintain a constant level of illumination from test to test since the relative brightness of the surroundings has some effect on the v.f.f.. This, of course, cannot be done conveniently in the field, and was not done in this experiment, although steps were taken to prevent large differences in the surrounding brightness.

The fact that a.f.f. demonstrated significant changes in cortical function as a result of combat stress, indicates that it, too, is a promising tool for future research, especially when ease of use in the field is considered. The data presented here shows changes in the a.f.f. for the control as well as for the experimental groups. The changes were not as large, and in only one case were they significant; however, they were all in the same direction. It almost appears as though a practice effect were present. This has not been previously noted in the research on v.f.f. or a.f.f.. No adequate explanation of this is presently available. However, it is possible that since the task is new to the subject he does give more <u>accurate</u> judgements on later trials. In all previous research on v.f.f. and a.f.f. a much larger number of trials were used to get a better estimate of the true fusion frequency. A more complete analysis of this data and further experimentation is necessary to determine the validity of the hypothesis that an accuracy-practice effect is present; if true, this would not seriously impair the value of a.f.f.. Measurement of a.f.f. is strictly sensory, the subject does not "learn" or acquire additional insight as a result of performing this task. Any practice effect must by definition of the measure be due to a lack of familiarity with the initial task. It could be easily overcome by giving the subject the necessary series of practice trials prior to testing.

INTERVIEWS OF EXPERIENCED COMBAT SOLDIERS

One member of the team visited the Sasebo Replacement Depot where front line soldiers, many with patrol and other combat experience, were going through the personnel processing routine before departure by troop ship for San Francisco.

Between 3 - 13 October eight officers (including two from the Medical Corps) and 24 enlisted men were interviewed. The length of interviews with single individuals or with groups of as many as four, varied from a few minutes to several hours. Although the questioning was conducted as informally as possible and no fixed list of inquiries was adhered to, the initial aim was to secure information on the following matters: general retrospective descriptions by individuals of their own experiences of stress and fatigue while on patrol or in other combat situations; discovering episodes where exhaustion prevented the group from reaching its military objective, or where fatigue and stress prevented an individual from effectively carrying out his mission; if such failures occurred what, in the soldier's opinion led up to these; how frequent were these breakdowns under fatigue and stress and, when they occurred, were just a few or a majority of the men involved; were officers relatively immune; what was done about these failures by the commander; and finally, whether, in the soldier's opinion they could have been forseen or prevented.

Interviews with the enlisted men were conducted when they had concluded the personnel processing routine and had only to stop at the cashier's window. The men to be questioned were selected by one of the processing officers on the basis of their combat records. Since only an occassional soldier was asked to go to the interviewer's table many of the others were curious as to what was wanted and approached the interviewer in the PX snack bar or on the grounds and usually in the course of conversation volunteered items of significant information.

Officers were approached in their billets when at leisure. Without exception they volunteered to continue the interviews either singly or in groups and on three occassions for a whole evening.

The subjects of the study were selected following the arrival of two troop ships each bringing about a thousand officers and men. They were interviewed on the basis of prolonged combat experience. The officers were in their thirties while the enlisted men averaged 24 years of age. The educational level of the enlisted men approximated graduation from high school. The officers included a number of graduates of college or professional school. In the case of the eight officers, the period of service averaged six months and the time in combat five months. For the 24 enlisted men the total period in Korea averaged seven months of which an average of six months was spent under combat conditions.

It should be noted that the interviewer in asking questions never referred specifically to stress or fatigue and in general attempted to avoid putting words in the soldier's mouth. Although many of the men interviewed had been engaged in severe combat during June no mention was made of mass exhaustion and muscular collapse. Of those questioned, only one volunteered a report of severe muscular fatigue after a patrol. The words most commonly used in describing patrol or combat behavior followed a fight-flight pattern, e.g., afraid, scared, worried, mad, sore, and the most frequent complaint was loss of sleep. Only one instance of disturbed sleep following the first combat patrol was reported. One captain noticed that he lost weight while in reserve and this he attributed to his responsibility and worry over plans for future patrols which had to be carried out when he returned to the MLR. The impression of a number of men was that they had put on weight since coming to Korea. No one reported loss of appetite although one soldier told of vomiting during his first day at the MLR and of urinating in his pants on his first patrol. Both loss of weight and loss of appetite together with gastrointestinal disturbances of soldiers at the MLR are noted elsewhere in this report. A possible explanation for these discrepancies will be suggested later.

Inquiry disclosed a multitude of variables involved in patrol action. Distances traversed depended upon the separation of the opposing positions and varied from a few hundred yards to five or ten miles. Time on patrol also varied widely with distance, whether contact with the enemy was made, and depending upon the duration of the ensuing combat. Being pinned down by enemy fire and similar unpredictable circumstances also determined the duration of the patrol. The number engaged in a patrol varied from two to 150 or more.

The men interviewed recounted their experiences on all of the types of patrol both during the day and at night. Nineteen of the men interviewed had patrol experience. Six of them had been on thirty to thirty-six patrols. Six had been on from twelve to eighteen, and seven had gone on from one to five patrol missions. The types of patrol described by them were as follows:

Reconnaissance patrol. The purpose of this patrol is to look over the ground in front of MLR in order to plan the route to be followed by a subsequent ambush patrol or raid. The men go single file and attempt to locate installations of any kind. Anything seen, heard, or smelled may prove important. For example, the smell of garlic may disclose the location of the Chinese. The maximum number of men for such a patrol is ten and the optimum six, according to the terrain and the distance between the lines. The men are not to fire unless fired upon and must wait for the officer's signal. These patrols are usually carried out in daylight but occassionally at night.

Ambush patrol. Here the purpose is to bring back prisoners, dead or alive. The patrol leaves MLR at dusk and chooses a concealed position in which to wait. Later, another position may be chosen. Quiet must be preserved and in cold, wet weather much hardship is experienced during the night. The patrol returns sometime before dawn.

Combat patrol. This patrol is committed to combat and may even be supported by tanks so stationed as to provide artillery reinforcement. It may involve a company size attack. It is usually carried out by day.

Raid. Those interviewed failed to make any sharp distinction between raid and combat patrol. More men and weapons are committed in setting up a raid. It is usually a daylight operation.

In order to secure first hand patrol experience one of the team went out on an ambush patrol during the night of 29 October. In describing the pre-patrol activities and the modus operandi of the patrol itself he writes:

> "It was not known by me how far in advance the men knew they were going on patrol but they all knew about it at least six hours before leaving.
>
> "The patrol consisted of fifteen GI's, two infantry officers, five ROK's and myself. We ate a hearty meal about 1630 and then went back up to the bunkers to get our gear. After assembling back in the mess area around 1730 at 1800 we were briefed by the officer in charge of the patrol for about 15 minutes on the purpose of the patrol, what support we had, factors affecting the time of our return, a general description of the ground we would be covering, where the enemy's known positions were in relation to our route and when we might contact their patrols.

"The patrol was broken into two groups, the attack group and the support group which were of about equal size. The actual "point" man was a GI of considerable experience but also nervous about his return. Following him was a man who was recognized as the "hero" of the outfit by his previous exceptional bravery in combat. The point man said he felt much safer with this good soldier right behind him. The patrol leader was third in line. I did not know the order of the rest of the patrol but I brought up the rear of the support group.

"We travelled in single file and close enough to always see the man ahead. The interval was only about 6 feet but it may have been that the O In C didn't want us to spread out.

"Afterwards I learned that the point man about "cracked up" while we lay in ambush the second time and heard a group of the enemy. The O In C apparently talked to him for a while and straigtened him out."

Notes describing his own experiences, prepared immediately upon his return, follow:

"Prior to leaving our position I was scared, and worried more about not coming back than of injuries which might be incurred. However, I had no trouble thinking about other things so it was not hard to keep from being worried.

"To cross the MLR we walked around a hill which we held and up through a saddle. We travelled pretty fast and by the time we reached the crest all the patrol were puffing and sweating. I carried a .45 pistol, a carbine, about 100 rounds of ammo, 2 grenades, and an armor vest. No canteens were allowed. After resting a few minutes on the MLR we went down the other side and set up an ambush in a rather open area. We stayed there 2 hours and I got very cold and shivered uncontrollably as the air and ground were quite cold. I took my pulse without a watch and guessed it was about 72 - 80.

"In front of us about 50 yards away was a small ridge with a bright moon behind it so the side facing us was dark. I heard noises over on this dark side and told the man beside me about it. He didn't seem too concerned. Later I realized what I was hearing was dry leaves falling from the trees and mice running around these leaves. I could hear very well in spite of our artillary and our harassing .50 cal. machine gun fire. But these noises I heard bothered me - especially since we had practically no cover.

"We moved on up and set up another ambush and waited again. At least this time we were concealed in grass and a clump of trees. There were many mice where I lay and they ran over and around me. My only thoughts about them were fear I might get hemorrhagic fever. In this ambush I was not consciously scared and at no later time did I feel scared and gave no thought of being fired upon. I was no longer cold from then until we got back.

"The man in front of me urinated five times during the 9 hours we were across the MLR and I urinated three times although I had originally hoped to wait until I returned to our bunker as it would be an interesting sample for analysis. No water, of course, was consumed on the patrol. Only the medic had a canteen.

"A larger friendly patrol which was in the same area had a fire fight with the enemy which we could see and hear. Afterwards we heard that they had taken quite a few casualties but we did not go to their assistance because we had our own mission.

"As we lay in ambush the second time a large group of the enemy passed in front of us but we did not fire on them because of their greatly superior numbers. They chattered away like high school girls but hearing them did not consciously increase my anxiety.

"We set up an ambush a third time and then started home following a creek for some distance and then going up the side of a steep mountain to our positions. Coming in I was very tired as was all the patrol since we had been in front of the MLR over eight hours. I was also hungry and wanted a cigarette. After three hours sleep I felt pretty good.

"The other men on the patrol were very touchy and jumpy before we went out on patrol. They talked freely to each other and were disgusted that they had to go so often but they were also very concerned about getting back safely and made no attempt to hide this. After we crossed the MLR going out they seemed to change and I felt that they were quite indifferent about the patrol. One or two even slept when we lay in ambush even though they knew they were expected to stay awake for the good of the patrol and themselves."

The hazards to which the members of a patrol are exposed vary drastically. One man had been on about 30 reconnaisance patrols with no contacts with the enemy and with no casualties. He was less frightened on later patrols than on the first one and his greatest reliance for feeling secure was on the patrol leader with combat experience whom all members of the patrol trusted. By contrast, the first patrol on which one lieutenant led his 30 men started from the MLR at 0830. When but 800 yards out they were surrounded and were unable to fight their way back to the MLR until 1400 after killing 40 Chinese and wounding 40. Their own casualties were two killed and three wounded. One officer stated that in his experience "the younger men regard the patrol as a lark until somebody gets wounded or killed."

There was unanimity among the officers and men interviewed concerning the degree of hazard or "ruggedness" of the several types of patrol action. In order of decreasing stress they were ranked: combat patrol, ambush patrol, and reconnaissance patrol. All of the soldiers questioned on the point agreed that they felt more apprehensive and under more stress in going out on patrol than in coming back although there was general agreement among the officers that the return journey is likely to be more hazardous. One experienced patrol leader made a practice before starting back of staying under cover for a time and then sending one man on his way back. This maneuver often drew enemy fire thus disclosing their position.

Both officers and men unanimously agreed that a soldier on first arriving at the MLR should be allowed a certain number of days there for adjusting or "levelling off" before going on his first patrol. In this situation the individual is in a state of continuing uncertainty concerning the unpredictable dangers which confront him -- dangers of attack, artillery fire, sniper's bullets, etcetera. Quiet at the MLR never means security.

The effect of artillery, and particularly of mortar fire, was characterized by two medical officers as most stressful. Even when fire is sporadic its impact in the form of intense, discrete stimuli may result in psychiatric casualties. In estimating the amount of stress to which a soldier has been subjected, one neuro-psychiatrist believes that the amount of exposure to artillery fire must be ascertained; both dates and estimated amount. In his experience in Korea the majority of psychiatric casualties were caused by artillery fire rather than by patrol duty.

A line officer recounted the following case of a severe anxiety reaction which he witnessed at the MLR as a consequence of the intense shelling of his platoon for an hour one night. The lieutenant's platoon had been on the MLR for 39 days. Formerly, they had been accustomed to 30 days up and 30 days back. On this occasion they were supposed to be relieved at midnight but at 2330 tremendous shelling began and all of the shells seemed to be falling in the platoon area, about 500 yards wide. At first, they thought that they were to be attacked. Instead, the shelling continued and everyone believed that they would not be relieved.

After about an hour, a rifleman 21 or 22 years old rushed from his own bunker about 60 yards away into the lieutenant's CP staring and clenching his rifle with both hands, shouting over and over: "The dirty yellow bastards why don't they come out and fight." His gun was taken away and he was told to sit down. He continued sobbing and the CO medic stayed with him in the bunker after giving him a sedative. Relief came at 0100 and the lieutenant, medic, and platoon sergeant accompanied by the patient walked to a truck a quarter of a mile away by which time the patient was reasonably quiet. He stayed at the collecting station for two days and returned to the unit with a recommendation for change of duty. The lieutenant and two sergeants had previously thought the patient to be "emotionally a little weak" and because of this impression he had not been taken on the last patrol. Moreover, he had fainted once for some unimportant reason - "nothing operational."

Other psychiatric casualties from combat were observed and evaluated by the neuro-psychiatrist of the team and are discussed elsewhere in this report.

Although relative quiet may prevail at the MLR, the experience of remaining there, even briefly, is disquieting. One soldier who had been in Korea for six months had spent his last four months in driving a two and a half ton truck with three cooks up to the MLR five miles away morning, noon, and night to feed the troops stationed there. He always found it a disagreeable experience to distribute the food at meal time in the open 100 yards behind the MLR.

In spite of the small number specifically questioned, it was surprising to discover how uniformly both officers and men recommended the number of days to be allowed a new man on the MLR before sending him on his first patrol. Of those questioned, five recommended a <u>period of ten days</u> and one suggested three to five days in the blocking position followed by seven days on the MLR, while three estimated seven days, one 2 days, and one 21 days. One neuro-psychiatrist replied: "Ten days but no longer."

In discussing their own experiences on patrol many of the men spontaneously expressed the opinion that the novice must go on a number of patrols before he becomes sufficiently adapted to become "battle wise" and dependable. One lieutenant who had led 25 patrols stated that on their first patrol, when contact with the enemy was made, they all wanted to go forward. It was his impression that aggressiveness was the new man's characteristic reaction to his first enemy contact. By the second patrol he had become more deliberate and looked to leadership more.

Of the five who ventured a recommendation as to the number of patrols necessary for "shaking down" or adjustment the number suggested was without regard to the type of patrol. It was their unanimous opinion that before adjustment three patrols are necessary. A large number, however, were uncertain and would only state that a number of patrols were desirable but that one never felt secure with an unknown leader. Sometimes the soldier on his first patrol experiences a disabling fear of land mines and may be afraid to step in front of the MLR.

An important matter upon which there was unanimous agreement among the eight officers and 24 enlisted men concerned the inevitable anxiety which all experienced in increasing degree during the final month before rotation to the United States. All of them were convinced that during this critical period of a month the soldier through mounting anxiety exhibits an exaggerated caution which may prove a danger to himself and others if he is assigned any duty of special hazard. He should not be selected either for patrol duty, for listening post, outpost, or forward observer according to one soldier. He reported himself as beginning to get "wound up" during the last month and a half before rotation.

The Role of Leadership

A principal cause of casualties in action either on patrol or in severe combat was believed both by officers and men to be poor leadership. Even the taking over of command by an unknown officer leads, at least temporarily, to distrust and feelings of insecurity. No conflict of opinion between officers and men was disclosed as to the importance of leadership. Good leadership is recognized as such both by the leader himself and by those under his command. As might be expected, the actual techniques employed depend upon the personality and experience of the officer. One officer explicity stated his aim to be that of inspiring feelings of mutual respect and trust as they are found within the family circle. Another officer stressed the importance of the leader preventing himself from showing uncertainty or even excitement and of talking privately with a disturbed soldier after, or even during patrol. With regard to discipline, one experienced leader said that he sometimes found it necessary to threaten a soldier "with something worse than fear." Another said that after a particularly harassing patrol he made a practice of holding a very rigid inspection the next morning. Here, anxious ruminations were transformed into overt resentment directed against him.

An experienced patrol leader who had been a social worker made a special point before each patrol of insuring the ego-involvement of each patrol member by using the briefing period as a period of mutual discussion. He attempted to evoke in each participant a clear "cognitive map" of the proposed action, often using his raincoat spread on the ground as a blackboard. The more inexperienced and anxious soldiers would ask many questions, most of them silly, while the "battle-wise" men would detect weak points and invariably raise questions about them. The leader, "as therapy" to use his own expression, would give his own solution for counter-action to build up confidence.

Group coherence on patrol was not solely a matter of leadership. It also depended upon long acquaintance of the patrol members, sometimes going back to days of basic training together.

Changes in Behavior During Continuing or Increasing Danger

It is the function of the medical officer to save lives and to return to duty the wounded or ill. His heavy burden should not be increased by imposing upon him the task of detecting in soldiers on the MLR those about to "crack up." It should be possible to specify minor changes in the front line soldier's behavior which an experienced officer might observe and to give him authorization to use his discretion in easing the burden of fear and anxiety in the case of such a soldier by appropriate change of duty.

One purpose of the interviews at Sasebo was to discover how often a soldier had been able to foretell that another soldier whom he knew well should not be chosen for a patrol. One case has already been mentioned of the young rifleman's severe anxiety reaction under bombardment. It will be recalled that the lieutenant in command and two of his sergeants suspected "emotional weakness" in connection with his fainting and that consequently he was released from patrol duty.

A medical sergeant who had been on 30 patrols knew his group from training days so well that he could see in two or three cases that a particular soldier could not "take" another patrol. When asked to be more specific he said that it was his unfamiliar behavior. Questioned further, he mentioned: "not being able to take a joke, irritability, aimless activity, excessive loquaciousness, or unusual silence." The captain of the company, who was present at the above interview, noted in the whole company a gradually mounting resentment during their six months in combat. During this period the company (of 150 men) had casualties totalling 13 killed and 20 wounded. Asked what he personally most resented he specified the following targets: (a) inequalities of pay; (b) inability to be promoted while assuming the responsibilities of a higher rank; (c) army petty economy - making the front line soldier pay for lost equipment; and (d) the futile armistice talks. He pointed out, however, that the resentment was basic and that it might be directed at any number of targets.

In attempting to piece together the disconnected items of information obtained at Sasebo and elsewhere a rough outline of changing behavior under continuing severe battle stress could be made out. The soldier just arriving at the MLR, or going on his first patrol is inclined to be "trigger happy." He may fire often and at random. How many times he fires and at what, as compared with the experienced soldier is always a matter of importance to the line officer or patrol leader because random firing is dangerous to all concerned. One soldier reported that in returning from their first patrol a number of them shot at something moving and discovered the next day that they had killed a deer.

This stage of acute vigilance (or "jitters") is often manifested in petty fault finding, and almost endless silly questions directed to the officer in command. One neuro-psychiatrist said that he routinely observed this barrage of silly questions in conducting his examination. He had made it a practice to arrive at a decision early and to tell the soldier at once what he meant to do with him.

Following this stage of "jitters" or exaggerated nervousness one may observe a range of oscillating behavior. For example, on returning from combat a soldier may exhibit, on successive occasions: (a) increased and then decreased loquatiousness; (b) silence or perseverating repetitiveness, e.g., in answer to a simple series of questions he will say the same thing over and over; (c) when on a patrol the command is given to halt and seek cover the soldier may keep on going apparently unable to stop, or if he stops he is unable to get going again when the command is given.

Finally, when the soldier is on the verge of complete breakdown more dramatic disorders of behavior make their appearance, such as vomiting, loss of consciousness, fits, manic behavior, uncontrollable sobbing, and the like.

In the combat situation both line officer and medical officer develop sensitivity and skill in observing seemingly trivial instances of behavior which indicate a soldier's impending ineffectiveness in combat or actual "combat exhaustion." One medical officer pointed out as significant in evaluating the effectiveness of a soldier such indications as the following: coming in from patrol he may resort to chain smoking where ordinarily he smokes little; or in contrast to his usual reserve he becomes boastful. If he suffers from a mild impediment of speech this difficulty is now noticeably exaggerated.

Through suitable indoctrination the line officer can be taught by his medical colleagues in service to take note of such suspicious behavior. Through the exercise of his practical judgement he may thus enhance the combat effectiveness of his men while at the same time he is preventing needless psychiatric casualties.

Motivation and the Military Ego-ideal

It was noted earlier that a number of the men interviewed at Sasebo had the impression that they had gained weight since coming tc Korea. No one reported loss of appetite. By contrast, the personal observations of one of the team members while at the MLR disclosed both loss of weight and appetite together with gastrointestinal disturbances. (It will be remembered, also, that only one man reported at Sasebo that he had experienced severe muscular fatigue after one patrol. He added, however, that he had completely recovered in an hour.)

Although forgetting physical discomfort is natural to healthy young men and may in part explain the above discrepancies, it is believed that more is involved. In a group of front line soldiers (squad, platoon, or company) committed to frequent patrols or under heavy artillery fire certain ideals which all accept and try to live up to may mean life or death. One of these is the ability "to take it." Failure to realize this ideal of fortitude, falling short of it in practice, leads to feelings of inadequacy.

This conjecture is supported by another example supplied by one neuro-psychiatrist in discussing the evaluation of fainting. In his experience, a soldier referred to him because of having fainted will tell the doctor that he "passed out" or "blacked out." The doctor replies: "You mean that you fainted." This, the soldier vehemently denies insisting that he "blacked out." In justifying his refusal of the word "fainted" he may tell what the doctor wants to know. It will regularly be found that the fainting did not occur in the combat situation. According to this neuro-psychiatrist the soldier must reject the word "fainted" because it implies weakness or effeminacy.

One may tentatively conclude that when the soldier is forced to realize his inadequacy in being able "to take it" guilt feelings are aroused. At some later time, because of guilt he will resort to retrospective falsification and may give a somewhat boastful account of how he was able to "take it" in the given situation as well as, or better than, other soldiers.

In the dangerous and drastically restricted life of combat such soldierly aspirations as fortitude, trustworthiness, and obedience supply the irreducible minimum of the combat infantryman's motivation. A research design for the study of motivation in combat might be derived from such simple considerations.

It is recommended that at the appropriate time and place in the training of medical and company officers they should receive joint instruction in the detection of those changes in the soldier's behavior which presage future inadequacy or failure in the discharge of military duties. This joint instruction should sensitize both line and medical officers in the detection of these seemingly trivial and transitory items of behavior because of their potential importance as determiners of the later combat effectiveness of the soldier.

The company officer should be trained to observe them because when they appear with significant frequency or intensity the soldier should not be assigned any duty of extra hazard such as a patrol. Even without added stress he may become a psychiatric casualty. If the officer has been suitably instructed he may dispose of such cases according to his own military judgement without imposing this extra burden upon the medical officer. Conversely, a psychiatric casualty sufficiently recovered for return to duty may be sent back to his unit with the doctor's suggestions. With joint indoctrination these recommendations should be couched in language such that the line officer will clearly understand the soldier's present mental and emotional state as evaluated by the doctor and will be in a position to better exercise his own judgement as to the new duties to be assigned the convalescent. At present, this rapport between line officer and medical officer does in fact obtain, particularly in the combat area, as was repeatedly noted. The present recommendation is only that this rapport and team work be facilitated as early during officer training as possible.

The importance of the leader on patrol, as disclosed by the interviews, suggests that in a study of leadership in combat, the smaller the group the more clearly will the essential features of the behavior of the group in relation to its leader appear. During the summer of 1951, Dr. David Solomon of the Canadian Operational Research Group directed such a study in Canada. A small group of sociologists, each man serving as a participant observer, lived and trained with basic recruits for a period of approximately three months. It is suggested that in relation to studies of the combat effectiveness of the front line soldier some of the factors involved in effective leadership might be analyzed by repeating the Canadian study in the basic training situation, choosing the squad or platoon as the unit.

How long should the soldier who has just arrived at the MLR be allowed to remain there before being given an assignment of extra hazard such as going on patrol? One soldier reported a practice of pulling the new men out of the line at night for their first ten days with the company.

The interviews at Sasebo, summarized in this report, show that a number of soldiers, both officers and enlisted men also felt that ten days were required to become adjusted or "level off" after arriving at the MLR. This repeated, specific mention of ten days invites further field study along the following lines:

Since artillery fire is described by the soldiers themselves as particularly disturbing, the attempt should be made to estimate as accurately as possible the intensity and duration of the artillery action from day to day during the course of the study. The soldier to be observed would be sent to the rear after his first night on the MLR for interview and a small number of tests chosen from among those which the present investigation has disclosed as most sensitively recording the individual's reactions to stress. After five days at the MLR, and then after ten days, the procedure of tests and interview behind the line should be repeated to discover if there are demonstrable quantitative changes in the soldier's responses to the stresses at the MLR after five or ten days of habituation.

The practical aim of the proposed study would be to discover if, as reported at Sasebo, ten days is optimum for adjustment to this new situation of continuing danger. If this time is enough, then the line officer may plan accordingly, and may assign the new man to patrol or other hazardous duty with minimum risk of his failure because of unmanageable fear and anxiety.

PSYCHIATRIC OBSERVATIONS

To formalize the recording of psychiatric data a rating chart was made up which included some twenty odd factors in the developmental background, army experience, and present situation of the subjects tested. The various pertinent influences could be given an evaluative rank, 1, 2, 3, and 4. These factors were selected as the indices of the maturity and personality integration of the individual soldiers which were felt to be closely correlated with their reaction to stress. (A sample copy of this chart accompanies this report as part of Appendix B.)

As explained previously, the original plan of the team was to study either combat or ambush patrols, obtaining samples and observations some time before the patrol, immediately following, and again three or four days later. The tactical situation precluded such a study and the samples were taken from men involved in battalion sized offensive and defensive actions of much greater stress than any patrol activity. The interviews were conducted in a variety of locations: at the MASH, aid stations, clearing company, regimental reserve area, and on various sectors of the MLR. The time available was quite limited so that no single interview was of more than thirty minutes duration.

The subjects in Korea fell into four main groups: (1) Five psychiatric casualties evacuated to the clearing company. They are reported individually because of their particular value in the psychiatric phase of the study. They are included in Group VII previously described; (2) Twenty men from the assault company of a major, friendly offensive (Group III); (3) Twelve men from an infantry company which withstood repeated enemy counter-attacks for five days (Group IV); (4) Twenty men from an infantry battalion which had been in reserve and blocking positions (Groups V and VI).

<u>Group VII: Five Neuro-psychiatric Cases</u>

W-4352. This eighteen year old soldier was evacuated to clearing company from a heavy mortar company which had spent six months on the line. His acute reaction followed an incoming artillery round which landed only a few feet from his position. The nature of his psychological reaction is not known; but he must have been pretty disturbed as he was heavily sedated with Sodium Amytal at the battalion aid station. When seen the day after, he showed no signs of psychiatric abnormality. He was hostile and defensive, apparently to compensate for his guilt feelings for being hospitalized without physical injury. He was held at clearing company for three days, only because more experimental data was desired. He was anxious to return to his platoon - a group in which he was proud to be a member. This man ran away from home when seventeen years old because of difficulty with his father. He is the third of nine siblings. Hostility toward the father with guilt may have been contributory to his reaction. The situational factors in his unit appear to be good and to stimulate integration and good motivation.

P-4360. This twenty-three year old soldier was evacuated to clearing company from an infantry company which had spent six months on the line. He had been out on more than twenty patrols on only one of which was there contact with the enemy. This man suffered from a combined conversion-dissociative reaction manifested by inability to speak, loss of affect, no change of facial expression, passivity, dependency, transitory disorientation. His break followed two days of enemy offensive in which at least four friends were killed. Because of his inability to talk, adequate information was not obtainable. He professed a strong Roman Catholic faith. In his training he felt more anxiety in firing the rifle than in going through the infiltration course. This observation, combined with his most disabling symptom - muteness - would indicate a primary inability to express aggression. His recovery was very slow and after six days observation at clearing company he was evacuated to a psychiatric hospital in Korea.

S-7571. This twenty-three year old soldier was evacuated from the assembly area prior to his units' departure for an offensive. He was reported as speaking irrationally and refusing to get out of his sleeping bag. When seen the following day at clearing company he showed only mild signs of anxiety. He claimed amnesia for the time of his evacuation. He had served with his company on the line for four months and had been on only three patrols. On one of these he received enemy fire. There is nothing in this man's background to indicate any psychiatric abnormality. He is large physically and of a considerably higher intelligence than the average of the group studied. He was returned to duty and when seen again on the line was making a good attempt at reestablishing his self respect and acceptance by members of his platoon. It is felt that there was a large conscious element in this man's reaction and that the primary problem was one of poor motivation.

P-5803. This twenty-two year old soldier was first seen at the forward battalion aid station on the morning of the friendly offensive. This man had an excellent civilian background, having attained a bachelors degree in economics. He is large, athletic, and socially well adjusted. He resigned from Officers Candidate School after completing 16 weeks. He had been with his unit only five weeks and had been on a few patrols. There had been no real combat experience prior to the attack under consideration. He had functioned well in the initial assault as an assistant squad leader. His psychiatric break came after carrying a seriously wounded friend down the hill to safety, only to find that he had died on the way down. He was crying uncontrollably and was completely out of contact a few minutes later at the aid station. He cried continuously throughout the next day, but managed to control himself rigidly when returned to duty on the second hospital day. He was seen some two weeks later on the line where he was a squad leader. He had refused the offer of the relatively safe job of jeep driver.

This last case exemplifies several important factors. The subject was potentially a very good soldier and probably is functioning as such now. The two factors which precipitated this man's break were: (1) Close and rather long contact with a fatally wounded friend; (2) Being in a position of relative security where the maintaining pressures of actual combat were not present. These are frequent findings in psychiatric casualties among well-motivated and well-integrated soldiers.

G-0442. This twenty-four year old sergeant was first seen at the battalion aid station on the morning of the friendly attack. He had fainted after walking only a few yards from the point of departure on the MLR. When seen a few minutes later he was apathetic, retarded, and could neither speak nor hear. Because of his condition it was impossible to obtain the data desired. He is of high normal intelligence. His present assignment was his second in Korea. He had served a full tour of duty with an infantry company and rotated to the Zone of Interior. He states that he struck an officer and was returned to Korea as a disciplinary measure. He was reported as being a "lone wolf" in his company and being the butt of many jokes. He functioned well on previous patrols. He was a frequent visitor on sick call with previous conversion symptoms - anaethesias of the hands and feet.

Conversion reactions in combat are frequently very close to the conscious level because of the high primary gain. This man had plenty of reason for poor motivation. This case is an example of the results of using Korea or even joining the Army as a form or equivalent of punishment.

Group III

This group consisted of 20 men from one of the assault companies in a large scale UN offensive. This company had spent most of the past six and one-half months on the line. They had suffered approximately forty casualties during the previous month while guarding an outpost position. The company had approximately 220 personnel including four officers. There were very few Korean and Puerto Rican soldiers, and only about 15 new replacements in the preceding month. Enlisted rank was tremendously deficient. Practically the entire company was committed in the assault, cooks being used as ammo-bearers, etcetera. About sixty men returned from the action without injury. The company was first observed for only a very short period of time after they knew they had been committed to a major offensive action. The common characteristic of all the men was a state of tension in preparation for a most serious testing of themselves. Roughly, the behavior of the individuals in this group experience was observed to fall into three general types:

Type I. There was a marked pressure of speech, motor hyperactivity, mirthless smiles and jokes, strong group interdependence. This reaction was seen in most of the men in the company; and probably represented men who had seen no real offensive combat and who were in a position (non-leader) to solicit emotional support from their friends. (M-3290 was typical of this category.)

Type II. Self confident, serious, realistic, normal motor activity, cooperative but preoccupied by the major job at hand. Answered questions freely, but not loquacious. This reaction was probably representative of men with previous successful combat experience and/or leaders who felt adequate to their job. ("Schow"; H-4808; B-7531 are representative.)

Type III. Reserved, serious, fearful, unsure, slight motor retardation, not mixing much. This reaction was probably representative of men with previous unsuccessful combat, immature personalities, and leaders who felt inadequate in their assignment. (C-4136, A-4492 typify this category.)

When observed at the aid station the men lightly wounded in action (LWIA) were generally tremendously relieved to be honorably evacuated with minor wounds. They were tremulous, showing pressure of speech and happy dependence (typical was J-4852).

The remnants of the company were observed approximately eighteen hours after withdrawing from combat. All displayed great physical fatigue and motor retardation. There was very little humor, but when they did smile it carried some meaning. The tension was gone; they were more relaxed. They were deployed in small closely knit groups about the company area, cleaning rifles and getting their equipment into shape. They appeared unable to rest even though the opportunity was available. They showed varying degrees of bitterness, pride, reserve, and hostility toward the interviewer.

At about noon they were informed that they were to go back on the MLR that night despite being at less than 50 percent strength and with only 15 KATUSA (Koreans attached to US Army) replacements. Their initial response was one of anger, increased bitterness, and reticence. H1296 stood out as being totally incapable of expressing hostility in this situation.

When seen on the line, four and six days after the assault, the persistence of their physical fatigue was marked. Very little sleep was obtainable. Twelve of the men were observed back at the MASH on the fifth day after the attack relaxing with cans of beer. Ten of the twelve were actively ventilating and "working through" their recent traumatic experiences. Two depressed, introspective exceptions were M-0305 and T-9985. On the other hand, W-1083 and W-2990 seemed to recover more rapidly than most. They were probably able to get more rest, being assigned to the communications section. S-7808 was lightly wounded in action later this same evening on a patrol and was exhausted the following day.

Of the twenty men studied, five were estimated to be superior combat soldiers, seven good, three fair, and five poor. In the five superior soldiers the following factors stand out: optimal parental background, rural environment, large physically, expert riflemen, better than average intelligence, and two months or more with the unit. The five contrasting soldiers showed: poor parental background, poor civilian occupation pattern, anxiety at both infiltration course and rifle range, small physical size, and low intelligence. Three had over thirty points for rotation. One had been with the unit only three weeks. One had accidentally shot and killed a friend on a patrol.

One was thirty-one years old and had been a mail clerk for the past two years. The seven soldiers classified as "good" were a cross section of average Americans who were able to mobilize aggression adequately in combat. The determining factors in this group are too variable to attempt even a cursory summary.

In the two weeks preceding observation Group IV had fought active defensive actions on two outposts and against repeated enemy counterattacks for a period of five days. This group had been under more prolonged but appreciably less intense stress than the previous group. The outward signs of physical fatigue were about the same, but these men talked much less freely and were much more likely to sleep whenever the opportunity presented itself. The combat effectiveness of this group was estimated as follows: three superior, six good, two fair, and one poor. Of the superior combat soldiers one was similar to those described above. Another was a very small full-blooded American Indian who drank continuously when not in combat and was a chronic source of trouble. In combat he was an excellent leader and gave the men more confidence than the platoon leader. The third was also typical except for very low intelligence. The two fair soldiers were both twenty-four years old, married, negroes of low intelligence who had been with the unit only a short time (three and six weeks respectively). These men may improve as they become better integrated in the unit. The poor soldier in this group (B-5392) was suffering acutely from his combat experience. He presented the following picture shortly after being withdrawn from combat: unreally idealistic, overly religious, self accusatory, speech impediment, marked pressure of speech, tremendously fearful, guilty, thought to be on the verge of a psychotic break. He was later reported by his platoon leader as almost "cracking up" on a subsequent patrol - crying, complaining loudly and bitterly. Ten days later, he was much improved, showed relatively free play of facial expression, was still talkative but not under pressure to talk as before.

The last group comprised 20 soldiers selected from the line companies of the first battalion of a third infantry regiment (Groups V and VI). This battalion had captured a hill two and one-half months earlier and spent some five or six days there as an outpost. They suffered moderate casualties at that time and had seen no combat since (Corps reserve). At the time of our study they were occupying a blocking position on the MLR. Therefore, there were no signs of physical exhaustion or anxiety (except in a few new men). They were perceptibly less cooperative and productive than the previous groups studied. Four of this group had no combat experience so that their evaluation as to combat effectiveness could not be made. Of the remaining 16 one was estimated to be superior in combat, eight good, four fair, three poor. These men were selected by their commanding officers to be brought down to the MASH. It is strongly suspected that many of them were men who were not performing well in their jobs and could thus be most readily spared.

The analysis of normal behavior before, during, and after combat shows many individual variations: reserve, pressure of speech, psychomotor retardation, hyper-alertness and hyper-mobility, anxiety, depression, etcetera. Of the 32 subjects in the two experimental groups under consideration only one (B-5392) displayed a pathological variation.

Theoretically, every man must have a breaking point. This covers a very broad spectrum from the man who becomes psychotic at the army induction center to the soldier who can sustain prolonged active combat without apparent pathological deviation. Combat can result in a good (ego-strengthening) or a bad (ego-weakening) effect on the individual; depending largely on whether the individual's performance conforms with his own standards or ideals. It has been proven repeatedly that the early return of selected neuropsychiatric casualties to combat from the lowest echelon possible results in saving manpower for the army as well as giving the individual additional opportunity to prove himself. Needless evacuation has a tendency to cripple the man (unconsciously he feels that he must remain sick to justify his evacuation from combat). Finally, in evaluating the effects of combat on any man a longitudinal, rather than a cross-sectional approach must be used.

It is important to note that no psychiatric casualties occurred during actual combat. From the data presented it would appear that the factors which predispose to combat exhaustion are: (a) close and prolonged contact with friends killed or seriously wounded; (b) incoming artillery and mortar fire, as opposed to small arms fire and close combat; (c) being alone in a position of relative security where the pressure of interdependence is off.

It would seem that the best combat soldiers are characterized by the following: optimal parental background, rural environment (farmers), expert riflemen, large physically, better than average intelligence, and at least two months with their present organization. The poorest combat soldiers are characterized by the following: poor parental background, poor civilian occupational pattern, anxiety at both infiltration course and rifle range, small physical size, and low intelligence.

It should be noted that one of the most important factors in establishing combat effectiveness is the cohesiveness of the small fighting group and the interdependence of the individuals. Factors in influencing group cohesiveness and esprit which will be further considered in the final report and which should probably be further investigated include the following: non-English speaking troops; interdependence in combat; deficiency in enlisted rank; the rotation program; leadership; marked variations in age; and the use of combat as a form of punishment.

GENERAL DISCUSSION

In order to analyze the problem of stress in the combat soldier, information in three distinct areas is essential: (1) The changes both physiological and psychological, which occur in the human organism as a result of battle stress must be measured and understood; (2) The principal components of the combat experience which make battle stressful, such as fear of body injury, must be evaluated; (3) The many factors which modify these stressful components of battle, such as effective leadership, need identification and detailed consideration.

The primary purpose of the research of this team has been to add to the understanding of the changes occurring in the soldier as a result of combat stress, and objective physiological and psychological measurements were made to accomplish this end. Figure 34 is a generalized, schematic representation of the inter-relationships of these various measures and the bodily functions studied. It is not meant to be an accurate theoretical representation of the response of the body to stress. The physiological measures used fall into two categories: those measuring changes in the pituitary adrenal system; and those involving the autonomic nervous system.

HISTORICAL BACKGROUND

From a historical point of view, there have been three main areas of study in stress physiology. The earliest phase was that concerned with the study of muscle physiology as a result of the development of measures based on ergometers. This was followed by the contributions of Walter Cannon, who developed the principle of homeostasis from the earlier concepts of Claude Bernard to describe the maintenance of a steady state by the organism.30/ Cannon also explored the maintenance of homeostasis in the face of environmental crises by autonomic stimulation and the secretion of adrenalin. His studies were concerned primarily with respiration, circulation, the gastro-intestinal system and body temperature. One of the most important recent advances in stress physiology has been the elucidation of the function of the adrenal-pituitary system. In this, the emphasis has been on biochemical measurements related to adrenal cortical function.

30/ Cannon, W.B. The Wisdom of the Body. (Second Ed.) New York, W.W. Norton and Company, Inc., 1939.

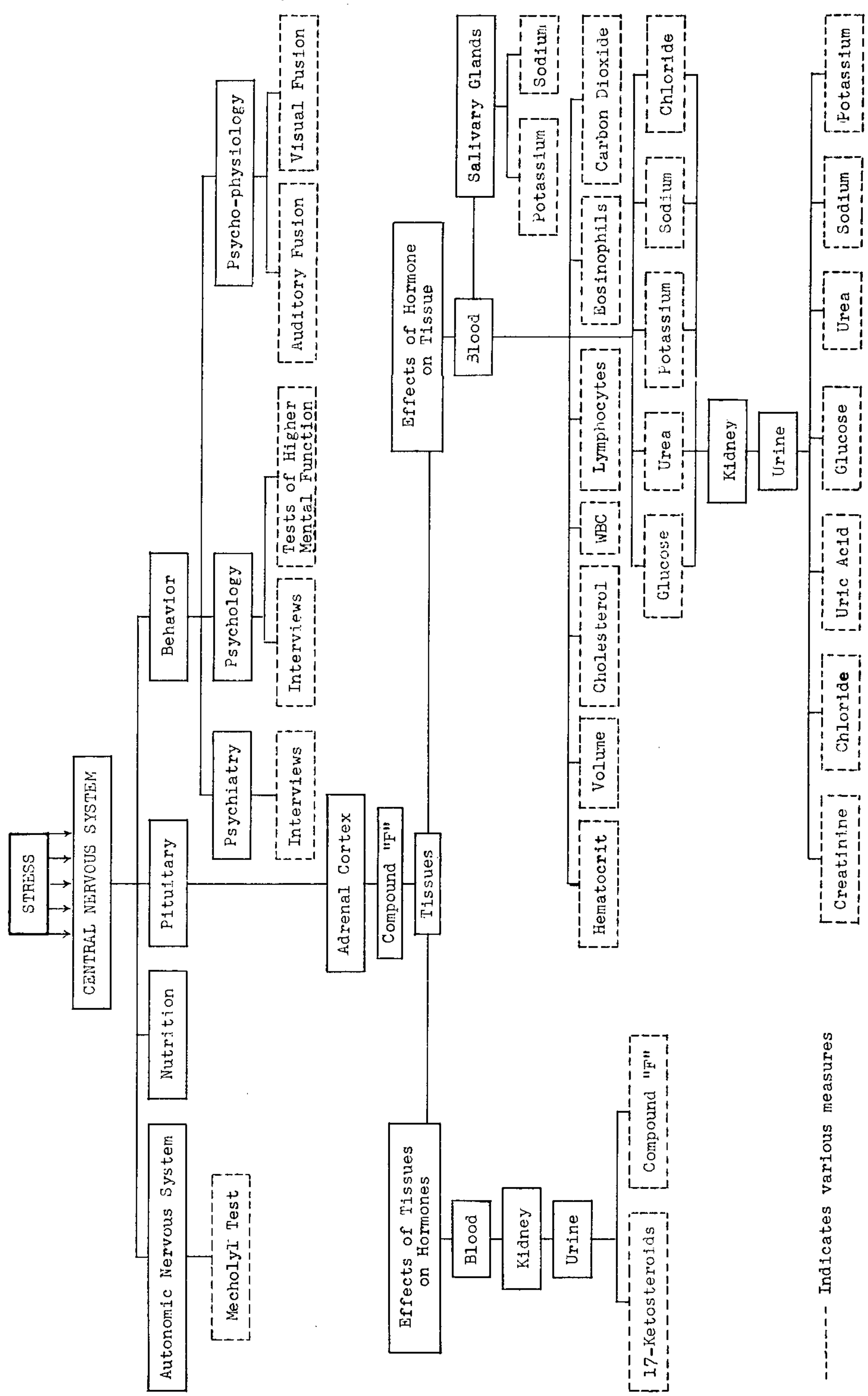


Fig. 34 - Schematic Representation of the Measures Employed in this Study

There is considerable experimental and clinical data indicating the involvement of the adrenal cortex in various stress situations. Although each stress, such as a burn, wound, infection, or psychic disturbance, has a description and a response specific for the stressing agent, there is one response in the organism common to all these different conditions which involves the function of the adrenal cortex. This adrenal cortical response is called the non-specific stress response of the organism. As to how this mechanism is implicated, the following is quite certain: the stress condition causes the pituitary gland to secrete adrenocorticotrophic hormone (ACTH). This in turn stimulates the adrenal cortex to secrete its hormone, which is principally compound "F." However, the mechanisms of pituitary stimulation are not as yet completely understood. There are three theories which are tentatively accepted by most endocrinologists. These theories complement each other and are not in the least incompatible.

Hypothalamic Control

The main contributions to this area of study are associated with the names of Hume in the United States and that of Harris in England. Electrical stimulation of the paraventricular nuclei and tuber cinereum of the hypothalamus causes stimulation of the adrenal pituitary axis. Stimulation of areas adjacent to these nuclei gives negative results. Furthermore, there is evidence that the integrity of these nuclei is essential for adrenal response in stress; following cauterization of these nuclei the adrenal response to stress is rendered ineffective.

Adrenalin Control

The main contributions to this theory are associated with the name of C.N.S. Long. It is known, from the studies of Cannon, that the adrenal medulla secretes adrenalin in stress situations. It has been found that the injection of adrenalin in physiological doses causes discharge of the adrenal pituitary system. This theory states that in stress adrenalin is liberated through the action of the autonomic nervous system and is also implicated in the stimulation of the pituitary, either directly or via the hypothalamus.

Utilization Theory

The principle contributor to this theory has been Sayers. It has been shown that previous injection of adrenal cortical extracts or adrenal cortical hormones decreases the effectiveness of the adrenal response to a standardized stress. Furthermore, the various active steroids have different degrees of effectiveness. It is inferred that the need of tissues for adrenal hormones controls the rate of secretion of the pituitary hormone (ACTH).

The mammalian organism cannot survive without the proper function of the adrenal cortex; nor can the organism withstand a stress situation or make adjustments to stress without the proper functioning of this gland. Fatigue states have been described which are related to the hypofunction of the adrenal gland. A wealth of experimental data supports the primary position of the adrenal cortex in stress situations.

Some twenty-five steroid substances have been extracted from the adrenal gland. Only six of these compounds are physiologically effective. These are corticosterone, 11-dehydro-corticosterone, 11-desoxy-corticosterone, 17-hydroxy-corticosterone, 17-hydroxy-11-dehydro-corticosterone, and 17-hydroxy-11-desoxy-corticosterone. From perfusion experiments and direct examination of the blood in intact animals, it is apparent that two of these substances, namely corticosterone and 17-hydroxy-corticosterone, are the hormones of the adrenal cortex, with the former, known also as compound "F," being the principal one.

RESULTS OF AVAILABLE DATA

Physiological Measures Employed

The measurements of adrenal cortical function may be divided into two principal categories: (a) the measurement of the amount of actual hormones secreted or of the metabolic end products of the hormones excreted in the urine; and (b) the measurement of the effect of the hormones on tissues and organs. This study has utilized both types of measurement.

The two areas of study for which the data are not yet available, namely the estimation of the compound "F" in the urine and the 17-ketosteroids in the urine, are examples of the first category. The measurements that cover the effect of the adrenal hormones on tissues and organs may be subdivided into several groups. The first of these is the hematology. In stress situations there is a decrease in the number of circulating lymphocytes and eosinophils and an increase in the polymorphonuclear leucocytes. The lymphopenia and eosinopenia are apparently dependent on the function of the adrenal cortex.

Important in the synthesis of hormones in the adrenal gland is cholesterol. This sterol is found in large amounts in the adrenal cortex and may be an important precursor to the actual hormones secreted. The measurement of the blood plasma cholesterol level has indicated a decrease after ACTH injection; this determination is used as an index of adrenal cortical function.

The catabolic phase of stress has been a much studied area in adrenal physiology. Although not caused directly by the increased adrenal function, it is quite apparent that adrenal function facilitates this catabolic phase. The catabolic phase has been seen in experimental animals in the atrophy of lymphatic tissue and the thymus and in the decrease in the circulating lymphocytes. Measurements usually made to examine the catabolic process from a biochemical point of view are urea and uric acid, the principal biochemical end products of tissue breakdown. Finally with increased adrenal function there are marked changes in carbohydrate metabolism. Decreased tolerance for sugar has been shown in hyperadrenal conditions and after hormone administrations, both ACTH and corticoids. Also, there is an increased incidence of glycosuria. In the present study the urine was analysed with respect to both glycosuric levels and variations of sugar excretion within normal limits.

Because the determinations of the urinary steroids and of sodium and potassium have not been completed, these measures cannot yet be evaluated in terms of the other findings.

Among the determinations which showed no specific changes due to combat are blood sugar, hematocrit, blood volume and plasma carbon dioxide.

Changes in plasma carbon dioxide due to combat were not detected, possibly because of the lapse between the time of withdrawal of the men from combat and the time of sampling; thus, hyperventilation which might have occurred during combat was not detected. On the other hand, there is some indication that the plasma carbon dioxide was lowered during the anticipatory state.

The stability of the hematocrit and blood volume values were expected, and these results reinforce the findings from the other blood data. No significant changes in blood glucose were observed.

Among the significant changes as a result of combat were the determinations of blood eosinophils, lymphocytes, plasma cholesterol, blood urea, and urinary chloride. The pattern of decrease in chloride excretion in plasma cholesterol, in number of circulating eosinophils and lymphocytes, and increase of blood urea, is consistent with findings obtained after adrenal cortical stimulation. The uric acid-creatinine ratio, which in previous work has shown significant changes after stress or increased adrenal cortical function, was not significantly greater in the stress sample than in the non-stress sample, probably because of the lack of control of such factors as diet and time of sampling under field conditions. This was also true of urinary urea excretion. The changes in these nitrogenous excretory products were in the expected direction however.

A few days after combat, the eosinophils, lymphocytes, plasma cholesterol, blood urea, and urinary chloride returned to normal levels. This may be interpreted as a return to normal adrenal cortical function after the increase which occurred consequent to the stress of combat. Considerably more information is needed on the time course of the recovery process; indications from the present data are that several days may be needed for full recovery.

Previous stress studies have not included the variation of urinary sugars within the normal values. After this stress situation there was a significant increase in the urinary glucose values, although still within normal levels. Furthermore, when sugar was found in glycosuric amounts after ACTH administration, there was a marked decrease in urinary sodium excretion. The converse, however, was not true.

The individuals who had been subjected to the intense combat stress (Group III) exhibited clear signs of dehydration. Although they had been withdrawn from active combat for about seventeen hours before they were examined, the specific gravity of their urine was significantly higher than normal. This was also true of the urine creatinine level. The effect of this degree of dehydration on pituitary adrenal function is only a matter for speculation at present, but may well be important. Further research is required along these lines.

Another heretofore unreported finding was the discovery, in the individuals subjected to severe combat stress, of a marked leucopenia with an increase in the immature polymorphonuclear leucocytes. This phenomenon has been observed within fourteen hours after severe burns, and in the terminal stage of acute infections. Generally, in stress there is an increase in the number of leucocytes with a shift toward a larger percentage of immature polymorphonuclear leucocytes. Leucopenia has not been reported even after large doses of ACTH. Five days post combat there was a tendency for the percentage of immature cells to decrease, and the leucocytes to rise toward normal levels; 22 days after the principal engagement the blood picture was that of an increased number of leucocytes, with a return to normal proportions of mature cells.

It is difficult at present to evaluate the complete picture with regard to adrenal cortical physiology because of the lack of steroid and electrolyte data. There is no doubt that adrenal cortical function in men in Korea, not in active combat, is normal, while immediately after severe combat stress there are marked signs of increases in adrenal function. The largest increases were observed in the casualties, both psychiatric and wounded. Further, there was a tendency for the increased adrenal function to return toward normal by the fifth day, and recovery was practically complete 22 days after the severe combat stress.

Perhaps more important than the level of activity is the reserve capacity of the adrenal cortex in time of stress. If the adrenal is functioning properly, the individual will be able to withstand continuing stressful situations, but if the reserve is expended, the ability of the individual to withstand such situations is lost. The measures employed may give an indication of adrenal reserve as well as adrenal activity, however, such indications are not apparent in the data available at present. The ACTH test was employed to evaluate the adrenal cortical reserve more directly by stimulating the gland to its utmost capacity and measuring the response. But an evaluation of this test cannot be made until the steroid and electrolyte data are available. Consequently, no conclusions can be drawn at this time regarding the reserve capacity of the adrenal cortex.

The sympatho-adrenal medullary system has long been recognized as the mediator of those physiological changes which bring about a rapid adaptation of the organism to meet an acute emergency. Adrenalin liberated by the immediate reaction of the adrenal medulla to stress stimuli, may also serve as the triggering mechanism for the release of ACTH, thus bringing about the longer lasting adaptation required for survival if the stress situation should continue.

The Mecholyl test was considered as a possible means of measuring the reactivity of the autonomic system, in particular those portions concerned with vascular and cardiac adjustments. To this extent the test is analogous to the ACTH test for determining adrenal cortical research.

The simplicity of the Mecholyl test made it quite suitable for field studies. Further, it was found that the response pattern displayed by the unstressed individual is reproducible, so that deviations from this pattern occurring under different test conditions are rather easily noted. Although the number of individuals in the test categories was small, changes in the response patterns, compared with patterns in the same subjects after recovery, were definitely greater than in tests and retests of a comparable group of subjects who had not been in active combat.

In the group subjected to acute combat stress, hypertension was found existing as long as eighteen hours after the subjects had retired from the combat situation; this can be regarded as a sustained elevation in tonus of the vasomotor center. The response pattern to the depressor stimulus of Mecholyl was otherwise essentially the same as in the same group after four days recovery. This finding would suggest that in acute stress, simple blood pressure measurement in the resting subject may be as informative as the Mecholyl test itself, and could be conducted on a far more extensive basis than is permitted by the more elaborate Mecholyl test.

In the group subjected to less acute but more prolonged stress, there was essentially no greater hypertension than was apparent in the control group. However, there was evidence of disturbances in the maintenance of vasomotor tone; moreover, the sympathetic discharge in response to Mecholyl appeared diminished. This may mean a decreased response by the autonomic centers mediating the reflexes concerned in restoration of blood pressure after Mecholyl vasodepression. Another possible explanation is the exhaustion of the adrenal medulla, or possibly a decreased sensitivity of the vessel wall itself to the medullary hormone and the sympathin liberated by the vasomotor endings. These constitute areas for future research.

The time elapsing between the end of the combat situation and the test itself may have been sufficient for partial recovery of normal autonomic function. Hence, until studies can be carried out promptly after the end of the stress, the full extent of autonomic disturbance produced by combat stress will remain unknown. However, there appears to be sufficient promise in the present findings to warrant further study on combat as well as on training.

Psychological Measures Employed

The objective psychological measures employed were based on a large body of research available on the psychological effects of stress. In general, the research in this area has attempted to demonstrate and quantify behavioral changes. Tests of higher mental function, psycho-motor tests, and the various projective techniques have been the main psychological measures used. For purposes of field expediency, the projective techniques were not employed because of the length of time taken to administer them. The tests of psycho-motor function require considerable apparatus which make them undesirable for field use, in addition, the research literature indicates they are not as sensitive indicators of changes resulting from stress as are tests of higher mental function. These latter measures, as well as apparently being the most sensitive, meet the requirements of ease of administration and convenience of usage in the field and were therefore the measures emphasized in this study. The original faith in these measures has not been justified, at least by this preliminary analysis. The possible reasons why these carefully selected measures failed to give significant results for these experimental conditions are many. Lack of controlled conditions, length of time after the stress before testing, lack of sensitivity for this situation, large practice effects, are the most obvious. The very large and definite changes observed in the physiological measures, along with the data from interviews and the general observations of the various experimenters strongly indicate that there must have been concomitant psychological changes. Whether the failure to obtain meaningful results is a product of unsatisfactory measuring instruments or inadequate use of these instruments appears to be relatively unimportant at this juncture. Psychology as a science has not yet provided measuring instruments suitable for studies of this nature.

Psychology, as any other science, increases the sensitivity of its measures through careful standardization and control. In Korea, the team established a physiological and biochemical laboratory in which the analysis of the obtained samples could be carefully controlled. It made little difference where the blood and urine samples were obtained just so long as they were obtained and transported to the laboratory without being contaminated. The laboratory of the psychologist, however, is the place where his tests are administered. In a combat zone it is practically impossible to establish a suitable psychology laboratory. The better the laboratory, i.e. the more controlled the conditions, the farther back it must be from the combat area. The farther back, the greater the time lag between the occurrence of the effects and the measurement of those effects. It is a matter for conjecture whether sacrificing the small amount of available control in order to decrease the time lag would have provided more significant results. Perhaps more emphasis should have been placed on adequately controlled conditions, at the expense of time lag. In any event, it is felt very strongly that adequate objective psychological measures for this study were not available. For psychology to contribute very much to this area of field measurement, it must develop new tests or other devices for which strict standardization and control are not basic requirements for sensitivity. Perhaps tests of perceptual abilities, either auditory or visual, might be sensitive to changes as a result of stress and permit some freedom from the requirement of standardization.

The measurement of the visual and auditory fusion frequencies as indicators of changes resulting from stress is somewhat new. Theoretically, these measures record changes in the sensitivity of the cortex. Just what brings about these changes is not known. Nor is it known how these measures may best be used to be most sensitive. It is entirely possible that different on-off ratios, or different intensities of sound or light than were used in this study might make these indices far more sensitive stress indicators. It is apparent from the data presented here that further work with these instruments is necessary and might prove valuable.

The qualitative evaluation of psychological changes obtained through interviews and other observation has pointed out several interesting factors. One of the most striking behavioral characteristics of the stress groups was changes in levels of group sociability. This might be a fruitful area for future research. Suitable sociability scales could well be developed, or perhaps some measures of spontaneous vocalization might be simpler to accomplish.

The primary purpose of extensive interviewing in Korea and at the Sasebo Replacement Depot was to obtain more detailed information as to just what in the combat experience is stressful, and what are the most important modifiers of this experience. There is little doubt that the following include the most important aspects of stressful combat experiences: (1) Fear of physical injury; (2) Unpleasant affect associated with the unavoidable physical discomforts of battle; (3) Empathy with other unit members leading to vicarious experiences of mutilation or death; (4) Fear of social disapproval; (5) Fear of official disapproval and its attendant punishments; (6) Fear of damage to ones self-picture. While not listed in order of importance (1) and (2) are generally considered basic drives, while the remaining factors are motives involving more complex learning. All these factors cannot be eliminated; however, their effect can be modified considerably. An analysis of the interview data indicates that the following are the major modifying factors over which the military has some control: (1) Leadership (all men interviewed said they were less afraid and had more confidence when they had good leaders); (2) Combat experience (there is no doubt that there is adaptation to combat conditions); (3) The ability of the combat soldier (the soldier's intelligence, physical fitness, personality structure, and training all affect his ability to withstand the rigors of combat); (4) Morale factors (the soldier's food, pay, clothing, attitudes about the war in Korea, promotion and rotation all modify effects of the basic factors outlined above); and (5) Interpersonal relationships (the social cohesiveness of his unit, which might be broken up by the presence of "odd-balls" or soldiers of strange cultures and languages or a disproportionate number of new men, are of prime importance to his dependence on others in combat).

In general, the results of the physiological and psychological measures made in this study indicate that the stress encountered in active combat results in clearly marked changes in function. It cannot be stated at this time what relationship these changes bear to the practical questions of how much the effectiveness of the combat infantryman may be reduced, or how close he comes to psychiatric breakdown, as a result of exposure to combat stress. On the basis of the present knowledge of stress, the relationship exists, and by continued study of combat stress it should be possible to define it more precisely.

TECHNICAL CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

1. The hematological findings indicate a lymphopenia and eosinopenia, with a rapid return of eosinophils and a slower return of lymphocytes to normal. Also observed were a leucopenia and neutropenia with an appearance of immature polymorphonuclear leucocytes.

2. No changes in hematocrit or blood volume were observed in stressed subjects. A weight gain was observed upon recovery, which was attributed to rehydration.

3. A decrease in chloride excretion was noted after stress, with considerable variability attributed to uncontrolled diet. Small, but significant changes in plasma chloride were also observed following combat. Data for the sodium and potassium analyses were only partially available at the time of this report. The preliminary results indicate that the Na/K ratio of saliva and urine will serve as an index of adrenal cortex activity.

4. Changes in plasma carbon dioxide were not observed following combat; however, low levels were noted, indicating hyperventilation, in the anticipatory phase prior to combat.

5. The plasma cholesterol level decreased as a result of combat stress. Considerable individual variation of normal values makes control determinations necessary.

6. Meaningful changes in uric acid excretion were not observed, probably because of dietary effects and diurnal variation.

7. A relation was not found between creatinine excretion and stress. However, the creatinine output was relatively constant and served as a base line for the comparison of other excretory products. This was especially valuable because of the difficulty in obtaining reliable data on the elapsed time of urine collections. The creatinine concentration, along with specific gravity of the urine, served as an indication of dehydration of subjects. Marked dehydration was found in one post-stress group.

8. Alterations in nitrogen metabolism in stress were indicated by increases in blood urea levels and urea excretion, in spite of low nitrogen intake. Large variations among individuals were found.

9. Urine sugar output was generally higher than normal in stress.

10. On the basis of some of the physiological measures, it appears that recovery from severe combat stress is not complete four days after removal from the stress. Considerably more work is required, however, to reach positive conclusions on this score.

11. The simplicity of the Mecholyl test for autonomic reactivity makes it a suitable method for field studies.

12. In re-testing non-stressed subjects the pattern of systolic blood pressure after Mecholyl is reproducible within satisfactory limits.

13. Eighteen hours following acute combat stress the chief difference in the composite Mecholyl pattern of four subjects compared with the pattern after four days of recovery is a degree of initial hypertension exceeding that seen in the corresponding test of the control groups.

14. In a group of four subjects subjected to more lasting stress initial hypertension is not evident. Instead, the composite pattern as compared with that after ten days of recovery exhibits the following features: a gradual decline in the base line; diminished extent and duration of overshoot after Mecholyl depression, and a final pressure level lower than at the start.

15. In general, the autonomic centers concerned in maintaining blood pressure appear to be less reactive following prolonged stress.

16. The tests of higher mental function used in this research failed to demonstrate a significant decrement in response to combat stress in this preliminary analysis.

17. There is some indication that improvement in higher mental function may occur as a result of stress.

18. Failure of the tests of higher mental function to show significant change may be due to the following: (a) the tests were not sensitive enough to show the effects of stress; (b) the inability to control test conditions adequately; (c) the time lag between the occurrence of stress and its measurement; (d) the effects of practice from repetition of the tests masked changes present.

19. The results of the Card-Sort test indicated that soldiers closer to combat demonstrate greater group solidarity.

20. Significant changes in the visual flicker and auditory flutter fusion frequencies as a result of stress were observed.

21. Considerable research on the measurement of auditory and visual fusion frequencies is necessary to increase the sensitivity of these measures still further.

22. The measurement of auditory fusion has advantages over visual fusion measures for field use because of the lack of interference of extraneous factors.

23. Knowledge of the factors which tend to modify the experiences of combat stress, may be obtained by adequate interview.

24. Effective leadership was cited as the most important factor in lessening the stressful experiences of combat.

25. Observable changes in overt behavior occur as a prelude to complete psychological failure of the individual in the combat situation.

26. With proper training, most platoon and company officers could learn to observe and become sensitive to these changes, so that combat soldiers could perhaps be removed from the stressful situation prior to complete collapse.

27. On the basis of interviews a leveling off period of approximately ten days is required for a soldier newly assigned to combat.

28. Although many psychiatric casualties were observed, there were no instances of psychiatric casualties occurring while an individual was actively engaged in a fire fight.

29. Some of the factors which predispose to succumbing to the effects of combat stress are: (a) close and prolonged contact with friends killed or wounded; (b) incoming artillery and mortar fire; and (c) being alone in a place of relative security.

RECOMMENDATIONS

1. Continued research should be carried on to further identify and interpret the physiological and psychological changes which occur as a result of combat stress, to evaluate the factors which give further rise to combat stress, and to determine more fully what factors tend to mitigate the adverse effects of combat stress.

2. Further studies in the field, specifically on combat stress, are indicated. The following problems should be considered:

a. Time relationships in the development of, duration of, and the recovery from combat stress.
b. The relationship of the degree of change in the physiological and psychological measures to the threshold for psychiatric breakdown.
c. The causes and effects of dehydration in combat soldiers.
d. The nutritional status of the men and combat stress.

3. More simple physiological and psychological indices of stress should be sought.

4. Procedures should be devised for the reduction of combat stress.

5. Research should be implemented to develop additional objective measures of the response of psychological functions to stress which are more amenable to field use.

6. Experimentation should be conducted to further define means for increasing the sensitivity and usefulness of visual and auditory fusion as measures of stress.

7. Measures of changes in the sociability within the small military unit should be investigated as possible indicators of the effects of stress.

APPENDIX A

SCHEDULE OF TESTS PERFORMED AND TABULATION OF RAW DATA OBTAINED

CONTENTS

TABLE A1

SCHEDULE OF TEST ON THE VARIOUS CONTROL GROUPS

Group	Run	Date	Days Btwn Runs	Men, No.	Individual	Blood Sample Time	Urine Sample Time	Test Time	Remarks
I	A	15 Sep 52	0	11	All	1800-1830	1800-2230	1800-2230	Camp Omiya, Japan
	A'	19 Sep	4	11	All	1300-1330	1300-1630	1300-1630	
	A''	23 Sep	4	11	All	1200-1230	0830-1200	1200-1530	
II	A	17 Sep 52	0	12	All	1230-1300	0830-1230	1230-1700	Camp Omiya, Japan.
	A'	21 Sep	4	12	All	1230-1300	0830-1230	1230-1630	
V	A	26 Oct 52	0	12	All	0900-0930	0900-1300	0930-1400	Korea; sampled and tested at MASH.
	A'	6 Nov	11	6	See Table A6	0845-0915	0830-1300	0930-1400	H-9329, K-3195 and W-9893 not repeated.
		7 Nov	12	3	M-3285 S-6942 W-7018	0930-1000	1000-1500	1000-1600	
VI	A	27 Oct 52	0	12	All	0900-0930	0900-1500	0930-1500	Korea; sampled and tested at MASH.
	A'	6 Nov	10	4	B-8787 C-6378 F-0536 W-1009	0845-0915	0830-1300	0930-1400	G-2474, G-6497 and K-4360 not repeated.
		7 Nov	11	5	See Table A6	0930-1000	1000-1400	1000-1600	

TABLE A2

SCHEDULE OF TESTS ON GROUP III (INTENSE COMBAT STRESS OF RELATIVELY SHORT DURATION)

Run	Date	Days Btwn Runs	Men, No.	Individual	Blood Sample Time	Urine Sample Time	Test Time	Remarks
A	13 Oct 52	0	24	All	1700-1730	1500-1730	1500-1730	Sampled and tested at Rear Collecting Area.
-	14 Oct	-	-	-	-	-	-	Started assault at 0600.
B	14 Oct	1	5	J-4852 P-1061 SCHOW SMITH G-5761	0910 0955 1110 1140 1145	- - - - -	- - - - -	Wounded; blood drawn at Aid Station. "
-	14 Oct	-	-	-	-	-	-	Withdrew from assault area at 2200.
B	15 Oct	2	1	SCHOW	-	0410-2140	-	Sampled as patient at MASH.
			20	See remarks	1330-1500	1230-1600	-	5 survivors from III-A plus 15 new subjects.
			12	"	-	-	1700-2030	12 of above 20 men tested at MASH.
C	19 Oct	4	8	See remarks	0830-0900	0645-0900	-	Sampled on MLR.
			12	"	1115-1145	0915-1300	1000-1500	Sampled and tested at MASH.
D	5 Nov	17	3	A-8639 H-1296 M-9987	0810-0820	0600-0830	-	Sampled on MLR; J-8455 and S-7808 not repeated.
			10	See remarks	0930-1000	0930-1230	1000-1400	Sampled and tested at MASH; L-6206 not repeated.
D	6 Nov	18	3	B-7531 W-0218 W-2990	1610 1550 1540	1500-1740 - 1510-1730	- - -	Sampled on MLR.
D	7 Nov	19	1	W-0218	-	0600-1300	-	Sampled on MLR.
	7 Nov	19	1	T-9985	1440	1410-1650	1400-1600	Sampled and tested at MASH.

TABLE A3

SCHEDULE OF TESTS ON GROUP IV (MODERATELY SEVERE COMBAT STRESS OF RELATIVELY LONG DURATION)

Run	Date	Days Btwn Runs	Men, No.	Individual	Blood Sample Time	Urine Sample Time	Test Time	Remarks
A	-	-	-	-	-	-	-	Not done.
-	15 Oct 52	-	-	-	-	-	-	Entered battle area at 1500.
-	20 Oct	-	-	-	-	-	-	Withdrew from battle area at 1500.
B	21 Oct	0	13	All	0400-0600	0120-0620	1000-1600	Sampled at Division Reserve, tested at MASH.
C	30 Oct	9	6	See Table A8	1415-1430	1415-1715	1430-1730	Sampled and tested at MASH; 0-8834 not repeated.
C	31 Oct	10	3	J-4476 P-4431 P-0411	1045-1100	1030-1430	1100-1430	Sampled and tested at MASH.
C	2 Nov	12	3	F-8576 L-0624 M-2880	1500-1515	1500-1800	1515-1730	Sampled and tested at MASH.

TABLE A4

SCHEDULE OF TEST ON GROUP VII (MISCELLANEOUS INDIVIDUALS)

Run	Date	Days Btwn Runs	Individual	Blood Sample Time	Urine Sample Time	Test Time	Remarks
A	-	-	-	-	-	-	Not done.
B	9 Oct 52	0	W-4352	0115	0145-0445	0200-0230	Psychiatric casualty; acute anxiety; sample at Regimental collecting.
		0	P-4360	0150	0250-0440	-	Psychiatric casualty; combat exhaustion (conversion hysteria); Regimental collecting.
		0	R-1552	0200	0200-0435	0230-0300	Lightly wounded; shell fragment wounds of face; no repeat; Regimental collecting.
	14 Oct	0	S-7571	0630	0740-1500	-	Psychiatric casualty; mild combat exhaustion; Regimental collecting.
		0	G-0442	0920	0925-1500	-	Psychiatric casualty: combat exhaustion (conversion hysteria); no repeat; Aid Station.
		0	P-5803	1055	-	-	Psychiatric casualty; Aid Station.
	30 Oct	0	K-2270	1430	1415-1720	1430-1500	Ambush patrol previous night; sampled and tested at MASH.
C	12 Oct	3	W-4352	1220	1045-1255	1800-1830	Recovered; sampled at Clearing Platoon.
			P-4360	1225	1050-1250	1830-1900	Not recovered; Clearing Platoon.
	19 Oct	5	S-7571	0910	0600-0915	-	Recovered; sampled on MLR.
	7 Nov	8	K-2270	1520	1515-1700	1800-1830	Sampled and tested at MASH.

TABLE A5

DATA FROM CONTROL GROUPS I AND II (CAMP OMIYA, JAPAN)

Individual	Height (in)	Weight (lbs)	Age (yrs)	Special Test	Eosinophils (cells/mm^3)			W.B.C. (cells/mm^3)			Lymphocytes (cells/mm^3)			Hematocrit (per cent)			Blood Volume (ml)			Urine Output[a] (ml/hr)			Urine Specific Gravity		
					A	A'	A''	A	A'	A''	A	A'	A''	A	A'	A''	A	A'	A''	A	A'	A''	A	A'	A''
GROUP I																									
B-4833	-	156	-	ME	432	988	1,106	10,550	14,300	19,850	-	5,850	9,528	48.2	46.8	43.8	-	-	-	-	93	139	1.022	1.007	1.008
F-4293	71	164	22	ME	131	188	188	14,050	11,900	11,575	-	4,300	8,093	45.5	50.0	47.3	-	-	-	-	51	43	1.016	1.017	1.022
G-1884	67	145	31	BV	293	263	169	8,725	6,775	5,400	4,890	4,250	3,240	44.4	45.6	43.0	4,148	4,310	-	-	43	77	1.023	1.023	1.017
G-3336	72	185	21	BV	231	246	263	10,700	10,500	9,550	6,850	3,600	4,680	46.2	49.0	46.3	5,795	-	-	-	79	103	1.006	1.013	1.005
J-9670	69	163	21	BV	250	205	213	7,950	6,500	6,800	4,850	3,440	3,740	47.0	49.0	46.5	7,719	4,335	5,980	-	45	42	1.019	1.006	1.020
M-7856	65	167	24	ACTH	138	106	294	12,800	-	10,175	8,960	-	4,263	51.0	-	51.5	-	-	-	- 84	147 130	45 39	1.020 1.011	1.007 1.007	1.025 1.026
R-5249	-	133	-	ACTH	144	100	150	9,800	9,375	11,525	5,488	3,725	4,946	48.5	49.1	47.3	-	-	-	- 112	110 115	64 28	1.020 1.006	1.009 1.002	1.018 1.016
W-0689	-	153	-	ME	94	213	200	9,950	8,425	8,500	-	6,000	3,740	46.8	44.5	46.5	-	-	-	-	54	70	1.015	1.016	1.016
W-9926	-	142	-	ACTH	288	388	175	11,300	9,825	10,500	5,085	2,450	3,700	50.0	51.0	46.0	-	-	-	- 117	106 153	104 44	1.022 1.006	1.012 1.004	1.013 1.014
V-4828	63	136	24	BV	1,088	581	863	12,400	9,525	12,775	5,704	5,250	5,150	49.5	48.4	45.0	4,448	3,990	6,990	-	67	43	1.029	1.011	1.024
V-1030	66	138	21	BV	144	121	163	9,200	6,225	6,825	5,520	3,300	5,600	40.7	44.1	38.5	4,642	3,840	5,520	-	219	94	1.017	1.004	1.013
GROUP II																									
B-2258	69	161	21	ME	2,838	2,850	-	11,250	-	-	2,700	-	-	41.7	43.8	-	-	-	-	68	9	-	1.013	1.009	-
E-4332	-	154	-	ME	113	106	-	6,900	-	-	2,400	-	-	53.0	51.5	-	-	-	-	67	50	-	1.014	1.020	-
H-4815	73	150	19	ME	106	88	-	7,125	-	-	2,450	-	-	39.0	39.8	-	-	-	-	34	29	-	1.010	1.017	-
J-7455	-	152	-	BV	100	263	-	6,125	-	-	1,960	-	-	40.8	42.1	-	-	5,350	-	93	62	-	1.014	1.020	-
J-1789	67	154	25	ACTH	131	81	-	5,200	-	-	2,500	-	-	41.7	48.6	-	-	-	-	84 71	132 71	- -	1.005 1.012	1.012 1.012	- -
M-2878	-	156	-	ACTH	106	121	-	11,875	-	-	2,960	-	-	44.2	44.0	-	-	-	-	141 66	103 152	- -	1.006 1.004	1.017 1.004	- -
M-7056	-	157	-	ACTH	316	463	-	5,675	-	-	2,670	-	-	39.8	39.8	-	-	-	-	35 80	54 91	- -	1.023 1.008	1.020 1.010	- -
P-9139	70	125	22	ACTH	106	119	-	6,275	-	-	3,260	-	-	47.3	51.8	-	-	-	-	93 86	22 36	- -	1.012 1.005	1.020 1.021	- -
R-0897	-	140	-	BV	63	125	-	9,325	-	-	3,280	-	-	46.3	47.1	-	-	-	-	92	114	-	1.010	1.014	-
R-2312	67	149	22	ME	556	350	-	5,775	-	-	1,800	-	-	36.8	45.4	-	-	-	-	36	66	-	1.013	1.012	-
S-0746	-	169	-	BV	263	200	-	5,525	-	-	2,800	-	-	38.1	44.8	-	-	-	-	90	55	-	1.012	1.017	-
S-6143	-	162	-	BV	219	388	-	11,650	-	-	3,900	-	-	45.8	45.0	-	-	5,230	-	70	98	-	1.014	1.014	-

a/ Some of these data are questionable because of uncertainty in the length of collection time.

TABLE A5 (CONT.)

DATA FROM CONTROL GROUPS I AND II (CAMP OMIYA, JAPAN)

Individual	Special Test	Plasma Na (meq/1)			Plasma K a/ (meq/1)			Plasma Cl (meq/1)			Plasma CO2 b/ (vol %)			Urine Na (meq/1)			Urine K (meq/1)			Urine Cl (meq/1)			Saliva Na (meq/1)			Saliva K (meq/1)			Plasma c/ Cholesterol (mg %)		
		A	A'	A''	A	A'	A''	A	A'	A''	A	A'	A''	A	A'	A''	A	A'	A''	A	A'	A''	A	A'	A''	A	A'	A''	A	A'	A''
GROUP I																															
B-4833	ME	132	134	149	6.0	9.7	9.0	106	105	106	-	54	52	181	99	85	33	13	20	158	97	101	-	18.9	16.3	-	25.7	28.6	147	155	146
F-4293	ME	132	130	140	5.2	12.5	8.3	104	106	107	-	51.	60	212	196	134	39	27	78	178	185	244	-	60.2	45.7	-	20.1	20.2	153	145	136
G-1884	BV	136	126	140	5.0	9.3	6.9	105	107	106	-	49	51	268	207	208	48	110	58	209	232	200	-	31.1	29.4	-	20.2	19.6	230	199	180
G-3336	BV	124	135	138	5.5	8.7	8.0	108	107	108	-	49	49	79	102	56	24	49	40	72	144	77	-	60.9	34.8	-	20.5	19.2	197	176	173
J-9670	BV	133	122	136	5.8	12.0	9.3	103	104	100	51	50	51	196	70	200	33	22	52	123	75	185	-	31.5	18.9	-	20.2	21.1	210	162	172
M-7856	ACTH	131	130	134	4.3	8.3	6.9	102	105	105	43	49	48	292 59	98 38	150 86	38 45	28 55	109 196	223 90	105 65	214 186	-	16.3	14.6	-	21.9	21.2	219	195	176
R-5249	ACTH	131	131	126	4.4	13.0	8.3	102	104	103	-	-	52	174 36	162 24	176 53	48 28	22 11	68 90	154 65	146 33	212 90	-	40.6	42.4	-	19.6	22.5	157	144	164
W-0689	ME	125	125	148	4.6	10.3	9.7	104	106	106	-	-	52	231	183	222	48	62	54	208	205	257	-	20.6	21.1	-	22.5	20.4	170	178	173
W-9926	ACTH	127	127	142	5.5	10.7	10.0	103	105	105	-	-	56	158 44	129 39	154 48	48 26	28 19	62 71	149 56	127 45	167 81	-	23.9	13.7	-	21.8	20.2	203	186	179
V-4828	BV	128	133	135	5.7	13.7	8.7	103	104	105	44	-	51	288	96	261	79	13	78	213	93	312	-	5.4	7.2	-	23.7	23.1	179	149	155
V-1030	BV	131	137	143	4.2	6.4	5.6	104	104	105	40	-	57	228	59	147	20	15	48	165	50	152	-	5.4	11.1	-	19.6	22.7	197	203	177
GROUP II																															
B-2258	ME	140	146	-	4.3	7.3	-	106	103	-	49	50	-	228	94	-	72	43	-	266	105	-	33.7	26.1	-	20.5	22.5	-	-	181	-
E-4332	ME	146	141	-	3.3	8.7	-	104	105	-	42	45	-	163	164	-	44	97	-	162	201	-	18.5	16.3	-	21.2	23.7	-	-	206	-
H-4815	ME	136	141	-	3.8	6.7	-	106	107	-	54	46	-	168	243	-	31	51	-	156	221	-	10.2	5.9	-	21.8	21.9	-	107	145	-
J-7455	BV	139	145	-	3.2	11.0	-	105	104	-	46	48	-	190	156	-	56	128	-	209	225	-	31.5	29.4	-	23.1	15.0	-	147	193	-
J-1789	ACTH	139	149	-	3.6	6.6	-	105	105	-	45	59	-	98 77	138 78	- -	41 92	36 100	- -	108 105	138 121	- -	19.6	12.0	-	22.5	20.2	-	164	270	-
M-2878	ACTH	140	146	-	4.0	9.7	-	105	106	-	51	57	-	63 34	199 30	- -	24 24	56 19	- -	78 44	169 39	- -	27.2	18.5	-	25.0	17.6	-	146	196	-
M-7056	ACTH	130	146	-	3.3	8.7	-	107	107	-	55	-	-	260 88	282 212	- -	53 37	78 48	- -	243 101	270 116	- -	14.6	18.5	-	19.6	11.5	-	118	130	-
P-9139	ACTH	136	146	-	3.9	11.0	-	107	105	-	54	-	-	221 61	202 156	- -	44 21	116 148	- -	201 65	135 -	- -	35.5	24.3	-	16.7	20.2	-	-	159	-
R-0897	BV	133	144	-	3.4	11.0	-	107	105	-	-	-	-	141	183	-	37	50	-	133	299	-	36.5	23.9	-	21.2	18.0	-	-	183	-
R-2312	ME	128	144	-	4.3	13.0	-	107	105	-	-	-	-	144	135	-	50	60	-	162	145	-	8.7	9.8	-	13.5	14.8	-	-	146	-
S-0746	BV	132	142	-	3.6	11.0	-	105	105	-	-	-	-	174	212	-	33	86	-	154	216	-	51.0	47.9	-	12.8	16.3	-	-	197	-
S-6143	BV	128	150	-	3.4	7.1	-	104	105	-	-	-	-	222	231	-	53	64	-	196	223	-	9.8	7.6	-	16.0	21.8	-	-	197	-

a/ These data are questionable because of hemolysis.
b/ These data are questionable because the samples were not analyzed within 24 hours.
c/ Samples from Groups I-A', I-A'', and II-A were not analyzed within 24 hours. and the values are low.

TABLE A5 (CONT.)

DATA FROM CONTROL GROUPS I AND II (CAMP OMIYA, JAPAN)

Individual	Special Test	Urine Uric Acid (mg/l)			Urine Creatinine (g/l)			Urine Urea[b] (g N/l)			Blood Urea[c] (mg N %)			Urine Glucose (g/l)			Blood Glucose (mg %)			Urine 17-Ketos			Urine Neutral Lipids			Auditory Fusion Frequency (cpm)			Visual Fusion Frequency (cps)		
		A	A'	A''	A	A'	A''	A	A'	A''	A	A'	A''	A	A'	A''	A	A'	A''	A	A'	A''	A	A'	A''	A	A'	A''	A	A'	A''
GROUP I																															
B-4833	ME	500	230	330	2.80	0.52	0.61	12.76	3.50	3.92	13.0	10.0	17.4	1.23	0.23	0.12	-	-	-	-	-	-	-	-	-	48	38	38	3117	2642	2485
F-4293	ME	400	530	500	1.77	1.82	1.71	8.10	9.53	10.81	15.3	10.8	16.1	0.52	0.66	0.60	-	-	-	-	-	-	-	-	-	-	44	39	2637	2634	2383
G-1884	BV	450	580	410	1.75	1.66	1.08	12.20	9.48	6.68	14.2	10.0	12.3	0.91	0.98	0.38	-	-	-	-	-	-	-	-	-	20	41	40	3030	3040	2827
G-3336	BV	160	420	185	0.57	1.32	0.49	2.86	7.63	2.98	11.8	11.0	13.5	0.28	0.55	0.11	-	-	-	-	-	-	-	-	-	63	59	44	2567	2354	2275
J-9670	BV	380	140	500	2.78	0.72	1.96	11.19	3.11	8.27	14.0	10.7	13.0	0.85	0.26	0.77	-	-	-	-	-	-	-	-	-	24	40	44	2510	2400	2290
M-7856	ACTH	500 270	220 280	680 660	1.25 0.89	0.40 0.62	1.39 2.00	9.08 4.78	4.82 3.82	11.77 13.00	13.8	15.3	15.1	0.76 0.14	0.21 0.16	0.90 1.34	-	-	-	- a/	- a/	- a/	- a/	- a/	- a/	23	26	25	2553	2704	2950
R-5249	ACTH	530 330	260 172	610 580	2.26 0.59	0.72 0.36	1.13 1.74	10.68 3.70	5.22 1.50	7.21 8.13	12.0	10.2	11.7	0.93 0.15	0.40 0.14	0.38 0.74	-	-	-	- -	- a/	- a/	- a/	- a/	- a/	43	43	30	3013	2916	2518
W-0689	ME	370	490	410	1.03	1.32	1.03	5.70	8.38	6.73	13.0	17.2	15.5	0.34	0.43	0.34	-	-	-	-	-	-	-	-	-	39	42	36	2538	2496	2455
W-9926	ACTH	500 490	310 213	400 470	1.71 0.52	0.71 0.45	0.75 1.18	11.88 5.74	4.84 2.33	5.50 6.90	12.8	10.2	12.2	1.16 0.26	0.19 1.27	0.26 2.28	-	-	-	- -	- a/	- a/	- a/	- a/	- a/	52	54	45	2850	2764	2682
V-4828	BV	650	620	660	2.82	1.02	1.45	13.42	6.86	9.55	16.2	13.8	16.3	0.86	0.41	0.56	-	-	-	-	-	-	-	-	-	22	34	26	3142	2892	2858
V-1030	BV	320	120	430	1.19	0.35	0.88	7.46	1.50	5.00	10.3	8.2	11.0	0.96	0.15	0.38	-	-	-	-	-	-	-	-	-	26	50	47	2608	2304	2310
GROUP II																															
B-2258	ME	496	270	-	1.18	0.86	-	4.02	5.06	-	8.5	13.8	-	0.58	0.25	--	-	-	-	-	-	-	-	-	-	17	33	-	2578	2560	-
E-4332	ME	660	550	-	1.21	1.15	-	6.55	9.16	-	14.1	14.9	-	0.42	0.28	-	-	-	-	-	-	-	-	-	-	18	29	-	2430	2470	-
H-4815	ME	310	600	-	0.75	1.62	-	3.84	8.04	-	9.3	10.5	-	0.46	0.70	-	-	-	-	-	-	-	-	-	-	16	39	-	2654	2720	-
J-7455	BV	310	430	-	1.02	0.52	-	4.06	7.28	-	13.8	13.6	-	0.25	0.56	-	-	-	-	-	-	-	-	-	-	14	44	-	2920	2810	-
J-1789	ACTH	270 220	470 430	- -	0.82 0.98	1.10 0.92	- -	5.92 5.34	6.88 5.46	- -	13.1	13.0	-	0.39 0.38	0.25 0.32	- -	-	-	-	- a/	- a/	- -	- a/	- a/	- -	45	60	-	2836	2570	-
M-2878	ACTH	37 260	525 170	- -	0.59 0.66	1.22 0.45	- -	3.70 3.50	7.80 2.68	- -	11.1	13.7	-	0.39 0.68	0.53 1.29	- -	-	-	-	- a/	- a/	- -	- a/	- a/	- -	17	21	-	2992	2750	-
M-7056	ACTH	710 200	550 380	- -	2.00 0.96	1.52 0.80	- -	9.01 4.89	6.79 4.98	- -	13.3	12.5	-	0.61 0.67	0.65 0.40	- -	-	-	-	- a/	- a/	- -	- a/	- a/	- -	27	33	-	2906	2550	-
P-9139	ACTH	220 210	610 500	- -	0.79 0.68	1.38 1.60	- -	4.20 3.48	6.65 8.75	- -	10.1	10.5	-	0.30 0.48	0.48 0.64	- -	-	-	-	- a/	- a/	- -	- a/	- a/	- -	31	40	-	2756	2540	-
R-0897	BV	390	390	-	0.77	0.87	-	5.11	6.51	-	13.4	14.6	-	0.38	0.51	-	-	-	-	-	-	-	-	-	-	19	36	-	2522	2550	-
R-2312	ME	660	430	-	2.38	1.36	-	7.12	6.41	-	8.0	9.8	-	1.14	0.53	-	-	-	-	-	-	-	-	-	-	40	52	-	2168	2740	-
S-0746	BV	720	490	-	1.10	1.88	-	3.91	8.55	-	6.7	10.9	-	0.48	0.46	-	-	-	-	-	-	-	-	-	-	30	22	-	2342	2470	-
S-6143	BV	590	470	-	1.06	0.86	-	7.63	5.92	-	9.9	11.1	-	0.33	0.26	-	-	-	-	-	-	-	-	-	-	34	39	-	2624	2990	-

a/ These data will be reported later.
b/ Data from Groups II-A are questionable because of insufficient diffusion time.
c/ Data from I-A' and II-A are questionable because of insufficient diffusion time.

TABLE A5 (CONT.)

DATA FROM CONTROL GROUPS I AND II (CAMP OMIYA, JAPAN)

Individual	Special Test	Identical Forms			Digit Symbol W-B			Cattell Culture-Free			Shipley-Hartford			Gottschaldt Figures			Similarities W-B			Digit Span : W-B (total)			Stroop Ratio (CNW/WNC)			Time Estimation (seconds)			Card Sort (self-squad) (rho)		
		A	A'	A''	A	A'	A''	A	A'	A''	A	A'	A''	A	A'	A''	A	A'	A''	A	A'	A''	A	A'	A''	A	A'	A''	A	A'	A''
GROUP I																															
B-4833	ME	19	22	27	42	43	42	0	1	3	3	1	1	5	5	9	10	13	-	12	-	11	-	2.887	2.868	-	-	6.8	0.74	-	-
F-4293	ME	8	13	15	34	41	39	3	3	3	4	6	6	1	3	-1	12	10	-	11	8	10	3.815	1.764	1.146	-	-	9.6	0.83	-	-
G-1884	BV	9	8	14	33	29	40	-	2	2	0	1	1	3	3	2	8	8	-	10	8	8	3.489	1.582	1.534	-	-	-	0.76	-	-
G-3336	BV	22	24	28	42	43	51	4	4	6	3	4	8	5	3	11	9	12	-	11	10	11	-	2.447	2.042	-	-	-	0.88	-	-
J-9670	BV	7	13	17	33	45	47.5	0	0	2	1	1	4	6	6	9	10	9	-	12	10	11	-	3.216	2.510	-	-	4.2	0.81	-	-
M-7856	ACTH	10	15	19	26	32	34	0	0	0	3	3	3	5	4	5	10	8	-	9	10	9	3.388	1.795	1.918	-	-	14.7	0.52	-	-
R-5249	ACTH	16	23	25	39	46	45	2	3	4	3	4	3	3	8	4	6	10	-	11	10	12	3.476	2.429	2.093	-	-	6.8	0.83	-	-
W-0689	ME	16	17	21	52	41	56	4	4	5	8	9	10	2	7	7	9	10	-	-	11	10	Color Blind			-	-	6.0	0.71	-	-
W-9926	ACTH	11	16	24	46	43	47	2	4	4	10	9	9	1	10	13	10	14	-	11	10	10	2.894	3.093	2.146	8.8	-	8.8	-0.68	-	-
V-4828	BV	9	9	11	15	26	32	2	0	1	2	4	3	0	1	1	11	9	-	9	9	7	-	3.170	2.245	-	-	11.6	0.88	-	-
V-1030	BV	16	22	22	54	56	57	3	3	5	4	8	10	3	5	6	12	12	-	14	14	14	2.941	2.500	2.563	-	-	6.3	0.71	-	-
GROUP II																															
B-2258	ME	1	4	-	23	25	-	0	3	-	1	1	-	2	0	-	5	6	-	9	9	-	2.917	2.911	-	-	-	-	-0.39	-	-
E-4332	ME	17	20	-	48	42	-	1	1	-	8	8	-	4	7	-	13	11	-	10	12	-	-	2.140	-	-	-	-	0.75	-	-
H-4815	ME	12	15	-	43	56	-	0	1	-	4	6	-	-	6	-	9	8	-	12	11	-	2.543	1.804	-	-	-	-	0.64	-	-
J-7455	BV	19	18	-	38.5	42	-	2	2	-	2	1	-	5	5	-	7	10	-	8	9	-	3.016	4.422	-	-	-	-	-0.04	-	-
J-1789	ACTH	21	28	-	42	44	-	3	3	-	7	10	-	5	10	-	16	8	-	10	9	-	2.115	1.712	-	-	-	-	0.90	-	-
M-2878	ACTH	20	23	-	42	45	-	1	3	-	4	4	-	11	13	-	9	10	-	8	11	-	1.451	1.354	-	-	-	-	0.88	-	-
M-7056	ACTH	14	19	-	47	59	-	6	6	-	3	6	-	9	9	-	5	8	-	14	12	-	2.353	2.176	-	-	-	-	0.95	-	-
P-9139	ACTH	10	13	-	35	39	-	3	4	-	3	3	-	7	11	-	8	9	-	9	11	-	2.589	2.526	-	-	-	-	0.11	-	-
R-0897	BV	22	21	-	42	42	-	3	7	-	8	9	-	9	12	-	13	13	-	14	13	-	2.197	2.045	-	-	-	-	0.83	-	-
R-2312	ME	21	22	-	42	55	-	0	3	-	5	4	-	4	7	-	8	9	-	9	10	-	1.438	1.449	-	-	-	-	0.71	-	-
S-0746	BV	15	14	-	28	34	-	1	3	-	7	7	-	11	12	-	9	9	-	11	11	-	1.176	1.265	-	-	-	-	0.69	-	-
S-6143	BV	20	25	-	47	54	-	0	1	-	1	4	-	11	13	-	16	14	-	10	11	-	2.490	1.902	-	-	-	-	0.88	-	-

TABLE A6

DATA FROM CONTROL GROUPS V AND VI (KOREA)

Individual	Height (in)	Weight (lbs)	Age (yrs)	Special Test	Eosinophils (cells/mm³)		W.B.C. (cells/mm³)		Lymphocytes (cells/mm³)		Hematocrit (per cent)		Blood Volume (ml)	
					A	A'	A	A'	A	A'	A	A'	A	A'
GROUP V														
A-5075	71	168	a/	ME	162	131	7,925	5,500	3,400	1,920	39.7	42.7	-	-
C-5107	69	147	a/	ME	425	430	11,300	9,725	4,500	4,150	48.5	48.0	-	-
H-9329	69	144	a/	ACTH	425	-	8,300	-	2,800	-	46.8	-	-	-
H-8421	66	154	a/	ACTH	75	137	11,625	9,150	2,920	3,380	48.3	45.8	-	-
H-3136	67	146	a/	ACTH	75	50	11,525	11,800	3,120	3,070	49.5	50.0	-	-
K-3195	67	173	a/	BV	350	-	9,075	-	3,700	-	46.0	-	-	-
M-3285	75	224	a/	ME	280	230	7,200	7,675	2,600	2,750	51.6	49.0	-	-
M-7371	71	164	a/	ACTH	169	194	9,500	7,450	2,100	2,530	47.5	48.0	-	-
S-6942	65	116	a/	ME	322	212	10,200	9,500	4,200	3,130	48.3	49.8	-	-
W-4130	72	150	a/	ACTH	137	63	6,575	11,450	2,160	1,600	47.8	49.5	-	-
W-9893	69	191	a/	BV	94	-	13,275	-	2,130	-	48.0	-	5,075	-
W-7018	72	167	a/	ACTH	194	63	12,000	9,600	3,000	2,790	50.7	53.5	-	-
GROUP VI														
B-9350	66	143	a/	ME	137	125	7,850	11,850	2,720	3,680	43.8	50.3	-	-
B-8787	71	194	a/	ME	194	256	9,650	9,700	3,760	3,300	48.2	48.8	-	-
C-9358	72	174	a/	ME	890	475	11,725	12,975	3,300	2,980	45.8	48.5	-	-
C-6378	69	156	a/	ME	125	106	6,875	11,450	3,160	3,560	44.5	45.8	-	-
F-0536	72	152	a/	BV	175	220	6,050	7,925	1,630	2,730	48.8	48.8	6,095	6,830
G-2474	69	154	a/	BV	150	-	5,100	-	2,660	-	49.0	-	4,580	-
G-6497	68	153	a/	BV	256	-	8,650	-	3,020	-	49.0	-	4,870	-
K-4360	69	154	a/	BV	600	-	7,450	-	2,460	-	44.0	-	-	-
M-5261	65	123	a/	BV	342	238	9,750	10,950	3,500	3,170	47.3	49.0	3,945	5,140
O-7035	70	144	a/	BV	106	113	5,750	7,175	2,010	1,700	48.5	48.7	4,810	6,185
S-1495	67	153	a/	ACTH	412	540	7,600	12,350	2,580	1,840	44.3	45.5	-	-
W-1009	68	148	a/	ACTH	200	256	6,850	11,250	2,260	3,000	47.0	50.0	-	-

Individual	Urine b/ Output (ml/hr)		Urine Specific Gravity		Plasma Na (meq/l)		Plasma K (meq/l)		Plasma Cl (meq/l)		Plasma CO2 (vol %)		Urine Na (meq/l)		Urine K (meq/l)		Urine Cl (meq/l)		Saliva Na (meq/l)		Saliva K (meq/l)	
	A	A'	A	A'	A	A'	A	A'	A	A'	A	A'	A	A'	A	A'	A	A'	A	A'	A	A'
GROUP V																						
A-5075	214	95	1.003	1.011	144	a/	4.4	a/	102	105	61	-	a/	a/	a/	a/	100	82	41.0	a/	21.8	a/
C-5107	53	55	1.016	1.023	142	a/	4.5	a/	106	106	62	-	a/	a/	a/	a/	171	306	22.5	a/	23.6	a/
H-9329	70 37	- -	1.020 1.022	- -	146	-	4.2	-	105	-	57	-	a/ a/	- -	a/ a/	- -	238 131	- -	39.8	-	20.9	-
H-8421	49 27	43 32	1.022 1.030	1.025 1.023	145	a/	4.2	a/	107	105	58	-	a/ a/	a/ a/	a/ a/	a/ a/	273 115	187 61	29.0	a/	28.2	a/
H-3136	57 27	64 32	1.022 1.030	1.023 1.023	149	a/	4.6	a/	105	104	61	-	a/ a/	a/ a/	a/ a/	a/ a/	270 116	278 51	39.8	a/	19.5	a/
K-3195	97	-	1.015	-	142	-	4.3	-	110	-	60	-	a/	-	a/	-	177	-	33.6	-	17.6	-
M-3285	80	47	1.023	1.023	152	a/	4.2	a/	108	110	-	-	a/	a/	a/	a/	282	283	41.0	a/	17.9	a/
M-7371	36 63	36 52	1.023 1.020	1.023 1.013	143	a/	4.9	a/	106	104	-	-	a/ a/	a/ a/	a/ a/	a/ a/	245 159	226 89	46.6	a/	22.8	a/
S-6942	112	44	1.009	1.014	146	a/	4.4	a/	105	105	-	-	a/	a/	a/	a/	128	200	29.0	a/	21.7	a/
W-4130	65 44	47 32	1.021 1.020	1.021 1.030	146	a/	4.6	a/	107	104	-	-	a/ a/	a/ a/	a/ a/	a/ a/	234 125	244 110	25.8	a/	22.6	a/
W-9893	63	-	1.020	-	139	-	4.5	-	105	-	-	-	a/	-	a/	-	256	-	28.0	-	22.6	-
W-7018	74 40	28 -	1.020 1.015	1.026 -	142	a/	3.9	a/	104	104	-	-	a/ a/	a/ -	a/ a/	a/ -	250 65	172 -	12.2	a/	19.6	a/
GROUP VI																						
B-9350	71	92	1.009	1.006	150	a/	4.2	a/	104	104	-	-	a/	a/	a/	a/	102	60	25.2	a/	20.2	a/
B-8787	83	90	1.017	1.012	145	a/	4.3	a/	-	105	-	-	a/	a/	a/	a/	240	151	10.0	a/	22.5	a/
C-9358	74	117	1.021	1.006	144	a/	4.2	a/	107	104	-	-	a/	a/	a/	a/	245	109	36.0	a/	18.6	a/
C-6378	60	46	1.025	1.026	a/	a/	a/	a/	105	103	-	-	a/	a/	a/	a/	260	257	21.6	a/	28.4	a/
F-0536	51	58	1.023	1.022	145	a/	4.1	a/	106	102	-	-	a/	a/	a/	a/	254	232	16.6	a/	19.4	a/
G-2474	65	-	1.019	-	a/	-	a/	-	105	-	-	-	a/	-	a/	-	164	-	9.2	a	18.6	-
G-6497	28	-	1.030	-	a/	-	a/	-	106	-	60	-	a/	-	a/	-	216	-	17.0	-	19.1	-
K-4360	55	-	1.021	-	142	-	3.9	-	106	-	57	-	a/	-	a/	-	222	-	6.2	-	23.0	-
M-5261	95	29	1.008	1.023	a/	a/	a/	a/	104	105	59	-	a/	a/	a/	a/	123	223	42.5	a/	20.8	a/
O-7035	70	30	1.012	1.020	a/	a/	a/	a/	104	105	59	-	a/	a/	a/	a/	113	206	29.0	a/	20.3	a/
S-1495	39 54	98 90	1.020 1.011	1.007 1.010	148	a/	3.0	a/	105	106	58	-	a/ a/	a/ a/	a/ a/	a/ a/	132 55	114 58	37.4	a/	20.4	a/
W-1009	41 36	108 37	1.019 1.019	1.011 1.015	138	a/	5.2	a/	107	105	62	-	a/ a/	a/ a/	a/ a/	a/ a/	193 156	135 113	7.4	a/	20.8	a/

a/ These data will be reported later.
b/ Some of these data are questionable because of uncertainty in the length of collection time.

TABLE A6 (CONT.)

DATA FROM CONTROL GROUPS V AND VI (KOREA)

Individual	Special Test	Plasma Cholesterol (mg %)		Urine Uric Acid (mg/1)		Urine Creatinine (g/1)		Urine Urea (g N/1)		Blood Urea (mg N %)		Urine Glucose (g/1)		Blood Glucose (mg %)		Urine 17-Ketos		Urine Neutral Lipids		Auditory Fusion Frequency (cpm)		Visual Fusion Frequency (cps)	
		A	A'	A	A'	A	A'	A	A'	A	A'	A	A'	A	A'	A	A'	A	A'	A	A'	A	A'
GROUP V																							
A-5075	ME	157	161	280	340	0.48	0.86	3.18	4.46	10.7	10.2	0.19	0.40	48	82	a/	-	a/	a/	21	35	2563	-
C-5107	ME	212	223	560	530	1.30	1.18	9.18	7.99	13.4	11.7	0.40	0.53	48	80	a/	-	a/	a/	37	41	2860	-
H-9329	ACTH	188	-	580 710	- -	1.18 1.76	- -	7.72 11.70	- -	12.6	-	0.50 0.86	- -	55	-	a/ a/	- -	a/ a/	- -	15	-	2707	-
H-8421	ACTH	138	152	670 910	800 590	1.37 1.36	1.44 1.06	10.40 11.20	13.20 8.82	16.7	16.0	0.59 0.97	0.98 0.73	50	88	a/ a/	- -	a/ a/	a/ a/	23	27	2773	-
H-3136	ACTH	173	173	590 1120	560 790	1.30 2.14	1.18 1.52	11.40 18.10	10.20 16.75	22.3	18.8	0.43 0.73	0.69 0.86	78	104	a/ a/	- -	a/ a/	a/ a/	41	62	2873	-
K-3195	BV	194	-	440	-	1.03	-	6.59	-	11.7	-	0.63	-	52	-	a/	-	a/	-	24	-	2707	-
M-3285	ME	179	177	850	860	1.68	1.88	10.40	11.81	14.7	12.6	0.62	1.75	43	88	a/	-	a/	a/	27	41	2810	-
M-7371	ACTH	258	264	620 640	650 420	1.98 1.68	1.66 0.78	10.60 9.65	9.29 5.74	14.4	14.3	0.60 0.27	1.14 1.17	64	86	a/ a/	- -	a/ a/	a/ a/	29	33	2433	-
S-6942	ME	169	169	315	400	0.44	0.90	4.68	6.04	13.0	11.1	0.22	0.33	64	87	a/	-	a/	a/	22	38	2897	-
W-4130	ACTH	209	274	610 610	650 1150	1.21 1.73	1.54 2.30	7.40 9.26	8.03 14.41	11.1	11.9	0.80 0.77	0.86 0.94	58	93	a/ a/	- -	a/ a/	a/ a/	30	32	2700	-
W-9893	BV	209	-	540	-	1.42	-	9.66	-	13.9	-	0.50		73	-	a/	-	a/	-	39	-	2780	-
W-7018	ACTH	182	197	590 510	930 -	1.24 1.25	2.68 -	3.25 10.60	12.90 -	20.4	14.2	0.59 0.61	1.89 -	66	81	a/ a/	- -	a/ a/	a/ -	17	42	2580	-
GROUP VI																							
B-9350	ME	279	297	580	270	0.91	0.52	4.00	3.28	9.4	9.7	0.34	0.31	74	93	a/	-	a/	a/	23	18	2423	-
B-8787	ME	232	223	490	250	1.00	0.90	6.47	4.34	12.8	14.5	0.52	0.51	63	78	a/	-	a/	a/	37	43	2650	-
C-9358	ME	199	185	530	190	1.21	0.54	9.04	3.64	16.2	11.0	0.55	0.18	71	90	a/	-	a/	a/	36	40	2927	-
C-6378	ME	151	160	620	730	1.49	1.90	12.00	12.33	17.7	14.1	0.65	1.51	70	89	a/	-	a/	a/	41	38	2910	-
F-0536	BV	209	200	690	490	1.46	1.18	9.29	8.43	11.0	11.7	0.72	0.86	92	81	a/	-	a/	a/	36	32	3180	-
G-2474	BV	185	-	460	-	1.45	-	7.54	-	12.5	-	0.48	-	64	-	a/	-	a/	-	30	-	2340	-
G-6497	BV	237	-	1140	-	2.56	-	4.04	-	15.4	-	1.50	-	51	-	a/	-	a/	-	38	-	2643	-
K-4360	BV	159	-	720	-	1.61	-	9.63	-	12.8	-	0.84	-	77	-	a/	-	a/	-	22	-	2517	-
M-5261	BV	174	202	340	710	0.65	1.74	3.67	8.99	9.6	11.8	0.43	0.78	83	101	a/	-	a/	a/	18	22	2590	-
O-7035	BV	191	187	480	620	0.91	1.50	6.86	9.90	14.1	12.2	0.49	0.61	63	100	a/	-	a/	a/	27	38	2710	-
S-1495	ACTH	214	204	970 350	240 340	1.88 0.65	0.62 0.70	9.60 5.32	3.43 3.95	10.9	10.5	0.94 0.79	0.43 0.65	83	95	a/ a/	- -	a/ a/	a/ a/	46	29	2457	-
W-1009	ACTH	159	152	675 470	300 330	1.54 1.00	0.73 0.90	7.09 5.66	4.82 5.70	9.6	12.2	1.09 1.54	0.53 0.39	67	76	a/ a/	- -	a/ a/	a/ a/	41	49	2720	-

a/ These data will be reported later.

TABLE A6 (CONT.)

DATA FROM CONTROL GROUPS V AND VI (KOREA)

Individual	Special Test	Identical Forms		Digit Symbol W-B		Cattell Culture-Free		Shipley-Hartford		Gottschaldt Figures		Similarities W-B		Digit Span: W-B (total)		Stroop Ratio (CNW/WNC)		Time Estimation (seconds)		Card Sort (self-squad) (rho)	
		A	A'	A	A'	A	A'	A	A'	A	A'	A	A'	A	A'	A	A'	A	A'	A	A'
GROUP V																							
A-5075	ME	1	8	32	29	3	0	0	1	2	2	3	7	8	7	4.551	2.551	7.5	9.2	-	-
C-5107	ME	6	17	42	54	2	3	0	1	6	-1	6	12	12	11	2.868	2.125	10.8	10.1	0.23	-
H-9329	ACTH	17	-	38	-	2	-	0	-	1	-	5	-	13	-	2.778	-	9.3	-	0.13	-
H-8421	ACTH	15	21	37	44	1	3	0	0	5	6	13	15	9	9	2.298	1.982	7.1	9.9	0.76	-
H-3136	ACTH	17	25	43	43	3	3	6	9	5	10	20	21	10	14	3.024	2.311	10.1	15.8	0.92	-
K-3195	BV	6	-	38	-	1	-	1	-	4	-	12	-	7	-	1.467	-	8.7	-	0.71	-
M-3285	ME	13	16	34	42	0	0	2	2	1	1	11	9	9	8	2.522	2.060	5.1	12.3	-0.18	-
M-7371	ACTH	10	11	22	26	1	2	0	1	4	6	17	12	8	8	2.814	2.797	4.6	8.6	0.82	-
S-6942	ME	12	16	37	38	4	3	3	4	7	3	14	12	11	8	3.978	1.308	10.4	14.0	0.92	-
W-4130	ACTH	8	10	19	24	0	0	0	0	0	1	7	7	9	8	1.033	0.839	11.9	9.7	0.95	-
W-9893	BV	13	-	40	-	5	-	6	-	7	-	16	-	14	-	-	-	-	-	-	-
W-7018	ACTH	11	19	38	40	0	1	0	1	-4	-1	8	8	8	9	1.900	1.888	4.3	8.0	0.59	-
GROUP VI																							
B-9350	ME	13	-	37	-	4	-	3	-	4	-	10	11	11	9	2.957	2.467	6.0	11.8	1.00	0.98
B-8787	ME	17	20	34	35	0	5	1	1	4	3	11	11	14	16	3.279	2.727	13.0	10.4	0.21	0.02
C-9358	ME	10	-	37	-	0	-	1	-	0	-	13	9	8	7	3.924	1.597	7.3	9.7	-0.08	0.81
C-6378	ME	9	9	18	19	0	0	1	1	4	4	8	8	7	8	-	-	8.3	10.3	0.57	0.85
F-0536	BV	11	15	42	38	1	2	0	3	7	4	13	11	11	12	3.722	3.058	8.1	11.2	0.82	0.81
G-2474	BV	8	-	33	-	2	-	2	-	7	-	9	-	9	-	2.446	-	4.5	-	0.79	-
G-6497	BV	14	-	38	-	1	-	1	-	2	-	10	-	9	-	3.154	-	8.6	-	0.92	-
K-4360	BV	9	-	33	-	0	-	1	-	5	-	11	-	9	-	3.085	-	10.7	-	0.81	-
M-5261	BV	13	15	23	33	0	2	0	0	5	14	6	11	9	8	1.838	1.839	8.2	8.2	0.62	0.90
O-7035	BV	13	13	48	32	1	2	3	5	7	9	9	13	11	11	2.244	4.556	9.6	9.7	0.95	0.98
S-1495	ACTH	12	12	41	35	1	3	4	5	4	4	7	12	9	9	1.762	1.493	8.5	9.5	0.79	0.88
W-1009	ACTH	13	17	31	28	2	2	1	2	7	6	8	9	10	10	2.429	2.672	7.3	11.4	0.52	0.52

TABLE A7

DATA FROM INTENSE COMBAT STRESS GROUP III (KOREA)

Individual	Height (in)	Weight (lbs)	Age (yrs)	Special Test	Eosinophils (cells/mm3)				W.B.C. (cells/mm3)				Lymphocytes (cells/mm3)			
					A	B	C	D	A	B	C	D	A	B	C	D
GROUP III																
A-8537	69	129	22	-	588	-	-	-	10,600	-	-	-	2,120	-	-	-
C-4136	71	175	22	ME	256	156	258	338	6,550	3,175	6,540	9,375	2,100	1,750	2,480	2,710
C-5898	70	159	24	-	363	-	-	-	12,300	-	-	-	4,200	-	-	-
E-3096	70	160	22	-	1031	-	-	-	11,200	-	-	-	4,600	-	-	-
G-5761	71	148	26	-	169	25	-	-	10,275	16,475	-	-	4,200	3,400	-	-
P-1061	68	120	24	-	175	25	-	-	8,625	7,500	-	-	2,500	1,500	-	-
SCHOW	-	-	-	-	463	19	-	-	11,450	5,750	-	-	3,800	860	-	-
SMITH	-	-	-	-	-	13	-	-	-	5,900	-	-	-	470	-	-
S-5171	72	178	22	-	125	-	-	-	11,625	-	-	-	3,480	-	-	-
A-4492	66	152	22	-	206	-	-	-	6,025	-	-	-	4,250	-	-	-
B-7531	66	147	28	-	175	119	113	181	8,475	5,600	7,300	6,900	3,000	2,180	1,970	2,080
H-7321	67	166	25	BV	263	162	181	246	11,225	7,300	8,525	10,975	3,600	2,100	3,200	3,173
J-4852	68	163	23	-	75	13	-	-	10,050	3,950	-	-	2,000	280	-	-
M-3290	74	191	22	-	203	-	-	-	12,550	-	-	-	2,900	-	-	-
O-4697	65	115	20	-	-	-	-	-	-	-	-	-	-	-	-	-
R-2423	61	103	20	-	-	-	-	-	-	-	-	-	-	-	-	-
B-2003	70	137	18	-	156	-	-	-	14,950	-	-	-	4,800	-	-	-
H-4808	73	175	22	ACTH	181	244	268	356	10,450	4,150	8,800	15,000	3,100	1,950	2,540	2,550
J-0703	67	134	21	-	269	-	-	-	5,800	-	-	-	2,260	-	-	-
M-7579	68	150	20	-	119	-	-	-	7,975	-	-	-	3,180	-	-	-
M-1604	68	131	18	-	700	-	-	-	8,575	-	-	-	4,420	-	-	-
M-0305	61	135	21	ACTH	88	88	100	100	6,750	3,750	4,250	7,300	2,820	1,380	1,360	1,900
MOSS	-	-	-	-	50	-	-	-	-	-	-	-	-	-	-	-
W-3173	70	164	24	-	169	-	-	-	7,550	-	-	-	2,940	-	-	-
A-8639	70	193	22	-	-	131	181	112	-	5,700	7,350	8,500	-	1,650	1,610	2,040
H-1864	70	169	25	ME	-	100	156	138	-	5,375	6,400	8,250	-	2,080	2,880	2,240
H-1296	67	134	21	-	-	31	37	112	-	3,750	6,200	9,800	-	1,780	1,920	3,240
J-4226	70	146	22	BV	-	381	300	320	-	5,400	6,200	7,150	-	3,450	3,300	2,220
J-8455	72	180	22	-	-	125	168	-	-	7,675	5,050	-	-	3,460	1,260	-
L-6206	70	158	21	ME	-	238	405	-	-	6,800	6,750	-	-	3,050	2,280	-
M-9987	66	150	23	-	-	685	810	770	-	5,850	5,650	10,275	-	2,750	2,480	2,780
P-4185	67	162	31	BV	-	238	181	188	-	11,875	7,450	16,875	-	5,000	3,050	3,380
S-7808	69	134	22	-	-	94	94	-	-	7,450	3,250	-	-	3,280	1,540	-
S-4171	69	156	24	ACTH	-	75	63	262	-	9,350	9,500	10,825	-	3,250	3,140	1,980
S-4917	70	164	22	ME	-	106	100	230	-	6,650	5,500	13,675	-	2,850	2,140	3,800
T-9985	71	149	22	BV	-	163	175	250	-	7,900	4,900	10,025	-	2,760	1,900	2,800
W-0218	71	142	24	-	-	150	220	392	-	3,650	3,525	5,500	-	1,680	1,480	2,640
W-2990	72	158	21	-	-	-	131	218	-	-	6,375	7,925	-	-	1,150	2,000
W-1083	67	152	22	ACTH	-	75	175	175	-	4,825	6,125	9,550	-	1,840	2,280	2,000

TABLE A7 (CONT.)

DATA FROM INTENSE COMBAT STRESS GROUP III (KOREA)

Individual	Special Test	Hematocrit (per cent)				Blood Volume (ml)				Urine Output b/ (ml/hr)				Urine Specific Gravity				Plasma Na (meq/l)				Plasma K c/ (meq/l)			
		A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
GROUP III																									
A-8537	-	40.8	-	-	-	-	-	-	-	44	-	-	-	1.023	-	-	-	a/	-	-	-	a/	-	-	-
C-4136	ME	46.5	48.0	47.3	47.1	-	-	-	-	104	67	31	66	1.025	1.030	1.019	1.023	139	150	139	a/	6.6	3.5	3.4	a/
C-5898	-	46.8	-	-	-	-	-	-	-	80	-	-	-	1.022	-	-	-	136	-	-	-	9.6	-	-	-
E-3096	-	47.0	-	-	-	-	-	-	-	66	-	-	-	1.023	-	-	-	137	-	-	-	7.7	-	-	-
G-5761	-	45.8	39.0	-	-	-	-	-	-	46	-	-	-	1.028	-	-	-	124	136	-	-	7.2	4.3	-	-
P-1061	-	47.0	44.6	-	-	-	-	-	-	56	-	-	-	1.019	-	-	-	146	a/	-	-	9.8	a/	-	-
SCHOW	-	52.7	45.3	-	-	-	-	-	-	58	23	-	-	1.020	1.031	-	-	138	a/	-	-	6.4	a/	-	-
SMITH	-	-	46.1	-	-	-	-	-	-	96	-	-	-	1.021	-	-	-	-	a/	-	-	-	a/	-	-
S-5171	-	47.0	-	-	-	-	-	-	-	75	-	-	-	1.018	-	-	-	131	-	-	-	6.5	-	-	-
A-4492	-	46.6	-	-	-	-	-	-	-	54	-	-	-	1.021	-	-	-	a	-	-	-	a/	-	-	-
B-7531	-	47.8	47.3	49.3	51.0	-	-	-	-	33	16	41	41	1.028	1.030	1.026	1.027	143	132	156	a/	6.6	3.5	4.0	a/
H-7321	BV	51.8	51.0	49.5	50.5	-	5,335	5,971	5,420	42	25	81	56	1.027	1.029	1.014	1.003	a/	148	137	a/	a/	4.0	3.7	a/
J-4852	-	44.5	45.1	-	-	-	-	-	-	58	-	-	-	1.021	-	-	-	132	a/	-	-	7.0	a/	-	-
M-3290	-	48.8	-	-	-	-	-	-	-	50	-	-	-	1.023	-	-	-	a/	-	-	-	a/	-	-	-
C-4697	-	-	-	-	-	-	-	-	-	56	-	-	-	1.021	-	-	-	-	-	-	-	-	-	-	-
R-2423	-	-	-	-	-	-	-	-	-	38	-	-	-	1.021	-	-	-	-	-	-	-	-	-	-	-
B-2003	-	44.3	-	-	-	-	-	-	-	14	-	-	-	1.024	-	-	-	a/	-	-	-	a/	-	-	-
H-4808	ACTH	46.0	48.7	44.6	47.0	-	-	-	-	10 -	33 64	62 76	77 86	1.025 -	1.031 1.014	1.020 1.015	1.022 1.018	147	a/	145	a/	6.9	a/	3.9	a/
J-0703	-	-	-	-	-	-	-	-	-	9	-	-	-	1.019	-	-	-	a/	-	-	-	a/	-	-	-
M-7579	-	47.0	-	-	-	-	-	-	-	80	-	-	-	1.015	-	-	-	140	-	-	-	7.1	-	-	-
M-1604	-	44.3	-	-	-	-	-	-	-	81	-	-	-	1.021	-	-	-	134	-	-	-	6.2	-	-	-
M-0305	ACTH	45.1	45.5	47.3	44.8	-	-	-	-	18 -	26 27	23 77	32 26	1.022 -	1.027 1.020	1.023 1.008	1.026 1.030	a/	143	142	a/	a/	3.9	4.0	a/
MOSS	-	-	-	-	-	-	-	-	-	92	-	-	-	1.020	-	-	-	a/	-	-	-	a/	-	-	-
W-3173	-	-	-	-	-	-	-	-	-	44	-	-	-	1.020	-	-	-	a/	-	-	-	a/	-	-	-
A-8639	-	-	48.3	47.5	49.8	-	-	-	-	-	42	33	50	-	1.024	1.023	1.023	-	139	a/	a/	-	4.1	a/	a/
H-1864	ME	-	44.9	43.3	51.8	-	-	-	-	-	21	135	58	-	1.023	1.007	1.016	-	a/	142	a/	-	a	4.4	a/
H-1296	-	-	47.3	49.5	49.7	-	-	-	-	-	196	59	53	-	1.005	1.018	1.017	-	a/	140	a/	-	a	4.0	a/
J-4226	BV	-	43.2	43.3	44.6	-	5,430	5,770	-	-	33	47	44	-	1.026	1.013	1.025	-	150	139	a/	-	3.6	4.1	a/
J-8455	-	-	43.3	41.8	-	-	-	-	-	-	43	21	-	-	1.022	1.025	-	-	140	129	-	-	3.9	5.0	-
L-6206	ME	-	51.2	51.3	-	-	-	-	-	-	31	39	-	-	1.022	1.025	-	-	a/	146	-	-	a/	3.7	-
M-9987	-	-	44.4	43.0	44.8	-	-	-	-	-	82	32	69	-	1.027	1.030	1.023	-	a/	140	a/	-	a/	4.5	a/
P-4185	BV	-	45.1	43.4	46.5	-	5,395	5,645	5,360	-	103	228	85	-	1.029	1.006	1.016	-	147	a/	a/	-	3.5	a/	a/
S-7808	-	-	47.8	47.6	-	-	-	-	-	-	63	21	-	-	1.027	1.021	-	-	133	141	-	-	3.4	3.7	-
S-4171	ACTH	-	50.4	52.2	52.4	-	-	-	-	- -	48 58	44 41	80 58	- -	1.022 1.015	1.022 1.025	1.020 1.026	-	136	143	a/	-	3.7	3.7	a/
S-4917	ME	-	47.5	49.3	47.8	-	-	-	-	-	129	82	26	-	1.026	1.015	1.021	-	135	138	a/	-	3.8	3.8	a/
T-9985	BV	-	46.0	42.1	45.8	-	5,040	6,080	5,900	-	22	82	96	-	1.030	1.017	1.020	-	138	138	a/	-	2.8	4.1	a/
W-0218	-	-	50.5	46.7	48.3	-	-	-	-	-	26	9	42	-	1.029	1.032	1.029	-	a/	145	a/	-	a/	3.9	a/
W-2990	-	-	-	46.8	45.8	-	-	-	-	-	76	38	139	-	1.024	1.023	1.017	-	138	a/	a/	-	4.0	a/	a/
W-1083	ACTH	-	42.8	45.3	44.6	-	-	-	-	- -	54 41	140 36	95 26	- -	1.026 1.027	1.011 1.023	1.019 1.030	-	155	a/	a/	-	3.6	a/	a/

a/ These data will be reported later.
b/ Some of these data are questionable because of uncertainty in the length of collection time.
c/ Samples in Group III-A are questionable because of hemolysis.

TABLE A7 (CONT.)

DATA FROM INTENSE COMBAT STRESS GROUP III (KOREA)

Individual	Special Test	Plasma Cl (meq/1)				Plasma CO_2 (vol %)				Urine Na (meq/1)				Urine K (meq/1)				Urine Cl (meq/1)				Saliva Na (meq/1)				Saliva K (meq/1)			
		A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
GROUP III																													
A-8537	-	105	-	-	-	56	-	-	-	128	-	-	-	106	-	-	-	132	-	-	-	-	-	-	-	-	-	-	-
C-4136	ME	106	107	106	105	62	62	61	-	185	67	220	a/	108	49	37	a/	176	110	229	223	-	-	-	-	-	-	-	-
C-5898	-	104	-	-	-	62	-	-	-	189	-	-	-	99	-	-	-	187	-	-	-	-	-	-	-	-	-	-	-
E-3096	-	104	-	-	-	52	-	-	-	179	-	-	-	102	-	-	-	183	-	-	-	-	-	-	-	-	-	-	-
G-5761	-	106	105	-	-	61	47	-	-	175	-	-	-	99	-	-	-	170	-	-	-	-	-	-	-	-	-	-	-
P-1061	-	105	105	-	-	60	47	-	-	156	-	-	-	77	-	-	-	165	-	-	-	-	-	-	-	-	-	-	-
SCHOW	-	105	103	-	-	59	55	-	-	98	108	-	-	110	145	-	-	121	106	-	-	-	-	-	-	-	-	-	-
SMITH	-	-	102	-	-	-	55	-	-	198	-	-	-	94	-	-	-	318	-	-	-	-	-	-	-	-	-	-	-
S-5171	-	108	-	-	-	56	-	-	-	171	-	-	-	46	-	-	-	175	-	-	-	-	-	-	-	-	-	-	-
A-4492	-	107	-	-	-	58	-	-	-	215	-	-	-	72	-	-	-	217	-	-	-	-	-	-	-	-	-	-	-
B-7531	-	107	107	109	107	50	61	62	-	156	117	217	a/	107	50	68	a/	158	139	284	131	-	-	-	-	-	-	-	-
H-7321	BV	106	109	108	104	56	64	62	-	161	90	205	a/	93	62	54	a/	163	86	185	183	-	-	-	-	-	-	-	-
J-4852	-	107	106	-	-	57	55	-	-	185	-	-	-	50	-	-	-	158	-	-	-	-	-	-	-	-	-	-	-
K-3290	-	106	-	-	-	53	-	-	-	186	-	-	-	54	-	-	-	176	-	-	-	-	-	-	-	-	-	-	-
O-4697	-	-	-	-	-	-	-	-	-	166	-	-	-	108	-	-	-	191	-	-	-	-	-	-	-	-	-	-	-
R-2423	-	-	-	-	-	-	-	-	-	208	-	-	-	61	-	-	-	207	-	-	-	-	-	-	-	-	-	-	-
B-2003	-	107	-	-	-	51	-	-	-	168	-	-	-	57	-	-	-	138	-	-	-	-	-	-	-	-	-	-	-
H-4808	ACTH	106	106	109	105	56	60	57	-	121 -	89 24	302 122	a/ a/	92 -	63 65	62 74	a/ a/	139 -	71 124	232 101	236 79	-	-	-	-	-	-	-	-
J-0703	-	106	-	-	-	52	-	-	-	138	-	-	-	100	-	-	-	120	-	-	-	-	-	-	-	-	-	-	-
M-7579	-	106	-	-	-	55	-	-	-	84	-	-	-	96	-	-	-	115	-	-	-	-	-	-	-	-	-	-	-
M-1604	-	106	-	-	-	54	-	-	-	176	-	-	-	109	-	-	-	205	-	-	-	-	-	-	-	-	-	-	-
M-0305	ACTH	105	105	109	105	55	57	58	-	202 -	111 65	170 71	a/ a/	83 -	54 44	59 34	a/ a/	193 -	155 105	169 82	187 160	-	-	-	-	-	-	-	-
MOSS	-	106	-	-	-	60	-	-	-	120	-	-	-	99	-	-	-	147	-	-	-	-	-	-	-	-	-	-	-
W-3173	-	108	-	-	-	61	-	-	-	185	-	-	-	100	-	-	-	209	-	-	-	-	-	-	-	-	-	-	-
A-8639	-	-	105	109	103	-	59	57	-	-	226	200	a/	-	61	95	a/	-	247	249	241	-	-	-	-	-	-	-	-
H-1864	ME	-	104	109	107	-	59	53	-	-	17	131	a/	-	38	36	a/	-	44	134	122	-	-	-	-	-	-	-	-
H-1296	-	-	103	105	104	-	58	56	-	-	42	117	a/	-	8	68	a/	-	33	140	155	-	-	-	-	-	-	-	-
J-4226	BV	-	106	107	106	-	57	60	-	-	183	199	a/	-	51	45	a/	-	186	183	237	-	-	-	-	-	-	-	-
J-8455	-	-	106	107	-	-	56	57	-	-	172	278	-	-	50	58	-	-	159	184	-	-	-	-	-	-	-	-	-
L-6206	ME	-	105	108	-	-	60	58	-	-	64	278	-	-	19	50	-	-	76	200	-	-	-	-	-	-	-	-	-
M-9987	-	-	106	109	104	-	52	55	-	-	213	214	a/	-	92	68	a/	-	231	205	240	-	-	-	-	-	-	-	-
P-4185	BV	-	103	106	105	-	57	59	-	-	76	105	a/	-	63	36	a/	-	55	109	143	-	-	-	-	-	-	-	-
S-7808	-	-	103	105	-	-	50	59	-	-	58	176	-	-	51	78	-	-	54	200	-	-	-	-	-	-	-	-	-
S-4171	ACTH	-	105	108	104	-	58	58	-	- -	153 62	195 99	a/ a/	- -	58 90	69 139	a/ a/	- -	140 88	139 133	148 155	-	-	-	-	-	-	-	-
S-4917	ME	-	105	108	105	-	56	56	-	-	78	147	a/	-	68	111	a/	-	94	198	87	-	-	-	-	-	-	-	-
T-9985	BV	-	104	108	105	-	54	56	-	-	38	213	a/	-	54	44	a/	-	94	216	236	-	-	-	-	-	-	-	-
W-0218	-	-	103	109	106	-	56	58	-	-	40	179	a/	-	51	73	a/	-	76	193	230	-	-	-	-	-	-	-	-
W-2990	-	-	103	108	107	-	63	60	-	-	47	180	a/	-	84	62	a/	-	72	198	229	-	-	-	-	-	-	-	-
W-1083	ACTH	-	108	108	108	-	59	58	-	- -	53 84	175 170	a/ a/	- -	54 59	38 86	a/ a/	- -	74 84	185 166	221 199	-	-	-	-	-	-	-	-

a/ These data will be reported later.

TABLE A7 (CONT.)

DATA FROM INTENSE COMBAT STRESS GROUP III (KOREA)

Individual	Special Test	Plasma Cholesterol (mg %)				Urine Uric Acid (mg/l)				Urine Creatinine (g/l)				Urine Urea (g N/l)				Blood Urea (mg N %)			
		A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
GROUP III																					
A-8537	-	183	-	-	-	930	-	-	-	1.40	-	-	-	10.58	-	-	-	13.3	-	-	-
C-4136	ME	176	140	168	157	910	1500	510	660	1.82	3.00	1.12	1.12	14.03	21.70	8.40	9.80	16.2	15.3	9.5	15.9
C-5898	-	226	-	-	-	640	-	-	-	1.12	-	-	-	9.26	-	-	-	14.1	-	-	-
E-3096	-	224	-	-	-	680	-	-	-	1.44	-	-	-	11.92	-	-	-	18.6	-	-	-
G-5761	-	272	211	-	-	930	-	-	-	1.92	-	-	-	14.88	-	-	-	17.0	16.4	-	-
P-1061	-	194	183	-	-	570	-	-	-	1.12	-	-	-	9.47	-	-	-	10.6	16.2	-	-
SCHOW	-	231	246	-	-	700	1180	-	-	1.33	2.56	-	-	12.54	7.45	-	-	15.3	17.8	-	-
SMITH	-	-	211	-	-	730	-	-	-	2.12	-	-	-	11.94	-	-	-	-	19.7	-	-
S-5171	-	217	-	-	-	1070	-	-	-	1.80	-	-	-	11.11	-	-	-	11.5	-	-	-
A-4492	-	240	-	-	-	560	-	-	-	1.86	-	-	-	10.52	-	-	-	13.8	-	-	-
B-7531	-	145	140	139	173	1070	1200	650	810	2.76	2.70	2.00	1.80	13.42	21.30	12.60	13.13	12.7	17.4	15.3	12.7
H-7321	BV	182	166	165	197	1160	1420	480	690	2.70	2.74	1.04	1.48	13.60	19.20	5.16	8.06	14.6	19.5	10.2	13.4
J-4852	-	247	234	-	-	730	-	-	-	1.96	-	-	-	8.24	-	-	-	13.0	10.1	-	-
M-3290	-	194	-	-	-	630	-	-	-	1.70	-	-	-	10.23	-	-	-	12.7	-	-	-
O-4697	-	-	-	-	-	710	-	-	-	1.42	-	-	-	8.86	-	-	-	-	-	-	-
R-2423	-	-	-	-	-	730	-	-	-	1.14	-	-	-	9.43	-	-	-	-	-	-	-
B-2003	-	179	-	-	-	750	-	-	-	1.02	-	-	-	16.41	-	-	-	14.6	-	-	-
H-4808	ACTH	212	200	176	191	790 -	1550 310	610 550	490 580	2.10 -	3.14 0.80	1.26 1.02	1.40 0.96	13.13 -	17.40 8.30	4.20 6.26	8.45 8.36	14.3	16.8	10.1	15.6
J-0703	-	185	-	-	-	600	-	-	-	1.64	-	-	-	9.40	-	-	-	12.1	-	-	-
M-7579	-	217	-	-	-	600	-	-	-	1.28	-	-	-	8.16	-	-	-	12.5	-	-	-
M-1604	-	172	-	-	-	700	-	-	-	1.22	-	-	-	8.66	-	-	-	18.1	-	-	-
M-0305	ACTH	184	169	168	172	490 -	940 300	650 185	700 520	1.54 -	2.40 1.52	2.42 0.64	1.78 2.50	8.90 -	17.00 13.40	13.40 4.35	12.50 18.18	11.9	16.0	10.6	16.7
MOSS	-	260	-	-	-	670	-	-	-	1.54	-	-	-	10.29	-	-	-	-	-	-	-
W-3173	-	246	-	-	-	690	-	-	-	2.30	-	-	-	8.19	-	-	-	10.8	-	-	-
A-8639	-	-	212	200	193	-	870	760	690	-	1.86	1.98	1.49	-	12.10	10.90	10.52	-	14.6	11.2	15.7
H-1864	ME	-	167	161	176	-	960	260	580	-	2.69	0.46	1.49	-	20.40	3.64	6.20	-	18.5	10.2	10.8
H-1296	-	-	212	234	218	-	220	600	390	-	0.48	1.54	0.79	-	2.94	9.75	6.25	-	15.1	11.6	13.3
J-4226	BV	-	175	192	184	-	740	550	710	-	1.78	1.48	1.53	-	16.40	10.50	10.43	-	23.7	16.7	16.8
J-8455	-	-	151	164	-	-	760	830	-	-	1.92	2.02	-	-	13.30	11.80	-	-	20.3	16.2	-
L-6206	ME	-	175	179	-	-	820	930	-	-	2.34	1.90	-	-	16.80	11.80	-	-	14.1	13.9	-
M-9987	-	-	192	200	197	-	830	1070	570	-	0.74	2.14	1.16	-	14.50	15.60	8.99	-	20.1	17.8	13.1
P-4185	BV	-	267	264	280	-	1100	290	500	-	2.64	0.42	0.98	-	22.10	3.15	7.76	-	35.7	10.4	14.9
S-7808	-	-	300	278	-	-	850	660	-	-	2.44	1.62	-	-	22.70	10.40	-	-	23.7	14.3	-
S-4171	ACTH	-	179	202	257	- -	1030 650	1040 740	540 620	- -	1.50 1.02	1.58 1.82	0.90 1.54	- -	11.20 8.10	12.80 14.50	8.60 8.80	-	16.7	16.2	18.4
S-4917	ME	-	212	199	182	-	1230	560	780	-	3.18	0.86	2.19	-	17.20	3.52	8.75	-	15.7	11.3	10.5
T-9985	BV	-	218	178	217	-	1030	570	490	-	3.06	0.82	0.74	-	22.60	5.97	8.67	-	22.4	17.1	16.0
W-0218	-	-	244	244	260	-	1060	1860	750	-	3.46	3.64	2.12	-	23.30	16.20	12.60	-	19.9	14.8	17.4
W-2990	-	-	164	172	169	-	1270	1960	380	-	3.02	2.62	0.83	-	16.70	9.71	5.43	-	-	11.2	12.8
W-1083	ACTH	-	168	176	174	- -	1250 780	330 675	540 780	- -	2.82 1.76	0.50 1.52	0.82 2.14	- -	20.10 18.10	5.51 12.00	7.35 13.79	-	21.6	16.5	15.1

TABLE A7 (CONT.)

DATA FROM INTENSE COMBAT STRESS GROUP III (KOREA)

Individual	Special Test	Urine Glucose (g/l)				Blood Glucose (mg %)				Urine 17-Ketos				Urine Neutral Lipids				Auditory Fusion Frequency (cpm)				Visual Fusion Frequency (cps)			
		A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
GROUP III																									
A-8537	-	1.87	-	-	-	-	-	-	-	a/	-	-	-	a/	-	-	-	-	-	-	-	-	-	-	-
C-4136	ME	2.03	2.27	0.52	0.81	-	-	54	74	a/	a/	a/	a/	a/	a/	a/	a/	-	48	59	42	-	2606	2923	2880
C-5898	-	1.83	-	-	-	-	-	-	-	a/	-	-	-	a/	-	-	-	-	-	-	-	-	-	-	-
E-3096	-	1.11	-	-	.	-	-	-	-	a/	-	-	-	a/	-	-	-	-	-	-	-	-	-	-	-
G-5761	-	1.52	-	-	-	-	-	-	-	a/	-	-	-	a/	-	-	-	-	-	-	-	-	-	-	-
P-1061	-	1.13	-	-	-	-	-	-	-	a/	-	-	-	a/	-	-	-	-	-	-	-	-	-	-	-
SCHOW	-	0.85	0.70	-	-	-	-	-	-	a/	a/	-	-	a/	a/	-	-	-	-	-	-	-	-	-	-
SMITH	-	0.92	-	-	-	-	-	-	-	a/	-	-	-	a/	-	-	-	-	-	-	-	-	-	-	-
S-5171	-	1.14	-	-	-	-	-	-	-	a/	-	-	-	a/	-	-	-	-	-	-	-	-	-	-	-
A-4492	-	1.00	-	-	-	-	-	-	-	a/	-	-	-	a/	-	-	-	-	-	-	-	-	-	-	-
B-7531	-	1.13	1.05	0.61	1.16	-	-	61	68	a/	a/	a/	-	a/	a/	a/	a/	-	-	-	-	-	-	-	-
H-7321	BV	2.35	1.81	0.55	0.63	-	-	69	54	a/	a/	a/	a/	a/	a/	a/	a/	-	26	41	43	-	2483	2870	2953
J-4852	-	1.36	-	-	-	-	-	-	-	a/	-	-	-	a/	-	-	-	-	-	-	-	-	-	-	-
W-3290	-	1.39	-	-	-	-	-	-	-	a/	-	-	-	a/	-	-	-	-	-	-	-	-	-	-	-
O-4697	-	1.32	-	-	-	-	-	-	-	a/	-	-	-	a/	-	-	-	-	-	-	-	-	-	-	-
R-2423	-	1.12	-	-	-	-	-	-	-	a/	-	-	-	a/	-	-	-	-	-	-	-	-	-	-	-
B-2003	-	1.13	-	-	-	-	-	-	-	-	-	-	-	a/	-	-	-	-	-	-	-	-	-	-	-
H-4808	ACTH	1.29 -	2.35 0.05	1.38 0.39	0.62 1.27	-	-	56	83	- -	a/ a/	a/ a/	a/ -	a/ -	a/ a/	a/ a/	a/ a/	-	32	26	25	-	2723	2773	2720
J-0703	-	1.04	-	-	-	-	-	-	-	-	-	-	-	a/	-	-	-	-	-	-	-	-	-	-	-
M-7579	-	1.28	-	-	-	-	-	-	-	a/	-	-	-	a/	-	-	-	-	-	-	-	-	-	-	-
M-1604	-	0.74	-	-	-	-	-	-	-	a/	-	-	-	a/	-	-	-	-	-	-	-	-	-	-	-
L-0305	ACTH	0.75 -	0.92 0.22	0.86 1.01	1.12 1.17	-	-	62	70	- -	a/ a/	a/ a/	a/ -	a/ -	a/ a/	a/ a/	a/ a/	-	13	24	12	-	2716	2740	2717
MOSS	-	0.91	-	-	-	-	-	-	-	a/	-	-	-	a/	-	-	-	-	-	-	-	-	-	-	-
A-3173	-	0.75	-	-	-	-	-	-	-	a/	-	-	-	a/	-	-	-	-	-	-	-	-	-	-	-
A-8639	-	-	0.67	1.42	0.65	-	-	74	93	-	a/	a/	a/	-	a/	a/	a/	-	-	-	-	-	-	-	-
H-1864	ME	-	1.14	0.18	1.17	-	-	58	70	-	a/	a/	a/	-	a/	a/	a/	-	-	-	37	-	-	-	2620
H-1296	-	-	0.25	0.80	0.45	-	-	77	73	-	a/	a/	a/	-	a/	a/	a/	-	-	-	-	-	-	-	-
J-4226	BV	-	0.90	0.68	1.14	-	-	56	78	-	a/	a/	a/	-	a/	a/	a/	-	34	45	41	-	2493	2836	2893
J-8455	-	-	0.86	0.81	-	-	-	79	-	-	a/	a/	-	-	a/	a/	-	-	-	-	-	-	-	-	-
L-6206	ME	-	1.44	1.23	-	-	-	59	-	-	a/	a/	-	-	a/	a/	-	-	33	33	-	-	2716	2843	-
M-9987	-	-	0.95	0.99	0.71	-	-	61	87	-	a/	a/	a/	-	a/	a/	a/	-	-	-	-	-	-	-	-
P-4185	BV	-	2.06	0.17	0.43	-	-	71	93	-	a/	a/	a/	-	a/	a/	a/	-	17	24	32	-	2750	2750	2900
S-7808	-	-	1.20	0.96	-	-	-	-	-	-	a/	a/	-	-	a/	a/	-	-	-	-	-	-	-	-	-
S-4171	ACTH	- -	0.95 0.39	0.70 0.92	0.56 0.92	-	-	64	97	- -	a/ a/	a/ a/	a/ -	- -	a/ a/	a/ a/	a/ a/	-	20	29	30	-	2330	2800	2737
S-4917	ME	-	1.12	0.33	1.83	-	-	77	81	-	a/	a/	a/	-	a/	a/	a/	-	12	20	19	-	2526	2796	2730
T-9985	BV	-	3.95	0.32	0.56	-	-	62	87	-	a/	a/	-	-	a/	a/	a/	-	37	32	35	-	2736	3006	-
W-0218	-	-	1.23	1.81	1.58	-	-	54	92	-	a/	-	-	-	a/	a/	a/	-	-	-	-	-	-	-	-
W-2990	-	-	1.74	1.29	0.53	-	-	50	91	-	a/	a/	-	-	a/	a/	a/	-	-	-	-	-	-	-	-
W-1083	ACTH	- -	2.26 0.53	0.11 0.67	0.38 1.08	-	-	51	94	- -	a/ a/	a/ a/	a/ -	- -	a/ a/	a/ a/	a/ a/	-	25	33	41	-	2613	2896	2893

a/ These data will be reported later.

TABLE A7 (CONT.)

DATA FROM INTENSE COMBAT STRESS GROUP III (KOREA)

Individual	Special Test	Identical Forms				Digit Symbol W-B				Cattell Culture-Free				Shipley-Hartford				Gottschaldt Figures			
		A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
GROUP III																					
A-8537	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C-4136	ME	-	15	17	21	-	30	41	42	-	2	2	1	-	-	2	2	-	2	4	7
C-5898	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E-3096	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
G-5761	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P-1061	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SCHOW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SMITH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S-5171	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A-4492	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B-7531	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H-7321	BV	-	15	14	17	-	34	37	44	-	2	1	2	-	-	4	2	-	6	7	7
J-4852	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
M-3290	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
O-4697	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
R-2423	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B-2003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H-4808	ACTH	-	20	19	19	-	48	53	52	-	2	3	5	-	-	6	8	-	9	12	12
J-0703	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
M-7579	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
M-1604	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
M-0305	ACTH	-	10	-	12	-	34	-	33	-	2	-	0	-	-	-	2	-	0	-	2
MOSS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
W-3173	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A-8639	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H-1864	ME	-	13	19	22	-	35.5	56	49.5	-	3	2	5	-	-	1	1	-	2	-1	4
H-1296	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
J-4226	BV	-	19	21	31	-	51	60	57.5	-	2	5	3	-	-	12	12	-	9	8	11
J-8455	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
L-6206	ME	-	10	21	-	-	36	50	-	-	1	1	-	-	-	3	-	-	8	7	-
M-9987	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P-4185	BV	-	13	16	19	-	34	40	36	-	0	0	1	-	-	1	1	-	2	2	0
S-7808	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S-4171	ACTH	-	16	14	17	-	29	32	28	-	0	2	4	-	-	6	5	-	6	9	2
S-4917	ME	-	16	17	21	-	33	51	46.5	-	2	1	2	-	-	4	4	-	5	6	7
T-9985	BV	-	11	17	18	-	36	48	53.5	-	0	1	3	-	-	1	0	-	1	2	0
W-0218	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
W-2990	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
W-1083	ACTH	-	11	17	23	-	39	51	49	-	3	4	6	-	-	7	5	-	6	9	6

TABLE A7 (CONT.)

DATA FROM INTENSE COMBAT STRESS GROUP III (KOREA)

Individual	Special Test	Similarities W-B				Digit Span: W-B (total)				Stroop Ratio (CNW/WNC)				Time Estimation (seconds)				Card Sort (self-squad) (rho)			
		A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
GROUP III																					
A-8537	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C-4136	ME	-	-	10	10	-	-	10	8	-	-	2.227	2.000	-	-	13.1	11.6	-	0.83	-	-
C-5898	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E-3096	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
G-5761	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P-1061	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SCHOW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SMITH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S-5171	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A-4492	-	-	-	-	-	13	-	-	-	3.048	-	-	-	-	-	-	-	0.95	-	-	-
B-7531	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H-7321	BV	4	11	14	11	11	10	13	13	3.676	3.211	2.595	-	-	-	8.8	9.4	0.98	-	-	-
J-4852	-	18	-	-	-	4	-	-	-	2.500	-	-	-	-	-	-	-	0.52	-	-	-
M-3290	-	18	-	-	-	11	-	-	-	2.542	-	-	-	-	-	-	-	0.85	-	-	-
O-4697	-	-	-	-	-	9	-	-	-	3.917	-	-	-	-	-	-	-	0.89	-	-	-
R-2423	-	-	-	-	-	8	-	-	-	2.020	-	-	-	-	-	-	-	0.67	-	-	-
B-2003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H-4808	ACTH	-	12	16	13	-	12	11	14	-	2.040	1.679	-	-	9.3	9.7	18.2	-	0.90	-	-
J-0703	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
M-7579	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
M-1604	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
M-0305	ACTH	-	9	9	9	-	13	11	8	-	3.673	3.000	2.500	-		-	-	-	0.95	-	-
MOSS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
W-3173	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A-8639	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H-1864	ME	-	12	10	12	-	12	12	12	-	-	-	-	-	-	11.4	11.5	-	0.45	-	-
H-1296	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
J-4226	BV	-	21	16	19	-	14	13	16	-	2.447	2.000	2.000	-	10.3	12.4	11.3	-	0.83	-	-
J-8455	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
L-6206	ME	-	3	-	-	-	11	8	-	-	3.229	3.135	-	-	5.2	8.2	-	-	0.90	-	-
M-9987	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P-4185	BV	-	7	5	9	-	10	9	9	-	2.889	2.760	1.667	-	4.7	5.9	12.1	-	0.39	-	-
S-7808	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S-4171	ACTH	-	10	12	10	-	10	11	14	-	2.714	1.513	1.361	-	9.8	12.3	10.7	-	0.40	-	-
S-4917	ME	-	11	14	12	-	13	10	15	-	2.816	2.085	2.299	-	9.2	9.6	10.2	-	0.88	-	-
T-9985	BV	-	0	4	12	-	8	11	8	-	3.521	2.327	2.500	-	7.4	9.0	13.8	-	0.95	-	-
W-0218	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
W-2990	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
W-1083	ACTH	-	15	15	15	-	11	10	9	-	3.667	2.467	2.302	-	12.7	9.4	10.0	-	0.95	-	-

TABLE A8

DATA FROM PROLONGED COMBAT STRESS GROUP IV, AND FROM MISCELLANEOUS GROUP VII

Individual	Height (in)	Weight (lbs)	Age (yrs)	Special Test	Eosinophils (cells/mm³)			W.B.C. (cells/mm³)			Lymphocytes (cells/mm³)			Hematocrit (per cent)			Blood Volume (ml)			Urine Output[a] (ml/hr)			Urine Specific Gravity		
					A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
GROUP IV																									
F-8576	71	148	24	ACTH	-	194	194	-	8,000	7,200	-	2,800	2,600	-	43.0	43.6	-	-	-	- -	10 37	77 87	- -	1.028 1.023	1.025 1.017
B-5392	69	177	21	ME	-	106	88	-	6,575	5,400	-	1,520	2,320	-	49.3	43.8	-	-	-	-	50	34	-	1.019	1.031
H-4368	71	166	22	ME	-	650	306	-	7,050	3,800	-	1,600	1,880	-	45.8	47.3	-	-	-	-	62	48	-	1.030	1.029
J-4476	68	152	25	ME	-	131	56	-	7,850	7,000	-	3,500	2,950	-	45.8	46.8	-	-	-	-	38	31	-	1.032	1.025
L-0624	69	169	21	ME	-	175	150	-	10,675	8,050	-	2,120	1,850	-	51.8	51.0	-	-	-	-	64	73	-	1.021	1.019
M-2880	66	130	22	BV	-	106	100	-	7,950	7,500	-	1,910	2,250	-	43.7	46.7	-	4,500	4,580	-	34	59	-	1.030	1.023
O-8834	71	148	-	BV	-	265	-	-	9,750	-	-	1,660	-	-	44.8	-	-	4,340	-	-	26	-	-	1.009	-
P-4431	71	157	22	BV	-	63	181	-	6,250	6,600	-	1,570	2,180	-	48.5	46.5	-	4,035	-	-	35	88	-	1.024	1.018
P-0411	66	147	21	BV	-	300	212	-	10,650	9,450	-	2,230	2,260	-	48.5	47.5	-	4,110	-	-	143	74	-	1.010	1.013
R-0371	65	134	26	ACTH	-	243	169	-	8,950	7,050	-	1,600	2,480	-	47.0	45.1	-	-	-	- -	30 84	53 64	- -	1.021 1.007	1.022 1.017
S-4749	66	179	23	ACTH	-	261	150	-	9,600	6,350	-	2,400	3,610	-	47.8	45.7	-	-	-	- -	26 123	44 100	- -	1.027 1.007	1.023 1.017
T-1483	64	154	23	ACTH	-	194	81	-	6,700	4,200	-	2,200	1,980	-	46.0	45.8	-	-	-	- -	39 41	85 42	- -	1.021 1.016	1.012 1.026
W-7805	73	185	22	ACTH	-	1250	900	-	9,400	9,900	-	1,700	3,460	-	49.5	50.5	-	-	-	- -	26 80	140 67	- -	1.007 1.008	1.007 1.016
GROUP VII																									
W-4352	-	-	-	ACTH	-	275	288	-	9,550	9,600	-	3,152	2,976	-	42.0	52.5	-	-	-	- -	18 20	35 111	- -	1.031 1.034	1.021 1.011
P-4360	-	-	-	ACTH	-	38	131	-	9,350	8,450	-	1,122	2,198	-	48.7	49.4	-	-	-	- -	18 15	13 107	- -	1.032 1.036	1.020 1.016
R-1552	-	-	-	ACTH	-	38	-	-	19,850	-	-	1,588	-	-	46.4	-	-	-	-	- -	86 27	- -	- -	1.010 1.026	- -
S-7571	72	187	23	ACTH	-	458	575	-	9,750	9,025	-	3,500	3,000	-	49.0	49.0	-	-	-	- -	14 16	78 -	- -	1.025 1.036	1.022 -
G-0442	70	140	25	ACTH	-	56	-	-	7,600	-	-	1,970	-	-	51.5	-	-	-	-	- -	24 64	- -	- -	1.021 1.025	- -
P-5803	-	-	-	-	-	70	-	-	7,375	-	-	1,030	-	-	44.8	-	-	-	-	-	-	-	-	-	-
K-2270	72	170	32	ME	-	81	106	-	9,050	10,450	-	3,260	3,580	-	43.9	47.6	-	-	-	-	129	66	-	1.027	1.017

a/ Some of these data are questionable because of uncertainty in the length of collection time.

TABLE A8 (CONT.)

DATA FROM PROLONGED COMBAT STRESS GROUP IV, AND FROM MISCELLANEOUS GROUP VII

Individual	Special Test	Plasma Na (meq/l)			Plasma K (meq/l)			Plasma Cl (meq/l)			Plasma CO_2 (vol %)			Urine Na (meq/l)			Urine K (meq/l)			Urine Cl (meq/l)			Saliva Na (meq/l)			Saliva K (meq/l)			Plasma Cholesterol (mg %)		
		A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
GROUP IV																															
F-8576	ACTH	-	140	a/	-	4.3	a/	-	104	107	-	60	61	- -	163 135	a/ a/	- -	53 78	a/ a/	- -	113 90	287 151	-	10.9	a/	-	17.0	a/	-	184	195
B-5392	ME	-	133	a/	-	4.7	a/	-	103	104	-	59	61	-	107	a/	-	63	a/	-	104	118	-	a/	a/	-	a/	a/	-	201	208
H-4368	ME	-	a/	a/	-	a/	a/	-	113	105	-	57	60	-	391	a/	-	72	a/	-	325	158	-	21.4	a/	-	19.2	a/	-	136	169
J-4476	ME	-	146	a/	-	4.3	a/	-	110	102	-	62	61	-	351	a/	-	47	a/	-	306	188	-	9.6	a/	-	22.7	a/	-	124	147
L-0624	ME	-	a/	a/	-	a/	a/	-	105	105	-	59	59	-	231	a/	-	31	a/	-	196	202	-	?.3	a/	-	19.8	a/	-	184	191
M-2880	BV	-	162	a/	-	3.4	a/	-	106	104	-	61	61	-	189	a/	-	49	a/	-	149	215	-	40.0	a/	-	12.8	a/	-	131	216
O-8834	BV	-	a/	-	-	a/	-	-	105	-	-	60	-	-	159	-	-	21	-	-	135	-	-	10.5	-	-	19.7	-	-	123	-
P-4431	BV	-	132	a/	-	5.3	a/	-	103	106	-	58	60	-	96	a/	-	71	a/	-	95	186	-	10.7	a/	-	22.3	a/	-	189	153
P-0411	BV	-	a/	a/	-	a/	a/	-	104	101	-	60	60	-	109	a/	-	16	a/	-	91	130	-	23.2	a/	-	16.8	a/	-	206	237
R-0371	ACTH	-	148	a/	-	3.9	a/	-	104	101	-	64	61	- -	143 41	a/ a/	- -	43 32	a/ a/	- -	160 49	142 100	-	10.7	a/	-	17.6	a/	-	146	197
S-4749	ACTH	-	a/	a/	-	a/	a/	-	105	104	-	60	56	- -	180 57	a/ a/	- -	47 42	a/ a/	- -	143 59	202 139	-	15.5	a/	-	17.1	a/	-	218	258
T-1483	ACTH	-	150	a/	-	4.4	a/	-	106	105	-	62	60	- -	207 89	a/ a/	- -	25 44	a/ a/	- -	196 106	124 170	-	6.4	a/	-	18.6	a/	-	120	187
W-7805	ACTH	-	a/	a/	-	a/	a/	-	105	105	-	59	60	- -	113 51	a/ a/	- -	16 30	a/ a/	- -	102 53	65 85	-	5.9	a/	-	22.7	a/	-	132	175
GROUP VII																															
W-4352	ACTH	-	141	141	-	4.3 b/	6.9 b/	-	105	104	-	52	56	- -	96 a/	208 40	- -	98 a/	117 62	- -	73 213	240 251	-	-	-	-	-	-	-	241	248
T-4360	ACTH	-	137	131	-	4.4 b/	6.7 b/	-	98	101	-	54	55	- -	a/ 57	147 22	- -	a/ 123	151 89	- -	104 89	61 61	-	-	-	-	-	-	-	241	223
R-1552	ACTH	-	143	-	-	4.5 b/	-	-	102	-	-	55	-	- -	66 33	- -	- -	31 107	- -	- -	75 91	- -	-	-	-	-	-	-	-	277	-
S-7571	ACTH	-	a/	159	-	a/	3.4	-	107	108	-	62	61	- -	152 118	155 -	- -	68 170	42 -	- -	161 160	161 -	-	-	-	-	-	-	-	140	138
G-0442	ACTH	-	147	-	-	3.7	-	-	105	-	-	57	-	- -	139 123	- -	- -	68 122	- -	- -	159 161	- -	-	-	-	-	-	-	-	214	-
P-5803	-	-	147	-	-	3.2	-	-	104	-	-	63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	188	-
K-2270	ME	-	a/	a/	-	a/	a/	-	107	106	-	60	-	-	a/	a/	-	a/	a/	-	187	100	-	-	-	-	-	-	-	197	245

a/ These data will be reported later.
b/ These data are questionable because of hemolysis.

TABLE A8 (CONT.)

DATA FROM PROLONGED COMBAT STRESS GROUP IV, AND FROM MISCELLANEOUS GROUP VII

Individual	Special Test	Urine Uric Acid (mg/l)			Urine Creatinine (g/l)			Urine Urea (g N/l)			Blood Urea (mg N %)			Urine Glucose (g/l)			Blood Glucose (mg %)			Urine 17-Ketos			Urine Neutral Lipids			Auditory Fusion Frequency (cpm)			Visual Fusion Frequency (cps)		
		A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
GROUP IV																															
F-8576	ACTH	- -	1030 700	510 510	- -	3.04 1.88	1.10 1.10	- -	19.20 14.10	9.76 9.18	-	13.5	11.5	- -	1.84 0.74	0.86 0.73	-	66	64	- -	- a/	a/ a/	- -	a/ a/	a/ a/	-	20	43	-	2406	2850
B-5392	ME	-	570	1140	-	1.44	2.04	-	9.82	15.60	-	12.1	15.9	-	0.92	1.47	-	54	86	-	a/	a/	-	a/	a/	-	19	19	-	2396	2530
H-4368	ME	-	960	930	-	1.60	1.78	-	11.70	14.28	-	20.5	20.7	-	1.11	1.06	-	73	79	-	a/	a/	-	a/	a/	-	27	39	-	2693	2950
J-4476	ME	-	980	920	-	1.74	2.72	-	13.50	11.76	-	16.8	9.7	-	1.51	2.22	-	63	92	-	a/	a/	-	a/	a/	-	20	16	-	2893	2820
L-0624	ME	-	630	580	-	0.98	1.22	-	8.20	8.88	-	13.6	10.0	-	0.72	1.00	-	76	90	-	a/	a/	-	a/	a/	-	30	46	-	2950	2787
M-2880	BV	-	1150	490	-	1.98	1.48	-	15.20	6.02	-	22.3	15.5	-	2.31	0.81	-	63	90	-	a/	a/	-	a/	a/	-	19	25	-	2740	2840
O-8834	BV	-	242	-	-	0.44	-	-	4.35	-	-	13.8	-	-	0.26	-	-	78	-	-	a/	-	-	a/	-	-	13	-	-	2370	-
P-4431	BV	-	980	560	-	2.34	1.16	-	14.10	12.13	-	14.7	14.1	-	0.90	1.12	-	63	73	-	a/	a/	-	a/	a/	-	29	34	-	2486	2640
P-0411	BV	-	258	450	-	0.50	1.06	-	4.08	6.30	-	9.8	8.5	-	1.38	0.86	-	54	87	-	a/	a/	-	a/	a/	-	15	16	-	2643	2703
R-0371	ACTH	- -	850 400	740 460	- -	2.12 0.62	1.72 1.18	- -	13.40 4.98	9.40 8.99	-	14.8	15.6	- -	1.07 0.59	1.15 0.92	-	96	107	- -	a/ a/	a/ a/	- -	a/ a/	a/ a/	-	18	19	-	2686	2917
S-4749	ACTH	- -	910 320	590 390	- -	3.42 0.72	2.06 1.08	- -	18.00 5.48	9.43 8.54	-	14.6	14.4	- -	1.08 0.36	0.84 1.10	-	84	87	- -	a/ a/	a/ a/	- -	a/ a/	a/ a/	-	26	41	-	2610	2720
T-1483	ACTH	- -	760 620	360 380	- -	1.68 1.20	0.87 1.48	- -	11.60 9.25	6.90 14.85	-	11.4	13.2	- -	1.18 2.16	0.63 0.53	-	72	88	- -	a/ a/	a/ a/	- -	a/ a/	a/ a/	-	19	23	-	2956	2453
W-7805	ACTH	- -	215 380	300 510	- -	0.34 0.62	0.70 1.10	- -	4.08 4.20	4.63 10.50	-	10.2	13.1	- -	0.27 0.67	0.48 1.08	-	92	89	- -	a/ a/	a/ a/	- -	a/ a/	a/ a/	-	30	32	-	2440	2570
GROUP VII																															
W-4352	ACTH	- -	1250 820	540 360	- -	3.10 2.78	1.22 0.52	- -	9.95 11.56	8.50 4.70	-	14.7	21.0	- -	1.77 6.23	0.19 3.00	-	-	-	- -	a/ a/	a/ a/	- -	a/ a/	a/ a/	-	-	-	-	-	-
P-4360	ACTH	- -	1500 1270	650 440	- -	3.34 2.84	1.50 0.77	- -	17.30 17.70	7.00 4.10	-	13.5	12.9	- -	1.56 0.99	0.52 15.75	-	-	-	- -	a/ a/	- a/	- -	a/ a/	a/ a/	-	-	-	-	-	-
R-1552	ACTH	- -	350 510	- -	- -	0.84 1.50	- -	- -	5.86 11.34	- -	-	13.4	-	- -	0.26 0.53	- -	-	-	-	- -	a/ a/	- -	- -	a/ a/	- -	-	-	-	-	-	-
S-7571	ACTH	- -	1300 960	760 -	- -	3.60 1.94	1.66 -	- -	13.40 15.80	12.30 -	-	13.9	15.8	- -	2.11 1.17	0.57 -	-	-	50	- -	a/ a/	a/ -	- -	a/ a/	a/ -	-	-	-	-	-	-
G-0442	ACTH	- -	770 650	- -	- -	2.18 1.30	- -	- -	15.80 12.20	- -	-	10.1	-	- -	2.19 0.56	- -	-	-	-	- -	a/ a/	- -	- -	a/ a/	- -	-	-	-	-	-	-
P-5803	-	-	-	-	-	-	-	-	-	-	-	13.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
K-2270	ME	-	1150	570	-	2.04	1.38	-	13.90	7.17	-	21.3	13.1	-	1.09	0.50	-	106	83	-	a/	-	-	a/	a/	-	54	-	-	2840	-

a/ These data will be reported later.

TABLE A8 (CONT.)

DATA FROM PROLONGED COMBAT STRESS GROUP IV, AND FROM MISCELLANEOUS GROUP VII

Individual	Special Test	Identical Forms			Digit Symbol W-B			Cattell Culture-Free			Shipley-Hartford			Gottschaldt Figures			Similarities W-B			Digit Span : W-B (total)			Stroop Ratio (CNW/WNC)			Time Estimation (seconds)			Card Sort (self-squad) (rho)		
		A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
GROUP IV																															
F-8576	ACTH	-	16	16	-	45.5	46	-	1	0	-	-	7	-	7	6	-	15	14	-	13	15	-	2.884	2.333	-	13.0	10.6	-	-	-
B-5392	ME	-	11	17	-	50	55	-	3	5	-	-	6	-	2	5	-	10	10	-	13	13	-	4.081	2.111	-	8.5	7.9	-	0.74	0.28
H-4368	ME	-	5	5	-	17	17	-	2	1	-	-	1	-	4	3	-	7	9	-	8	9	-	4.301	3.727	-	10.2	9.3	-	0.76	0.98
J-4476	ME	-	7	8	-	17.5	21	-	1	1	-	-	0	-	0	2	-	15	10	-	9	10	-	2.098	2.000	-	4.7	6.6	-	0.40	0.35
L-0624	ME	-	21	22	-	42	46	-	5	5	-	-	7	-	6	7	-	15	11	-	9	12	-	1.979	1.400	-	7.7	8.9	-	0.98	1.00
M-2880	BV	-	10	15	-	41	48	-	1	1	-	-	0	-	3	6	-	12	14	-	8	12	-	3.541	2.636	-	6.9	11.7	-	0.98	0.95
O-8834	BV	-	5	-	-	25	-	-	2	-	-	-	-	-	-3	-	-	5	-	-	8	-	-	2.524	-	-	11.7	-	-	0.62	-
P-4431	BV	-	15	19	-	39	44	-	2	2	-	-	4	-	7	4	-	17	17	-	9	11	-	5.143	3.059	-	11.7	12.4	-	0.90	0.98
P-0411	BV	-	14	14	-	39	44	-	3	4	-	-	4	-	3	3	-	13	11	-	11	12	-	5.144	4.561	-	8.8	13.3	-	0.98	0.93
R-0371	ACTH	-	15	15	-	42	41	-	2	2	-	-	2	-	1	5	-	12	11	-	9	8	-	5.543	2.776	-	14.3	10.9	-	0.76	0.83
S-4749	ACTH	-	13	17	-	37	43	-	1	4	-	-	1	-	6	5	-	10	12	-	11	9	-	1.950	1.673	-	6.0	7.8	-	0.52	0.93
T-1483	ACTH	-	11	18	-	49	57	-	1	0	-	-	1	-	7	7	-	10	11	-	9	11	-	2.542	2.878	-	7.5	7.2	-	0.98	0.90
W-7805	ACTH	-	16	26	-	36.5	55	-	3	4	-	-	8	-	5	7	-	12	9	-	14	14	-	3.422	2.064	-	7.3	-	-	0.93	1.00
GROUP VII																															
W-4352	ACTH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0[a]	9	-	10[a]	9	-	-	-	-	-	5.9	-	-	-
P-4360	ACTH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	5	-	-	-	-	-	5.7	-	-	-
R-1552	ACTH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13	-	-	11	-	-	4.591	-	-	7.0	-	-	-	-
S-7571	ACTH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
G-0442	ACTH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
P-5803	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
K-2270	ME	-	22	-	-	53	-	-	4	-	-	10	-	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

a/ Data obtained while individual was sedated with 3 gr sodium amytal.

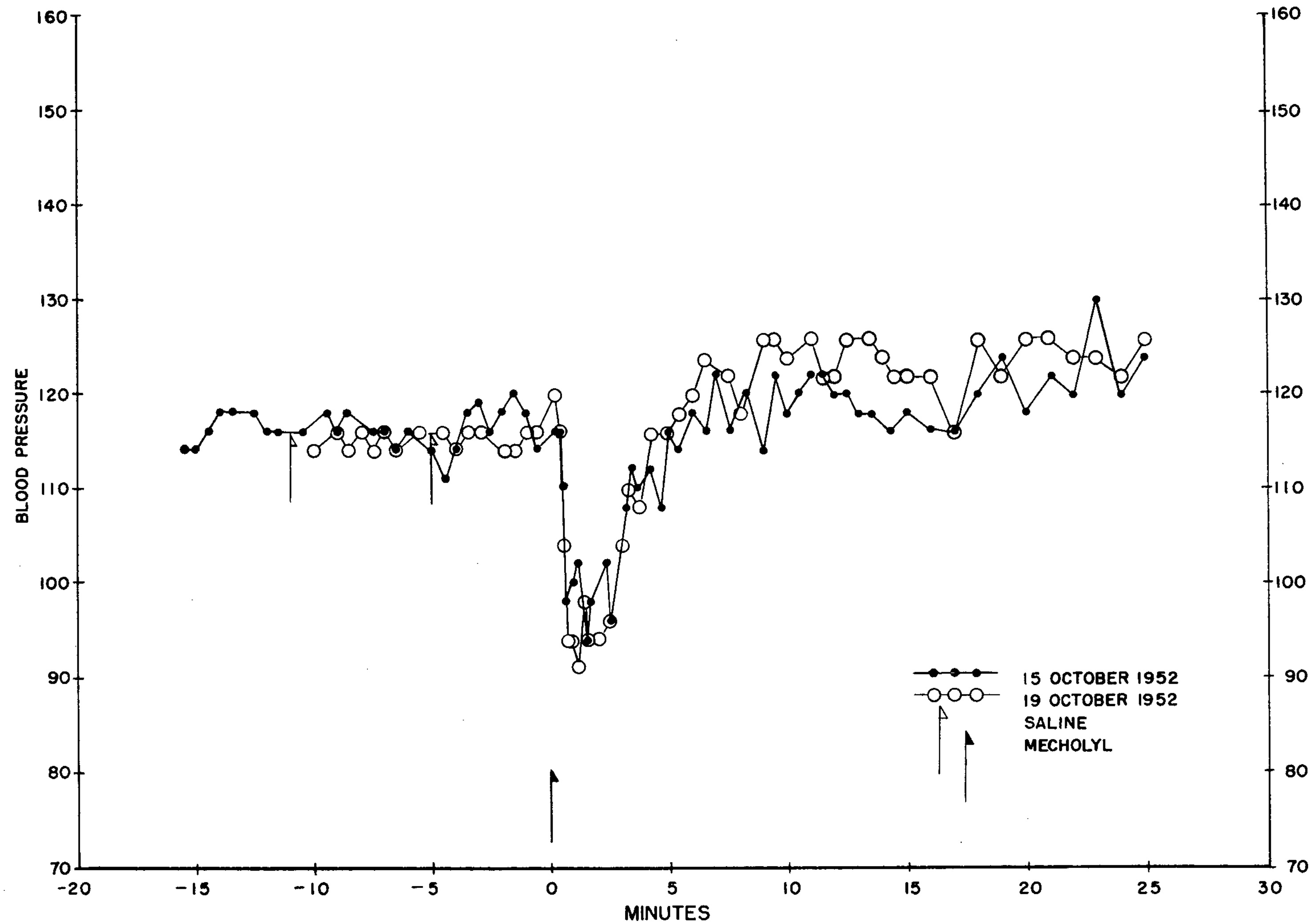


Fig. A1 - Individual C-4136a/

a/ Figures A1 through A12 show blood pressure curve before and after saline and Mecholyl injections.

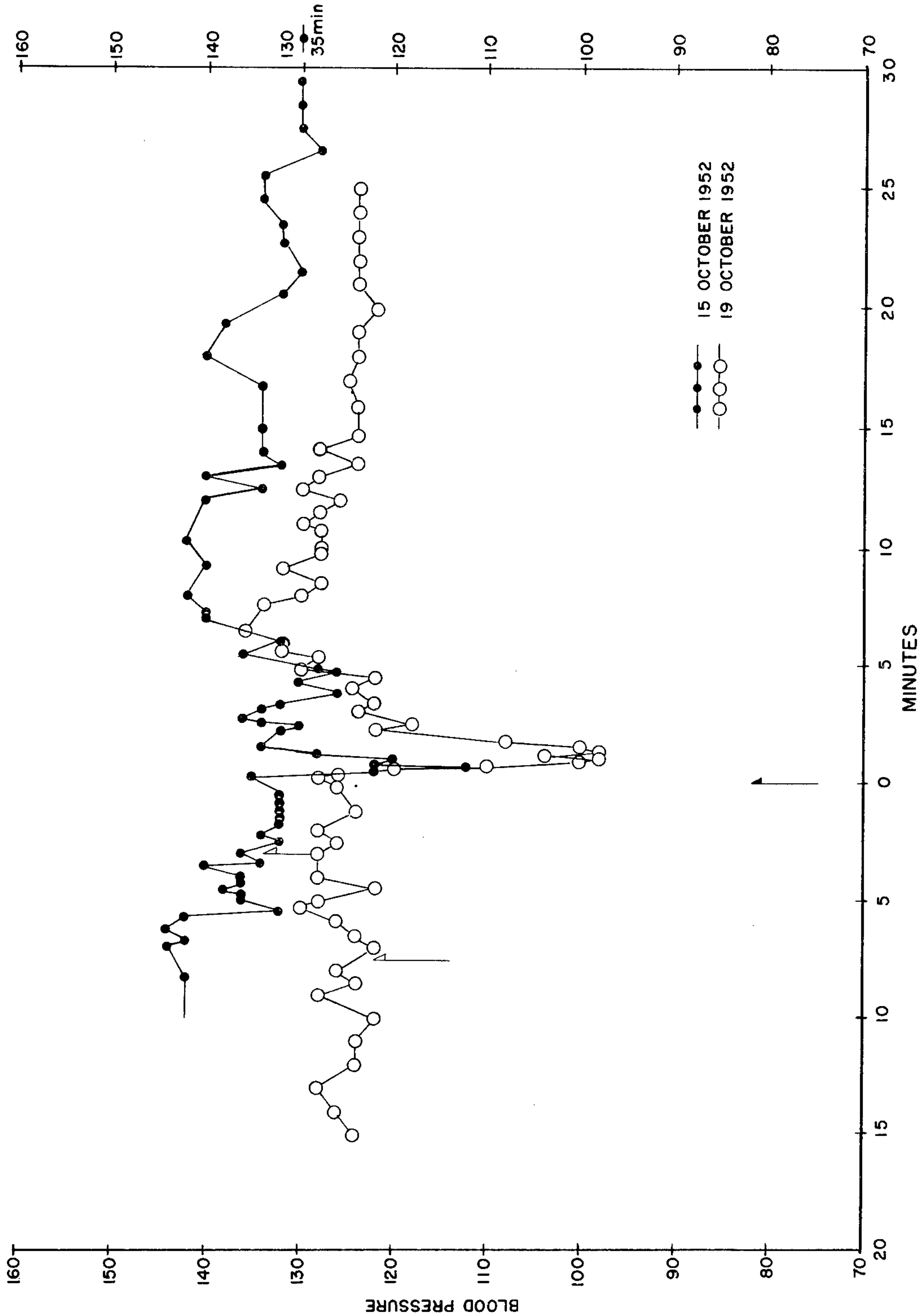


Fig. A2 - Individual H-1864

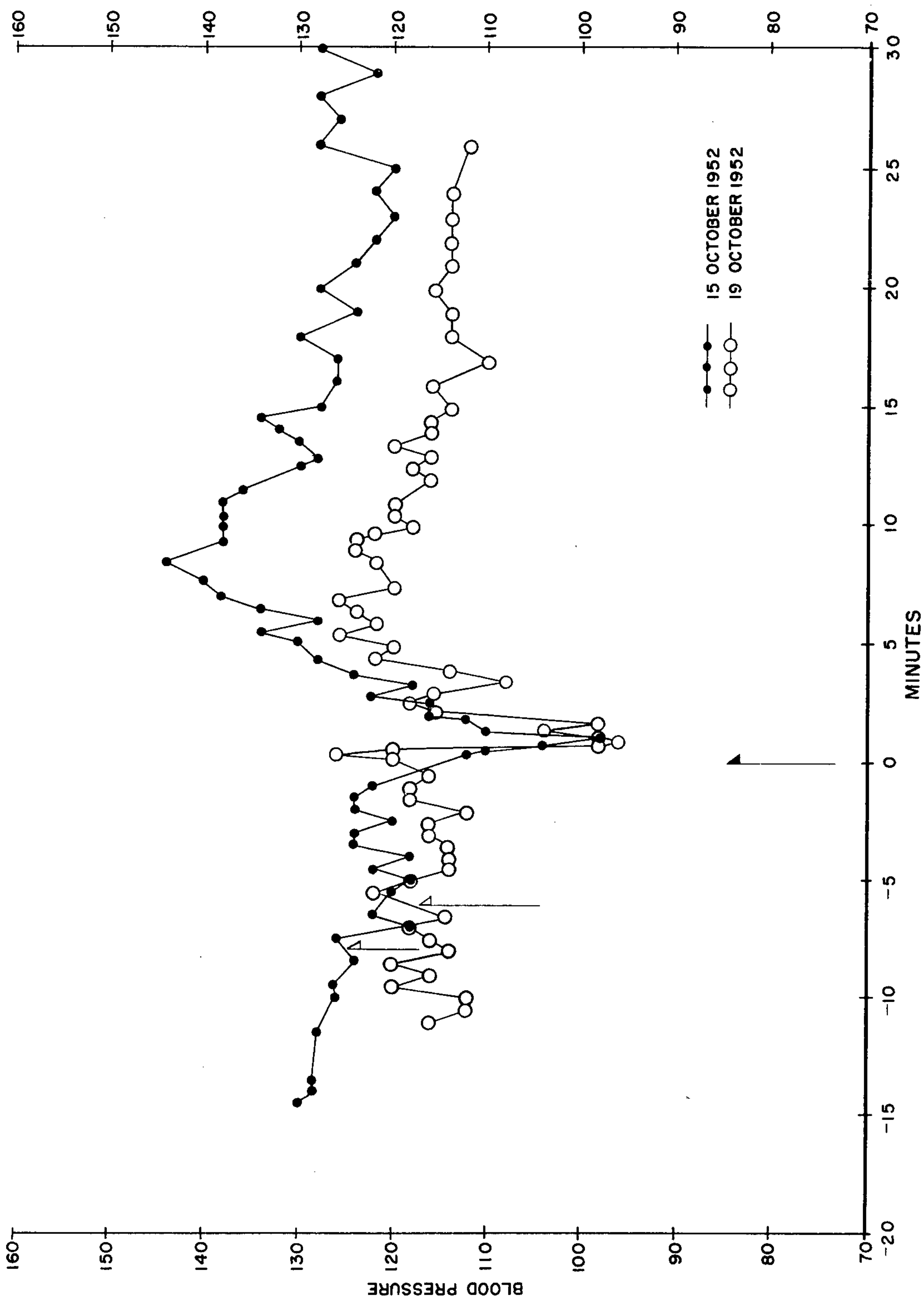


Fig. A3 - Individual L-6206

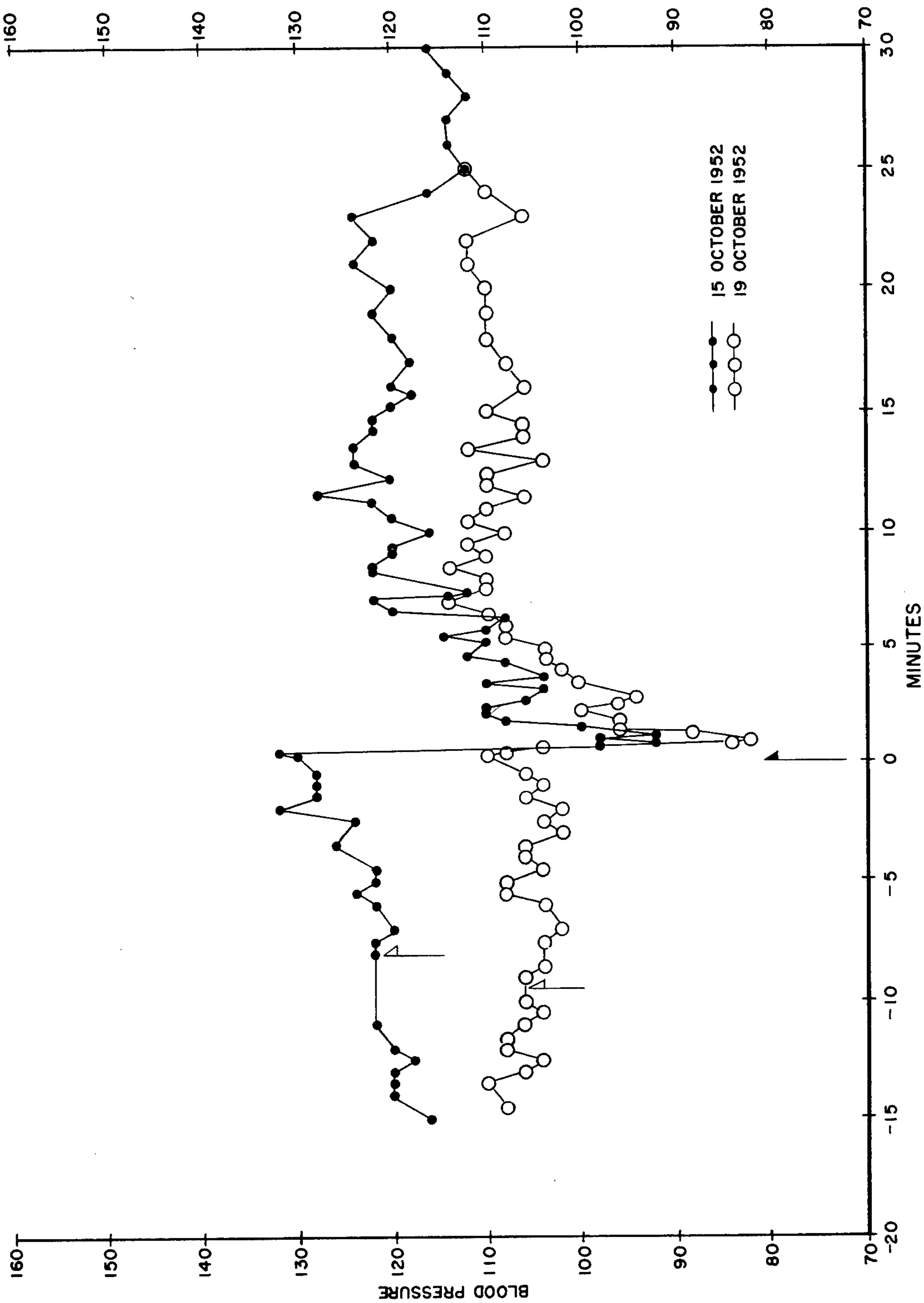


Fig. A4 - Individual S-4917

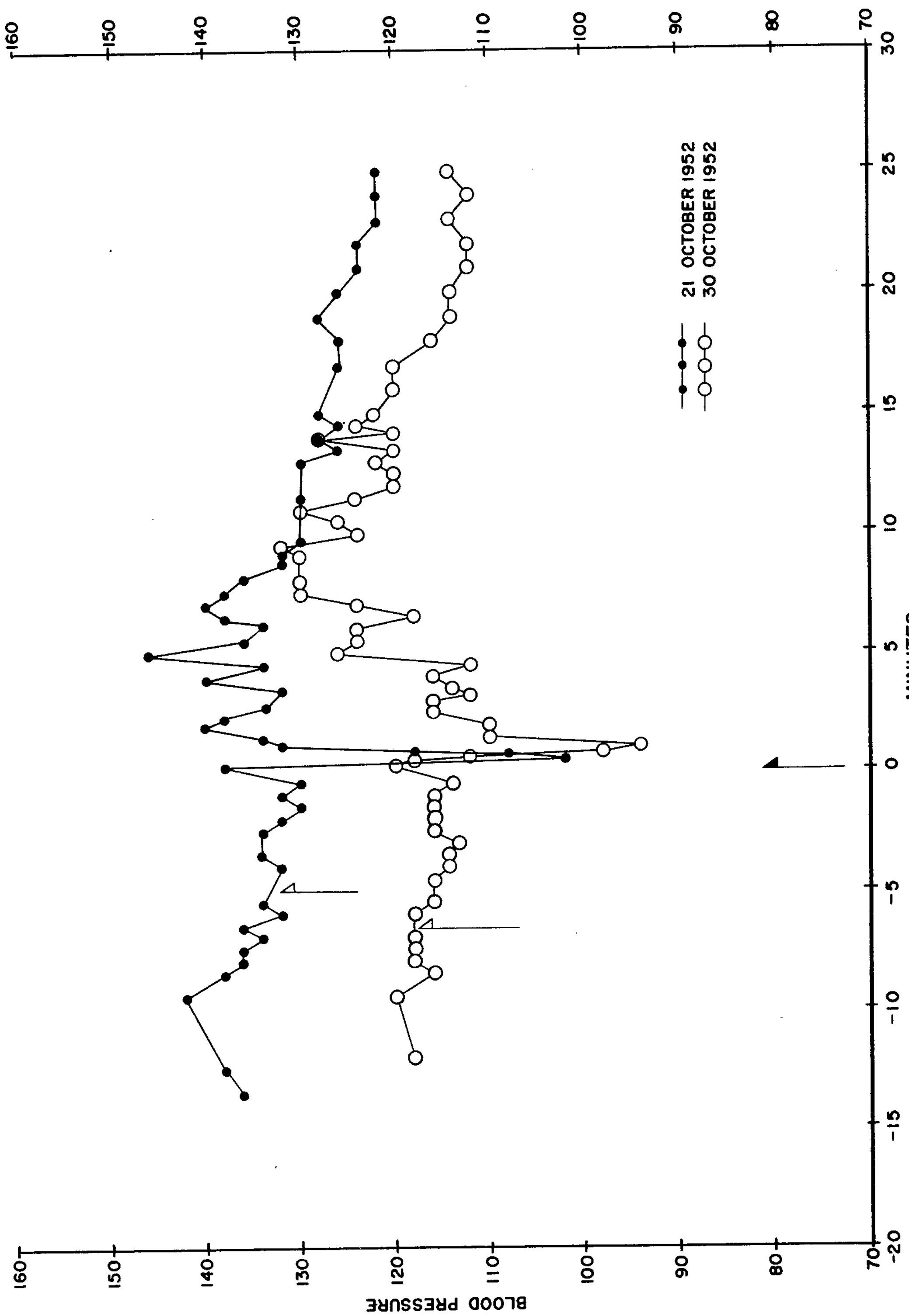


Fig. A5 - Individual B-5392

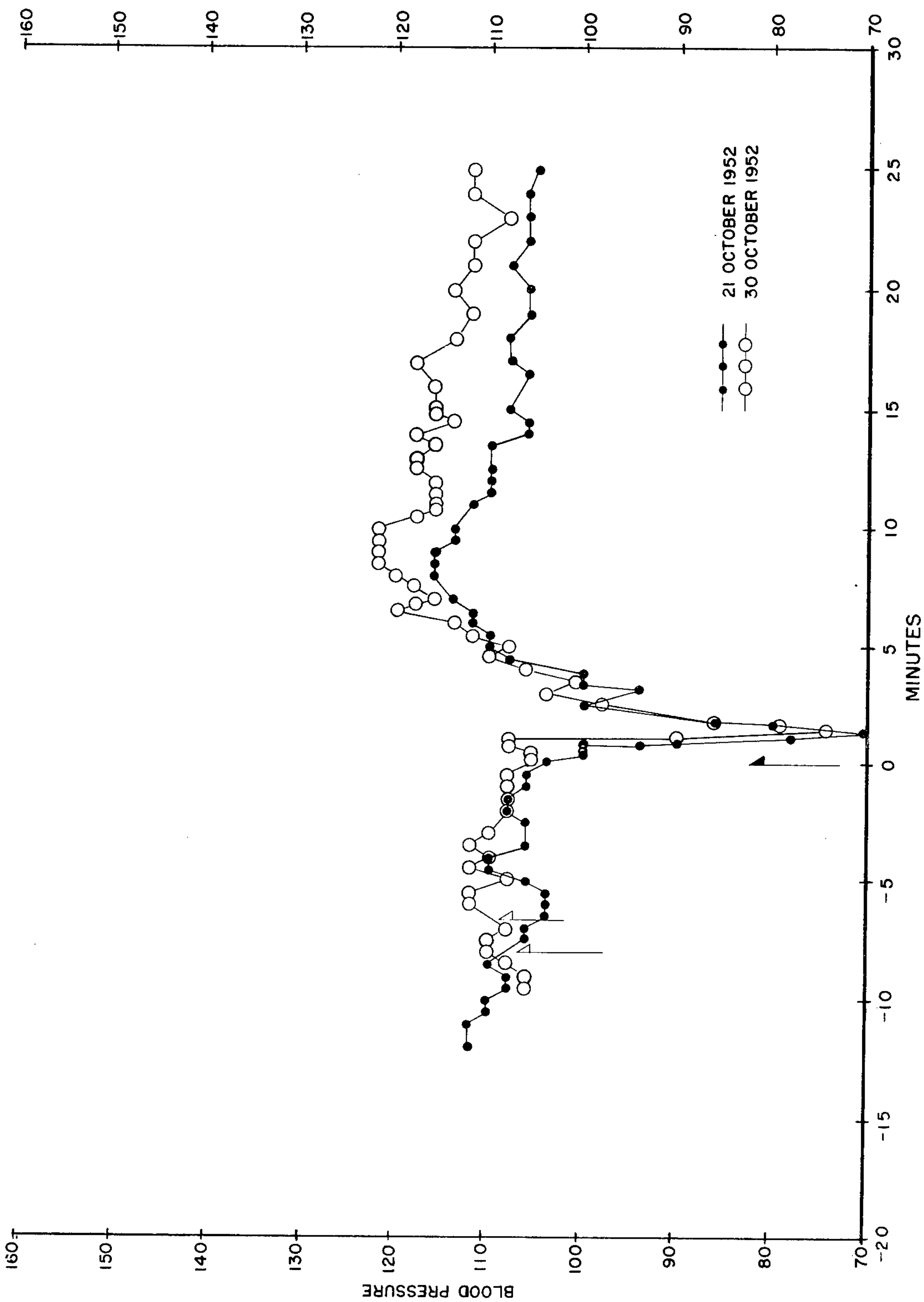


Fig. A6 - Individual H-4368

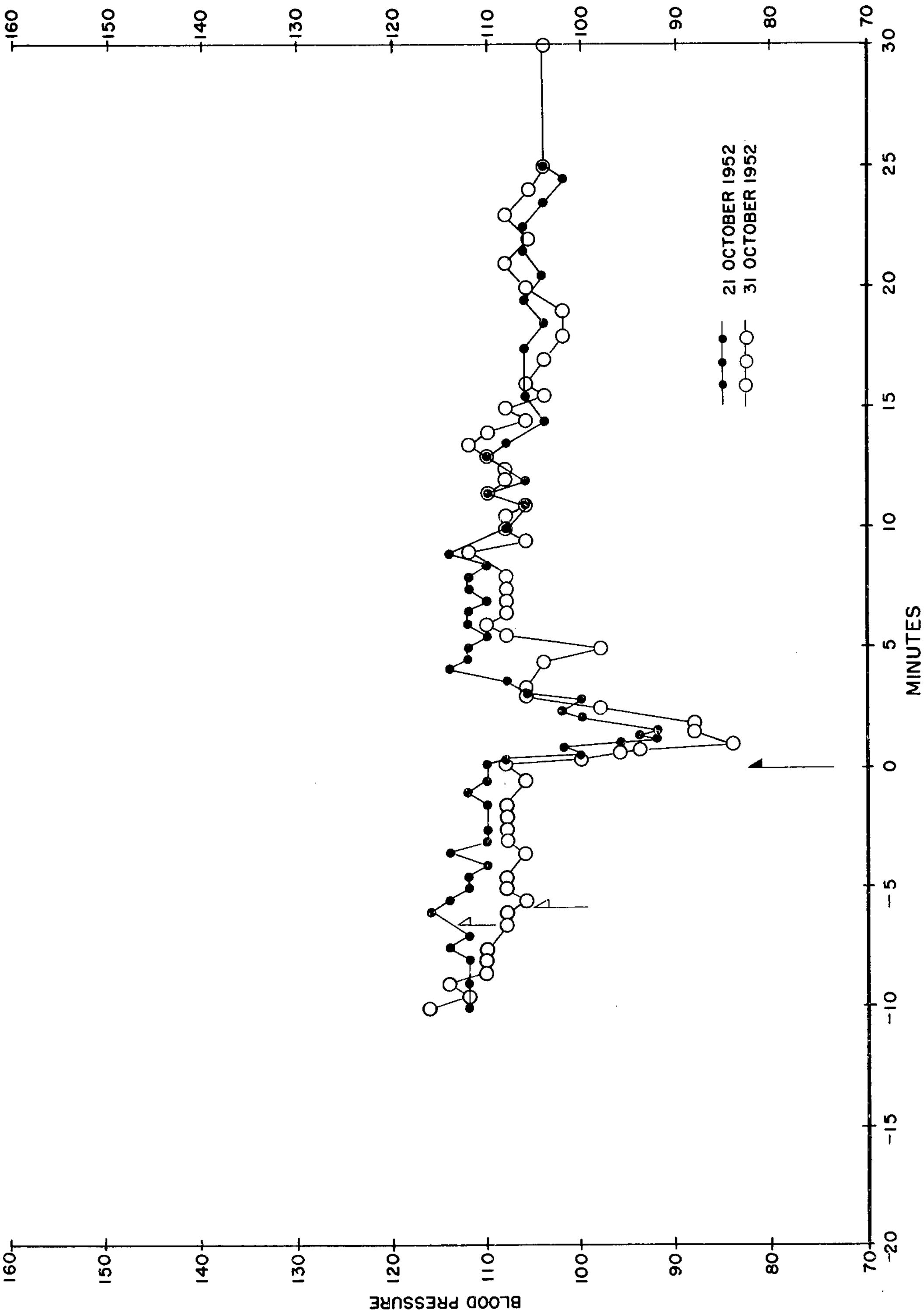


Fig. A7 - Individual J-4476

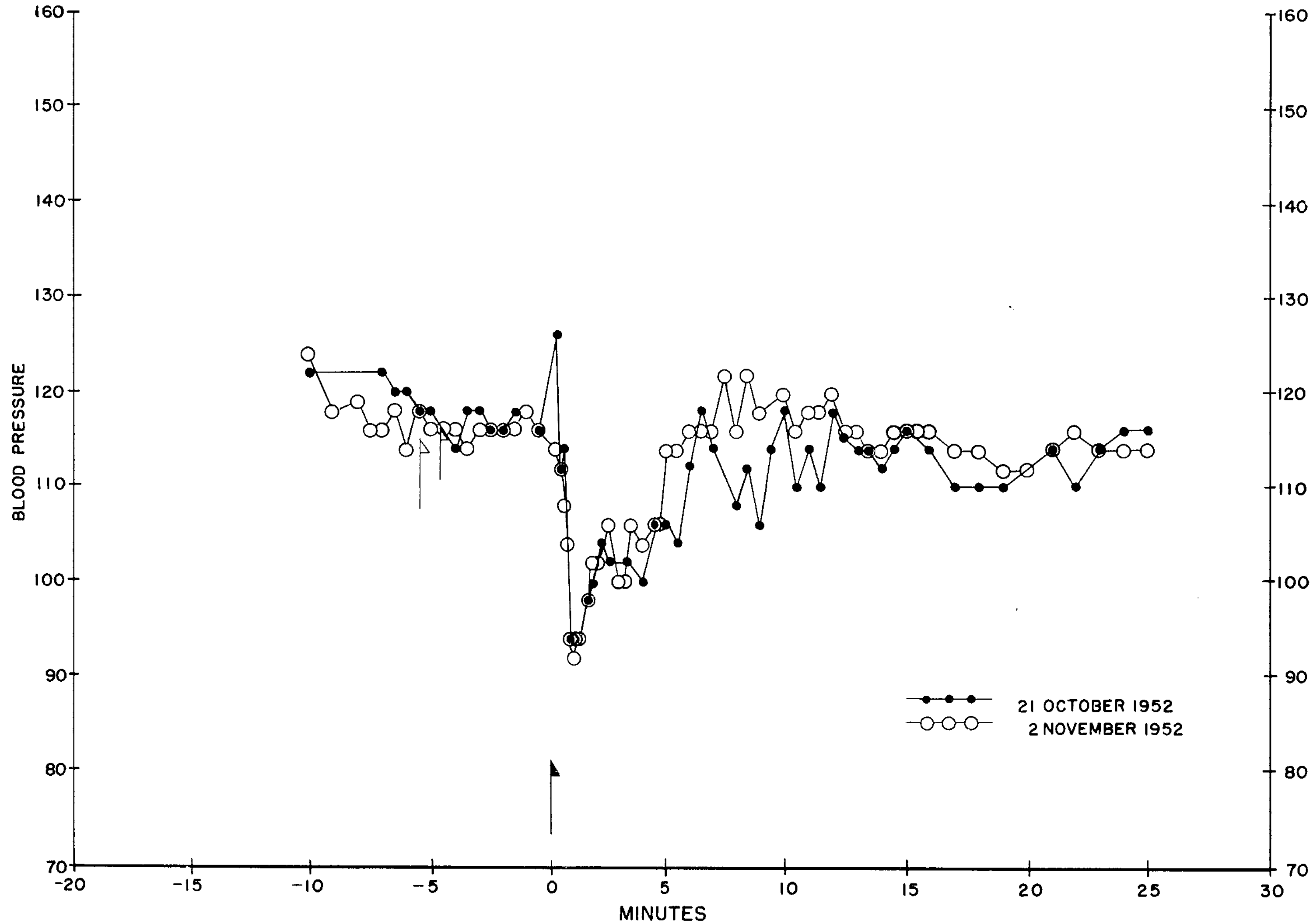


Fig. A8 - Individual L-0624

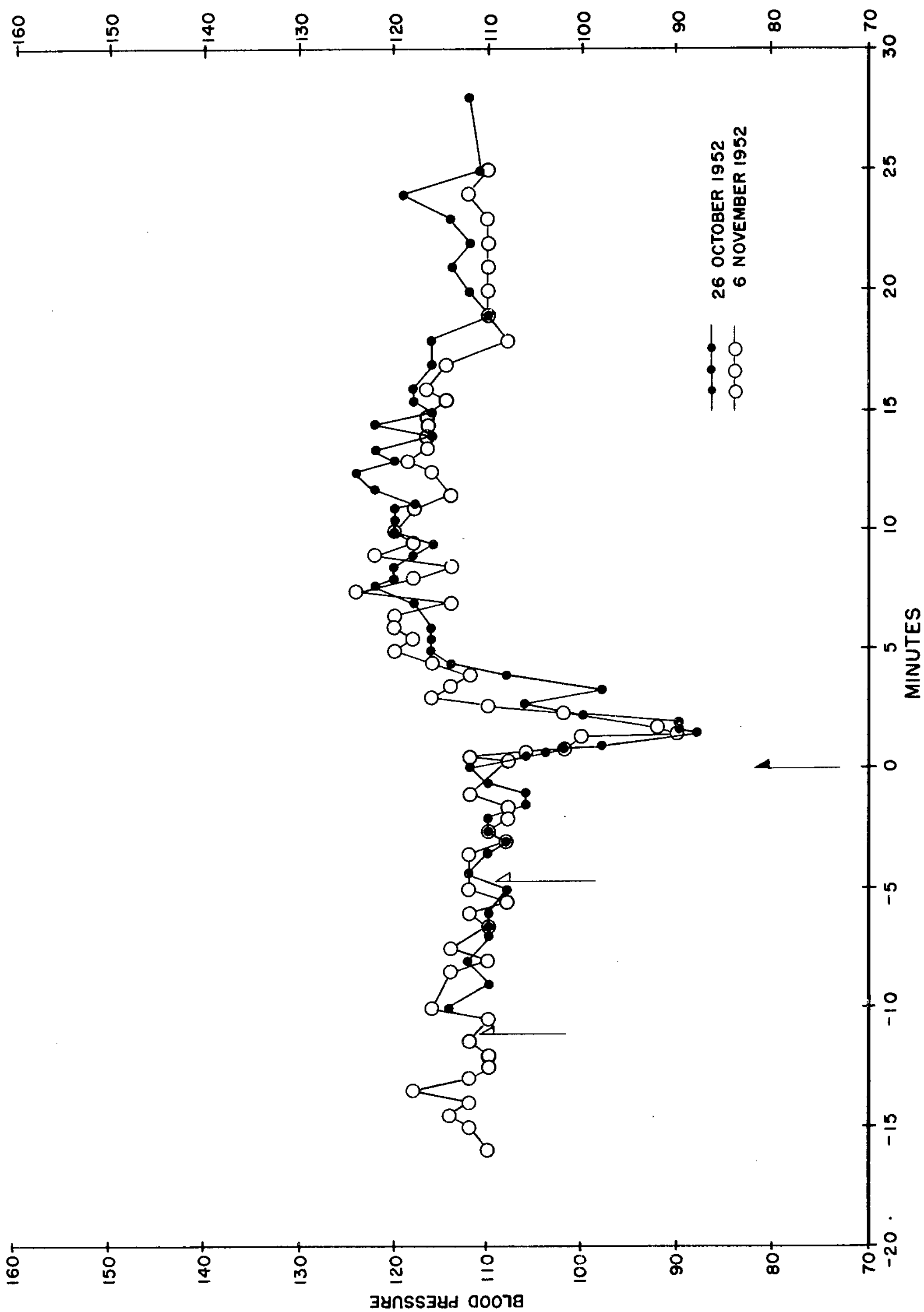


Fig. A9 - Individual A-5075

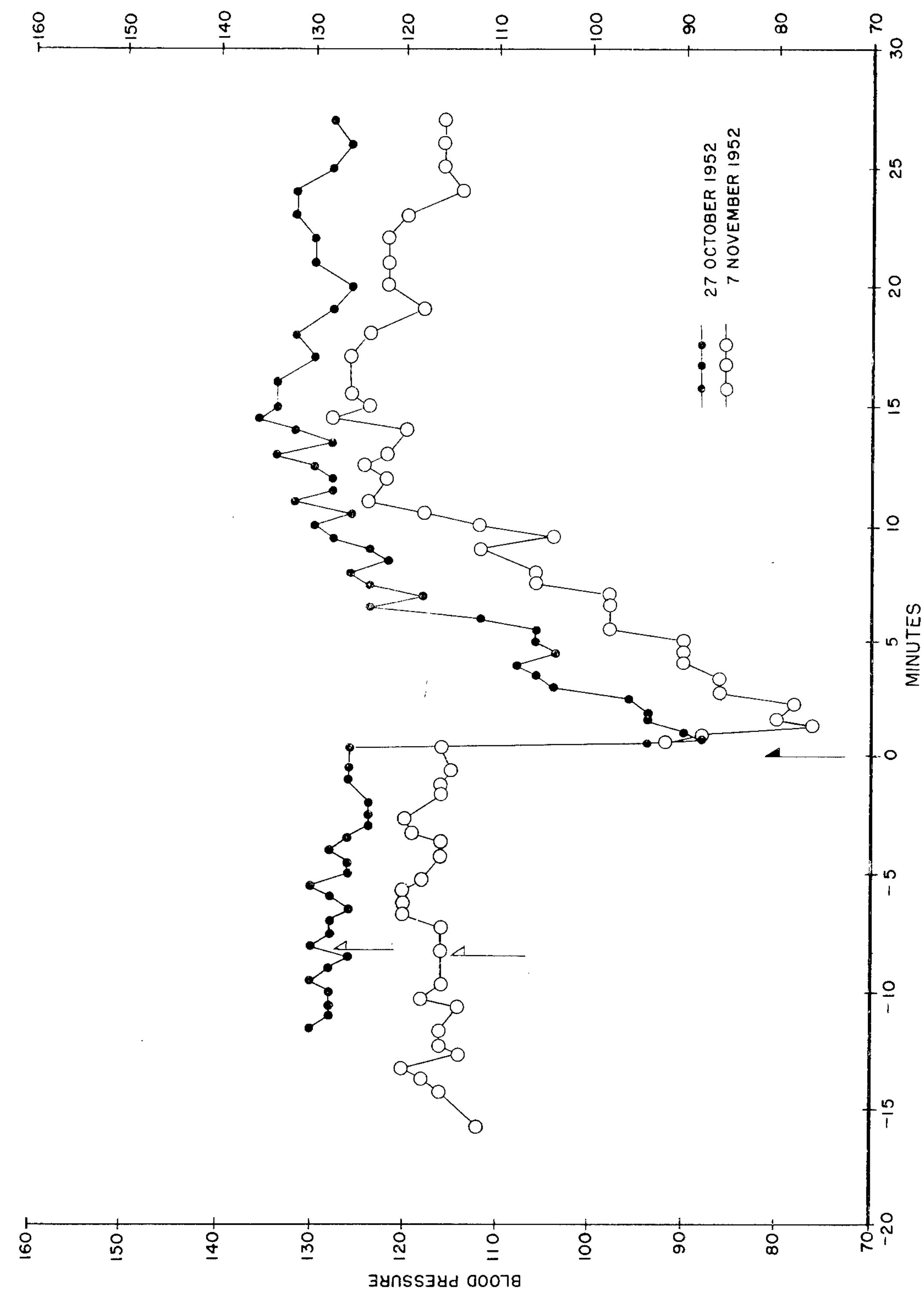


Fig. A10 - Individual B-9350

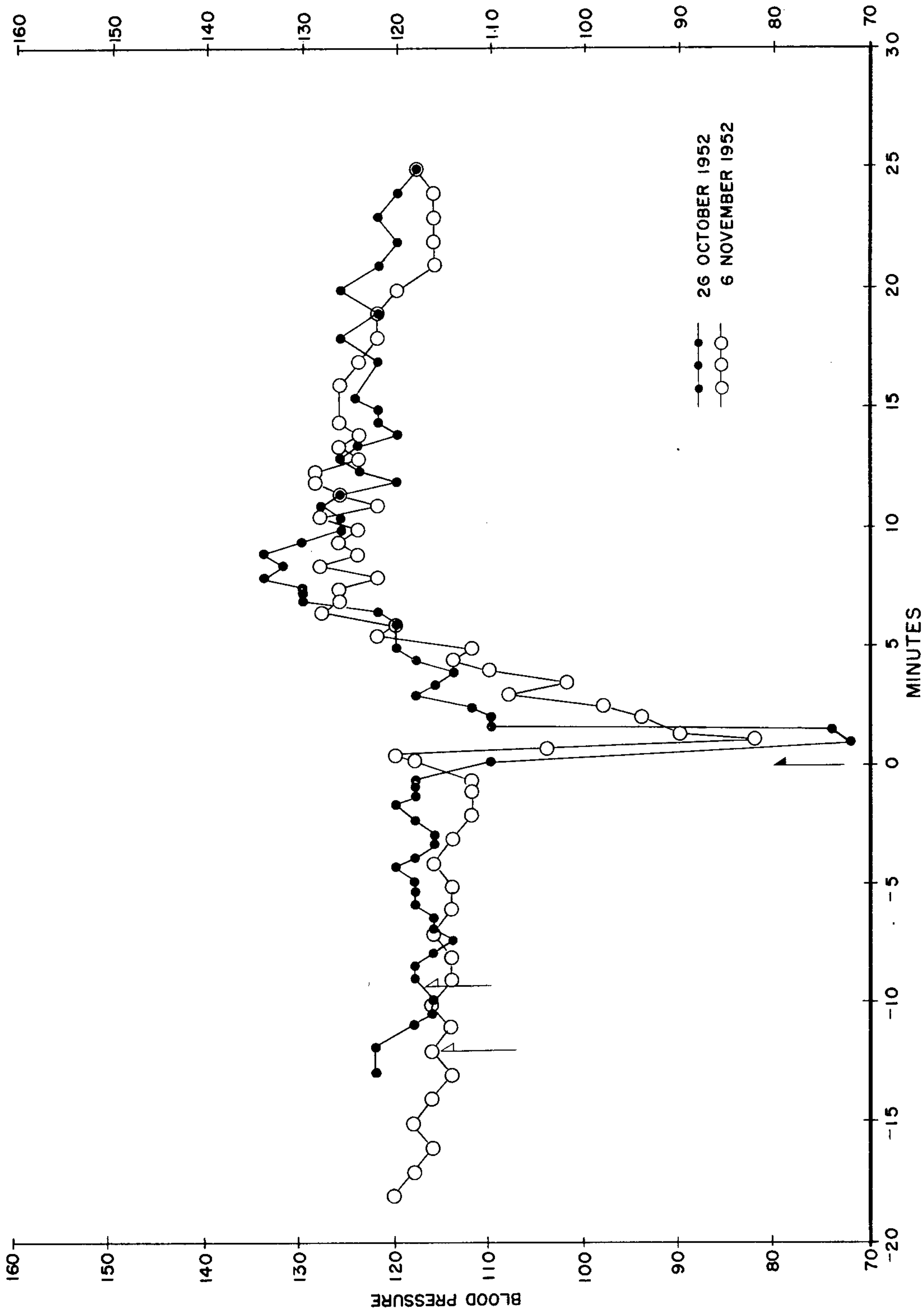


Fig. A11 - Individual C-5107

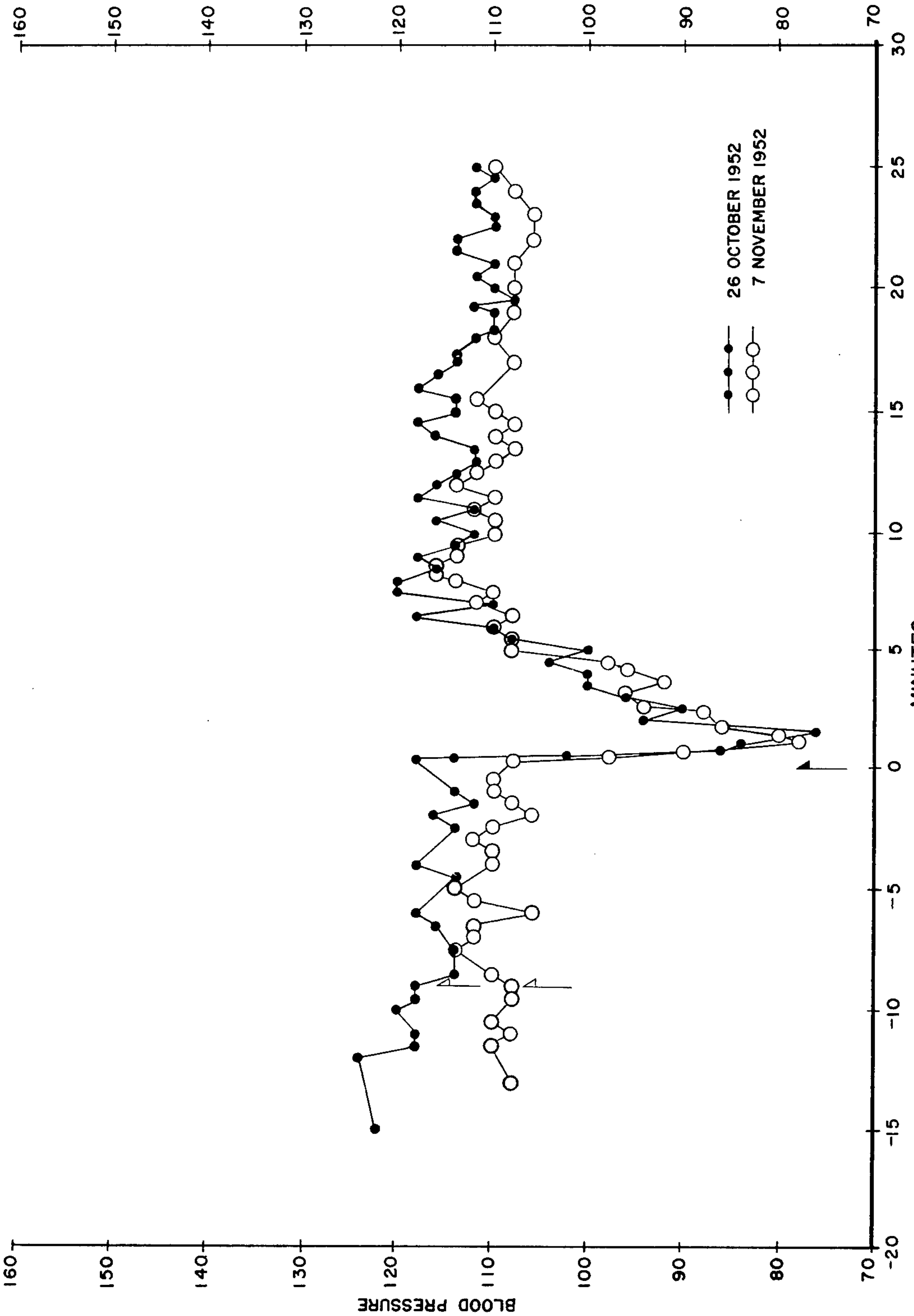


Fig. A12 - Individual S-6942

APPENDIX B

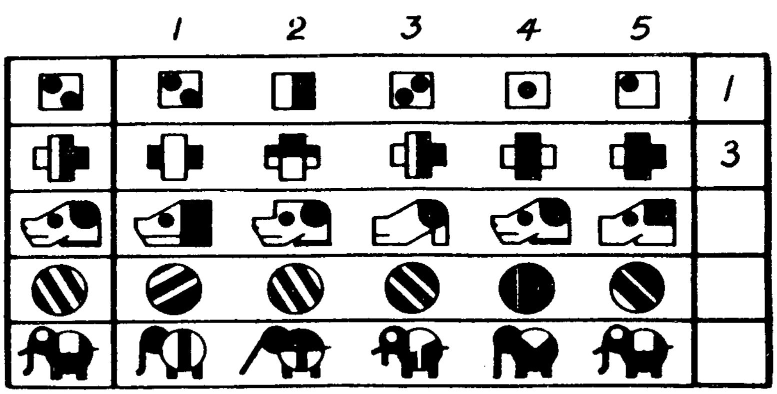
SAMPLE FORMS
(PSYCHOLOGICAL AND PSYCHIATRIC)

L. L. Thurstone
The University of Chicago

IDENTICAL FORMS

Name ____

The first figure in each line below is exactly the same as one of the five numbered figures following. In the blank space at the right of each line, write the number of the figure which is exactly the same as the first figure in the line. The first two blank spaces have been filled in correctly. You fill in the other three. Go right ahead. Do not wait for any signal.



When the signal is given (not yet) turn the page and mark more problems of the same kind. Work rapidly and accurately because your mark will be the total number of correct answers. You may not be able to finish in the time allowed.

Stop here. Wait for further instructions.

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P-12-X Please use 7-551 when reordering this test booklet.

ASN | | DS I | | | | | |

KEY:

1	2	3	4	5	6	7	8	9
−	И	⊐	L	U	O	Λ	X	=

SAMPLE

2	1	3	1	2	4	3	5	3	1	2	1	3	2	1	4	2	3	5	2	3	1	4	6	3

1	5	4	2	7	6	3	5	7	2	8	5	4	6	3	7	2	8	1	9	5	8	4	7	3

6	2	5	1	9	2	8	3	7	4	6	5	9	4	8	3	7	2	6	1	5	4	6	3	7

Instructions: In the KEY there are divided boxes or squares. Notice that each has a number on the upper part and a little mark on the lower part. Notice also that with every number there is a different mark. Now look at the SAMPLE where the boxes have only numbers and the squares underneath are empty. Put in each of the sample squares the mark that should go there. Do not go on until told to start.

ASN | | DS II | | | | | |

KEY:

1	2	3	4	5	6	7	8	9
∸	)	+	⊢	⅂	V	(	÷	⊣

SAMPLE

2	1	4	6	3	5	2	1	3	4	2	1	3	1	2	3	1	4	2	6	3	1	2	5	1

3	1	5	4	2	7	4	6	9	2	5	8	4	7	6	1	8	7	5	4	8	6	9	4	3

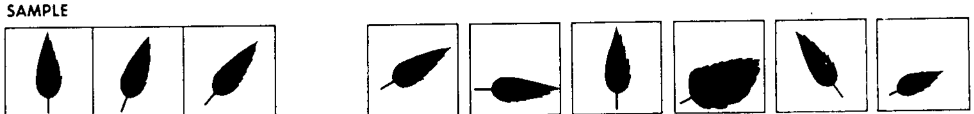
1	8	2	9	7	6	2	5	4	7	3	6	8	5	9	4	1	6	8	9	3	7	5	1	4

9	1	5	8	7	6	9	7	8	2	4	8	3	5	6	7	1	9	4	3	6	2	7	9	3

ASN | | | CCF | | | | |

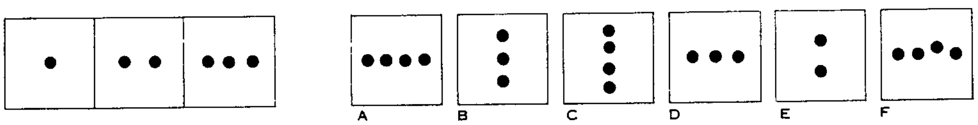
Instructions: Choose a figure from the six at the right which will complete the series started at the left. Look at the sample. You will see three stages of a falling tree. The picture which shows the fourth stage of the tree's falling down has been underlined. You always have to pick out what comes next. In the items below, see what change goes on in the first three, underline and put its letter at the right-hand side of the page in the space provided. Are there any questions? Do not go on until told to start.

SAMPLE



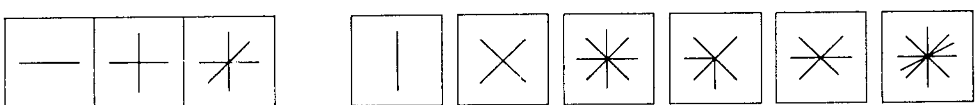
A B C D E F   A

1.



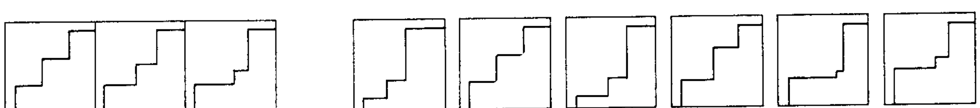
A B C D E F ___

2.



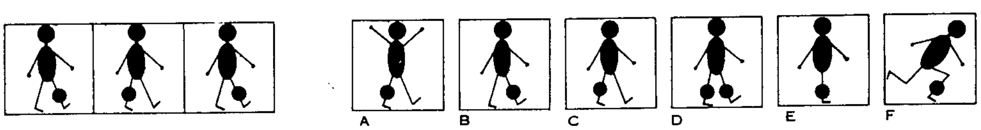
A B C D E F ___

3.



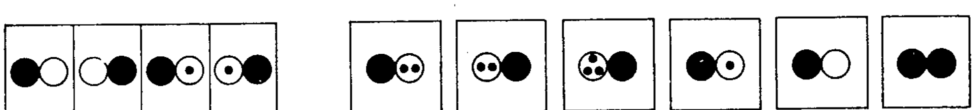
A B C D E F ___

4.



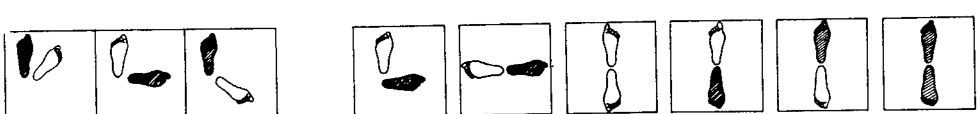
A B C D E F ___

5.



A B C D E F ___

6.



A B C D E F ___

OVER

SH

ASN

Complete the following. Each dash (____) calls for either a number or a letter to be filled in. Every line is a separate item. Take the items in order, but don't spend too much time on any one.

START HERE

(1) 1 2 3 4 5 __

(2) white black short long down __

(3) AB BC CD D__

(4) Z Y X W V U __

(5) 1 2 3 2 1 2 3 4 3 2 3 4 5 4 3 4 5 6 __ __

(6) NE/SW SE/NW E/W N/__

(7) escape scape cape __ __ __

(8) oh ho rat tar mood __ __ __ __

(9) A Z B Y C X D

(10) tot tot bard drab 537 __ __ __

(11) mist is wasp as pint in tone __ __

(12) 57326 73265 32657 26573 __ __ __ __ __

(13) knit in spud up both to stay __ __

(14) Scotland landscape scapegoat __ __ __ __ee

(15) surgeon 1234567 snore 17635 rogue __ __ __ __ __

(16) tam tan rib rid rat raw hip __ __ __

(17) tar pitch throw saloon bar rod fee tip end plank __ __ __ __ __ meals

(18) 3124 82 73 154 46 13__

(19) lag leg pen pin big bog rob __ __ __

(20) two w four r one o three __

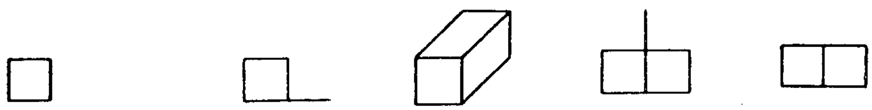
Research Form GF47

L. L. Thurstone
The University of Chicago

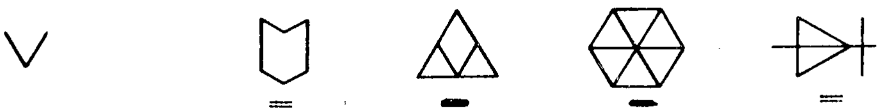
GOTTSCHALDT FIGURES

Name ______________________________

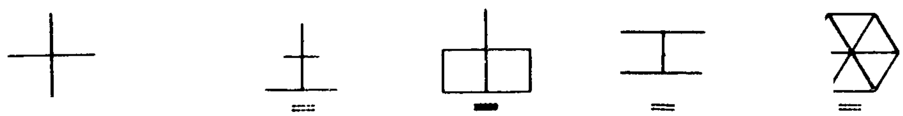
Look at the row of drawings below. The first design is hidden in each of the more complex drawings. Can you find the square in each of the drawings?



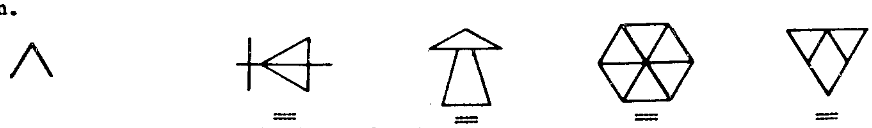
The design must be in the same position in the drawing as shown at the left. In the row of drawings below two contain the design. Those two drawings are marked. The other two drawings are not marked because they do not contain the design in the same position as is shown at the left.



A drawing is to be marked if it contains the exact design in the correct position. Here is another row in which the answers are shown by marking the answer spaces.

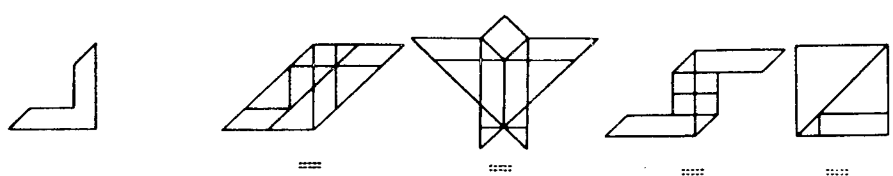


In the next row you are to mark the spaces under the drawings which contain the design.



You should have marked the last two drawings.

Here is another row for you to practice on.



You should have marked the first and third drawings.

Do not turn the page until the examiner tells you to do so. **The following pages contain rows of designs and drawings. If a drawing contains the design, mark it. If it does not contain the design, do not mark it. You will have only a few minutes for this task.** WORK JUST AS FAST AS YOU CAN.

WAIT FOR THE STARTING SIGNAL

Science Research Associates, 228 South Wabash Avenue, Chicago 4, Illinois

I	II
Orange-Banana	Plum-Peach
Coat-Dress	Beer-Wine
Dog-Lion	Cat-Mouse
Wagon-Bicycle	Piano-Violin
Paper-Radio	Paper-Coal
Air-Water	Pound-Yard
Wood-Alcohol	Scissors-Copper Pan
Eye-Ear	Mountain-Lake
Egg-Seed	First-Last
Poem-Statue	Salt-Water
Praise-Punishment	Liberty-Justice
Fly-Tree	49-121

NOT USED

	I 1	I 2	I 3	I 4	II 1	II 2	II 3	II 4	III 1	III 2	III 3	III 4	CS	I Se	I Sq	II SE	II Sq	III Se	III Sq	DS I
Rule													1							
Skirt													2							No.
Diamond													3							Er
File													4							Net
Bond													5							Time
Club													6							
Gum													7							DS II
Lumber													8							No.
Lump													9							Er
Duck																				Net
Mean																				Time
Cell																				

TIME ESTIMATION:

	(A)	(B)	(C)	AVE.
I				
II				
III				

DSp I F	DSp I B	DSp II F	DSp II B
5, 8, 2	6, 2, 9	(3) 3, 8, 6	(2) 2, 5
6, 9, 4	4, 1, 5	6, 1, 2	6, 3
6, 4, 3, 9	3, 2, 7, 9	(4) 3, 4, 1, 7	(3) 5, 7, 4
7, 2, 8, 6	4, 9, 6, 8	6, 1, 5, 8	2, 5, 9
4, 2, 7, 3, 1	1, 5, 2, 8, 6	(5) 8, 4, 2, 3, 9	(4) 7, 2, 9, 6
7, 5, 8, 3, 6	6, 1, 8, 4, 3	5, 2, 1, 8, 6	8, 4, 1, 3
6, 1, 9, 4, 7, 3	5, 3, 9, 4, 1, 8	(6) 3, 8, 9, 1, 7, 4	(5) 4, 1, 6, 2, 7
3, 9, 2, 4, 8, 7	7, 2, 4, 8, 5, 6	7, 9, 6, 4, 8, 3	9, 7, 8, 5, 2
5, 9, 1, 7, 4, 2, 8	8, 1, 2, 9, 3, 6, 5	(7) 5, 1, 7, 4, 2, 3, 8	(6) 1, 6, 5, 2, 9, 8
4, 1, 7, 9, 3, 8, 6	4, 7, 3, 9, 1, 2, 8	9, 8, 5, 2, 1, 6, 3	3, 6, 7, 1, 9, 4
5, 8, 1, 9, 2, 6, 4, 7	9, 4, 3, 7, 6, 2, 5, 8	(8) 1, 6, 4, 5, 9, 7, 6, 3	(7) 8, 5, 9, 2, 3, 4, 2
3, 8, 2, 9, 5, 1, 7, 4	7, 2, 8, 1, 9, 6, 5, 3	2, 9, 7, 6, 3, 1, 5, 4	4, 5, 7, 9, 2, 8, 1
2, 7, 5, 8, 6, 2, 5, 8, 4		(9) 5, 3, 8, 7, 1, 2, 4, 6, 9	(8) 6, 9, 1, 6, 3, 2, 5, 8
7, 1, 3, 9, 4, 2, 5, 6, 8		4, 2, 6, 9, 1, 7, 8, 3, 5	3, 1, 7, 9, 5, 4, 8, 2

SR	I E	I T	II E	II T	III E	III T
CNW (B)						
WNC (A)						

SIM	HOM	CS	DS	DSP	SR	SH	GF	IF	CCF	PM

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E			
T			
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S			
ape			
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W			
735			
on			
65732			
at			
goat			
36425			
hit			
board (3)			
6			
rub			
r			
Time			

GF	I	II	III
1 BD			
7 D			
13 B			
2 CD			
8 AB			
14 C			
3 AB			
9 AC			
15 ACD			
4 CD			
10 ABD			
16 ACD			
5 BD			
11 AD			
17 AC			
6 ABCD			
12 AB			
18 A			
Time			

IF		I	II	III
1	2			
21	4			
41	5			
2	4			
22	2			
42	1			
3	5			
23	5			
43	4			
4	4			
24	4			
44	2			
5	2			
25	5			
45	3			
6	3			
26	1			
46	1			
7	5			
27	3			
47	5			
8	1			
28	2			
48	4			
9	2			
29	5			
49	4			
10	4			
30	4			
50	5			
11	3			
31	1			
51	2			
12	1			
32	3			
52	3			
13	5			
33	2			
53	1			
14	2			
34	4			
54	5			
15	5			
35	5			
55	3			
16	3			
36	1			
56	3			
17	1			
37	3			
57	2			
18	4			
38	5			
58	5			
19	2			
39	2			
59	1			
20	3			
40	3			
60	4			
Time				

CCF	I	II	III
7C			
8B			
9C			
10F			
1A			
11F			
2C			
12C			
3E			
13B			
4C			
14D			
5A			
15F			
6D			
Time			

Porteus I

	Lift	Pause	T	
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14				
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II				

II

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12				
14				
I				
II				

III

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12				
14				
I				
II				

NOT USED

Psychiatric Data

		0	1	2	3
1.	Parental Background	Both parents living. Father Dominant	Both parents living. Mother dominant or neurotic	Mother dead or separated before age 10	Father dead or separated before age 10
2.	Parental Discipline	Strict	Moderate	Lenient	
3.	Heterosexual Activity*	3 before 20	2 before 20	1 before 20	none before 20
4.	Education and Occupation	Recent HS graduate or skilled job for 2 yrs	Unskilled steady job	Frequent job changes	No job for more than 3 months
5.	Fights	Many	Occasional	Few	None
6.	Athletics	Team frequent	Team occasional	Individual	None
7.	Religious Adherence	Strong	Average	Slight	None
8.	Infiltration Course	No Anxiety	slight anxiety	Moderate anxiety	Conversion
9.	Rifle Range	Marksman no anxiety	qualified no anxiety	qualified some anxiety	didn't qualify
10.	Social Adjustment	Many Friends	Few Friends	One Buddy	Lone Wolf
11.	Attitude Toward officers	Good	Indifferent	Hostile	
12.	Attitude Toward NCOs	Good	Indifferent	Hostile	
13.	Attitude Toward Job	Fair	Indifferent	Unfair	
14.	Body Type	Large	Medium	Small	
15.	Intelligence	High	Average	Low	
16.	Number of siblings				
17.	Length of Service				
18.	Time in Korea				
19.	Points				
20.	Number of Patrols				
21.	Number of times fired at enemy				
22.	Estimate of Combat Effectiveness				

Comments:

* 1. Dating 2. Steady girl 3. Age of first intercourse