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FIELD TEST OF ACCEPTABILITY AND ADEQUACY OF U. S. ARMY C, K,
10-in-1 AND CANADIAN ARMY MESS TIN RATIONS

1. PROJECT: No. 30—Final Report of Acceptability and Adequacy of U. S. Army C, K, 10-in-1 and Canadian Army Mess Tin Rations.

a. Authority: Letter SPQRD 400.112 (Ration Acceptability, C and K) and 4th Ind. A.S.F. Office of the Surgeon General SPMDO 4 April 1944.

b. Purpose: To determine the acceptability and adequacy of the packaged expeditionary* rations C, 10-in-1 and Canadian Army Mess Tin compared with a supplemented Field Ration B.

2. DISCUSSION:

A comprehensive field test of rations was desirable because of reports from combat areas and the Canadian Army winter trials and because newly introduced changes and ration components had not been tested previously.

The *acceptability* and the *adequacy* of the rations were studied by all methods available within the limitations of time and personnel to carry out procedures and collect information. The entire testing program was integrated with the infantry training schedule of the battalion; and it was possible for the subjects to complete most of their POR training during the test.

Methods—Five principal methods were used to measure acceptability and adequacy as follows:

- (1) Questionnaires of individual likes and dislikes of items.
- (2) Individual item and calorie consumption.
- (3) Food wastage by company.
- (4) Physical fitness as determined by:
 - (a) A battery of 3 fitness tests.
 - (b) Appraisal of the military fitness of the individual soldier by line and noncommissioned officers, and by observers.
- (5) Clinical and biochemical examination to ascertain the nutritional status of individual subjects and companies on the different ration programs.

Conditions—In planning the test 5 principles of control were laid down. They were:

- (1) There be a large enough number of subjects tested to have statistical validity.
- (2) The men be on the test rations for a long enough period to give meaningful results.
- (3) Complete isolation from outside sources of food and mutual isolation of the several test groups be enforced.
- (4) The testing personnel have a preliminary period of training and indoctrination with tests and procedures.
- (5) The subjects carry out military training resembling combat activities and be organized in units according to army regulations. The officers responsible for the test to have control of the troops and a single program of activity be carried out by all groups to allow satisfactory comparison.

Details of procedures and the general program are set forth in the appendices. The 5 conditions of control stipulated prior to the test were satisfied. It was recognized that perhaps the most important element in acceptability of combat rations—the emotional stress of warfare—was absent in this test. Another factor which undoubtedly influenced acceptability was the freshness of the rations tested, most of which were not over 3 months old when consumed. Overseas rations are not often eaten before they are 12 months old. Other conditions of environment affected acceptability and consumption and must be considered in the final evaluation and in applying these findings to other situations.

* C and K Rations are called emergency or combat rations in the appendices. Support rations refer only to 10-in-1 and B Rations.

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227

3. SUMMARY OF RESULTS:

a. *Acceptability*: The high general level of acceptability of all rations was noted throughout, though a number of items were never well received. The New and Experimental C Rations were rated unequivocally the best of the rations packaged for individual consumption; and the Experimental was preferred over the New. All meat components of the old C Ration were rated low and there was large waste of M-1, -2 and -3 components when ample food was available. The new biscuits were preferred over the old. The chief complaints were the absence of any meat appropriate to breakfast, and the side-opening of the meat cans. K Ration was received fairly well, and consumption improved with time as hunger increased and as new methods of preparation evolved. When there was maximal variety the ration was well received. Exceptions to the general trend were bouillon and biscuits which rated low. Confections were universally well liked. Lemon powder was intermediate. The Canadian Army Mess Tin Ration was fairly well accepted, though use of sardines and tea declined during the test and pea soup and milk-and-sugar powder rated low throughout. The 10-in-1 Ration was well received, especially when used for only 2 weeks as a support-area ration. When used for 2 months it became tiresome. The noon meal of K Ration components was not relished, particularly by subjects who had been eating K Ration. When issue was restricted to 1 ration daily during the 6th and 7th weeks, the subjects wanted more food though consumption was about the same as when the ration was first used. No direct comparison was made between the 10-in-1 and the Supplemented B Ration though all observers who had eaten both were unanimous in favor of the latter.

All items customarily eaten hot were preferred hot and rated low when eaten cold, but actual consumption fell off surprisingly little when no heat was allowed. Acceptability of fruit beverages was higher when the weather was warm or hot, and cool water was available; hot drinks were preferred when the weather was cold. Acceptability of most foods was the same at all meals. The emergency-type rations could be prepared and eaten in less time than the 10-in-1.

All confections, jams and sugar had high acceptability and little waste. Many packages and containers were opened for these items alone when the issue of rations was high. Of the drinks, bouillon was rated lowest, and the lemon powder was never highly acceptable. Cheeses in the K Ration were rated fairly high, but the waste was large. Beans were popular; in the Experimental C Ration 5 of the 6 best meat components contained beans. Meat components ranged from very high to very low in consumption and ratings. Some were excellent, especially the new products in the C Rations. Others were never highly acceptable. Many of the new biscuits and crackers, approximating the ordinary soda, graham and neutral crackers were rated high, and were still better received when jam was available.

Packaging in general was excellent. At the altitude of the test the air tight pliofilm container in the K Ration expanded and its removal from the box was slightly difficult.

For details, see Appendix D, Section I.

b. *Calorie Intake*: The average intake was in the neighborhood of 4000 Calories daily which agrees well with the estimate of energy expenditure (Appendix C). Individual variations in calorie intake were marked, but that of the heaviest men did not exceed that of the lightest men. Other factors than weight apparently determined calorie intake. (Appendix D, Section II).

c. *Weight Changes*: All companies experienced a moderate loss of weight during the early part of the test. This was most pronounced in heavy and overweight men. There was a tendency for average weight to fall when calorie intake was under 4000, to remain stable when it was equalled and to rise when it was exceeded. In view of the improvement in physical fitness and the medical and biochemical findings, the weight losses seen here cannot be looked on as detrimental. They probably represent loss of superfluous fat. Many of the lighter men gained weight during the test (Appendix D, Section II).

d. *Physical Fitness*: Performance in marches, in the training program and in the repeated series of physical fitness tests increased steadily in all companies. Line and non-commissioned officers' rating of the subjects agreed well with actual scores on fitness tests. On the 4 mile road march with full pack (AGF Test) only 40% finished the first test on time and over 99% finished the last test on time. Morale and a highly competitive spirit, though good from the start, improved during the test. Within the short period of calorie deficit, morale appeared to suffer before there was actual impairment in physical fitness (Appendix D, Section III).

e. *Rifle Firing*: Percentages of hits scored on the rifle range before and after all marches did not

show any consistent change related to specific rations. There was a slight improvement in average scores during the test. Pre-and-post-march scores fluctuated and there was no regular trend (Appendix D, Section IV).

f. *Nutritional Status:* Examination of the eyes, mouth, skin, and the neuromuscular system revealed no evidence of ill effect of any ration on the subjects. Indeed the nutritional status of the troops was much better at the end of the test than at the start, both in respect to clinical signs of poor nutrition, and in the decreased incidence of overweight and underweight men. The health was better during the test than it was in similar groups in garrison. This probably resulted from enforced activity, regular hours and absence of sprees (Appendix D, Sections V and VI).

g. *Biochemical Studies:* The extensive series of vitamin and other biochemical measurements generally confirmed the good nutritional status of the troops. Riboflavin appeared to be low in the Canadian Army Mess Tin Ration as eaten. Vitamin C, in the 10-in-1 Ration, contained chiefly in the powdered lemon beverage, was not well consumed (Appendix D, Section VII).

Administration of vitamins for 3 weeks to subjects on the Supplemented B Ration had no effect on fitness scores, weight or clinical signs. The only change was an increased excretion of vitamins.

h. *Future Information:* Numerous photographs, movie films, machine records cards, all original and tabulated data and the original questionnaires are on file at the Armored Medical Research Laboratory, Fort Knox, Kentucky. Special correlations are being studied and the original data are available for future investigations by authorized persons.

This report is final and supersedes any preliminary unofficial reports.

4. CONCLUSIONS:

a. The improvements in C Ration embodied in the Experimental and New types have rendered it highly acceptable: the components of the Old C Ration had low consumption and poor acceptability rating. Variety, good quality and the use of common American foods all contributed to the excellence of the ration. The inherently messy side-opening of cans was the chief drawback.

b. The present K Ration, when the fullest variety was available, was well received and consumed. The issue of cheese was too large. Bouillon was poorly received. Lemon powder rated fair. The new meat components and new biscuits were a definite improvement over the old types.

c. Sardines, pea soup and milk-and-sugar powder in the Canadian Army Mess Tin Ration were not well received, but acceptability of jam and butter was high. Monotony is the chief fault over a 3 week period. Low acceptability by American troops is not necessarily true for Canadian or British troops.

d. The 10-in-1 Ration was excellent for support area feeding. The K Ration components of the noon meal rated low on acceptability. Dehydrated products were not generally acceptable unless their preparation received special attention. The rotation of 5 menus provided ample variation where menus differ significantly, though qualitative ratings showed decreasing acceptability of certain items as monotony became a factor. The philosophy of having an emergency type ration lunch in a support area ration is not consistent, and its use in theaters of operations should be studied. If mobility is essential, each meal should be packed individually so that all the components would not have to be assembled and sorted when movement takes place. Packaged emergency type rations also present problems where used as "kitchen rations" because of the multitude of small individual containers.

e. The Supplemented B Ration used in this test was superior as a support area ration. It was a control ration and not tested in detail.

f. *Military efficiency, physical fitness, capacity for long marches and morale* were not only well sustained but improved substantially on all rations. Scores in tests of physical fitness and judgment of fitness by trained officers showed good agreement. A moderate protracted calorie deficit may affect morale earlier than it does physical fitness, and officers not familiar with the early manifestations misjudge the condition of their troops. Both quality and quantity of rations have a pronounced effect on morale which rises when quantity is ample and quality is excellent.

g. *Rifle Firing* improved slightly in the test battalion and no ration was associated with a significant decrease in scores. Firing after marches was about as accurate as that before marches.

h. *Medical Status:* No vitamin deficiency disease ascribable to any ration appeared in any company during the test. General health was excellent. No ration imposed any measurable physiological handicap.

i. *Biochemical Status*: Thiamin, niacin and salt were adequate or high on all rations tested, as judged by the chemical status of the troops. Riboflavin was lower in subjects on the Canadian Mess Tin Ration than in those on any other. Vitamin C levels of subjects on the 10-in-1 Ration were lower than those on the other rations. While such levels might prove disadvantageous if allowed to continue they were associated with no clinical sign of deficiency and they occurred in conjunction with improving fitness and morale. Within the limits of time of this test they were of no significance.

j. "A Ration is the allowance of food for the subsistence of one person for one day" (AR-30-2210). This regulation assumes that all men are the same and all work is the same or that in large messes it will average out. It does not take into consideration individual packaged rations. The calorie value of each of these rations is fixed. The needs per man vary with size and work output. Large men and/or hard work frequently require more food than is in the rations tested. It is concluded from this study that the basis of issue requires reconsideration when calorie requirement exceeds that of individual packaged rations.

k. It is concluded that the specific rations tested have been improved to the point where further field testing of these rations in zones of the interior is not warranted. New and improved rations, however, should be subjected to field testing before standardization.

5. RECOMMENDATIONS:

a. *General*—It is recommended that:

- (1) All packaged expeditionary rations be packed so that the maximal variety is contained in the standard bulk package. Carload lots of a ration containing no variation should never be used as the only source of supply to a unit. This should be incorporated into the ration specifications.
- (2) C, K and 10-in-1 Rations be issued automatically up to 1½ rations per man per day without the authorizations and medical concurrence now required. Above these levels of issue the usual regulations will hold.
- (3) Consideration be given to the following in all rations. Jam increases the consumption of biscuits; and canned milk and adequate sugar increase the consumption of coffee.
- (4) Every effort be made to have packaged rations consumed in as fresh a state as is compatible with the logistics of the strategic and tactical situation.

b. *C Ration*—It is recommended that the following be accomplished:

- (1) Remove M-1, -2 and -3 items and ham-egg-and-potato. Retain the components and variety of the Experimental C Ration.
- (2) Improve cans by eliminating the side-opening.
- (3) Include sweet-center cookie.
- (4) Add jam or other spreads.
- (5) Retain new types of biscuits.
- (6) Increase issue of coffee.
- (7) Include the utility pack.

c. *K Ration*—It is recommended that the following be accomplished:

- (1) Add jam.
- (2) Eliminate K-1A and K-2 biscuits and retain other types tested.
- (3) Reduce quantity of cheese but retain varieties.
- (4) Eliminate bouillon and increase coffee issue.
- (5) Add other meat components for variety.
- (6) Add cocoa.

d. *Canadian Army Mess Tin Ration*

- (1) If use for more than a short period is considered, increase available riboflavin by varying sardines with other fish; improve opener for can; improve packaging and stability of milk-and-sugar-powder, packaging of cheese, and stability of butter.
- (2) Increase issue of coffee and sugar.

- e. *10-in-1 Ration*—It is recommended that the following be accomplished:
- (1) Include sugar with Menu #2.
 - (2) Increase *availability* of Vitamin C by distribution into additional components.
 - (3) Reduce issue of dehydrated products or improve their acceptability.
 - (4) Increase proportion of fruit beverages other than lemon powder.
 - (5) Increase issue of coffee.
 - (6) Increase issue of canned milk.
 - (7) Eliminate the K Ration noon meal and replace with acceptable support-area lunch.
 - (8) Replace old C biscuits and whole wheat biscuits with Type I and II biscuits.
 - (9) Add a packet of condiments for individual seasoning.
 - (10) Increase issue of chewing gum and peanuts.
 - (11) Rearrange Menu #5 so that chocolate bars and cocoa are served at different meals.
 - (12) Increase the proportion of sweet chocolate and reduce the issue of D bars and fruit bars.
 - (13) Add acceptable desserts to all menus.

The test was carried out and the report was prepared by the observers under the direction of:
Major William B. Bean, M.C., Armored Medical Research Laboratory
in collaboration with:

Col. John B. Youmans, M.C. (Nutritional Examination Section)
Major William F. Ashe, M.C. (Nutritional Examination Section)
Major Norton Nelson, Sn. C. (Metabolism Section)
Captain David M. Bell, R.C.A.M.C. (Physical Fitness Section)
Captain L. M. Richardson, Jr., Q.M.C. (Rations Section)
1st Lieut. Cyrus E. French, Sn.C. (Test Organization Section)
1st Lieut. Charles R. Henderson, Sn.C. (Statistical Section)
Dr. Robert E. Johnson (Biochemical Section)

with the assistance of:

1st Lieut. Guy M. Ashmore, Q.M.C.
2d Lieut. K. N. Halvorsen, Q.M.C.
2d Lieut. John Wright, Q.M.C.

and all members of the Tabulation Section.

Cooperation of the Machine Records Branch, Military Personnel Division, Seventh Service Command, Omaha, Nebraska, facilitated preparation of the report.

APPROVED

Willard Machle
WILLARD MACHLE
Colonel, Medical Corps
Commanding

7 Incls :

- #1—Appendix A
- #2—Appendix B
- #3—Appendix C
- #4—Appendix D
 - a—Section I
 - b—Section II
 - c—Section III
 - d—Section IV
 - e—Section V
 - f—Section VI
 - g—Section VII
- #5—Appendix E
- #6—Appendix F
- #7—Appendix G

APPENDIX A TEST ORGANIZATION AND PROCEDURE

I. BACKGROUND:

Since there is no permanent organization in the Army for the type of field testing carried out—no Table of Basic Allowances and no Table of Organization—the present ration trials were set up without precedent, and without fixed channels. The original authorization came from G-4, War Department through the direction of Colonel Crawford S. Sams, General Staff Corps, Chief of Supply Division, to the Office of the Quartermaster General. Colonel Georges F. Doriot, Chief of the Military Planning Division, and Lt. Colonel D. B. Dill of the Research and Development Branch, OQMG, requested the Armored Medical Research Laboratory, Fort Knox, Kentucky, to be the testing agency. The Surgeon General's Office concurred. Colonel Willard Machle, M. C., Commanding Officer of this Laboratory, assigned this mission to Major William B. Bean, M. C. Test troops were authorized by Army Ground Forces, and the 201st Infantry Regiment, Colonel James O'Reilly, Commanding, was assigned the task of providing the troops. Test equipment, trucks, tentage, and other supplies for the test groups and the observers were furnished by the Quartermaster, Seventh Service Command, and the Armored Medical Research Laboratory. Responsibility for rations was taken by the Office of the Quartermaster General.

2. TEST PERSONNEL; RESPONSIBILITIES AND INDOCTRINATION:

Eighteen officers and 30 enlisted men were assigned on temporary duty to the test by the Quartermaster General. Additional observers, officers and men were assigned by the Surgeon General, The Armored Medical Research Laboratory, and the Royal Canadian Army Medical Corps. A team of civilian and military medical consultants was organized, and headed by Colonel J. B. Youmans. The chemical test section was directed by Dr. R. E. Johnson. The physical fitness testing program was under the direction of Captain D. M. Bell, RCAMC, after the first series. The metabolism section was headed by Major Norton Nelson, Armored Medical Research Laboratory. All test assignments in the field are given in Table 1. The following is a summary of types of data gathered, methods used, responsible personnel and section of report in which details are presented.

Types of Data	Methods of Collection Or Observation	Responsible Personnel	Appendix	Details	Section
I Acceptability of Rations	1 Daily Questionnaire 2 Issue and Waste 3 Summary Questionnaire 4 Observer's Reports	Test Subjects Observers Test Subjects Observers	D		I
II Physical Fitness	1 Battery of Tests 2 Opinions of Officers	Hq. Observers Company Line and non-commissioned Officers	D D		III III
III Military Efficiency of Subjects	1 Scored Rifle Firing 2 Training Program 3 Marches	Company Officers Company Officers Company Officers	D D D		IV III III
IV Morale	1 Observation	Company Officers	D		III
V General Health & Nutritional Status	1 Routine Examination 2 Consultation with Battalion Surgeon	Panel of Medical Consultants Test Commanding Officer	D D		V VI
VI Biochemical Balances					
a. Calories	1 Weight & Food data 2 Energy Expenditure	Observers Metabolism Test Section	D C		II I
b. Water	1 Determinations of serum protein & chloride 2 Estimate of intake	Biochemical Section Observers	D D		VII I & VI
c. Salt	1 Determination of serum and urinary chlorides	Biochemical Section	D		VII
d. Vitamins	1 Determination of Vitamins C, B1, B2, and niacin in the fasting state and after load tests	Biochemical Section	D		VII
VII Weather Data	1 Headquarters Weather Station 2 Company Weather Stations	Test Commanding Officer Observers	A A		I I

Appendix A
Inclosure #1

A preliminary period of 5 to 20 days, varying with the time of arrival of test officers and enlisted men at Fort Knox, was devoted to training in conduct of fitness tests, study of rations, familiarization with the questionnaires and a trial run with C Ration on a battalion engaged in battle training in the Armored Replacement Training Center. Major L. W. Eichna held classes and practice sessions in conducting the 3 fitness tests. Captains Bell and Richardson were in charge of the ration indoctrination. Major W. F. Ashe, 1st Lt. C. E. French, and others helped draft final plans for the test, and Major Ashe acted as S-3 Officer during the critical preliminary stages. Colonel Machle, Majors Bean and Ashe held conferences with the regimental and battalion officers of the 2d Bn, 201st Infantry Regiment. Colonel James O'Reilly, Regimental Commander, Major James Robison, Battalion Commander, Major Thompson, Captain Myer and others worked out detailed plans for handling troops, equipment and supplies. Majors Robison, Bean and Ashe made reconnaissance of the area selected for the test, established tentative camp sites and set up a program of supply and control.

3. TEST SUBJECTS:

a. *Organization*—The test subjects were organized as a complete battalion of Infantry riflemen, (2d Battalion of the 201st Infantry) receiving their final training for combat. It was composed of an Infantry cadre and enlisted men from deactivated Tank Destroyer and Anti-Aircraft organizations, with smaller numbers from Signal, Ordnance, Infantry Replacement Training Centers, Finance and Quartermaster Organizations. A total of 827 men were designated as test subjects, with an overhead of approximately 70 men and 40 officers (See Table 2) for the functions of supply and command. An initial selection weeded out all men with disabilities which might have caused them to become casualties later. A redistribution of the men within the battalion was effected to create 6 test companies, as follows: E Company, 130 men; F Company, 129 men; G Company, 139 men; H Company, 141 men; X Company, 142 men; and Y Company, 146 men. All companies participating in the test had a permanent cadre of 26 men, except X and Y Companies. These cadre men had served in Alaska, and had been with the outfit for some time. In addition to the cadre, the companies had the following special composition: E Company was a mixture of Tank Destroyer and Anti-Aircraft men with 23 former Infantrymen included. F Company was a mixture of almost all arms and services except Infantry. These included Anti-Aircraft, Harbor Defense, Signal Corps, Quartermaster, and Finance. G Company was composed primarily of Tank Destroyers, with a few Anti-Aircraft and Infantry. H Company was formed of Tank Destroyers with the exception of 20 men who were a composite of all arms. X Company was all Tank Destroyers except 40 men who were from an Anti-Aircraft outfit. Y Company was all Tank Destroyers except 10 men who were from other components. The assignment of the different ration programs to the specific companies was done at random after the general plan of testing had been established.

b. *Strength*—During the 2-month test period, a total of 111 men (13%) were dropped as test subjects. Those who were lost because of medical reasons totaled 36 men, or approximately 4% of the 827 men who started the tests. Seventy-five were dropped for reasons listed in Table 3. Only the data from men who completed the entire test were used in preparation of the various charts and tables of ration acceptability, physical fitness, and nutritional status.

c. *Age*—The men ranged in age from 18 to 41 years, with a mean age of 23.7 years. Tables 4 and 5 indicate the mean age by company, and the percentage of men in various groups for each company. None of the companies varied significantly in mean age, but age distribution in F Company was different from that of other companies.

d. *Height*—The men ranged in height from 58 to 76 inches, with a mean height of 68.8 inches (see Tables 6 and 7).

e. *Weight*—At the start of the test, the men ranged in weight from 111 lbs. to 215 lbs., with an average for all men of 152.8 lbs. Average weights for each company and the extremes are shown in Tables 8 and 9. No significant difference existed between companies at the start of the test.

f. *Initial Physical Fitness*—A considerable difference existed in the physical fitness of the 6 companies at the start of the test. Average company scores from the combined Step Test, AAF Test and AGF Test scores ranged from 168 to 200 (of a possible 330). The scores and the distribution by company are presented in Tables 10 and 11.

g. *Initial Medical Status*—A special clinical examination designed to assess nutritional state was given

to all subjects on the first and last test days. Only the first 3 platoons of each company were examined after Period I and Period II. The initial clinical findings have been tabulated by company, and are presented in Tables 12-15.

h. *Initial Biochemical Data*—A number of biochemical tests, including vitamin determinations, were carried out on blood and urine samples from the test subjects at the start and several times during the progress of the test. In each company only men in the first platoon and the first half of the second platoon (approximately 50 men) received vitamin load tests. All men in the first 3 platoons, however, (approximately 100) received all other tests. The company averages at the start of the test are presented in Table 16.

i. *Years of School*—The average time spent in school for all men was 9.9 years. Tables 17 and 18 present these data in mean years of school by companies, and the distribution in each company. F Company was the only one that showed any significant difference from the others. Its subjects averaged 1 year more of school than the men of all other companies.

j. *Army General Classification Test*—With the exception of F Company, with an average score of 105.2, all other companies did not vary significantly from an average score of 94.3. These data are shown in Tables 19 and 20, with the distribution of scores for each company.

k. *Geographical Distribution*—All service command areas and some foreign countries were represented by the group of test subjects; the greater proportion coming from the 3d, 5th, 7th, 8th, and 8th Service Commands in the order mentioned. Table 21 and Figure 1 present the distribution by companies. The 6 companies differed significantly in proportion of men from each of the nine service commands.

l. *COS*—The personnel of the companies acting as test subjects were derived from a wide cross section of civilian occupations. The general types can be seen by referring to Table 22 giving the civilian occupational specialty (COS) of all subjects. Those occurring less than 10 times have been indicated by number only.

m. *MOS*—Since the battalion was composed of soldiers being converted to Infantrymen from a number of other military specialties, the military occupational specialties (MOS) were also heterogeneous. The categories occurring most frequently are given in Table 23 and those less often are listed by MOS number only.

n. *Length of Army Service*—The length of service in the Army ranged from 6 to 149 months, and averaged 21.6 months. The only company that varied significantly from F Company (control company) was X Company. The data are presented in Tables 24 and 25, with the distribution of length of service by all companies. None of the men reported actual combat experience, but many men with 36-41 months' service were in the cadre which had seen service in the Alaska-Aleutian region.

o. *Men Who Had Previous Experience with Combat Rations*—Nearly half of the men had previously lived for a period of days on either C or K Rations; and almost all subject personnel had eaten at least 1 meal of C or K Rations. Only a few had ever eaten 10-in-1 Ration. None had experience with the Canadian Army Mess Tin Ration. These data are presented by companies in Table 26. Some of the differences between companies may have resulted from different instructions given for recording answers to questions 60, 61, and 62 on the Master Form (see Appendix G).

4. LOCATION:

a. *General Description*—The site chosen for the test was the Pike National Forest in the Rocky Mountain area of central Colorado (See pictures in Appendix F). It provided isolation of the test subjects from external sources of food, and mutual isolation of the several groups by virtue of this dispersal. The area included varied terrain and a multitude of excellent camp locations. Rugged mountains, both rock and timbered, rolling hills and valleys, wide plains and little-traversed roads furnished an ideal region for maneuvers, cross-country or road marches, squad, platoon and company problems, and firing ranges. Mr. Gus White, the Game Warden, and Mr. Frank Sokolsky, the Forest Ranger, and other park officials were helpful in selection of camp sites.

Supplies and equipment were convoyed to the test site from headquarters at Camp Carson, a distance of about 75 miles. No large towns were nearby. Only a few isolated ranches exist in the very sparsely

settled region. A few tourists visited the lake and streams for fishing. This was strictly forbidden all test subjects and personnel, as was any form of hunting or trapping of game.

The altitude of the bivouac areas varied from 8700 to 9000 feet. Camp Carson, where the test subjects had been stationed several weeks to several months prior to the test had an altitude of 6100 feet.

b. *Dispersal of Camp Sites*—In order to insure absolute segregation of the several companies, their bivouac areas were widely separated. The park area is well off the main roads, and tourist traffic was at a minimum because of the tire and gasoline shortages. The physical separation was even greater than is indicated on the map (Fig. 2) because of intervening mountains and rocky terrain. Either the Test Commanding Officer or the Battalion Commanding Officer visited all company areas daily, with a few exceptions late in the test.

Bivouac areas were established tactically, with consideration for dispersal and cover. The forest ranger gave each company a talk and demonstration on forest fire prevention. The soldiers lived in pup tents, many of which had improvised improvements. A command post tent was used by the company commanders, and radio sending and receiving sets were established in it or in the hospital ward tent which was used for recreation, movies, reading, and weekly religious services. Messing was usually individual because of the nature of the rations, but by squads or platoons with the 10-in-1, and F Company had a regular field mess for the Supplemented B Ration. Each observer group had a pyramidal tent for tabulating, collecting and weighing waste, and keeping records. Field sanitation was practiced, the slit trenches being changed frequently because of the shallow top soil. Water was filtered, aerated and chlorinated at three water points controlled by a detachment of engineers (Fig. 2).

c. *Climate*—The climate in the test area was temperate during the months of June, July and August. Weather data were collected daily in the test headquarters area. The maximum daily temperatures ranged from 72° to 90°F., while the minimum temperatures ranged from 32° to 45°F. The average relative humidity varied from 26% to 76% during the day time. Light rains fell for brief periods on 23 of the 63 days of the test, usually in afternoon thunderstorms. Total precipitation for the entire period was 3.9 inches. Wind was gusty in nature with an overall average velocity of 5 miles per hour, and extreme averages of 15 and 1.5 miles per hour, as measured over a period of one hour. Minimum and maximum thermometers and rain gauges were set up in each of the camp areas. Although there were some variations from one site to another, especially in rain storms, these were not significantly different from one another, or from those at headquarters.

5. STANDING OPERATING PROCEDURE FOR OBSERVERS IN THE FIELD:

(Extract from Test Headquarters Memorandum #4).

- a. Officers will be attached to the AMRL for the purposes of administration and pay.
- b. Enlisted personnel will be attached to designated units of the 201st Infantry Regiment for administration and pay.
- c. Mail will be delivered through routine 201st Infantry Regiment channels. Packages will be delivered at Test Headquarters where they will be opened in the presence of a test officer.
- d. Sick call will be in accordance with the regulations of the unit to which personnel are attached.
- e. Discipline in Company Areas will be that of the Company. Observers are not to interfere with the training of the test subjects. Time will be arranged after each meal for supervising the recording of questionnaires by each subject.
- f. Religious services will be held in Company Areas every 7th day.
- g. Duties of Company Observers:
 - (1) Control, distribution, supervision of filling out and collection of questionnaires daily.
 - (2) Completion of observer portion of questionnaires.
 - (3) Report to be written on daily observations.
 - (4) Supervision of the daily collection and weighing of left-over food.
 - (5) Check the issue of all rations, manufacturer, lot number and date of issue.
 - (6) Assistance in physical fitness tests and weighing of men.

h. Responsibilities of All Test Personnel:

- (1) Wear identifying arm band at all times.
- (2) Vehicles will be operated in accordance with standard operational procedure with special regard to park and road regulations. No unnecessary driving will be done, as maintenance in the field will be difficult.
- (3) Principles of field sanitation will be observed.
- (4) Fire prevention regulations will be observed.
- (5) Observers will not be permitted to hunt or fish.

i. All test personnel will draw necessary equipment through the test supply officer at Camp Carson, Colorado.

j. Observers will avoid influencing the answers given by the test subjects in filling out the questionnaires.

k. A rotational system of assignment will be established with respect to the duties of the observer personnel. Some observers will eat the test ration; others will subsist on the Supplemented B Ration. The groups will be alternated.

l. Selected observers will be designated to form a permanent field headquarters and be assigned duties.

m. No leaves will be issued during the experiment, and the observer personnel will remain in the camp area throughout.

6. BATTALION OPERATION (Extracted with slight changes from Battalion Operational Memorandum #1).

a. *General Rations Discipline*—All infraction of ration discipline will be handled by placing the men in a labor group on K Rations under guard. Disciplinary matters are solely command functions. Observer enlisted men are attached to companies and are subject to their discipline. Observer officers who wish to exercise disciplinary function must do so through the Test Commanding Officer who will in turn give his recommendation to the Battalion Commander.

Each company commander will give orders to all members of his command to the effect that no foods or liquids of any kind, other than those issued to them, will be consumed; and in addition, that no such food or liquid will be taken or brought into the operation area. Further, that they will not visit any private homes in the vicinity or have any contact with unauthorized persons.

b. *Restriction to Bivouac Area*—All personnel of Testing Companies are restricted to the immediate area of the bivouac while off duty, and permission to leave this area will be granted only by an officer. The water supply truck driver will leave daily to obtain water. He will be instructed that he must pick up no food of any kind, and he will be searched by a responsible officer when coming into the bivouac area with water or other supplies. The searching officer will be under the supervision of the Test Commander in this regard.

c. *Garbage Disposal*—All burnable garbage and trash will be burned in the bivouac area. Special fireplaces will be prepared for this purpose. All unburnable garbage and trash will be buried.

d. *Medical Plan*

(1) *Sanitation*—The Battalion Surgeon will be responsible for periodic inspection of all bivouac areas and reporting on sanitary conditions direct to the Battalion Commanding Officer.

(2) *Sick Call*—Sick call will be held each morning by the company aid men who will notify the first sergeant of the company if, in their opinion, a medical officer should be consulted by any of the men on sick call. The first sergeant will cause this information to be transmitted to Battalion Command Post when the daily strength report is submitted. Urgent cases will be so reported. The Battalion Surgeon will then visit the company as soon as possible. Due to the late hour of sick call on rest days, the request for a medical officer (See List of Calls—Table 27) will be submitted immediately after sick call, but the strength report will not be delayed for that reason.

- (3) *Tick Discipline*—Instructions for prevention of tick infection will be given at a Battalion Orientation School. Commanders are responsible that these instructions are followed in the field.
- e. *Mail*—Mail will be delivered to bivouac areas daily. *No packages will be delivered during this operation.*
- f. *Bathing*—Bathing will be done only as scheduled on rest days. One 24-head mobile shower unit is available for this purpose.
- g. *Laundry*—Each company will be provided with four washtubs and washboards by Battalion Supply. Laundering will be done by individuals and will be accomplished during “off duty” hours.
- h. *Barbering*—Each company will provide itself with a barber who will work at the trade during “off duty” hours for the extra compensation. (A maximum price of 35 cents may be charged for this service). The hair of all men will be kept short, but no heads will be shaved.
- i. *Fire Prevention*—Strict Fire Discipline will be maintained by all Commanders. Warming and cooking fires will be built on open ground in preference to woods. In all cases, the ground at the firesite will be scraped clear of all combustible material prior to building the fire.
- j. *Fire Fighting*—On request of the district National Forest Ranger, all possible assistance will be given to fight forest fires in the area. If a fire is discovered by military personnel, they will immediately take steps to extinguish it. If the fire is of such size that help is needed to control it, the closest company will be notified, will send assistance and notify the Battalion Command Post stating whether additional help is needed and give the location of the fire as accurately as possible. Battalion Command Post will notify the Ranger by telephone, giving all details.
- k. *Hunting and Fishing*—No hunting or fishing will be allowed at Topside. No hunting or fishing equipment will be taken to Topside by any military personnel. Ammunition for combat firing will be issued at the firing point only. All unexpended rounds will be collected prior to leaving the firing point. For that reason, and in fairness to the men, no observing personnel, civilian or otherwise, will be permitted to engage in hunting or fishing.
- l. *Overhead—Companies*—In all companies except F Company, the overhead will consist of 1 Camp Guard who will be rotated within the company. This guard will allow no unauthorized military personnel, and no civilians without a pass to enter the bivouac area. The Camp Guard will be always on the alert, and be prepared to inform authorized persons of the location of his company.
- m. *Supply Plan*
- (1) *Rations*—Companies will be issued rations from the Supply Dump after presenting to the Battalion Supply Officer approval from Test Headquarters. Test Headquarters is responsible for the count of rations issued to each unit.
 - (2) *Water*
 - (a) Each company will erect a Lyster Bag in its bivouac area.
 - (b) A 250 gallon tank trailer will be assigned to each company for the purpose of transporting water from a water distributing point to the company area.
 - (3) *Cooking Sets*—Cooking sets will be furnished by the Test Group to all companies using the 10-in-1 Ration (and such other rations as may be designated by the Test Headquarters).
 - (4) *Heating Units, Hot Water*—Each company will have 3 hot water heating units to be used as a mess kit laundry.
 - (5) *Electric Current*—Six generators will be procured by Test Supply. Installation of wiring in bivouac areas and Headquarters to be done by Battalion personnel as authorized by the Commanding Officer or his Executive.
 - (6) *Ammunition and Cleaning and Preserving Materials*—Ammunition requirements for test firing (691,200 rounds .30 cal ball) to be requisitioned by Battalion Supply. Authority for honoring requisition to be sent by Test Headquarters to Supply Source XVI Corps. Other ammunition required for training purposes will be supplied by Battalion Supply; coordination for shipping to be with Test Supply. Cleaning and preserving material needs and requisitioning to be done

by Battalion Supply. If these requirements exceed amounts which can be requisitioned by the Battalion, additional amounts will be drawn for the test by Test Supply.

(7) *Toilet Paper and Soap*—Toilet paper and soap will be supplied by the companies.

(8) *Clothing and Equipment*—See Table 27.

n. *Transportation*—The requirements in vehicles for both troops and test units are of necessity not completely separable. The test area is approximately 75 miles from a railhead. It will be necessary to move approximately 1000 men with full equipment to and from this area and periodically throughout the period to move them twice daily (to and from fitness test area and showers). Also, it will be necessary to move approximately 300 tons of equipment from Camp Carson to the test area over the 60-day period. The total vehicular requirements are as follows:

11 trucks, 2½ ton, 6 x 6
6 trucks, 1½ ton, 4 x 4
1 trailer, 2 wheel, 1 ton
6 trailers, water tank, 250 gal.
2 trucks, ¾ ton, ammunition carrier
1 ambulance

14 trucks, ¾ ton (jeep)
2 trailers, 2 wheel, ¾ ton
1 truck, ¾ ton, carry all
1 truck, refrigerator, 5 ton
1 truck, 4 ton wrecker, 6 x 6 with winch
1 command car, Sedan

Considering all equipment and replacements there will be approximately 300 tons of material to be taken from Camp Carson to the test area. We plan to take 40 tons in the first convoy on 9 June 1944. Thereafter, one 2½ ton truck will return to Camp Carson daily for a load of supplies allocated in terms of predicted needs with sufficient surplus for emergencies. Detailed arrangements for the shipping of rations and ammunition as well as other items will be worked out by Battalion Supply and Test Supply so that no shortages will develop at Test Headquarters.

o. *Training*

(1) *Ration Questionnaire Instruction*—To be given in a 2 hour period the evening of D-1 at Topside Command Post.

(2) *Ranges*—Ranges for combat firing have been located near each bivouac area and safety limits will be prescribed on the ground by Battalion S-3.

(3) *Rest Periods*—Every 7th day will be a rest period. In general, rest days will consist of showers, religious services, movies, and such individual activities as men wish to indulge in.

(4) *Night Vision Test Program*—Schedules will be coordinated by the Battalion S-3 and Major Roberts. Lt. Mann is to be at Camp Carson by 6 June 1944. Use of incendiary signaling equipment must be approved by the Battalion Commander.

p. *Salt Supply to Troops*—When and if the Test Commanding Officer deems it necessary to supply the troops with salted water, he will be responsible for instructing the water vehicle drivers in the supply of 0.1% salt solution. It will be SOP that when the water truck comes to men on the march, they will empty their canteens and refill them with water from the truck. The Test Supply Officer will make salt available to Test Headquarters for this program. Arrangements will have to be made by the Test Commanding Officer and the Test Supply Officer as to whether this salt is supplied in bulk, or packages for a 250 gallon trailer.

7. SYNOPSIS OF TRAINING AND ACTIVITY:

The battalion had previously been given the mission of training and qualifying infantrymen as overseas replacements. When selected for the ration tests, training became its secondary mission. With this in mind, all available time was utilized; and any phase of infantry combat training that could be given was added to the training required by the Testing Group. The training was intensive and consisted mainly of practical field work; lectures were held to a minimum. Training of the 6 companies was uniform and each week's quantity of work was planned to be approximately equivalent to that of any other week. (Tables 29 and 30).

a. *Marches*—Each company participated in 2 day marches each week, and in addition, each company held 3 night marches during the test. During the last week of the test, each company marched for 4 consecutive days on a 90-mile circuit. The marches were tactical, with advance and rear guards preceding and following the column to warn any traffic of moving troops on the road.

The marches lasted 8 consecutive hours, exclusive of lunch-time, and were of various lengths, depending on the type of terrain. Cross-country marches, mountain climbing marches and road marches were

held, varying in length from 16 to 32 miles. As a rule, there were 10 minute breaks on the hour, with 1 hour for lunch. The men carried arms, ammunition belts, and combat packs with rifle, weighing about 20 pounds in all. In several instances, the marches were continuous and no hourly breaks were taken; also, at times, the marches ran well over 8 hours' duration.

b. *Combat Firing*—Each company constructed a combat range near its bivouac area, with targets at ranges varying from 250 to 500 yards. On days when marches were scheduled, each company fired before going on the march, and then again immediately after the march, before returning to the bivouac area. Ammunition was issued to a platoon at a time. This platoon then moved to the firing line and fired (see Appendix E). The process was repeated by the other platoons. The average score for the company was determined. Firing was done on a different range, before and after the 90-mile march.

c. *Platoon and Squad Tactics*—These consisted of field work, both offensive and defensive; some were meeting engagements. When 2 forces opposed each other, blank ammunition was used; and umpires controlled the action. When field targets were used, the troops were issued ball ammunition, and advanced by fire and movement.

d. *Organization of the Army*—All troops attended a lecture on this subject.

e. *Outpost Problems*—All phases of outpost work were covered. March outposts, combat outposts, and perimeter defenses were set up, infiltrating groups worked against them, each side used blank ammunition; and in each case, the action was carried through to a decision. Some of these field problems lasted well over the allotted time.

f. *Map Reading and Compass Work*—This consisted of lectures and field work. The compass courses consisted of selected cross-country routes of various lengths ranging from 12 to 18 miles, with an average of 8 changes of direction. These courses were run under full field equipment, both day and night.

g. *Scouting and Patrolling*—This work consisted of both individual and group training in the field. The exercises covered many miles of terrain, and were exceedingly strenuous in execution. Problems in observation and combat were written up and presented to the patrol leaders, who then directed the exercises. Critiques were held.

h. *Tactical Training of the Individual*—This type of training was carried out in conjunction with the Scouting, Patrolling and all other field exercises.

i. *Transition Firing*—Ranges were constructed, and all men fired a Transition Course. Men failing to qualify fired the course again during open time.

j. *Open Time*—The term Open Time was a misnomer, since the schedule was set up for 6 eight-hour days per week. Open Time on the schedule was actually resting time during the day, due to the fact that training time was scheduled during off-duty hours. However, Close Combat ranges and Blitz courses were constructed and the companies utilized this Open Time by sending the company through the courses and other phases of training.

k. *Bayonet Training*—Courses were constructed, and the men were instructed in the use of the bayonet. After this instruction, the men were pitted against each other individually, then 2 men against 1, and 3 against 2. This training was rough, and many times it was necessary to curb it in order to curtail injuries.

l. *Field Fortifications*—All types of Infantry field fortifications were constructed and camouflaged. They were used extensively in the field problems.

m. *Foxholes*—The foxholes were constructed in tactical defensive positions. The men entered them and remained there for approximately 24 hours. Live overhead fire was practiced where feasible. The feeding was tactical where the Supplemented B Ration and the 10-in-1 Ration were used; a squad from each platoon was withdrawn to eat while the rest remained in position. All men remained in the fox holes to eat C, K and Canadian Army Mess Tin Rations (See Appendix F).

n. *Night Vision*—This work was taken up in various phases; (1) NCO's were trained in the testing process; (2) the companies were tested, and men who possessed the best night vision were noted; (3) the training was put to practical use and was stressed at every possible opportunity in the field.

o. *Grenade Training*—This was training in form and accuracy. Only dummy grenades were used.

8. MORALE:

Morale of the test subjects throughout the entire period was excellent. The will to work and cooperate in act and spirit on all phases of the test was, with rare exception, common to all involved. There was definite improvement in all groups regardless of the ration during the weeks of association in the test.

The test personnel were well aware that the success of the test depended in large measure upon complete cooperation and much thought was devoted to securing it. At the very start, an effort was made to select a battalion in which the officer leadership was outstanding. This perhaps more than any other thing, contributed to whole-hearted cooperation, for hardly a day passed that some friction between subjects and test personnel did not arise, and was promptly corrected by the Battalion and Test Commanders.

Early in the 2d week of the test, final arrangements were completed to grant a terminal 2-week furlough for each enlisted man who conscientiously did his duty throughout the test. This reward for work well done appealed to the average man, and was undoubtedly effective at times when the going was rough.

The Battalion was extremely fortunate in having as its senior Chaplain Captain O. W. Randall, who worked steadily to make life as pleasant as possible under the isolation required for the test. Because of the rotation schedule, it was necessary for the Chaplain to hold religious services and show movies on successive days to each of the 7 groups (6 company and 1 headquarters group). In addition to this, he established a traveling Post Exchange which was well stocked with all small items desired except for food and drinks.

A spirit of competition between companies and between platoons within each company was maintained throughout the test. Physical Fitness Test scores were calculated by platoon upon completion of each test, and were posted in each company area. Company Commanders were successful in encouraging their men to do their best in tests as well as in all other phases of activity.

Mail was carefully handled and delivered once daily to all men and officers, at a regular time. A special truck and driver were designated to make a daily round trip to Camp Carson, taking down the outgoing mail in the morning at 0800, and returning with the incoming mail at 1800. The incoming mail was then sorted at the Headquarters Message Center, and dispatched to each company area on the ration trucks.

A portable field shower unit was set up on the banks of Tarryall Creek at a point approximately equidistant from all company areas, and the men in each company used it once a week on a regular schedule, so that all companies had the same number of showers and on the same day of the test (rest days, after fitness tests, and after foxholes). The opportunity to take warm showers was highly appreciated, and contributed to the general feeling that those responsible for the test were interested in the welfare of the men.

9. SCHEDULE OF RATION PERIODS AND TESTING:

Within the limitations of the test, the program of ration periods was set up to resemble a hypothetical tactical situation with 3 weeks* of combat rations, 2 weeks support area rations, and a final 3 weeks of combat rations. Hereafter these will be called Period I, Period II and Period III. Testing facilities with the available personnel permitted processing only 1 company a day so the schedule was staggered over 6 days. Another reason for the staggered schedule was that trucks for convoying subjects, equipment and rations were limited and the program had to be arranged with a view to battalion logistics. This meant that on the 6th day at headquarters, the last company was being tested while the 1st company processed was in the 5th day of its activities. The only complicating factor was the possibility of a sharp general change in weather occurring with different companies engaged in different activities. No such sudden disturbance occurred.

The final schedule, which was adhered to throughout, is given in Tables 30, 31 and 32. The experimental design included a control company (F) on the Supplemented B Ration throughout, another company (H) on the 10-in-1 Ration throughout and 4 companies whose schedule was varied so that they could be compared with (1) the control groups, (2) the other companies on the same rations with either the same or different levels of ration issue, and (3) themselves, on the same or different rations at different times. Two companies (G and E) initially on K Ration had 10-in-1 and Supplemented B Ration for their respective support area ration. Two companies (Y and G) tested C, 10-in-1 and K; and K, 10-in-1 and C in that order, respectively. X Company, which tested the Canadian Army Mess Tin Ration for 3 weeks, had 2 weeks on 10-in-1 Ration, 1 on experimental C Ration, 1 on K Ration, and a week when they had their choice of C, K, or Mess Tin Rations.

* Because of the extra fitness test (#3) Period I was actually 22 days.

For the first 3 weeks all companies were issued rations at a level approximately isocaloric, and high enough to insure adequate selection. They had more than they wanted to eat so calculation of the waste as unopened boxes, individual items and garbage gave an internal check on the validity of the palatability ratings from the questionnaires.

During the last 3 weeks additional experimental items in several rations were tested, and an attempt was made to restrict the issue to that indicated by the packaging of the ration (i.e. 3 boxes of K Rations, 10-in-1 for 10 men, and 6 cans of C Ration). See Tables 30 and 31.

The routine of the typical test day is given in Table 33. During the morning it was necessary to integrate 5 main procedures: (1) weighing all men, (2) biochemical studies which required collection of fasting and load samples of urine and blood letting on 100 men; (3) a clinical examination; (4) the Step Test; and (5) the Army Air Forces Test. (6) The Army Ground Forces Test was carried out in the afternoon. It was possible to accomplish this multitude of tests and procedures only by careful planning and rigid attention to control of men, keeping groups together, seeing that each part of the test was carried out on schedule, and channeling groups of subjects to the proper areas at the right time. Laying out the area with attention to the schedule of movement from one test to another aided the process of testing. Control and sampling of men was facilitated by the system used to number the test subjects (vide infra). Without splendid cooperation by squad, platoon and company leaders the intricate planning would have been to no avail.

10. METHODS OF COLLECTING DATA:

The considerable body of data accumulated during the test required an accurate and simple system of collecting and compiling. Since it was imperative that the analysis of results proceed rapidly, facilities of the Machine Records Unit of the 7th Service Command were enlisted. Many of the questionnaires were designed so that the data could be transferred to punch cards with rapidity and ease.

For brevity, speed in filing, to assist the Machine Records Unit in punching cards, and to facilitate sampling of test subjects and processing various groups and sub-groups a code system for numbering each test subject was used. The number consisted of an initial letter and 3 numerals, the letter indicating the company, the 1st numeral indicating the platoon, and the last 2 numerals representing the subject's number in the platoon. Example: No. G303 indicates that the subject was in G Company, 3d platoon, and the 3d man in the platoon.

To facilitate the weighings, and pairing men for the pig-a-back test, men in each platoon were arranged in order of increasing weight before the test numbers were assigned, so that the balance on the scales was changed very little from one man to the next. The men were weighed, the names arranged according to ascending weights, and each subject was assigned his number and given a piece of adhesive tape with the number inked on, which was fastened to his identification tags. Each record, questionnaire, and all other individual data had the test subject's number on it.

A questionnaire (See Appendix G) was filled out by each soldier on the test after each meal day, except F Company on Supplemented B Ration with questionnaires during alternate 10-day cycles. Four categories were included for each item in most questionnaires—(1) meal at which a component was used, whether used hot or cold (See Appendix G). Since the Supplemented B Ration and the 10-in-1 Ration required group messing, and it was not feasible in the field to weigh the issue and waste of each item issued to each soldier for each meal, consumption figures were determined for the whole company by deducting the waste from the total issue (by item). In addition to the record of quantity on the questionnaires, from which daily calculations of calorie consumption per man and per company were made, the waste was collected by individual component (opened, i.e. plate waste or garbage, and the unopened cans or packages) and deducted from the issue by item. When any considerable discrepancy occurred, a showdown inspection was held. This revealed the degree and type of hoarding, and gave another form of information about the soldier's likes and dislikes. In spite of all efforts, there was an irreducible minimum of food unaccounted for—which may have been eaten and not recorded, or waste thrown away, or hoarded and hidden too well to be found. After the first few days this error usually ran around 1-2% and very rarely exceeded 5%. Since it was desired to simulate practices usual to army life, no effort was made to prevent exchanges and swapping, which were recorded in the quantity portion of the individual questionnaires. There was also some lag between issue and return of unopened cans, though the overall accuracy was not affected thereby.

Appendix A
Inclosure #1

The questionnaires were collected daily by the company observers; and in some companies they were collected for safe keeping by the platoon or squad leader after they had been filled out following each meal and issued again before the next one.

The general comments of the test subjects were solicited. These constitute an interesting tribute to the good items and a scathing denunciation of the less acceptable ones in the soldiers' inimitable vernacular.

In addition to the tabulated information concerning the rations on each questionnaire, a record was entered of the quantity of water consumed, the number of hours slept, number of bowel movements for the 24-hour period, and the time to prepare and eat each meal.

Each day the observers calculated the calorie intake, remarked on the general fitness of the subjects, and noted abnormalities of alimentary physiology.

At the conclusion of each ration testing period, the subjects filled out questionnaires stating their general opinions and comments on the items tested. This provided a check on the daily questionnaire. This summary questionnaire for the initial ration used was filled out again at the end of subsequent ration periods, in order to see how well the likes and dislikes were remembered and how consistent were the later data with the earlier.

The test observers submitted daily written reports, containing such information as acceptability of items, condition of the items, general morale of the men, criticisms, suggestions, unusual weather and the types of activity which would tend to affect consumption of the rations.

The company officers submitted data throughout the test as to the physical fitness of the men under their command, and a bi-weekly report giving the marksmanship qualifications of their units—i.e. the scored rifle fire (percentage of hits) before and after the marches.

The Tabulation Section distributed and collected the questionnaires and reports. Each form was checked for completeness and accuracy of information before mailing to the Machine Records Section. Men in this Section also scored the fitness tests, transcribed the chemical data, checked the Master Forms, kept a daily strength roster by platoon and acted as scribes for the clinical examination. The records not processed by the Machine Records Unit were kept on file in the tabulating tent and later sent to the Armored Medical Research Laboratory at Fort Knox for final study. The Machine Records Section punched the information indicated using a separate card for each individual per meal.

Because of the company isolation and control, breaches of ration discipline were difficult. We have no record of any extraneous food coming into any company area. Three men who went A.W.O.L. were put into a labor detail, and subsisted on K Ration thereafter. In G Company, during the period when they were on C Ration, New, (issue, 1 ration per man) 3 cases of rations were stolen from the dump and hidden. Though 1 platoon was implicated, and 1 squad was suspected, it was not possible to obtain a confession from any soldier. This, of course, introduces an inaccuracy into the data for this company, but it is of little import in the average figures (3 ration cases out of 400 for the period). No other instance of stealing was detected, and the check on rations by the company and observer officers makes its occurrence doubtful. This is a high tribute to the cooperation of the test subjects and their line and non-commissioned officer leadership.

11. RATION ISSUE, WASTE AND QUESTIONNAIRES:

a. General

All rations were received by the test supply officer at the railhead at Camp Carson, Colorado. They were then brought by truck convoy to the main ration dump at Topside (see Appendix F). An attempt was made to keep about 10 days' rations on hand, depending on the availability of trucks. The rations were issued daily to the Chief Observer with each company and transported to the company bivouac area where rations for 48 hours were kept in the local ration dump.

Rations for F Company and Headquarters on Supplemented B Ration were convoyed directly to the F Company area where they were stored. A refrigerator truck facilitated the handling of meats and perishable food not ordinarily used in Field Ration B. Ration breakdown was in charge of the Mess Officer.

b. Issue

(1) *C Ration*—This ration was issued at the rate of 1-1/3 rations, or 8 cans per man per day during Period I; at other times it was issued on the basis of 1 ration per man per day. Each man was issued 4 dif-

ferent meat units, 4 different biscuit cans, plus a jar of jam during specified periods. To prevent duplication, each man was issued 6 cans in one row, top or bottom, and 2 cans from the same row in the other layer.

(2) *K Ration*—Each man was issued 5 boxes (meals) of rations during the isocaloric period (I). Care was taken to give no more than 2 boxes of any 1 meal per day. At other times the issue was limited to 3 boxes per man per day, each of the same meals occurring one time. A 1½ ounce jar of jam each day per man was issued during specific periods.

(3) *Canadian Army Mess Tin Ration*—One and one-third rations were issued per man per day. Four rations were issued to each group of 3 men, the 4th ration to be divided as they saw fit. The actual disposition was recorded on the individual questionnaire. One man picked up the 4 rations at the time of issue. Sterno for cooking was issued the first day on the basis of 1 can and a tripod to each 3 men; after that, as required, until discontinued on the 7th day because of its suspected use for beverage purposes.

(4) *10-in-1 Ration*—Rations were issued at the rate of 10 rations for 8 men except for an 11 day period H Company used it as an actual 10-in-1. Messing groups usually ranged from 8 to 32 men (squads or platoons). One designated man received and signed for the rations for his group.

(5) *Supplemented B Ration*—Regular field mess facilities and field kitchens were set up and the usual field practices carried out. For men on marches and in foxholes food was transported in Marmite containers.

c. *Time of Issue*—Rations were issued at a designated time each day, between 1800 and 1900 hours except when the time conflicted with the training schedule.

d. *Cigarettes* were issued to all men 20 per day, or the ration was supplemented to make this number—a pack (20) every other day with the Canadian Army Mess Tin and 10-in-1 Rations, every day with the C Ration and none with the K Ration. No effort was made to study a possible effect of smoking on food preferences or intake.

e. *Waste Collection*—Everything not consumed was collected as waste except drinks in the liquid state, of which there was little excess. Appropriately labeled cans or boxes were set up in each platoon area to receive each individual item of waste. The usual time for collection of waste was immediately after the evening meal, and prior to issuing the next day's ration. The waste receptacles, however, were always present and waste could be placed in them at any time, preventing indiscriminate discarding and loss. Prior to, and during the issue of rations, at least 1 observer was on duty with the troops to prevent any other disposition of the waste. After collection, waste was weighed on a 4 pound capacity postal scale.

f. *Questionnaires—Issue and Collection*—Questionnaires were given to each man as he drew his rations, when this was done individually. With the Canadian Mess Tin and 10-in-1 Rations, questionnaires were issued for the number of men in a group to the man drawing rations. They were collected in 2 different ways. (1) When the man came to receive his next day's rations, he turned his questionnaire over to an observer, who checked it for correctness before allowing him to draw his rations. (2) The platoon sergeant or group leader in the case of 10-in-1, collected them, checked them for completeness, and turned them over to the observer, before permitting his platoon or group to draw rations.

g. *Methods of Calculating the Calorie Consumption*—The calorie values for the components of the various emergency rations were obtained from the Office of the Quartermaster General and from the Canadian Army Staff. They are presented in Table 34. Values for all items used in the Supplemented B Ration were obtained from National Research Council Tables of Food Composition.

Procedures were adopted for calculating calorie consumption of the C Ration, K Ration and Canadian Mess Tin Ration, as follows: (1) Daily tabulation on each test subject. At the end of each day the company observers collected and checked all questionnaire forms for completeness and accuracy. When this was accomplished, the correct calorie value for the amount of each item consumed was entered on the right hand margin of each questionnaire form. The forms were then turned over to the tabulating section where they were rechecked and the total calories consumed by each man each day were added and entered in the proper place in the questionnaire. The calories consumed by all men in the company were then totaled and divided by the number of men to obtain the average daily calorie consumption per man for that day. (2) Total issued calories less total waste calories. The company observers collected and tabulated all waste

food at the end of each day and computed the number of calories for the total waste. This value was subtracted from the total calorie value of the issued food for that day to give total consumption. Divided by the number of men in the company, the average calorie consumption per man per day was obtained. This method gave data only approximately accurate on a daily basis because of the lag in return of full packages and unopened individual component. The data over an entire period, however, were valid.

Because the 10-in-1 Ration was a group issue, calorie consumption was determined as in (2) above. All waste and left-over food was turned in daily so that there was no lag in the consumption figures from day to day.

The company average calorie consumption of the Supplemented B Ration was calculated each day by computing the calorie value of the total issue of each food item, and deducting the calorie value of the waste on each item, and totaling the results. The average consumption per man was then obtained by dividing the total calories eaten by the number of men.

h. *Tabulation Section*—All questionnaires and waste reports were taken to the test Tabulating Section where they were rechecked for accuracy and completeness. If not complete, the forms were returned to the field to be filled in before final calculations on calorie consumptions were made. When finally verified, the reports were sent to the Machine Records Unit, Omaha, Nebraska, for transfer to punch cards, of which more than 160,000 were used.

i. *Variations* in the above procedures were made in certain circumstances because of some unusual training measure; and minor changes were effected by the chief observer with each company to facilitate obtaining the necessary information. No change was made which might have compromised the validity and comparability of the data.

TABLE 1
FIELD ASSIGNMENTS OF TEST PERSONNEL

HEADQUARTERS

Major W. B. Bean, Commanding
 Captain D. M. Bell, RCAMC, S-3
 Captain L. M. Richardson, Jr., S-1
 1st Lt. C. E. French, S-1
 1st Lt. W. A. Cramer, Property Officer, S-4
 2d Lt. T. E. Lahy, Assistant S-3
 2d Lt. G. W. Hull, Transp. Officer

Mr. C. J. Mangan, Consultant
 Tec 3 M. E. Ress, Asst to CO
 Pfc W. J. Rega, Sergeant Major
 Sgt J. F. Demeter, Ration Dump
 Pfc C. H. Kennedy, Ration Dump
 Cpl R. C. Gibson, Daily Mail Trip
 Sgt C. L. Aquino
 Pvt R. R. Smith

OBSERVER GROUPS

E COMPANY

1st Lt. C. C. Seebold
 2d Lt. L. T. Larson
 S Sgt E. L. Curran
 Pfc J. F. Boehling
 Pvt J. H. Burkholder

G COMPANY

Captain L. L. Kettering
 1st Lt. J. G. Stein
 Pfc J. M. Robinson
 Pvt R. D. Ryder
 Pvt G. D. Voorhees

X COMPANY

2d Lt. K. N. Halvorsen
 Pfc R. H. Copenheaver
 Pvt A. W. Hill
 Pvt E. McHenry, Jr.

F COMPANY

1st Lt. C. R. Henderson
 2d Lt. M. G. Jacobs
 2d Lt. B. B. Margolis
 Pfc F. M. Pugh
 Pvt A. Thomas
 Pvt R. B. Thornton

H COMPANY

1st Lt. G. M. Ashmore
 Pfc I. L. Mitchell, Jr.
 Pvt E. B. Bergman
 Pvt D. W. Peters, Jr.

Y COMPANY

2d Lt. S. Cohen
 2d Lt. J. Wright
 Pfc C. P. Clark
 Pvt J. U. Taylor
 Pvt G. S. Webb

TABULATION SECTION

Major C. D. Shurtleff
 Pfc R. J. Parden
 Pvt A. B. Blagg, Sr.
 Pvt J. C. Dempster
 Pvt H. A. Eschenbacher

CHEMICAL TEST SECTION

Dr. R. E. Johnson, OIC
 Mr. P. F. Robinson
 Dr. L. Contreras
 Tec 4 E. Ainsworth
 Tec 4 J. Poulin
 Tec 5 A. Razoyk
 Tec 5 M. Castiglione
 Pfc J. Stachelek
 Cpl H. Aiton, RCAMC
 Cpl E. D. Pease, RCAMC

METABOLISM TEST SECTION

Major N. A. Nelson
 M Sgt T. C. Swigert
 Pfc F. W. Urbush

BASE SUPPLY SECTION

Camp Carson
 Captain C. F. Simpson, S-4
 S Sgt P. Covey

FORT KNOX SECTION

1st Lt. J. R. Hall
 Pvt H. E. Diamond
 Pvt R. E. Schnell

MESS SECTION

1st Lt. R. O'Brien

NIGHT VISION SECTION

Major L. B. Roberts
 1st Lt. W. E. Mann

CLINICAL EXAMINATION SECTION

Colonel J. B. Youmans, OIC
 Major W. F. Ashe
 Dr. V. P. Sydenstricker
 Dr. F. J. Stare
 Captain W. H. Sebrell, USPHS
 Major R. Kark, RCAMC
 Dr. C. B. Chapman

Major W. B. Bean
 Captain M. Corlette
 Dr. J. Ruffin
 Dr. R. H. Kampmeier
 Dr. M. Hamburger
 Captain A. Freedman
 Dr. A. Mendeloff

Appendix A
 Inclosure #1

TABLE 2
OFFICERS ROSTER—2D BN., 201ST INFANTRY REGIMENT

HEADQUARTERS

Major J. C. Robison, Commanding Officer
Captain A. H. Myer, S-3
1st Lt. M. F. Schoening, S-4
1st Lt. W. M. Erickson, S-1 and Hq Mess Officer
2d Lt. J. F. Walz, Motor Officer (11 June—10 July 44)
1st Lt. P. H. Burks, Motor Officer (10 July—15 Aug 44)
Captain H. M. Gruenberg, Battalion Surgeon (10 June—15 Aug 44)
Captain W. B. Alsup, Battalion Surgeon (11 July—13 July 44)
2d Lt. W. T. Secor, MAC
Captain L. W. Thompson, Dentist
Captain W. O. Randall, Chaplains Corps
1st Lt. Harley, Chaplains Corps

E COMPANY

Captain J. E. Joyal, CO
1st Lt. V. McKenney
2d Lt. M. F. Gowen
2d Lt. A. Blossin
2d Lt. W. W. Lundberg
(15 June—20 July 44)

F COMPANY

Captain R. E. Oldaker, CO
1st Lt. W. E. Brewer
1st Lt. J. D. Anders
1st Lt. D. F. Dienna, Jr.
2d Lt. J. J. Tuffy, Mess Officer
2d Lt. R. Wolfe
(17 June—20 July 44)

G COMPANY

Captain R. J. Pullin, CO
1st Lt. E. Thompson
1st Lt. J. D. Braham
2d Lt. C. E. Burton
2d Lt. Harrysaull
(14 June—20 July 44)

H COMPANY

Captain J. Hunt, CO
1st Lt. J. E. Sherren
2d Lt. J. W. Patrick, Jr.
2d Lt. J. B. Moore
2d Lt. J. W. Newman
(16 June—20 July 44)

X COMPANY

Captain H. L. Hadley, Jr., CO
1st Lt. F. A. DeYoe
2d Lt. M. E. Evans
2d Lt. W. C. Fields
(13 June—20 July 44)
2d Lt. C. A. Becker
(13 June—20 July 44)
1st Lt. J. E. Robinson
(22 July—11 Aug 44)

Y COMPANY

Captain C. L. Graybill, CO
(12 June—8 July 44)
Captain C. R. Wheeler, CO
(8 July—22 July 44)
1st Lt. D. L. Gardner, CO
(22 July—10 Aug 44)
1st Lt. R. P. Judson
2d Lt. J. D. Shake
2d Lt. R. W. Heidelberg
1st Lt. B. B. Lukacs
(12 June—28 July 44)
2d Lt. L. Griset
(12 June—28 July 44)
2d Lt. R. E. Snider
(22 July—10 Aug 44)
2d Lt. A. L. Shaw
(22 July—10 Aug 44)

TABLE 3
PERSONNEL LOSSES DURING TEST

COMPANY	Hospitalized *	Physically Unfit	Transferred Out	Emergency Furlough	Truck Drivers	Key NCO's	Cooks	Prisoners	Guards	TOTALS
E	3	2	8	1	4	2	5	3		28
F	3	1			1	1	2	1	2	11
G	10	3	1	3	3	2	1	1	1	25
H	3		9		4					16
X	3	2	4	2		4			1	16
Y	1	5	3	1	3			1	1	15
Totals	23	13	25	7	15	9	8	6	5	111

* These include 10 severe upper respiratory infections, 5 fevers of undetermined cause, 2 gastro-intestinal upsets, 2 cases of appendicitis, hemorrhoids and gonorrhoea (the last from exposure just prior to start of test). The physically unfit were mostly feet and leg casualties.

TABLE 4
MEAN AGE BY COMPANIES

COMPANY	MEAN AGE (Yrs.)
E	24.1
F	23.6
G	24.2
H	23.8
X	23.1
Y	23.6
All Companies	23.7

TABLE 5
PERCENTAGE OF MEN IN VARIOUS AGE GROUPS

AGE	COMPANY						Average All Companies
	E	F	G	H	X	Y	
18-20	24.8	25.2	20.3	24.5	32.8	24.8	25.2
21-23	27.9	26.0	36.5	35.4	33.8	39.6	33.5
24-26	21.7	30.5	15.5	15.6	12.3	12.1	17.7
27-29	12.4	9.2	12.8	11.6	10.8	10.7	11.3
30-32	7.0	6.1	8.1	7.5	6.3	9.4	7.3
33-35	5.4	2.3	3.4	4.1	3.8	2.0	3.5
36-38	0.8	0.8	3.4	0.7	0.8	0.7	1.2
39-41	0	0	0	0.7	0	0.7	0.2

TABLE 6
AVERAGE HEIGHTS BY COMPANIES

COMPANY	HEIGHT (inches)
E	68.8
F	69.3
G	68.9
H	68.4
X	68.8
Y	68.5
Average	68.8

TABLE 7
RANGES OF HEIGHT IN INCHES

Company	Shortest	Midpoint	Tallest
E	<u>62</u>	<u>69</u>	<u>75</u>
F	<u>63</u>	<u>69</u>	<u>75</u>
G	<u>62</u>	<u>69</u>	<u>75</u>
H	<u>61</u>	<u>68</u>	<u>75</u>
X	<u>64</u>	<u>70</u>	<u>76</u>
Y	<u>58</u>	<u>66</u>	<u>74</u>

Extremes of all companies are underlined

TABLE 8
AVERAGE WEIGHT AT START OF TEST

Company	Average Weight	No. Of Men
E	153.3	130
F	153.8	129
G	153.1	139
H	152.1	141
X	152.8	142
Y	151.6	146
Average	152.8	138

Appendix A
Inclosure #1

TABLE 9
RANGES OF WEIGHT IN POUNDS

Company	Lightest	Midpoint	Heaviest
E	117	150	195
F	120	160	212
G	124	158	191
H	119	162	205
X	<u>111</u>	155	198
Y	116	160	<u>215</u>

Extremes of all companies are underlined

TABLE 10
PHYSICAL FITNESS SCORES AT
START
(Sum of three tests)

Company	Average Scores	No. Of Men
E	179.0	191
F	200.2	124
G	182.2	133
H	183.6	138
X	173.5	186
Y	168.0	137
Average	180.8	131.5

TABLE 11
DISTRIBUTION OF SCORES (SUM OF THREE TESTS) BY COMPANIES FOR SECOND TEST
(Per Cent of Company Strength)

Company	90-109	110-129	130-149	150-169	170-189	190-209	210-229	230-249	250-269
E	0	1	9	21	27	31	11	0	0
F	0	0	6	4	15	33	30	11	1
G	0	1	8	19	22	36	13	1	0
H	0	0	4	10	33	38	14	1	0
X	1	2	17	23	24	27	6	0	0
Y	2	3	9	21	40	21	4	0	0
All	0.5	1.2	9.5	16.8	26.9	30.4	12.5	2.0	0.2

TABLE 12
CLINICAL DATA AT START OF TEST-EYES
(Expressed in percent of those examined)

Company	Dryness	Gross Change in Opacity of Sclera		Gross Change in Opacity of Cornea	Vascularization of Cornea, Hand Slit Lamp	Gross Conjunctivitis		Pterygia	Pingeculae
		S	M&S*			S	M&S°		
E	Only one re-ported in 2052 Examinations	75	8	3	12	60	12	14	8
F		73	5	1	2	71	7	6	7
G		55	8	0	2	55	12	7	10
H		65	9	0	9	52	17	10	8
X		51	16	0	10	29	10	14	11
Y		38	15	5	17	8	2	7	3

- * Severe only 0.3% of total examinations
- ° Severe only 0.1% of total examinations
- S Slight
- M&S Moderate & Severe

Appendix A
Inclosure #1

TABLE 13
CLINICAL DATA AT START OF TEST—LIPS & MOUTH
(Expressed in percent of those examined)

Company	Angular Fissure	Cheilosis	Red Glossitis of Pellagra	Gingivitis	Active Acute Inflammation of Dental Margin, etc.	Oral Hygiene		
						Good	Fair	Poor
E	0	15	2*	32	36	28	55	17
F	0	2	0	11	20	46	43	11
G	0	5	0	20	19	45	47	8
H	0	8	0	20	15	59	35	9
X	0	3	0	15	3	49	49	2
Y	2	5	0	12	4	34	55	11

* Slight
Pellagrous stomatitis—none seen

TABLE 14
CLINICAL DATA AT START OF TEST—SKIN
(Expressed in percent of those examined)

Company	Follicular Hyperkeratosis		Acneiform Eruption		Petechial Hemorrhages	Pellagrous Dermatitis				
	Slight	Mod. & Sev.*	Slight	Mod. & Sev.°		Ac	Chr.	Sl.	Mod.	Sev.
E	28	4	20	5	0	0	0	0	0	0
F	34	2	16	2	0	0	1	1	0	0
G	30	1	33	5	0	0	0	0	0	0
H	29	3	14	1	0	0	0	1	0	0
X	19	1	10	2	1	0	1	1	0	0
Y	13	2	17	4	0	0	0	3	0	0

* Severe only 0.2%
° 1 case Severe out of 2052 examinations
Dermatitis of Riboflavin Deficiency; purpura—none

TABLE 15
CLINICAL DATA AT START OF TEST—NEUROLOGIC
(Expressed in percent of those examined)

Company	Knee Jerks Absent			Ankle Jerks Absent			Tenderness of Calf Muscles	Nerve Tenderness	Vibratory Sense Lost	Pitting Edema Pretibial
	R	L	Both	R	L	Both				
E	0	0	0	1	0	0	0	2	1	2
F	0	0	0	0	0	0	0	0	0	0
G	0	0	1	0	0	1	0	0	0	0
H	0	0	0	0	0	0	0	0	0	0
X	0	0	1	0	0	1	0	0	0	0
Y	0	0	0	0	0	1	1	0	0	3

* Edema is included under neuromuscular findings because of its occurrence in beriberi.
Muscular weakness, atrophy, and pitting edema of feet or sacrum not seen.

Appendix A
Inclosure #1

TABLE 16

BIOCHEMICAL DATA (MEANS AT START OF TEST)

DETERMINATION	C O M P A N Y					
	E	F	G	H	X	Y
Whole Blood Hemoglobin (Gms./100 ml.)	-	19.0	17.2	18.8	16.5	17.2
Serum Protein (Gms./100 ml.)	6.5	6.5	6.2	6.2	6.2	6.4
Serum Chloride (Meq./l)	103	103	105	102	105	105
Urinary Chloride (Gms. NaCl/Hr.)	0.5	0.7	0.5	0.6	0.8	0.4
Fasting Urinary Vitamin C (Mg./Hr.)	0.4	0.5	0.4	0.7	0.5	0.5
Vitamin C Load Test (Mg./4 Hr.) *	38	38	42	32	20	34
Fasting Urinary Vitamin B ₁ (γ/4 Hr.)*	14	11	17	13	12	9
Vitamin B ₁ Load Test (γ/4 Hr.)*	510	265	515	440	250	185
Fasting Urinary Factor F ₂ (γ/Hr.)	11	11	12	14	13	8
Factor F ₂ Load Test (γ/4 Hr.)*	160	130	115	160	145	125
Fasting Urinary Vitamin B ₂ (γ/Hr.)	52	24	26	36	77	32
Vitamin B ₂ Load Test (γ/4 Hr.)*	2210	1070	1170	1510	2520	1190

1. Figures on Whole Blood, Serum, and Fasting Urine are average of approximately 100 subjects (The same as in Tables 12-15).*

*2. Figures on load tests are average of approximately 50 subjects.

TABLE 17

MEAN YEARS OF SCHOOL
BY COMPANIES

Company	Years School
E	9.7
F	10.9
G	9.5
H	9.6
X	9.9
Y	9.9
Average All Companies	9.9

TABLE 18

DISTRIBUTION OF YEARS IN SCHOOL BY COMPANIES
(Percent of Company Strength)

Years	E	F	G	H	X	Y	All Companies
0-4	.8	0	4.1	3.4	3.2	2.7	2.4
5-6	11.6	2.3	7.4	2.7	9.3	5.4	6.5
7-8	27.9	19.8	27.0	25.2	19.4	23.5	23.9
9-10	14.7	17.6	23.6	28.6	16.3	22.1	20.8
11-12	39.5	41.2	33.1	36.1	42.6	40.9	38.8
13-14	5.1	13.0	3.4	2.7	5.4	3.4	5.0
15 or more	2.3	6.1	1.4	1.4	3.9	2.0	2.8

TABLE 19

MEAN AGCT SCORES BY COMPANIES

COMPANY	AGCT SCORE
E	93.2
F	105.2
G	94.5
H	95.5
X	95.4
Y	93.0
All Companies	96.0

TABLE 20

DISTRIBUTION OF AGCT SCORES BY COMPANIES
(Percent of Total Company)

SCORE	E	F	G	H	X	Y	Average All Companies
0-19	0	0	.7	.7	0	0	.2
20-39	.7	0	0	0	2.3	0	.5
40-59	5.4	.8	2.7	4.7	2.3	4.7	3.5
60-79	23.3	9.2	17.6	14.2	18.5	24.2	17.9
80-99	28.7	25.4	34.5	39.9	30.8	28.9	31.5
100-119	31.8	41.5	37.8	27.0	36.2	35.6	34.9
120-139	7.0	21.5	6.8	11.5	10.0	6.0	10.3
140-159	3.1	1.5	.0	2.0	.0	.7	1.2

TABLE 21

DISTRIBUTION OF MEN IN VARIOUS SERVICE COMMANDS BY COMPANIES
(Percent of Company Strength)

SERVICE COMMAND	E	F	G	H	X	Y	Average All Companies
1st	1	4	4	1	2	4	3
2nd	6	4	5	5	5	5	5
3rd	21	4	30	28	25	24	22
4th	2	4	11	8	7	7	7
5th	21	18	18	14	9	8	15
6th	14	14	8	13	15	10	12
7th	17	21	7	9	22	14	14
8th	13	20	6	10	8	14	12
9th	2	10	6	8	1	7	6
Foreign	3	1	5	4	6	7	4

TABLE 22

CIVILIAN OCCUPATIONAL SPECIALTY
ALL COMPANIES COMBINED

COS NO.	NO. OF MEN	DESCRIPTION
590	135	Laborer
499	99	Farmer
245	48	Truck Driver, Heavy
345	43	Truck Driver, Light
400	42	Student, High School, Academic
302	32	Machine Operator
373	23	Sales Clerk
55	13	Clerk, General
316	11	Automobile Serviceman
50	10	Carpenter, Construction
186	10	Receiving or Shipping Checker
244	10	Tractor Driver
321	10	Salesman
482	10	Student, High School, Vocational

Nine men had number 481; 8 had number 14; 7 number 60; 6 numbers 199 and 255; 5 had numbers 235, 329, 354 and 405; 4 had numbers 348 and 483; 3 had numbers 37, 101, 114, 195, 248; 2 had numbers 12, 17, 103, 223, 251, 256, 257, 314, 327, 336, 344, 431, 478 and 833; 1 had numbers 19, 21, 26, 34, 49, 56, 81, 84, 93, 95, 100, 113, 122, 127, 128, 129, 144, 148, 163, 164, 174, 185, 190, 191, 204, 213, 221, 222, 224, 225, 234, 247, 260, 268, 269, 295, 304, 309, 311, 323, 324, 334, 339, 343, 352, 355, 359, 360, 368, 374, 383, 386, 406, 411, 429, 433, 439, 440, 470, 498, 510, 521, 629, 688, 732, 734, 735, 745, 760, 810, 831, 872 and 992.

TABLE 23

MILITARY OCCUPATIONAL SPECIALTY
ALL COMPANIES COMBINED

MOS NO.	NO. OF MEN	DESCRIPTION
531	67	Cannoneer
345	61	Truck Driver, Light
653	45	Squad Leader
610	44	Antitank Gunner
736	42	Tank Driver
521	40	Basic or Cook's Helper
652	38	Section Leader
745	36	Rifleman
14	34	Mechanic, Automobile
606	30	Antiaircraft Machine Gunner
60	29	Cook
651	29	Platoon Sergeant
602	28	Gun Commander
601	17	Antiaircraft Gunner
645	17	Fire Control Instrument Operator
733	12	Reconnaissance or Scout Car Driver
821	11	Supply NCO
704	10	Telephone Operator, Field
824	10	Mess Sergeant

Eight men had numbers 121 and 370; 7 had numbers 55, 405, 585, 604, 636, 712 and 846; 6 had numbers 504 and 511; 5 had numbers 245, 514, 605, 641 and 660; 4 had 103, 539, 677, 776, 803, 813, 835; 3 had numbers 368, 533, 650, 734, 744, 761, 763, 795, 931; 2 had numbers 56, 62, 102, 256, 527, 542, 545, 584, 590, 690, 692, 696, 802 and 814; 1 had numbers 59, 81, 104, 128, 137, 213, 236, 244, 252, 314, 323, 344, 347, 355, 431, 433, 436, 438, 440, 441, 501, 502, 503, 505, 522, 541, 603, 607, 629, 631, 632, 657, 667, 676, 695, 716, 721, 746, 812, 833 and 975.

TABLE 24

MEAN TIME IN ARMY BY COMPANIES

COMPANY	MEAN MONTHS
E	23.3
F	21.6
G	24.7
H	22.4
X	17.9
Y	19.4
Average All Companies	21.6

TABLE 25

DISTRIBUTION OF TIME IN ARMY AMONG COMPANIES
(Percent of Company Strength)

Months In Army	E	F	G	H	X	Y	Average All Companies
6-11	17.1	33.6	1.4	4.1	5.4	15.4	12.5
12-17	41.1	19.1	53.4	52.4	62.3	59.7	48.4
18-23	10.1	11.5	12.8	9.5	17.7	4.7	10.9
24-29	3.9	4.6	4.1	8.2	5.4	5.4	5.3
30-35	5.4	9.9	1.4	8.8	3.8	1.3	5.0
* 36-41	12.4	15.3	16.2	11.6	2.3	6.0	10.7
* 42-47	1.6	.8	4.1	3.4	.8	2.7	2.3
* 48-149	8.5	5.3	6.8	2.0	2.3	4.7	4.9

* Unusually large group of men in the 36 to 149 month classes due to training cadre.

TABLE 26

PERCENTAGE OF MEN IN VARIOUS COMPANIES WHO HAD LIVED ON
C, K, AND 10-in-1 RATIONS PRIOR TO THE TEST

COMPANY	C RATION	K RATION	10-in-1 RATION
E	77	61	0
F	1	0	0
G	72	56	5
H	5	1	0
X	6	5	0
Y	78	82	2
Average All Companies	41	35	1

TABLE 27
CLOTHING AND EQUIPMENT TO BE TAKEN TO TOPSIDE

1 pr. Boots, trench	1 Raincoat
1 pr. Shoes, service	1 Meat Can, Cover, Knife, Fork, Spoon
4 pr. Socks, cushion	2 Towels, hand (minimum)
2 pr. Underwear (minimum)	1 Towel, bath (minimum)
2 pr. Trousers, HBT	1 Jacket, field
2 Jackets, HBT	1 Jacket, fleece lined
1 Belt, cartridge, .30 cal	1 Helmet, steel, with fiber liner
1 Belt, web	1 pr. Gloves, wool, OD
1 Canteen, Cup and Cover	1 Entrenching Tool
1 Bayonet	1 Sleeping Bag
1 First Aid Packet and Pouch with Sulfanilamide powder and pills	1 M1 Rifle
1 Haversack	5 M1 Clips (minimum)

Two months supply of the following toilet articles will be taken:

Razor and Blades
Shaving Cream
Shaving Brush (not required if brushless cream issued)
Tooth Brush and paste or powder
Comb and Mirror
Toilet Soap

TABLE 28
LIST OF CALLS

Call	Work Day	Time	Rest Day
First Call	0530		0630
Reveille	0540		0640
Assembly	0545		0645
Sick Call	0550		0650
Mess Call	0600		0700
Drill Call	0655		0755
Assembly	0700		0800
Recall	1100		1200
Mess Call	1105		1205
Drill Call	1155		1255
Assembly	1200		1300
Recall	1600		1700
Mess Call	1730		1730
Guard Assembly (Outpost Security)	1750		1750
Guard Mount	1800		1800
Tattoo	2100		2100
Call to Quarters	2145		2145
Taps	2200		2200

Movies will be shown at 1900 on rest days.

TABLE 29
CONSOLIDATED TRAINING SCHEDULE

ACTIVITY	WEEK OF TEST								TOTAL HOURS
	1	2	3	4	5	6	7	8	
	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	
Marches, day	16	16	16	16	16	16	16	16	112
Marches, night		8		8		8			24
Marches, 90 miles									24
Foxhole								32	32
Outpost Problems		8	24	8	24	8	24		72*
Tests	8	8	8		8				24
Map Reading	2	2	2	2				8	40
Grenades	2		4	2					8
Bayonet	4		4		4			2	8
Field Fortification		4		4				2	16
Organization of Army		2							8
Scouting and Patrolling	4	2	2	4	4				2
Tactical Training - Individual	2	4	2					4	20
Tactical Training - Squad				2	6	8	2		8
Tactical Training - Platoon							2		18
Technique of Fire	4					4	8		12
Combat Firing		2	2	2					4
Infiltration						2	2	2	12
Antiaircraft Firing							2		2
Transition Firing	4					2			2
Close Combat	2			2					4
TOTAL	48	56	64*	48	54*	48	56*	48	432*

* Abnormally high totals due to 24-hour periods in foxhole or slit trench.

TYPICAL WEEK OF COMPANY ACTIVITY

DAY	TIME	ACTIVITY	DAY	TIME	ACTIVITY
1	0700-0730	Combat Firing	4	0700-0900	Tactical Tng. - Individual
	0730-1630	March (cross country)		0900-1100	Scouting and Patrolling
	1630-1700	Combat Firing		1200-1400	Tactical Tng. - Squad
2	0545-0630	Weigh in (all men)	5	1400-1600	Open Time (clean-up)
	0700-1100	Grenades		0700-0730	Combat Firing
	1200-1400	Field Fortifications (2-man foxholes)		0730-1630	March (on roads)
3	1400-1600	Tactical Tng. - Squad	6	1630-1700	Combat Firing
	0700-0900	Tactical Tng. - Individual		0545-0630	Weigh in (all men)
	0900-1100	Scouting and Patrolling		0700-1100	Outpost Problem
	1200-1600	Outpost Problem		1200-1600	Open Time(clean-up)
	2000-2400	Night Outpost Problem	7		Day of Rest

Appendix A
Inclosure #1

TABLE 31
 DETAILS OF SCHEDULE OF THIRD RATION PERIOD

COMPANY	6th Week	7th Week	8th Week
Y	<u>K Ration</u> : Without supplement of Jam one ration daily for 11 days; increased to 1-2/3 rations for last 10 days. New Type IV and V Biscuits for 5 days only.		
X	<u>C Ration</u> : Experimental with Jam; 1-1/3 rations daily.	<u>K Ration</u> : With Jam, 1-2/3 rations daily	<u>4 days</u> Select ration from C, K and CMT <u>3 days</u> Choice of ration items in C, K, and CMT
G	<u>C Ration</u> , New, with Jam; 1 ration daily	Same as 6th Week	<u>C Ration</u> , Experimental, with Jam; 1 ration daily
E	<u>K Ration</u> , 1-2/3 rations daily Type IV and V Biscuit for 2 days Without Jam	With Jam	With Jam Last 5 days cheese was replaced by compressed cheese
H	<u>10-in-1 Ration</u> : with new Type I and Type II biscuits for first 10 days; 1 ration daily.	1-1/4 rations daily for last 11 days. On odd days replace Type I with 1 box sugar wafers, and 1 box sandwich Type cookies, on even days replace Type II.	
F	<u>B Ration</u> , Supplemented Vitamin tablets - 3 daily to Platoons 2 and 4 Placebos - 3 daily to Platoons 1 and 3	Same as 6th Week	Same as 7th Week Cocoa and soups tested

Appendix A
 Inclosure #1

TABLE 32
SCHEDULE

E COMPANY

June 13	Step Test and AAF Test at Carson
June 13	Physical Examination at Carson
June 16	Complete Fitness Tests at Topside
June 17	Start K Ration (1-2/3 rations)
June 23	Complete Fitness Tests
July 8	End K Ration. Complete Fitness Tests. Physical Exam.
July 9	Start Supplemented B Ration
July 22	End Supplemented B Ration. Complete Fitness Tests. Physical Exam.
July 23	Start K Ration (1-2/3 ration with one each Type IV and V biscuits for 2 days)
July 31	Add jam to 1-2/3 K Ration (last 5 days cheese replaced by compressed cheese)
August 12	End K Ration. Complete Fitness Tests. Physical Exam.

F COMPANY

June 14	Physical Examination at Carson
June 15	Step Test and AAF Test at Carson
June 18	Complete Fitness Test at Topside
June 19	Start Supplemented B Ration
June 25	Complete Fitness Tests
July 8	Physical Examination
July 10	Complete Fitness Tests
July 24	Complete Fitness Tests
July 24	Physical Examination. Vitamins and placebos begun
August 12-14	Cocoa and Soups tested
August 14	End Supplemented B Ration. Complete Fitness Tests. Physical Examination

G COMPANY

June 12	Step Test and AAF Test at Carson
June 13	Physical Examination at Carson
June 15	Complete Fitness Tests at Topside
June 16	Start K Ration (1-2/3 rations)
June 22	Complete Fitness Tests
July 7	End K Ration. Complete Fitness Tests.
July 8	Physical Examination
July 8	Start 10-in-1 Ration (as 3-in-1)
July 21	End 10-in-1 Ration. Complete Fitness Tests
July 22	Start New C Ration (1 ration with jam)
July 24	Physical Examination
August 3	End New C Ration (supply gone)
August 4	Start Experimental C Ration (1 ration with jam)
August 11	End Experimental C Ration. Complete Fitness Tests. Physical Examination

Table 32
Pg. 1

TABLE 32 (Continued)

SCHEDULE

H COMPANY

June 14	Step Test and AAF Test at Carson
June 14	Physical Examination at Carson
June 17	Complete Fitness Tests at Topside
June 18	Start 10-in-1 Ration (as 8-in-1)
June 24	Complete Fitness Tests
July 9	Complete Fitness Tests. Physical Examination
July 23	Complete Fitness Tests. Physical Examination
July 24	Start 10-in-1 (as 10-in-1) with one each New Type I and II biscuits
August 2	End 10-in-1 (as 10-in-1)
August 3	Start 10-in-1 Ration as 8-in-1 with 1 box sandwich type cookies replacing on alternate days one box of Type I or IV biscuit
August 13	End 10-in-1 Ration. Complete Fitness Tests. Physical Exam

X COMPANY

June 11	Step Test and AAF Test at Carson
June 12	Physical Examination at Carson
June 14	Complete Fitness Tests at Topside
June 15	Start Canadian Mess Tin (1-1/3 rations)
June 21	Complete Fitness Tests
July 6	End CMT Ration. Complete Fitness Tests. Physical Exam.
July 7	Start 10-in-1 Ration (as 8-in-1)
July 20	End 10-in-1 Ration. Complete Fitness Tests
July 21	Start Experimental C Ration (1-1/3 rations with jam)
July 24	Physical Examination
July 27	End Experimental C Ration
July 28	Start K Ration (1-2/3 rations with jam)
August 3	End K Ration
August 4	Start choice of C, K, or CMT complete rations
August 7	End choice of complete rations
August 8	Start choice of any components of C, K, or CMT Rations
August 10	End Rations. Complete Fitness Tests. Physical Exam.

Y COMPANY

June 10	Step Test and AAF Test at Carson
June 12	Physical Examination at Carson
June 13	Complete Fitness Tests at Topside
June 14	Start Experimental C Ration (1-1/3 rations)
June 20	Complete Fitness Tests
July 5	End Experimental C Ration. Complete Fitness Tests
July 6	Start 10-in-1 Ration (8-in-1)
July 9	Physical Examinations
July 19	End 10-in-1 Ration. Complete Fitness Tests
July 20	Start K Ration (1 ration, New Type IV and V biscuits for 5 days only)
July 23	Physical Examinations
July 30	Complete Fitness Tests
July 31	Increase K Ration to 1-2/3 rations
August 9	Complete Fitness Tests. End K Ration. Physical Exam.

TABLE 33

TEST DAY SCHEDULE

HOUR	PROGRAM ALL MEN	CHEMISTRY SECTION	STEP TEST	AMP TEST	CLINICAL EXAM	A C F TEST			
						ASSEMBLY AREA	REGIM FIELD TEST	REGIM MARCH	
0645	Reveille								
0500		1,2,3 ^a Void & Discard							
0500-0530	Weighing								
0630		1,2,3 Void & Collect Give Test Dose							
0645-0700	Breakfast								
0800-0900		1,2,3 Bleeding	1	3	1,2				
0900-1000			2	4	3,4				
1000-1100			3	1					
1030		1,2,3 Urine Samples							
1100-1200			4	2					
1130-1215	Lunch								
1215-1300	Rest								
1245						1,2			
1300									
1320							1		
1330							2		
1340						3,4			
1400							3		
1420							4		1
1440									2
1500									3
									4

^a The numbers 1,2,3 and 4 refer to Platoons

TABLE 34
APPROXIMATE CALORIE CONTENT OF RATIONS, Cont'd

10 - IN - 1 RATION					
Item	Total Wt. Oz.	Total Calories	Item	Total Wt. Oz.	Total Calories
MENU #1			MENU #3		
Cereal	20	2250	Cereal	20	2250
Pork Sausage	68	5100	Ham & Eggs	68	4520
C Biscuits	32	3780	Biscuits (C Square)	32	3790
Jam	22	1580	Jam	22	1580
Coffee	2	210	Coffee	2	210
Milk	12	470	Milk	12	470
Sugar	12	1350	Sugar	12	1350
K Biscuits	24.8	3040	Meat Product	38.7	2870
Hard Candy	13.75	1520	K Biscuits	24.8	3040
Lemon powder	2.47	270	Sweet Chocolate	20	2990
Sugar	8	900	Orange Powder	2.47	270
Egg & Meat Product	35.0	2720	Sugar	8	900
Meat & Rice Dehyd.	26	3470	Beef, Corned	48	3550
Tomatoes	38	200	Peas	40	700
Peanuts	15	2550	C Biscuits	32	3790
C Biscuits	32	3790	Army Spread	7.5	1180
Army Spread	7.5	1180	Fruit Bar	20	1810
Cocoa	20	2210	Cocoa	20	2210
TOTAL		36600	TOTAL		37480
MENU #2			MENU #4		
Cereal	20	2250	Cereal	20	2250
Bacon	48	9740	Bacon	48	9740
K ₄ Biscuits	32	4020	Biscuits (C Square)	32	3790
Jam	22	1580	Jam	22	1580
Coffee	2	210	Coffee	2	210
Milk	6	240	Milk	6	240
Sugar	12	1350	Sugar	12	1350
Cheese	40	4410	Meat & Egg Product	35.0	2720
K Biscuits	24.8	3040	K Biscuits	24.8	3040
Caramels	20	2430	Fruit Bar	20	1810
Lemon powder	2.47	270	Lemon Powder	2.47	270
Sugar	8	900	Sugar	8	900
Stew English Style	60	2360	Roast Beef	48	2790
Snap Beans	38	240	Corn	40	930
K ₄ Biscuits	32	4020	C Biscuits	32	3790
Army Spread	7.5	1180	Army Spread	7.5	1180
Fruit Bar	20	1810	Hard Candy	13.75	1520
Coffee	2	210	Coffee	2	210
Sugar	12	1350	Sugar	12	1350
Milk	6	240			
TOTAL		41850	TOTAL		39670

TABLE 34

APPROXIMATE CALORIE CONTENT OF RATIONS, Cont'd

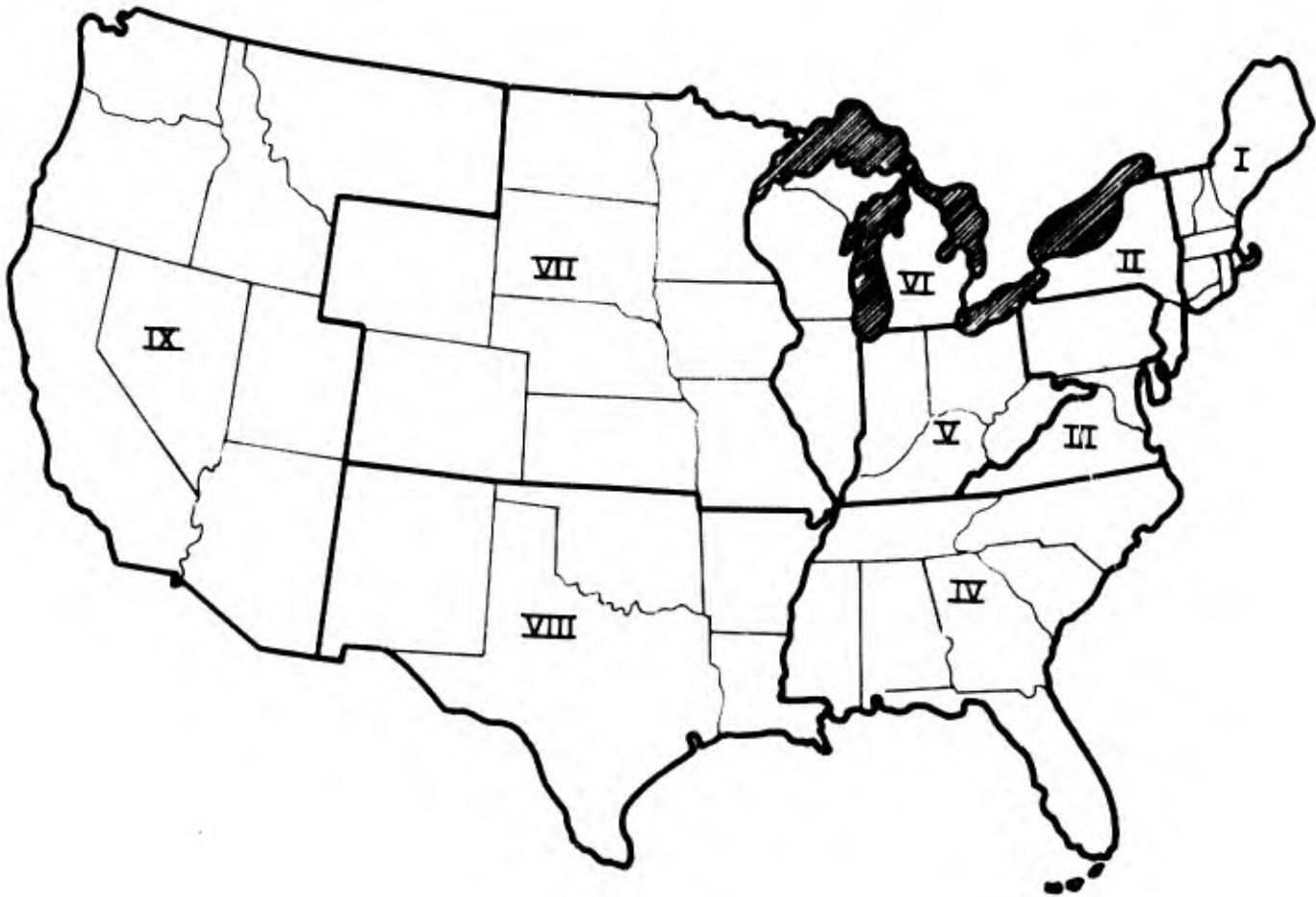
10-IN-1 RATION		
Item	Total Wt. Oz.	Total Calories
MENU #5		
Cereal	20	2250
Pork & Egg Yolk	68	5930
K4 Biscuits	32	4020
Jam	22	1580
Coffee	2	210
Milk	12	470
Sugar	12	1350
Cheese	40	4410
K Biscuits	24.8	3040
Fruit Bar	20	1810
Orange Powder	2.47	270
Sugar	8	900
Corned Beef Hash	26	3020
Lima Beans	40	880
K4 Biscuits	32	4020
Army Spread	7.5	1180
Chocolate Bar	20	2990
Cocoa	20	2210
TOTAL		40540

CALORIES PER MAN (10-in-1 RATION)		
MENU	WHEN CONSUMED BY 10 MEN	WHEN CONSUMED BY 8 MEN
#1	3660	4575
#2	4180	5225
#3	3750	4688
#4	3970	4963
#5	4050	5063
AVERAGE	3920	4900

Appendix A
Inclosure #1

Table 34
Fig. 3

FIG. I
 DISTRIBUTION OF MEN IN VARIOUS COMPANIES
 BY SERVICE COMMANDS



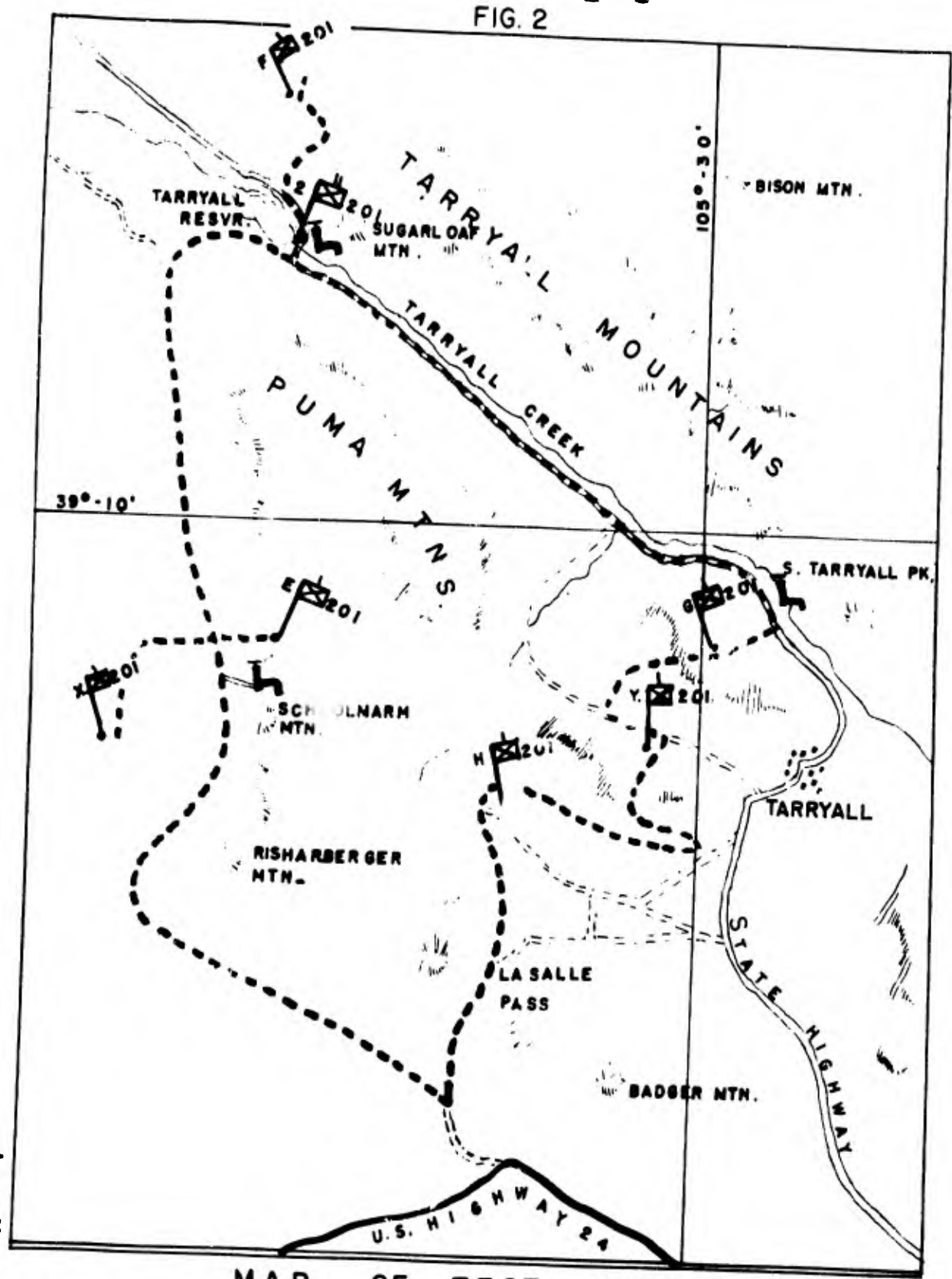
COMPANY	I	II	III	IV	V	VI	VII	VIII	IX	FOREIGN
E.....	1%	6%	21%	2%	21%	14%	17%	13%	2%	3%
F.....	4%	4%	4%	4%	18%	14%	21%	20%	10%	1%
G.....	4%	5%	30%	11%	18%	8%	7%	6%	6%	5%
H.....	1%	5%	28%	8%	14%	13%	9%	10%	8%	4%
X.....	2%	5%	25%	7%	9%	15%	22%	8%	1%	6%
Y.....	4%	5%	24%	7%	8%	10%	14%	14%	7%	7%
ALL.....	3%	5%	22%	7%	15%	12%	12%	12%	3%	4%

PERCENT OF STRENGTH

Appendix A
 Inclosure #1

FIG. I

FIG. 2



Appendix A
Inclosure #1

APPENDIX B DESCRIPTION OF RATIONS

1. GENERAL:

When comparing one ration with another, it is necessary to bear in mind the specific use for which each ration was designated. Since various rations have different primary uses, one might be more satisfactory than another merely because of the conditions of the test.

2. INTENDED USE:

K Ration was designed to be used for a few meals, or at most for 3-5 days. Its calorie content is sufficient for light to moderate activity for such periods, but an increased rate of issue is needed for soldiers undergoing hard work. It is the lightest and most compact of the U. S. Army combat rations, essentially a light assault ration, and one for use by paratroops. The C Ration was designed for front-line feeding of combat troops for periods from a few days to an extreme of 3 weeks when no better ration could be brought up and used effectively. It is adequate for moderate activity and is a medium weight ration. K Ration may be used alternately with it to avoid monotony. Either may be supplemented with D Ration chocolate, hot soups, or sandwiches whenever the tactical situation permits. The Canadian Army Mess Tin Ration is similar to the U. S. Army C and K Rations; it was designed as a combat ration to be used whenever a bulk ration could not be supplied. Its designed period of use is about a week, and its calorie content is adequate for moderate activity.

The 10-in-1 Ration has a dual function, primarily as a support area ration, but also as a heavy combat ration for use by tank crews, artillery groups and even by infantry along a stabilized section of the front. In areas behind the front the 10-in-1 Ration is used extensively but is replaced by B Ration whenever the problems of supplying a bulk ration can be overcome. Moderate to heavy work can be sustained on the 10-in-1 Ration for periods of many weeks. The control ration used to establish a basis of comparison was a Supplemented Field Ration B. This ration is designed to support heavy activity for a period of months.

3. USE IN THE PRESENT TEST:

The design of the test (Appendix A) required certain departures from the intended use of the emergency rations K, C and Canadian Army Mess Tin which were used for 1 or more periods of 3 weeks. This is well within the limits of use in actual practice but necessarily affects the acceptability of rations which have no variety to avoid monotony. Thus we may expect changes in acceptability and consumption which would not appear during a very short period of use. The calorie issue was standardized during Period I so that inadequate food would not be a factor in acceptability, while the last period (III) was used to study the ration issued according to the specifications of a ration per man per day. These factors are discussed at length in Appendix D, Section I.

4. PACKAGING:

This problem was not specifically studied. The rations were shipped and reshipped many times, and exposed to the elements during the test and in general held up well. The fibre case of the Canadian Army Mess Tin Ration tore in some instances, and there was some breakage of C Ration cases.

5. DISCUSSION OF RATIONS:

The following is a brief description of the rations noted. For more detailed consideration see Chicago Quartermaster Depot specifications for each of the U. S. Army packaged rations.

a. *Ration, Type K*—The Ration, Type K, consists of food for 1 man for a day packaged in 3 oblong wax-dipped inner cartons, overwrapped in a camouflaged paperboard carton; 1 package for each meal. The components of each of the meals are as follows:

ITEM	NET WEIGHT (ounces)	CALORIES
Breakfast		
K Biscuits, 2 pkgs.	2.5	300
Meat and Egg Product	3.8	270
Fruit Bar	2.0	180

ITEM	NET WEIGHT (ounces)	CALORIES
Breakfast (Continued)		
Soluble Coffee Product	0.3	20
Sugar	0.8	90
Gum	1 piece	
Cigarettes, 4	1 pkg.	
Key, can opening	1	
Dinner		
K Biscuits, 2 pkgs.	2.5	300
Cheese Product	4	440
Caramels	4	240
Lemon or Orange Juice Powder	0.3	30
Sugar	0.8	90
Gum	1 piece	
Cigarettes, 4	1 pkg.	
Key, can opening	1	
Matches	1 book	
Supper		
K Biscuits, 2 pkgs.	2.5	300
Meat Product	3.8	290
Chocolate Bar	2.0	300
Bouillon Powder	0.4	30
Gum	1 piece	
Toilet paper, 12 sheets	1 pkg.	
Cigarettes, 4	1 pkg.	
		2880

The meat and egg products can be either ham and eggs or chopped pork and egg yolk. The cheese product can be processed American cheese, processed American cheese with bacon, or processed American and Swiss cheese blend. The meat products can be either beef and pork loaf, or corned pork loaf with carrot and apple flakes added. There are five types of K biscuits, as follows: K-1A (wheat-oat biscuit); K-2 (graham biscuit); K-3 (a sweet milk biscuit); K-4 (a neutral cracker); and K-5 (an enriched soda cracker).

Thirty-six meals (12 rations) are packed in a nailed wooden box.

b. *Ration, Type C, Experimental*—The Ration, Type C, Experimental, consists of food for 1 man for a day packaged in 6 key-opening cans 3 inches in diameter, and 3½ inches tall. Three of these cans are Biscuit Units; the other 3 are Meat Units. A meal consists of 1 can of each. The Biscuit Units of the 2 menus are as follows:

MENU NO. 1

- Breakfast (B-1)**
 4 Biscuits (Type IV)
 Premixed Cereal (General Mills)
 Candy Coated Peanuts
 Coffee
 Sugar
- Dinner (B-2)**
 5 Biscuits (Type V)
 Hard Candy
 Lemon Juice
 Sugar

MENU NO. 2

- Breakfast (B-4)**
 4 Biscuits (Type IV)
 Premixed Cereal (General Foods)
 Jelly Beans
 Coffee
 Sugar
- Dinner (B-5)**
 5 Biscuits (Type V)
 Candy Coated Raisins
 Orange Juice
 Sugar

MENU NO. 1

- Supper (B-3)
 4 Biscuits (Type I)
 1 Sandwich Cookie
 Caramels
 Cocoa

MENU NO. 2

- Supper (B-6)
 3 Biscuits (Type I)
 1 Compressed Chocolate Cake
 Caramels
 Bouillon

With each of the Biscuit Units described above, one of the following Meat Units is added to make a complete meal:

M-1	Meat and Beans	12 oz.
M-2	Meat and Vegetable Hash	"
M-3	Meat and Vegetable Stew	"
M-4	Ground Meat and Spaghetti	"
M-5	Chicken and Vegetables	"
M-6A	Beans and Frankfurters (Tomato Sauce)	"
M-6B	Beans and Frankfurters (in Molasses)	"
M-7A	Pork and Beans (Tomato Sauce)	"
M-7B	Pork and Beans (in Molasses)	"
M-8	Beef and Noodles	"
M-9	Ham and Lima Beans	"

As provided for this test, 8 C Rations (48 cans) were packed in a nailed wooden box and arranged so that a row of 6 cans is 1 complete ration.

The calorie content of this ration is estimated at about 3200 calories per man per day, not including the 1½ ounce jam supplement which was issued with this ration during the test. The Ration, Type C, Experimental, has been supplemented by the Ration, Type C, New.

c. *Ration, Type C, New*—The Ration, Type C, New, like its predecessor has food packed in key-opening cans, 3 by 3½ inches. There are 6 cans per ration, half of which are Meat Units. There is more variety in the 6 menus of the present Ration, Type C, than in any earlier Ration, Type C. The 6 menus are composed of various combinations of the 6 B Units and the 10 M Units.

The B Units are assembled as follows:

ITEM	NEW WEIGHT	CALORIES
Breakfast (B-1)		
4 Biscuits, Type IV, Round	2.0 oz.	260
Cereal, Comp., Premixed	2.0 oz.	240
Peanuts, Candy Coated	1.2 oz.	80
Raisins, Candy Coated	1.2 oz.	60
Coffee Product, Soluble	5.0 oz.	20
Sugar	0.8 oz.	90
Dinner (B-2)		
5 Biscuits, Type V, Round	1.75 oz.	220
Lemon Juice Powder, Syn.	7.0 gr.	30
Sugar	1.2 oz.	140
Candy, Hard	0.8 oz.	70
Supper (B-3)		
4 Biscuits, Type I, Round	2.0 oz.	250
Jam, Canned	1.5 oz.	110
Cocoa Beverage Powder	1.5 oz.	160
Caramels	0.5 oz.	60
		1790

Breakfast (B-4)		
4 Biscuits, Type IV, Round	2.0 oz.	260
Cereal, Comp., Premixed	2.0 oz.	220
Peanuts, Candy Coated	1.2 oz.	80
Raisins, Candy Coated	1.2 oz.	60
Coffee Product, Soluble	5.0 gr.	20
Sugar	0.8 oz.	90
Dinner (B-5)		
5 Biscuits, Type V, Round	1.75 oz.	220
Orange Juice Powder, Syn.	7.0 oz.	30
Sugar	1.2 oz.	140
Candy	0.6 oz.	70
Supper (B-6)		
5 Biscuits, Type I, Round	2.0 oz.	250
Jam, Canned	1.5 oz.	110
Coffee Product, Soluble	5.0 gr.	20
Caramels	1.1 oz.	130
Sugar	0.8 oz.	90
		1790

The M Units consist of the following:

ITEM	NEW WEIGHT (ounces)	CALORIES
M-1 Meat and Beans	12	390
M-3 Meat and Vegetable Stew	"	400
M-4 Ground Meat and Spaghetti	"	480
M-5 Ham, Egg and Potato	"	500
M-6 Meat and Noodles	"	570
M-7 Pork and Rice	"	710
M-8 Frankfurters and Beans	"	670
M-9 Pork and Beans	"	480

The Menus are made up as follows:

	BREAKFAST	DINNER	SUPPER
Menu No. 1	B-1 + M-5	B-2 + M-1	B-3 + M-11
Menu No. 2	B-4 + M-6	B-5 + M-8	B-6 + M-7
Menu No. 3	B-4 + M-7	B-5 + M-4	B-6 + M-3
Menu No. 4	B-1 + M-9	B-5 + M-4	B-3 + M-10
Menu No. 5	B-1 + M-6	B-2 + M-3	B-3 + M-5
Menu No. 6	B-4 + M-10	B-5 + M-8	B-6 + M-11

Forty-eight cans are packed to the shipping case in such a manner that a row of 6 cans is a ration and there are no 2 cans alike in any ration.

An accessory Packet included with each ration contains the following components:

ITEM	AMOUNT
Cigarettes	9 ea.
Halazone Tablets	12 ea.
Matches, Book	1 (10 sticks ea.)
Toilet Paper	1 packet
Gum, Candy Coated	2 tablets
Can Opener	1 per shipping case (i. e. 1 per 8 rations)

d. *Canadian Army Mess Tin Ration*—The Canadian Army Mess Tin Ration consists of food for 1 man for 1 day packaged in a wax-dipped carton. The ration contains the following components:

ITEM	NEW WEIGHT (ounces)	CALORIES
Spiced Beef	3	230
Pork Loaf	3	180
Sardines	3.5	310
Pea Soup (Dehydrated)	2	170
Butter	2	380
Jam	1.5	150
Biscuits (3 pkgs., 3 oz. each)	9	1100
Chocolate	2	300
Chocolate Drink	1.5	120
Milk and Sugar Powder	1.5	160
Hard Candy	4-9 pieces	150
Cheese	1.5	180
Gum (3 pieces)	1 pkg.	
Cigarettes, 10	1 pkg.	
Lump Sugar	0.7	50
Salt (1 pkg.)	0.4	
Matches (20)	1 book	
Wooden Fork	1	
Wooden Spoon	1	
Fiber Caps for reclosing	1	
Butter and Jam Cans	2	
Can Opener	1	
Menu	1	

3480

Twenty-four rations are packed in a solid fiber steel-banded shipping case.

e. *Ration, 10-in-1*—The Ration, 10-in-1, consists of food for 10 men for 1 day and is packed in a steel-banded, fiber shipping case. The ration can be divided and used as a 5-in-1. A typical menu is as follows:

Items for Breakfast and Supper	Units	Net Wt.	Calories
Army Spread (Preserved Butter)	2 cans	3.8 oz.	1180
Sliced Bacon	2 cans	24.0 oz.	9740
String Beans	2 cans	19.0 oz.	240
Coffee Product, Soluble	4 cans	1.0 oz.	420
Jam	2 cans	11.0 oz.	1580
Milk, Evaporated	2 cans	6.0 oz.	480
English Style Stew	2 cans	30.0 oz.	2360
Biscuits (Type I or Type II)	2 cans	32.0 oz.	8040
Cereal w/added Milk & Sugar	2 boxes	10.0 oz.	2250
Fruit Bar	10 bars	2.0 oz.	1810
Sugar	4 pkgs.	6.0 oz.	2700
Items for Lunch			
Cheese	10 cans	4.0 oz.	4410
Partial Dinner Unit, Menu No. 2	10 boxes		
Biscuits (Type II, IV, V)		2.4 oz.	3040
Caramels		2.0 oz.	2430
Lemon Juice Powder, Synthetic		0.3 oz.	270
Sugar		0.8 oz.	900

Items for Lunch (Continued)	Units	Net Wt.	Calories
Chewing Gum		1 piece	
Key, Can Opening		1.0 oz.	
Miscellaneous			
Salt	2 bags	1.0 oz.	
Cigarettes	10 pkgs.	10.0 oz.	
Halazone Tablets	2 bottles	50 tablets	
Matches	10 books	20.0 oz.	
Can Opener, Small	2		
Toilet Paper	2 packets	125 sheets	
Soap	2 cakes	2.0 oz.	
Paper Towels	10 sheets		
			41,850

In the other menus, pork sausage meat, ham and eggs, pork and egg yolk, roast beef, corned beef, dehydrated corned beef hash, and dehydrated meat and rice are used as alternates for the breakfast and supper meat products. Canned corn, lima beans, peas, and tomatoes are alternates for the supper vegetable. Beverages include coffee, cocoa, orange, grape and lemon. The partial dinner unit and the canned dinner component are varied with each menu. The noon meal is similar to the K Ration dinner unit.

The canned components of the 10-in-1 Ration are packed together in 2 inner fiber boxes. All food components of the 2 halves are packed in 2 wax-dipped inner cartons. The 4 cartons containing the ration are then packed in the fiber shipping case.

The average calorie content of the 5 menus of the 10-in-1 Ration is such that each man receives 3900 calories per day.

f. *Supplemented B Ration*—A Supplemented B Ration was used as the control ration designed to supply the men with the best possible food. Accordingly, it contained fresh bread, frozen meat, fresh fruit, and a number of other items which would not occur in most B Rations. There was, in addition to the supplementary items, the usual non-perishable subsistence of canned meats, fruits, vegetables and dehydrated eggs. No dehydrated vegetables were used; all vegetables were canned except potatoes and onions, which were issued fresh. Menus were planned on a 10-day cycle, repeated as long as the ration was used.

APPENDIX C

OBSERVATIONS ON RESPIRATORY METABOLISM

1. INTRODUCTION:

Estimation of the daily energy expenditure of the test subjects was desirable for several reasons. (1) The severity of daily work affects acceptability of a ration and determines the requirement for maintenance of calorie balance. (2) Although data are available for many activities of infantry troops, previous studies have been done at sea level, and not at altitudes around 9000 feet. The influence of altitude had to be assessed for this reason. (3) Even the most complete tables contain significant gaps in estimates of many common activities. Therefore, an evaluation of the calorie expenditure for a number of the daily activities was undertaken.

2. METHODS:

Four subjects were used throughout, 2 from F Company and 2 from X Company. They approximated the battalion average in age, height, weight and physical fitness (See Table 1).

The data were collected between 20 June and 7 July, the standard open-circuit Douglas bag technique being used. A valve, chosen for its low resistance to air flow, was connected to a 3-way valve permitting diversion of expired air into the Douglas bag for sampling. Collection was carried out for a measured interval, the contents of the bag metered, and samples withdrawn for analysis in the Haldane apparatus. Following very severe work, expired air was collected during a recovery period of 2 to 4 minutes. In most instances, the R. Q. was between 0.80 and 0.90. The actual R. Q. for a particular collection was disregarded in the calculation of the calorie equivalent of oxygen; and the value of 4.85 calories per liter of oxygen was used throughout.

The results presented in the tables are all expressed as calories per hour or unit of work per man. Since the subjects were closely similar in weight and surface area (less than 5% spread) and these values are very close to the average for soldiers, no correction to a common weight or surface was made. The results should be evaluated with 2 types of limitations in mind: those inherent in establishing a representative measure of the calorie cost of a given task, and those which derive from the uncertainty as to the actual pattern of a day's activities. In the first category are the technical uncertainties of the procedure. The sampling interval is very short, frequently covering only 2 to 3 minutes. Apprehension on the part of the subject was reduced by training and trial runs, but even in the absence of apprehension the equipment modifies in some degree the performance of the subject. Finally, the calorie cost of a given task varies from man to man and is influenced by the training and skill of an individual subject. The march-day was the most predictable of the various training days observed in this study.

These limitations do permit, nevertheless, the establishment of a range of values and an approximation of the calorie cost of various activities.

3. ENERGY EXPENDITURE IN VARIOUS TYPES OF ACTIVITIES:

In Table 2 are assembled the measurements on the basal condition and light activity. The Basal values ranged from 3 to 4 per cent higher than the Dubois standards in 3 subjects and 12 per cent higher in the case of Her.

Table 3 lists a group of activities, exclusive of marching, measured on the subjects. The data are expressed as the cost in excess over a minimal value. This minimal cost was taken as 100 calories per hour. Two advantages are present in this type of treatment: (1) It has been demonstrated that there is less variance in oxygen consumption with respect to rates of work when the excess cost over the resting value, rather than the total oxygen consumption, is related to the work accomplished. (2) Deduction of a reasonable value for resting energy expenditure from the total cost of the measured activity permits this rate to be used as a base cost for all the waking hours. On this value the excess cost of the actual activities can be superimposed. This allows a simpler and more reliable summing of expenditure for a day than does an hour-by-hour addition of the total rates per hour. In order to reconvert the tabulated data to the total cost per hour, one should add 100 calories to the values given in the tables. The marching data, expressed as calories per mile in excess of base, are assembled in Table 4. The pack carried was a light infantry pack of approximately 20 pounds including rifle and canteen. The rate varied from 3.0 to 3.3 mph at cadences of from 106 to 120 steps per minute.

The opportunity was taken to compare the relative efficiency of various modes of locomotion. It will be seen from Table 5 that modes of progression involving walking or running cost far less than those involving getting up and down off the ground or lying on the ground. Experience has shown that field rushes, creeping and crawling are exhausting types of exercise, and the present data illustrate some of the reasons. The cost per 100 yards increases markedly when the pace is greatly increased.

So far as comparison is possible, these data agree reasonably well with other measurements that are available. (See Armored Medical Research Laboratory Report, Sub-Project No. 2-14, dated 10 April 1944, and the Quartermaster Board Report on Project S-44, 1943.) Apparently, altitude had but little effect.

4. ENERGY EXPENDITURE IN ACTIVITIES PECULIAR TO PRESENT TEST TROOPS:

One important feature of the present trials was the battery of physical fitness tests. They took only part of the test day, but the subjects always felt that they had had a strenuous workout. The relative severity of the individual items of the tests is indicated in Table 6 in the column listing the rate per hour. All components of the tests are relatively severe, the pig-a-back exercise being the most strenuous. Considering the time taken to finish each item, the Step Test, the shuttle-run, the 300 yard run and the 4 mile road march are the most exhausting. In spite of the arduous nature of the individual exercises, the total extra energy expenditure due to the fitness tests amounted to only about 610 calories. In terms of total work output, test days were relatively easy though considered the hardest day's work by almost all subjects.

5. ENERGY EXPENDITURE OF TYPICAL DAYS:

The procedure followed in estimation of the daily calorie expenditure was to establish a minimum or base representing the sum of the sleeping expenditure (8 hours @ 80 cal/hr.) plus the minimal waking expenditure (16 hours @ 100 cal/hr.), plus the cost of the essential and probable daily chores. These are tabulated in Table 7, and lead to an estimate of about 2800 calories per day as the minimal expenditure. On this minimal value are superimposed the specific activities of the day.

The results of such estimates for 5 typical days are given in Table 8. The calorie expenditure ranges from a low of about 2800 calories to a high value of about 4800 calories the severest day of the schedule (marching).

On the basis that each week includes 1 rest day, 3 march days, 2 days each made up of one-half day of class instruction and one-half day of field work, one is led to a rough estimate of about 4000 calories per day for the average week.

It should be noted again that these values are subject to uncertainty and are applied to generalized schedules; hence, they should be taken only as an indication of the order of magnitude of the calorie expenditure.

6. SUMMARY:

- a. Observations were made on energy expenditure in a number of typical daily tasks.
- b. The data gave no indication that the altitude significantly modified the cost of the various activities.
- c. Estimates were made of the calorie expenditure of the troops on typical days. For rest days the figure was about 2800 calories; for test days, about 3400 calories; for days involving long cross-country marches, about 4800 calories; and for days of work without long marches, from 3600 to 4000 calories.
- d. Data on the metabolic cost of various modes of locomotion are presented.
- e. Calorie expenditure is not necessarily a good measure of the effect of work on the subject in terms of discomfort and subjective reaction.

TABLE 1

PHYSICAL CHARACTERISTICS OF THE SUBJECTS

		Height (inches)	Weight (pounds)	Surface Area*	Age
F Company	Har	70-3/4	154	1.88	21
	Luk	67-7/8	158	1.84	20
X Company	Wol	72-3/4	153	1.91	22
	Kel	73-3/4	152	1.92	20

* In square meters

TABLE 2

BASAL METABOLISM AND LIGHT ACTIVITY
Calories per Man per Hour

	Har	Luk	Wol	Kel
Basal Metabolism	86	79	80	77
Foxhole (awake)	108*	86	83	93
Supine (awake)	112	104	89	87
Sitting	118	103	97	101
Standing	127	106	97	107
Sitting in Class	133	139	125	104
Letter Writing	144	137	-	-

* Restless

TABLE 3

MISCELLANEOUS ACTIVITIES
Cost per Man in Excess of Base (100 Calories per Hour)

ACTIVITY	Har	Luk	Wol	Kel	Average Cal/hr	Unit	Average Cal/unit
Bayonet Drill	371	482			427	20 min.	143.0
Parry Stick Drill	348	470			409	25 min.	170.0
Grenade Throwing	-	-	338	250	289	2 gren.	2.2
Grenade & Retrieving	245	203			224	2 gren. & retrieve	8.6
Grenade Assault Course	921	739			830	Course	28.0
Firing M1 Prone	212	246*	137	157	188	12 rds.	6.3
Shoveling	294	385	446	447	393	1 hr.	393.0
Using Pick	604	640	576	443	567	1 hr.	567.0
Scouting & Patrolling	-	-	352	225	289	1 hr.	289.0
Manual of Arms	-	-	126	153	140	5 min. 8 cycles	11.7
Cleaning Rifle	52	86	103	57	69.5	1 hr.	69.5
Policing (pick up sticks)	305	-	-	-	305	1 hr.	305.0
Raking	213	221	-	-	217	1 hr.	217.0
Washing Socks	108	82	-	-	95	1 hr.	95.0
Playing Horse Shoes	141	131	-	-	136	1 hr.	136.0

* Jam

TABLE 4

COST OF MARCHING
Calories per Man per Mile in Excess of Base (100 Calories per Hour)

Grade	Har	Luk	Wol	Kel	Average
Down	78	45	54	45	69.1
	86	67	88	79	
	-	71	-	-	
Level	-	-	69*	64*	82.8
	-	-	97**	95**	
	-	-	101	71	
Up & Down	104	87	80	85	97.7
	-	119	99	110	
Up	-	97	-	-	128.9
	96	141	106	102	
	139	169	109	124	
	143	192	-	-	

* Downwind ** Upwind

TABLE 5

INFLUENCE OF RATE AND OTHER FACTORS ON COST OF LOCOMOTION

Activity	Har	Luk	Wol	Kel	Av Speed Yds/min	Average Cal/100 yds
Casual Walk (n)			4.9	4.1	74	4.50
March (l)	Average				91	5.70
Forced March (h)	6.2	6.5			156	6.35
Double Time (h)	8.4	8.0			245	8.20
Run-150 yd turn (n)	7.7	6.9			269	7.30
Run-60 yd turn (n)	6.3	7.7			271	7.00
Rushes (l)	20.9	24.5	22.4	19.4	240	21.80
Creeping (l)	50.0	59.0	55.0	81.0	12.1	61.20
Crawling (l)	82.0	109.0	123.0	85.0	5.3	100.00

h = heavy pack (30 lbs.)

l = light pack (20 lbs.)

n = no equipment

TABLE 6

TEST ACTIVITIES
Cost in excess of base (100 Calories per hour)

TEST	Score and Duration	Har		Luk		Average Cal/Test
		Cal/Hr.	Cal/Test	Cal/Hr.	Cal/Test	
Step	H 5:00 146	675	56.2	790	66.0	61.1
	L 5:00 130					
Chin-Ups	H 11/0:30	720	5.5/10	1115	8.0/10	6.7/10
	L 6/0:15					
Shuttle Run 100 Yd. Turn	H 1:07	1020	19.0	1288	23.5	21.2
	L 1:06					
Zig Zag	H 0:26	1780	12.9	1800	14.5	13.7
	L 0:29					
Road March	H 53:04	495	438.0	527	457.0	448.0
	L 52:04					
300 Yd. Run	H 1:06	1255	23.0	1090	20.6	21.8
	L 1:06					
Fig-a-Back	H 0:22	2030	12.4	1720	11.0	11.8
	L 0:23					
Burpees	H 10/0:20	1800	9.1	1893	10.7	9.9
	L 11/0:20					
Pushups	H 19/0:32	660	3.1/10	-	-	(3.1/10)
	L -----					
Situps	H -----	-	-	435	3.45/10	(3.45/10)
	L 21/0:60					

H - Har
L - Luk

TABLE 7
MINIMUM DAILY ENERGY EXPENDITURE

ACTIVITY	Time or Distance	Calories/Unit	Total Calories
Wash and dress	.25 hr.	@ 50/hr.	13
Pick up rations	200 yds.	@ 4.5/100 yds.	9
Preparations of rations, eating, and clean up	.5 hr.	@ 20/hr. 10 x 3	30
Police duties	.5 hr.	@ 250/hr.	125
Miscellaneous walking (latrine, about area, etc.)	1200 yds.	@ 4.5/100 yds.	54
Wash and shave	.5 hr.	@ 95/hr.	48
Laundry	.5 hr.	@ 95/hr.	48
Evening activities (letter writing, etc.)	.5 hr.	@ 40/hr.	20
Sports	.5 hr.	@ 135/hr.	68
Cleaning rifle	.25 hr.	@ 75/hr.	19
March to and from instruction area	1400 yds.	@ 5.7/100 yds.	<u>80</u>
Total Misc. daily activities	514
Sleep	8 hrs.	@ 80/hr	640
Base	16 hrs.	* 100/hr.	<u>1600</u>
Total minimal cost normal day	2754

TABLE 8

ESTIMATES OF CALORIE EXPENDITURE FOR TYPICAL DAYS

ACTIVITY	Time or Distance	Calories/Unit	Total Calories
MARCH DAY			
20 miles Base		@ 100/mile	2000
Total			<u>2800</u> 4800
CLASS INSTRUCTION DAY			
Morning Class, Compass & Map Reading	3½ hrs.	@ 25/hr.	88
Afternoon Scouting & Patrolling	.83 hrs. class	@ 25/hr.	21
Field Work	2.5 hrs.	@ 290/hr.	<u>725</u>
Base			834
Total			<u>2800</u> 3634
NON-MARCH FIELD WORK			
Morning Individual Crawling	20 yds.	@ 100/100 yds.	20
Creeping	50 yds.	@ 61/100 yds.	31
Rushes	200 yds.	@ 22/100 yds.	44
Grenade Throwing Throw and Retrieve	30 grenades	@ 8.6/2 grenades	129
Grenade Assault Course		@ 28/course	28
Afternoon Bayonet Drill	2 hrs.	@ 145/hr.	290
Parry Stick Drill	2 hrs.	@ 170/hr.	<u>340</u>
Base			882
Total			<u>2800</u> 3682
NON-MARCH FIELD WORK			
Morning Outpost Problem	5 mile march	@ 100/mile	500
Afternoon Scouting & Patrolling	.83 hrs.	@ 25/hr.	21
Class	2.5 hrs.	@ 290/hr.	<u>725</u>
Field Work			1246
Base			2800
Total			<u>4046</u>
TEST DAY			
Harvard Step Test			61
Army Air Forces Test			36
Army Ground Forces Test			<u>515</u>
Base			612
Total			<u>2800</u> 3412

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APPENDIX D

Section I

ACCEPTABILITY OF RATIONS SUMMARY OF RATIONS TESTED

Company	Ration	Daily Ration Issue Per Man	Week of Test Period Used
Y	C (Exper.)	1-1/3	1, 2 and 3
X	C (Exper.)	1-1/3	6 and 8
G	C (Exper.)	1	8
G	C (New)	1	6 and 7
E	K	1-2/3	1, 2, 3, 6, 7 and 8
G	K	1-2/3	1, 2 and 3
X	K	1-2/3	7
Y	K	1	6 and 7
Y	K	1-2/3	7 and 8
X	Canad. M. T.	1-1/3	1, 2 and 3
H	10-in-1	1-1/4	1, 2, 3, 4, 5, 7 and 8
H	10-in-1	1	6 and 7
C	10-in-1	1-1/4	4 and 5
X	10-in-1	1-1/4	4 and 5
Y	10-in-1	1-1/4	4 and 5
F	Supp. B	4800 calories	1, 2, 3, 4, 5, 6, 7 and 8
E	Supp. B	4800 calories	4 and 5

1. INTRODUCTION:

It was pointed out in a report from this Laboratory* that acceptability is the essential requirement of any ration, for regardless of its food value or other attributes, if it is not eaten it is worthless. A prime consideration in a test of rations therefore is acceptability. Information on this point was obtained in a number of ways so that multiple internal checks were available—to study if discrepancies occurred, or to reinforce one another if they agreed. The general consistency of these several types of data in this study increases the significance of the results and indicates the validity of the methods used.

2. GENERAL PLAN:

In Appendix A the general plan of the ration trials was presented. Certain aspects require detailing here. The test was divided into 8 weeks, each with approximately equivalent work. The first 3 weeks constituted Period I, the middle 2 weeks, Period II, and the last 3 weeks, Period III. Tests were done and changes in rations were made in accordance with the scheme presented in Figure 1.

Period I was designed to compare the rations when issued on an approximately isocaloric basis. In order to obtain data on item acceptability more food was issued than was consumed so that the choice and preference records could be checked against the waste and unopened items returned. Trading was allowed. Its extent was determined from the daily questionnaire record of quantity of each item eaten. Quantity of plate waste differed somewhat from unopened unit or item waste. Waste returned from opened cans was usually of foods rated higher than that in unopened cans. Items actively disliked were not even opened after brief experience with them.

Period II was set up to test support area rations. The main comparison was between the Supplemented B Ration and the 10-in-1 Ration.

* Armored Medical Research Laboratory Report on Projects 1-7, 1-15, 2-5, 2-14, A Critique of Army Rations; Acceptability and Dietary Requirements, 10 April 1944.

Period III was designed to test combat rations, with a number of differences from Period I. Instead of isocaloric issue, some rations were issued in units as packaged with 1 ration per man daily regardless of calorie value. At the prescribed level of energy expenditure a calorie deficit ensued. During the last week of this period, X Company had a choice of C, K or Canadian Mess Tin Rations on 4 days, and a choice of any component of these rations for the last 3 days. E Company was issued jam with K Ration (1-2/3 rations per man per day) which contained a variety of items rather than the monotonous issue of Period I. G Company used both the New and Experimental C Ration with added jam. New biscuits were tested by H Company on the 10-in-1 Ration. Additional B Ration components were given a preliminary test by F Company and some substitutions were made in components of K ration tested by Y Company.

The supplemented B Ration was used as a control. An effort was made to have the best possible field ration, so fresh bread, fruits and frozen meats were used, and a few special items added.

3. METHODS OF COLLECTING DATA:

Types of Data	Method
Quantitative	<ol style="list-style-type: none"> 1. Individual questionnaires 2. Group issue minus waste (opened and unopened)
Qualitative	<ol style="list-style-type: none"> 1. Individual questionnaires 2. Summary questionnaires 3. Conferences and discussion 4. Data on hoarding 5. Subjects' comments and observers' reports

During the first week, some of the data were inaccurate because of inexperience and early difficulties with the methods used. These were corrected rapidly, and by repeated checking the system finally used was evolved by the trial and error of the first few days. A change was made in the method of recording on the questionnaires to facilitate transferring data to the punch cards. There were some differences in details of management in different companies. The following is a description of the methods which worked best and were generally practiced.

a. *Daily questionnaires* were devised to obtain information on quantity eaten, rating by item as good, fair or poor, meal at which the item was used and whether eaten hot or cold. Periods when heating was not permitted gave adequate information on the last point. Questionnaires are included in Appendix C. Except for the Supplemented B and 10-in-1 Rations, quantitative data on food eaten were obtained by item and calculated as individual calorie intake. Before each company used its first test ration a meeting was held with all subject personnel, company and observer officers and enlisted men. The ration and the questionnaire were explained in detail. In spite of this it took a few days before reliable information could be obtained, and the best methods of procedure evolved.

It was the usual practice to issue questionnaires after supper when the ration was issued. When it became advisable to use 1 questionnaire for each meal to facilitate punching cards, they were issued 3 to a man. Before the ration was issued, questionnaires for the previous day were collected, checks, and any omission filled in by the subject. New ones were then issued with rations for the next day. Observers were with the subjects at every meal, and they, with platoon and squad leaders, assisted the few illiterate or foreign subjects, but did not influence their opinions. Sufficient time was always allowed for filling in questionnaires. The observers took the forms to their tent, rechecked them, calculated calorie intake and brought them to the Tabulating Section. They were checked again and sent to the Machine Records unit at Omaha where a final check for completeness was made.

The daily questionnaires have a drawback which affects the acceptability ratings when the issue is substantially greater than consumption. Only food eaten is rated, and after a short period the tentative pattern of likes and dislikes is fixed. Less acceptable items may not be opened or rated but bulk large in the

waste. It is believed that the few examples of inconsistency between acceptability and waste are to be explained on this basis.

b. The consistency with which individuals rated the acceptability of ration items was investigated by tabulating samples of the entire acceptability data. The following samples were used:

- (1) That from 10 men for 5 scattered days for all items from each company for every ration period.
- (2) That for 2 items by all men in 1 company for a period of 3 weeks.

These analyses showed that:

- (1) Individuals were very consistent throughout a ration period in their opinions of a given item, and
- (2) Men differ greatly among themselves in their opinions of a given item. It might, therefore, be concluded that little accuracy would be sacrificed if opinion questionnaires were obtained only on alternate days or every 3d or 4th day, and that groups of fairly large size are needed in order to minimize the error due to wide differences of opinion.

c. *Quantitative data* on consumption were obtained on each item consumed every day by each man on all rations except the 10-in-1 and the Supplemented B Ration. These were used originally to obtain calorie consumption and little is to be gained from including the mass of figures accumulated since they agree well with the information obtained in other ways (waste and acceptability ratings).

d. *Summary Questionnaires*. In order to get slightly different data, a concise form was filled in by each subject just before each ration was changed and several were repeated 2 and 5 weeks after the ration was last used. The information so obtained was a check against other data on acceptability. It also gave an opportunity to test the subjects' memory of likes and dislikes. Two sample summary questionnaires are included in Appendix G. Data from these questionnaires are in Appendix E.

e. *Additional information* was obtained from the daily reports by each observer group. Round table discussions of observers with company line and noncommissioned officers were held from time to time in most companies. Weekly meetings of the headquarters group with all observer groups were held to discuss improvement in methods for eliciting information.

4. METHODS OF ISSUE:

The usual practice with packaged rations was for each company to establish a ration dump near the center of the bivouac area. Ordinarily not more than 2 days' rations were kept there. After supper, when questionnaires had been checked, rations for the next day were issued. This was done by platoons. The company mess sergeant and cooks did the actual issuing assisted by squad leaders, all under the direction of the observers. Excellent cooperation of all parties facilitated this detail.

5. COLLECTION OF WASTE:

In each platoon area, receptacles (#10 cans and ration boxes) were placed for disposal of unopened packages, unopened cans and waste from partially used products. These were under the supervision of the platoon leader, whose responsibility in seeing that they were used properly was shared by the observers. No effort was made to prevent temporary hoarding, but showdown inspections had to be held from time to time to see what was being hoarded, and to correct the data on waste. Hoarding in itself gave an estimate of certain preferences; and failure ever to hoard special items bore witness to their universal lack of acceptability. A few of the sharp drops in apparent consumption resulted from accumulations turned in during a showdown inspection. Showdowns were held before every change of rations.

6. CONDITIONS INFLUENCING ACCEPTABILITY IN THESE TESTS:

a. Length of time ration is used: With emergency rations acceptability is often poor at first because of strangeness, unaccustomed foods and containers. It may improve as familiarity and new ideas of preparation develop. Finally, monotony brings a decrease in acceptability. Items issued only rarely may have a spurious high rating because of novelty.

b. Type of previous ration: Whenever the previous ration has been rated low, a new ration is likely to be well received. When the previous ration has been excellent, a new one appears at a disadvantage.

Appendix D I
Inclosure #4a

c. Basis of issue and energy expenditure: If the quantity of food issued is below that required for a given level of work, most will be eaten, though it may be rated low. When more than enough is available, a choice is permitted.

d. Supplements of jam: The acceptability of biscuits and crackers is increased by the use of spreads such as jam, butter or cheese.

e. Fatigue: After exhausting marches many subjects will not take the trouble to open and prepare the packaged rations but will eat if the food is prepared and served.

f. Heat: Most meat items are preferred when hot, especially if there is much grease. In this test the presence or absence of heat did not influence consumption significantly but did affect ratings of acceptability. In very cold operations heat is often the main determinant of acceptability. Anything hot is acceptable.

g. Cold Drinks: Acceptability and consumption of synthetic fruit juices is poor when water is luke-warm, good when cool and excellent if cold. No ice was available in these trials, but F Company used its refrigerator truck to cool beverages.

7. METHOD OF SCORING PREFERENCE:

The tables and figures in each section on acceptability were obtained from the percentage of all ratings which were classified as good. In many tables an *arbitrary score* is used to obtain comparative ratings of each item. Scores of 3, 2 and 1 were given ratings of good, fair and poor, and the average ratings thus obtained were then used to classify preferences in the tables. There is good agreement between the two methods.

Each ration is discussed under the following headings: (1) Introduction (2) Companies tested (3) Basis of issue—variation (4) Preparation and consumption (5) General acceptability (6) Suggestions for improvement (7) Summary and conclusion and (8) Charts and tables.

8. C RATION (Experimental and New)

a. Introduction

This ration was designed as a combat ration. The special types used in the present test contained many experimental items in addition to those in the old type C Ration. They thus avoided its main faults; lack of variety and unpalatability of most components especially when eaten cold.

b. *Companies Tested on Ration.* G, X and Y Companies subsisted on C Ration at different times under the following circumstances:

Ration	Company	Week of Test Period Used	Basis of Daily Issue Per Man
C (Exper.)	Y	1, 2 and 3	1-1/3 ration
C (Exper.)	X	6 and 8*	1-1/3 ration
C (Exper.)	G	8	1 ration
C (New)	G	6 and 7	1 ration

* During the 8th week, X Company had its choice of C, K and CMT Rations. C Ration was chosen almost exclusively.

c. *Basis of Issue*—Y Company was issued the Experimental C Ration on a 1 and 1/3 ration basis (8 cans per man per day). G Company was issued the New C Ration with jam for the first 13 days of Period III, and the Experimental C Ration with jam on the last 8 days, both on a 1 ration basis (6 cans per man per day). X Company was issued the Experimental C Ration with jam on a 1 and 1/3 ration per day basis for 1 week. Variation was effected by alternation of meat components and the 2 menus (See Appendix B).

d. *Preparation and Consumption*—Heating was done by use of stove, Coleman, gasoline 1 burner (2 men were issued 1 stove) or by use of an open pit fire. The stove gave a steady hot flame if protected from the wind, and was found to be more satisfactory than the open fire. The utensils were the individual mess set with meat can, knife, fork, spoon and canteen cup. The meat can was often used as a cooking utensil. Food prepared by this method was better than when heated in the ration can because water or bouillon could be added to moisten and season the food. The ration was prepared and eaten individually. The average time required to prepare meals was breakfast, 28 minutes; dinner, 27 minutes; and supper, 32 minutes.

Appendix D I
Inclosure #4a

e. *General Acceptability*—(Tabulated data are given in Figs. 2, 3 and 4 and the tables at the end of the discussion.)

- (1) Confections were most often rated good. The return of waste was negligible. In Y Company on Experimental C Ration, candy-coated peanuts and raisins were rated a little lower than the other candies. In G Company on New C Ration, hard candies were rated a trifle lower. Jam and sugar were universally well liked and practically all consumed.
- (2) Beverages: One of the most favored was the cocoa, none of which was ever turned in. The orange drink was the next most popular, followed by the lemon drink. Coffee was rated much lower though little was returned. Bouillon was the least acceptable and least used of the drinks. Many biscuit tins were opened just for the confection and drinks.
- (3) Cereals: The compressed cereal cake was well received and very little waste occurred. The General Mills product was preferred over that of General Foods.
- (4) Meats: The most obvious finding in the acceptability ratings of the meat products was the relegation of the M1, 2 and 3 units, the old C Ration, to the bottom of the list. Almost 75% of the meat and vegetable hash was returned by Y Company. The best accepted items were baked beans and frankfurters with tomatoes and with molasses, pork and baked beans with tomato sauce, and pork and baked beans with molasses. Less acceptable were meat and spaghetti and beef and noodles. Five of the 9 preferred items contained beans. The rather remarkable reciprocal agreement between acceptability ratings and waste return is shown in Figs. 2 and 3. Of the 6 meat components adequately tested in the New C Ration, ham-egg-potatoes, and meat and vegetable stew rated low. Differences between the others were of small magnitude. Waste was insignificant. Pork and beans, and pork and rice were available in limited quantities so their ratings are of dubious value.
- (5) Biscuits: The soda cracker (C-5) had the highest acceptability, but its waste was approximately equivalent to that of C-4, the neutral cracker. C-1, the whole wheat cracker was rated the same as C-4, but there was a larger return of waste. G Company used three new biscuits which were found to be highly acceptable. The salt cracker was the preferred biscuit of this group. Acceptability of biscuits improved when jam was issued. The cream center cookie and the compressed chocolate cake never appeared in the waste and were very well liked.

Breakfast was the most unsatisfactory meal. The only items usual for this meal were coffee, cereal and biscuits. There is no typical breakfast meat in the ration.

Lunch was a satisfactory meal. Since this meal often was eaten cold, acceptability was lowered on items containing grease and fats, but actual consumption was little affected.

Supper was the most satisfactory meal. Combinations of the various items were used and then cooked to suit tastes. Bouillon was often added as flavoring. The meat items preferred when eaten cold were, in order of preference, frankfurters and beans, pork and beans, ham and lima beans, and chicken and vegetables.

The accessory utility packet was useful and well received.

f. *Suggestions for Improvement.*

- (1) Ham-egg-potatoes found in New C Rations should be discarded or improved by decreasing the amount of potatoes.
- (2) Amount of coffee should be doubled.
- (3) Milk would improve acceptability of coffee.
- (4) Coffee or cocoa should be substituted for bouillon.
- (5) Dryness and texture of spaghetti should be improved.
- (6) Cans of meat products should open on top, not on the side.

g. *Summary and conclusion*—The New and Experimental C are both superior to the old type C Ration, whose components rated lowest. The meat and beans and the hash components should be eliminated from the ration. The new utility pack with the new C Ration was useful and should be included.

TABLE 1
RELATIVE ACCEPTABILITY OF EXPERIMENTAL C RATION ITEMS AND TRENDS IN ACCEPTABILITY

Item	Y Company Scores*				Combined scores* G, X & Y Cos., All Periods
	June 14-20	June 20-25	June 25-30	30 June 5 July	
<i>Meats</i>					
Beans & Frankfurters w/tomato	2.75	2.80	2.84	2.90	2.87
Chicken & Vegetables	2.81	2.77	2.83	2.82	2.85
Ham & Lima Beans	2.73	2.72	2.77	2.81	2.79
Beans & Frankfurters w/molasses	2.67	2.75	2.74	2.77	2.83
Pork & Beans w/tomato	2.64	2.44	2.62	2.75	2.77
Pork & Beans w/molasses	2.49	2.45	2.62	2.58	2.72
Meat & Spaghetti	2.52	2.40	2.49	2.47	2.71
Beef & Noodles	2.53	2.40	2.46	2.42	2.64
Meat & Beans	2.40	2.27	2.40	2.36	2.63
Meat & Vegetable Stew	2.31	2.18	2.38	2.10	2.58
Meat & Vegetable Hash	2.11	1.92	2.00	1.95	2.42
<i>Cereals</i>					
General Mills	2.69	2.85	2.90	2.90	2.89
General Foods	2.57	2.68	2.80	2.95	2.84
<i>Drinks</i>					
Cocoa	2.86	2.93	2.96	2.97	2.94
Orange Juice	2.86	2.90	2.92	2.94	2.93
Lemon Juice	2.67	2.72	2.80	2.86	2.79
Coffee	2.41	2.62	2.70	2.73	2.75
Bouillon	1.95	1.70	2.03	2.18	2.20
<i>Confection</i>					
Jam	2.95	2.97	2.98	2.98	2.98
Sugar	2.94	2.94	2.96	2.96	2.96
Caramels	2.90	2.93	2.95	2.95	2.96
Candy Coated Peanuts	2.87	2.88	2.95	2.93	2.94
Candy Coated Raisins	2.84	2.83	2.85	2.90	2.91
Jelly Beans	2.88	2.96	2.93	2.96	2.96
Hard Candy	2.87	2.94	2.95	2.95	2.92
<i>Biscuits</i>					
Cream Center Cookies	2.95	2.97	3.00	3.00	2.98
Compressed Chocolate Cake	2.83	2.91	2.94	2.98	2.95
Concentrated Fruit Cake	2.74	2.81	2.93	2.85	2.88
Plain Biscuits B3 or B6	2.58	2.65	2.72	2.76	2.67
Plain Biscuits B2 or B5	2.39	2.52	2.59	2.64	2.67
Plain Biscuits B1 or B4	2.39	2.52	2.59	2.64	2.77

* See Par. 7 for method of scoring.

TABLE 2
DIFFERENCES AMONG COMPANIES
IN ACCEPTABILITY OF EXPERIMENTAL
C RATION FOOD GROUPS

Group	Score		
	G Co.	X Co.	Y Co.
Meats	2.74	2.87	2.59
Cereals	2.91	2.94	2.80
Drinks	2.78	2.89	2.74
Confections	2.97	2.97	2.93
Crackers	2.91	2.87	2.64

TABLE 3
RELATIVE ACCEPTABILITY OF EXPERIMENTAL
C RATION ITEMS EATEN
HOT VS. COLD (G, X & Y CO'S)

Item	Cold Hot	
	(Score)	
<i>Meats</i>		
Beans & Frankfurters w/tomato	2.86	2.88
Chicken & Vegetables	2.75	2.87
Ham & Lima Beans	2.70	2.81
Beans & Frankfurters w/molasses	2.79	2.85
Pork & Beans w/tomato	2.70	2.79
Pork & Beans w/molasses	2.68	2.74
Meat & Spaghetti	2.47	2.75
Beef & Noodles	2.32	2.70
Meat & Beans	2.50	2.67
Meat & Vegetable Stew	2.36	2.62
Meat & Vegetable Hash	2.19	2.47
<i>Cereals</i>		
General Mills	2.80	2.93
General Foods	2.72	2.89
<i>Drinks</i>		
Cocoa	2.90	2.95
Coffee	2.48	2.77
Bouillon	1.80	2.37

TABLE 4
RELATIVE ACCEPTABILITY OF EXPERIMENTAL
C RATION ITEMS EATEN AT DIFFERENT
MEALS (G, X & Y CO'S)

Item	Breakfast	Dinner	Supper
<i>Meats</i>			
Beans & Frankfurters w/tomato	2.88	2.87	2.87
Chicken & Vegetables	2.83	2.84	2.87
Ham & Lima Beans	2.80	2.78	2.79
Beans & Frankfurters w/molasses	2.85	2.84	2.81
Pork & Beans w/tomato	2.75	2.79	2.75
Pork & Beans w/molasses	2.71	2.73	2.71
Meat & Spaghetti	2.72	2.71	2.70
Beef & Noodles	2.63	2.63	2.66
Meat & Beans	2.66	2.58	2.65
Meat & Vegetable Stew	2.57	2.56	2.59
Meat & Vegetable Hash	2.39	2.40	2.44
<i>Cereals</i>			
General Mills	2.92	2.81	2.81
General Foods	2.86	2.77	2.81
<i>Drinks</i>			
Cocoa	2.95	2.92	2.95
Orange Juice	2.88	2.93	2.94
Lemon Juice	2.72	2.80	2.79
Coffee	2.76	2.66	2.73
Bouillon	2.14	2.12	2.24
<i>Confection</i>			
Jam	2.98	2.97	2.98
Sugar	2.97	2.96	2.95
Caramels	2.95	2.97	2.96
Candy Coated Peanuts	2.94	2.95	2.92
Candy Coated Raisins	2.91	2.92	2.90
Jelly Beans	2.93	2.92	2.93
Hard Candy	2.95	2.97	2.96
<i>Biscuits</i>			
Cream Center Cookies	2.99	2.98	2.98
Compressed Chocolate Cake	2.95	2.95	2.94
Concentrated Fruit Cake	2.83	2.90	2.93
Plain Biscuits B3 or B6	2.75	2.75	2.79
Plain Biscuits B2 or B5	2.58	2.71	2.64
Plain Biscuits B1 or B4	2.69	2.63	2.61

TABLE 5
TREND IN ACCEPTABILITY OF NEW C RATION
ITEMS (G Company, 22 July-3 August)

Item	Score			Days 1-13
	Days 1-5	Days 6-9	Days 10-13	
<i>Meats</i>				
Frankfurters & Beans	2.89	2.94	2.94	2.92
Meat & Spaghetti	2.91	2.89	2.86	2.89
Meat & Beans	2.87	2.84	2.91	2.87
Meat & Noodles	2.80	2.86	2.84	2.83
Meat & Vegetable Stew	2.82	2.85	2.79	2.82
Ham-Egg-Potato	2.70	2.69	2.77	2.72
<i>Cereal, Compressed</i>	2.93	2.97	2.96	2.95
<i>Drinks</i>				
Cocoa	2.95	2.97	2.97	2.96
Orange Juice	2.93	2.93	2.92	2.93
Coffee	2.91	2.87	2.89	2.87
Lemon Juice	2.67	2.67	2.70	2.68
<i>Confections</i>				
Jam	2.99	2.98	2.99	2.99
Sugar	2.99	2.98	2.98	2.98
Candy Coated Peanuts	2.96	2.97	2.98	2.97
Candy Coated Raisins	2.96	2.97	2.98	2.97
Caramels	2.97	2.98	2.98	2.97
Hard Candy	2.92	2.89	2.91	2.91
<i>Biscuits</i>				
Type V	2.90	2.90	2.90	2.90
Type IV	2.88	2.91	2.89	2.89
Type I	2.82	2.85	2.86	2.85

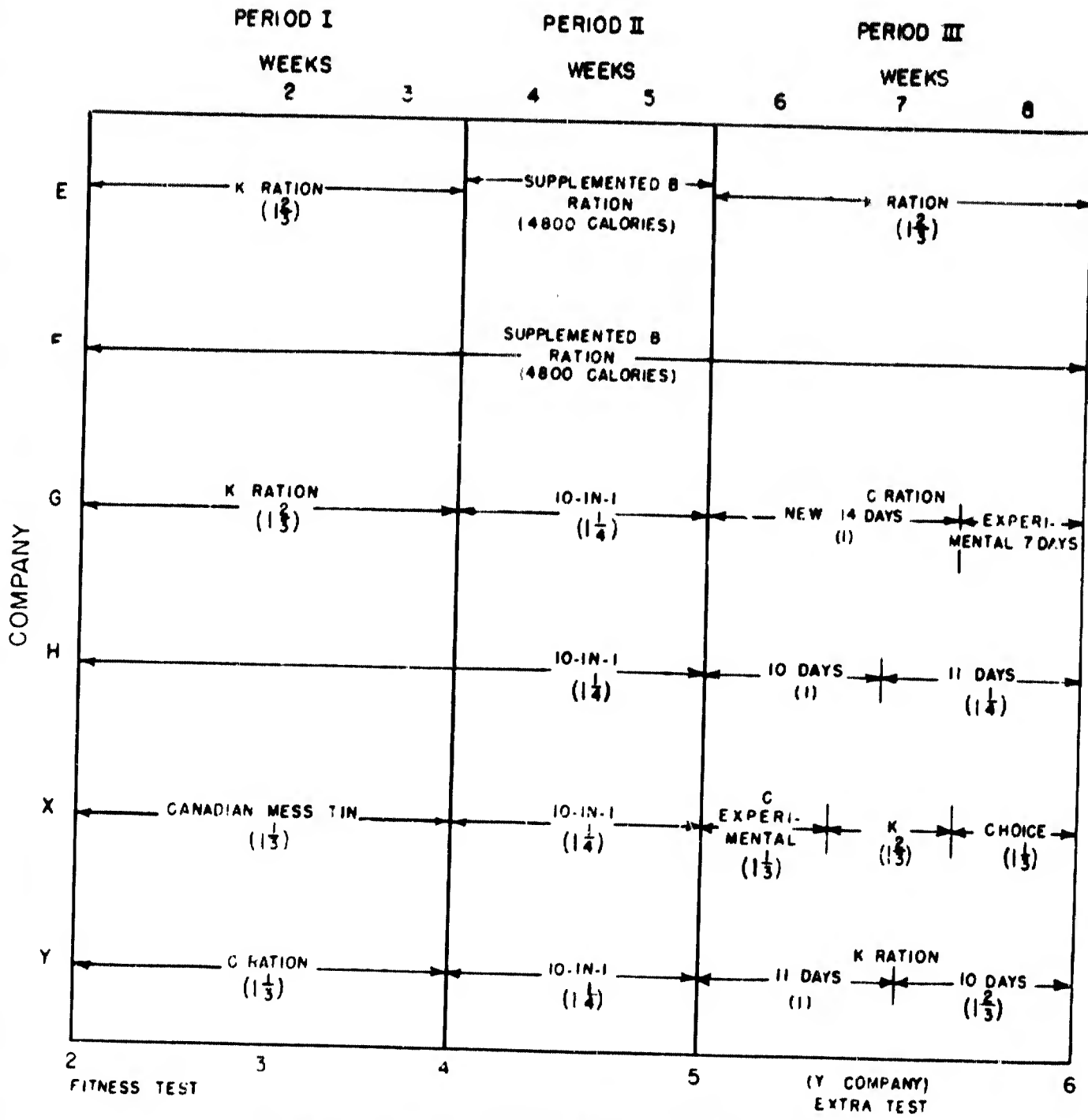
TABLE 6
RELATIVE ACCEPTABILITY OF NEW
C RATION ITEMS EATEN HOT VS.
COLD (G Company, 22 July-3 August)

Items	Score	
	Cold	Hot
Frankfurters & Beans	2.89	2.93
Meat & Spaghetti	2.89	2.90
Meat & Beans	2.83	2.88
Meat & Noodles	2.79	2.84
Meat & Vegetable Stew	2.75	2.83
Ham-Egg-Potato	2.73	2.72
<i>Cereal, Compressed</i>	2.96	2.95

TABLE 7
RELATIVE ACCEPTABILITY OF NEW
C RATION ITEMS WHEN EATEN AT
DIFFERENT MEALS
(G Company, 22 July-3 August)

Item	Score		
	Breakfast	Dinner	Supper
<i>Meats</i>			
Frankfurters & Beans	2.91	2.92	2.96
Meat & Spaghetti	2.80	2.87	2.93
Meat & Beans	2.94	2.86	2.89
Meat & Noodles	2.95	2.80	2.83
Meat & Vegetable Stew	2.87	2.87	2.73
Ham-Egg Potato	2.72	2.81	2.54
<i>Cereal, Compressed</i>	2.95	2.92	2.99
<i>Drinks</i>			
Cocoa	2.97	2.87	2.97
Orange Juice	--	2.94	2.78
Coffee	2.87	2.84	2.87
Lemon Juice	--	2.68	2.58
<i>Confections</i>			
Jam	2.99	2.97	2.99
Sugar	2.99	2.98	2.97
Candy Coated Peanuts	2.97	2.96	2.96
Candy Coated Raisins	2.97	3.00	2.95
Caramels	2.99	2.96	2.98
Hard Candy	2.98	2.91	2.99
<i>Biscuits</i>			
Type V	2.92	2.90	2.88
Type IV	2.90	2.88	2.87
Type I	2.87	2.80	2.84

FIG. I
SCHEDULE OF RATIONS AND ISSUE



NUMBERS IN PARENTHESIS ARE RATIONS ISSUED PER MAN PER DAY

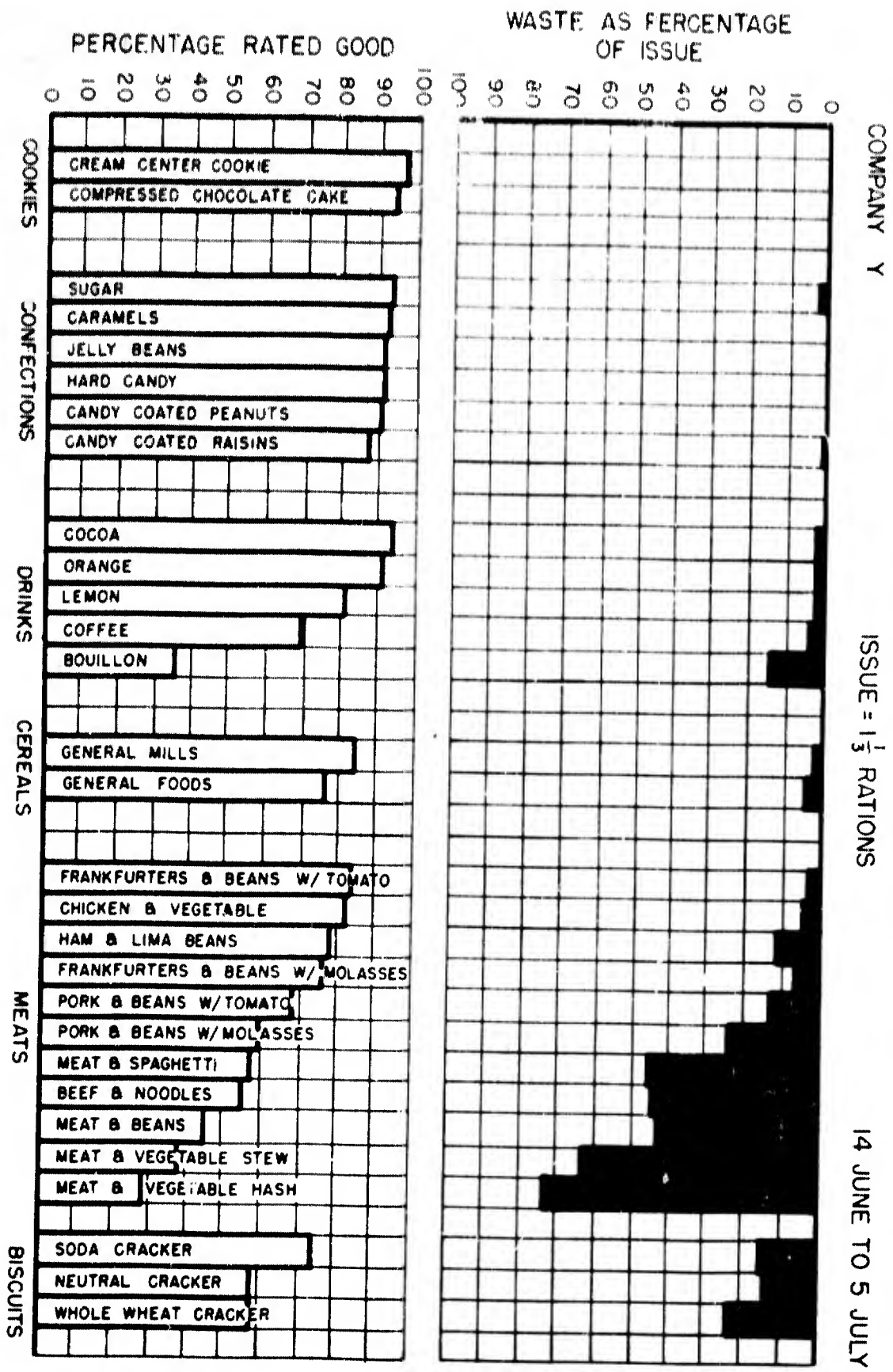


FIG. 2

Appendix D I
Inclosure #4a

FIG. 2

ACCEPTABILITY AND WASTE
"C" RATION (EXPERIMENTAL)

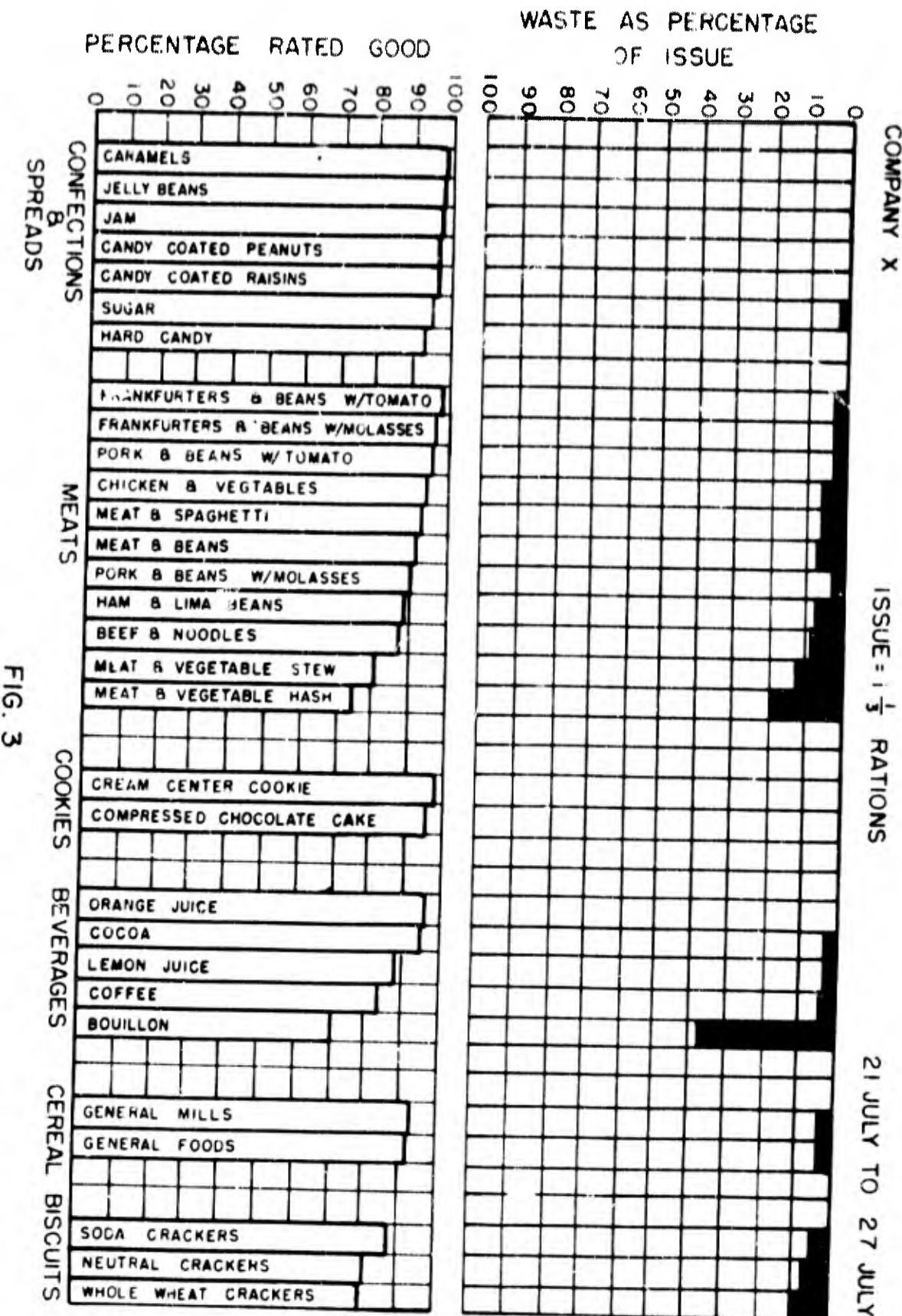


FIG. 3

Appendix D I
Inclosure #4a

FIG. 3

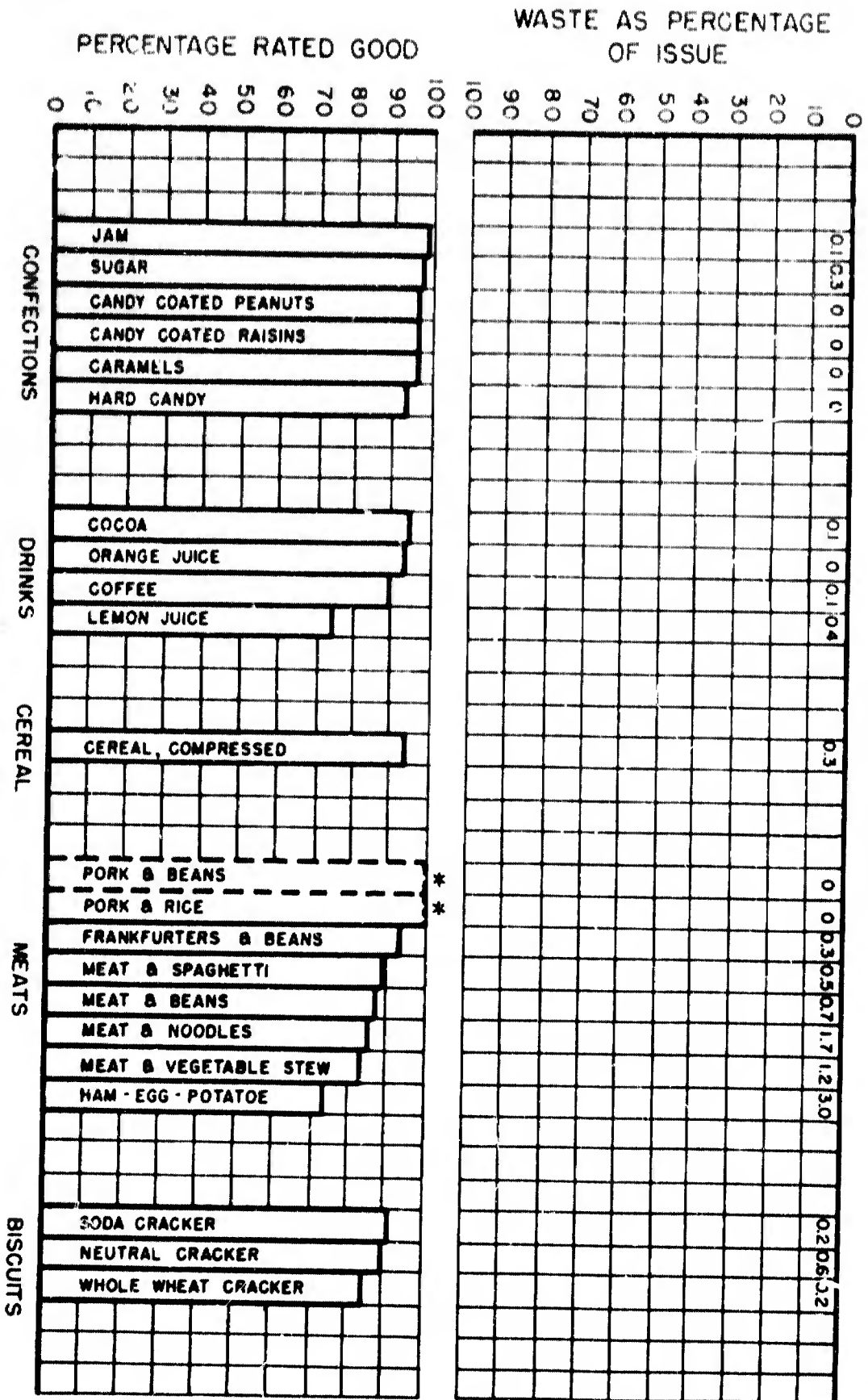
ACCEPTABILITY AND WASTE

"C" RATION (NEW)

COMPANY 3

ISSUE = 1 RATION

22 JULY TO 4 AUGUST



* ONLY A FEW TESTED

FIG. 4

Appendix D I
Inclosure #4a

FIG. 4

9. K RATION:

a. Introduction

K Ration is intended only as an emergency ration. Its size, weight and packaging make it ideal for this use. Being a ration for forward areas, where it is difficult or impossible to supplement by post exchange purchases and Red Cross issuance, taste acceptability is essential to insure consumption for adequate calories. Size of units and packaging simplify breakdown and issue.

b. *Companies Tested on Ration*—During the entire ration test, 4 companies, E, G, X and Y used K Ration in varied amounts and under varied conditions as follows:

COMPANY	WEEK OF TEST PERIOD USED	BASIS OF DAILY ISSUE PER MAN
E	1, 2, 3, 6, 7 and 8	1-2/3 ration
G	1, 2 and 3	1-2/3 "
X	7	1-2/3 "
Y	6 and #7	1 "
Y	#7 and 8	1-2/3 "

c. *Basis of Issue*—All companies were issued K Ration, 1-2/3 rations per man daily except Y Company for the first 11 days of Period III when the issue was 1 ration per man daily.

Variation of Menus—Patten Food Products Company, the Cracker Jack Company and the H. J. Heinz Company supplied K Ration. G Company used only the Patten K Ration, as did E Company during Period I. X and Y Company issued the 3 packs equally. The Patten K Ration and Cracker Jack K Ration were similar, except that popular brands of cigarettes were in Cracker Jack, Chelseas in the Patten product. Heinz K Ration pack had an ample variety of all canned items, more synthetic orange powder, Chocolettos instead of caramels, and Chiclets instead of stick gum. After a little experience, men asked for the Heinz product exclusively, because of its variety.

d. *Preparation and Consumption*—Preparation of K Ration was simple. Breakfast and supper were best hot. Each platoon had a fireplace where various ways of heating canned products were used. Cans opened one turn with the key were placed in the fire, or suspended over it on a stick or the metal band from the ration case. Three 32-gallon capacity cans of hot water were set up in the center of the bivouac area in a kitchen fly and attended to by the company mess sergeants and cooks. Water from one of these cans was used to wash out canteen cups, and water from the others was used to prepare coffee and bouillon. Dinner required no hot water since the cheese products did not require heating and the synthetic lemon and orange juice powders were mixed with cold water. Individual field mess gear was used.

K Ration required no group eating, but a number of men in each platoon combined in improvisations such as making jam with fruit bars. The average time for all companies to prepare and eat breakfast was 23 minutes; dinner, 22 minutes; and supper, 27 minutes.

e. *General Acceptability* (Figures 5-10 and tables at end of discussion).

- (1) *Confections*—All items in this category had a high acceptability at all times. The American soldiers' desire for sweets was emphasized once more. The waste usually was negligible. Aside from sugar and gum, which rated best, sweet chocolate and caramels were preferred with the D bar and fruit bar regularly rated lower. The actual ratings varied from company to company but the differences were slight and the agreement good. (See Figs. 5-10). There was no return of jam, and the total consumption of biscuits increased when jam was added.
- (2) *Beverages*—The most popular drinks rated just lower than the confections. With a few exceptions coffee and orange juice rated highest while there was no exception to the low acceptability and very high waste of bouillon. The infrequent issue of orange powder may have had something to do with its high acceptability.
- (3) *Meat and Cheese*—Figs. 5-10 indicate variable acceptability of the meat and cheese components which usually had a low rating. With 1-2/3 rations per man 2/3 of the men had a half pound

of cheese for dinner, and this large quantity was far too much for the average subject, so that returns on cheese were very high regardless of rating except for the rarely issued processed Swiss and American cheese. Chopped ham and eggs was generally the best liked of the meat and egg products while beef and pork loaf was preferred over corned pork loaf. The trends and variations from company to company and from period to period may be seen in the figures and tables.

- (4) **Biscuits**—Acceptability of various K biscuits was regularly very low compared with other items. Data on percentage of waste are not complete for all types of biscuit because the issue varied and could not be ascertained without opening each box issued every man every day. The differences in preference are not striking, K-4 and K-5 usually rated highest with K-1A and K-2 lowest in acceptability. With issue of 1-2/3 rations per man daily there were always too many biscuits. The various ratings are given in Figs. 5-10.

Trends of Acceptability: Acceptability of most items was low for the first few days on K ration. It increased with time.

Hot and Cold: During periods when the meals were eaten cold, coffee and bouillon waste increased greatly. Although complaints were numerous, waste from the canned items did not increase to any marked degree.

Menus and Items: Breakfast and supper were the most popular K Ration units. Trading was allowed and it was not uncommon to exchange 2 dinner units for a breakfast or supper unit. Exchanges of single items was not common. Men who did not smoke sometimes exchanged their cigarettes for caramels or chocolate.

f. Suggested Changes

The following are some of the suggestions offered by the subjects and observers during their use of K Ration.

- a. Increase variety and pack each case so the maximum variety is included in each individual case.
- b. Add jam to ration.
- c. Introduce sausage or Spam.
- d. Add cereal such as in C Ration.
- e. Increase the issue of coffee.
- f. Add powdered or canned milk.
- g. Add a packet of salt and condiments.
- h. Try bacon with cheese flavor, or add more bacon to the cheese and bacon product.

g. Summary and Conclusion

Although intended only as an emergency ration it was found that men could get along well on K ration for periods of 3 weeks when issue was 1-2/3 rations. Monotony was the chief fault, and when this was obviated, and as familiarity with the ration and new ideas about the preparation of mixtures developed, consumption increased substantially.

TABLE 8
RELATIVE ACCEPTABILITY OF K RATION ITEMS AND TRENDS IN ACCEPTABILITY
 (E Company 17 June - 8 July, 23 July - 11 August)

ITEMS	E Company Scores by Periods of 5 or 6 Days**									Combined Scores E, O, Y and X Companies All Periods
	17/6- 21/6	22/6- 27/6	28/6 2/7	3/7 8/7	23/7- 27/7	28/7- 1/8	2/8- 6/8	7/8- 11/8		
MEATS										
Ham & eggs	2.52	-	-	-	2.62	2.67	2.67	2.68	2.67	2.67
American & Swiss cheese	2.40	2.13	2.21	1.73	2.00	-	2.25	2.64	2.47	2.47
Beef & pork loaf	2.51	2.58	2.77	1.12	2.36	2.36	2.35	2.41	2.47	2.47
Pork & egg yolk	2.35	2.37	2.43	2.24	2.16	2.22	2.26	2.33	2.45	2.45
American cheese	2.39	2.47	2.85	2.30	2.17	2.19	2.32	2.31	2.45	2.45
Beef & pork loaf w/C & A Flakes	2.41	2.46	2.51	2.27	2.26	2.24	2.26	2.36	2.45	2.45
American cheese w/bacon	2.44	2.30	2.26	2.17	2.04	2.04	2.09	2.04	2.36	2.36
DRINKS										
Orange juice	2.81	2.80	2.94	2.77	2.74	2.70	2.66	2.67	2.81	2.81
Coffee	2.58	2.70	2.73	2.44	2.68	2.71	2.71	2.75	2.72	2.72
Lesson juice	2.62	2.54	2.51	2.47	2.30	2.27	2.21	2.36	2.60	2.60
Bovillon	2.35	2.37	2.41	2.21	2.20	2.24	2.25	2.32	2.34	2.34
CONFECTIONS										
Sugars	2.94	2.91	2.90	2.83	2.86	2.85	2.84	2.85	2.91	2.91
Jam	2.92	2.85	3.00	2.94	2.74	2.70	2.66	2.67	2.91	2.91
Gum	2.90	2.89	2.89	2.87	2.87	2.86	2.86	2.87	2.91	2.91
Caramels	2.90	2.86	2.82	2.80	2.75	2.72	2.72	2.76	2.87	2.87
Sweet chocolate bar	2.84	2.83	2.83	2.81	2.75	2.73	2.78	2.76	2.87	2.87
Fruit bar	2.65	2.62	2.64	2.61	2.48	2.53	2.61	2.61	2.72	2.72
D Ration Bar	2.74	2.54	2.62	2.53	2.40	2.41	2.45	2.58	2.67	2.67
CRACKERS										
K-4 Biscuits	2.31	2.40	2.44	2.42	2.52	2.49	2.46	2.54	2.61	2.61
K-5 Biscuits	2.20	2.31	2.31	2.28	2.54	2.48	2.43	2.52	2.49	2.49
K-1A Biscuits	2.14	2.23	2.35	2.25	2.33	2.26	2.27	2.33	2.43	2.43
K-3 Biscuits	2.15	2.34	2.43	2.34	2.21	2.18	2.29	2.54	2.41	2.41
K-2 Biscuits	2.19	2.33	2.31	2.27	1.94	2.24	2.15	2.37	2.28	2.28

* See Par. 7 for method of scoring.

TABLE 9
ACCEPTABILITY OF K RATION ITEMS COLD VS. HOT

Item	Score	
	Cold	Hot
<i>Meats</i>		
Ham & Eggs	2.55	2.70
Beef & Pork Loaf	2.43	2.49
Pork & Egg Yolk	2.25	2.52
Beef & Pork Loaf w/C. & A. Flakes	2.31	2.52
<i>Drinks</i>		
Coffee	2.29	2.78
Bouillon	2.05	2.42

TABLE 10
ACCEPTABILITY OF K RATION ITEMS WHEN EATEN AT DIFFERENT MEALS
(E, G, X and Y Companies)

Item	Score		
	Breakfast	Dinner	Supper
<i>Meats</i>			
Ham & Eggs	2.68	2.57	2.69
American & Swiss Cheese	2.73	2.41	2.59
Beef & Pork Loaf	2.56	2.26	2.50
Pork & Egg Yolk	2.44	2.45	2.54
American Cheese	2.67	2.42	2.54
Beef & Pork Loaf w/C. & A. Flakes	2.57	2.46	2.44
American Cheese w/Bacon	2.53	2.35	2.37
<i>Drinks</i>			
Orange Juice	2.86	2.81	2.82
Coffee	2.71	2.59	2.80
Lemon Juice	2.72	2.59	2.64
Bouillon	2.69	2.36	2.33
<i>Confections</i>			
Sugar	2.92	2.91	2.90
Jam	2.92	2.88	2.92
Gum	2.93	2.91	2.90
Caramels	2.89	2.87	2.83
Sweet Chocolate Bar	2.93	2.84	2.87
Fruit Bar	2.72	2.72	2.71
D Ration Bar	2.73	2.60	2.68
<i>Biscuits</i>			
K-4	2.61	2.63	2.59
K-5	2.70	2.38	2.58
K-1A	2.41	2.55	2.38
K-3	2.41	2.36	2.41
K-2	2.22	2.38	2.34

ACCEPTABILITY AND WASTE

"K" RATION

COMPANY E

ISSUE = 1 1/2 RATIONS

17 JUNE TO 8 JULY

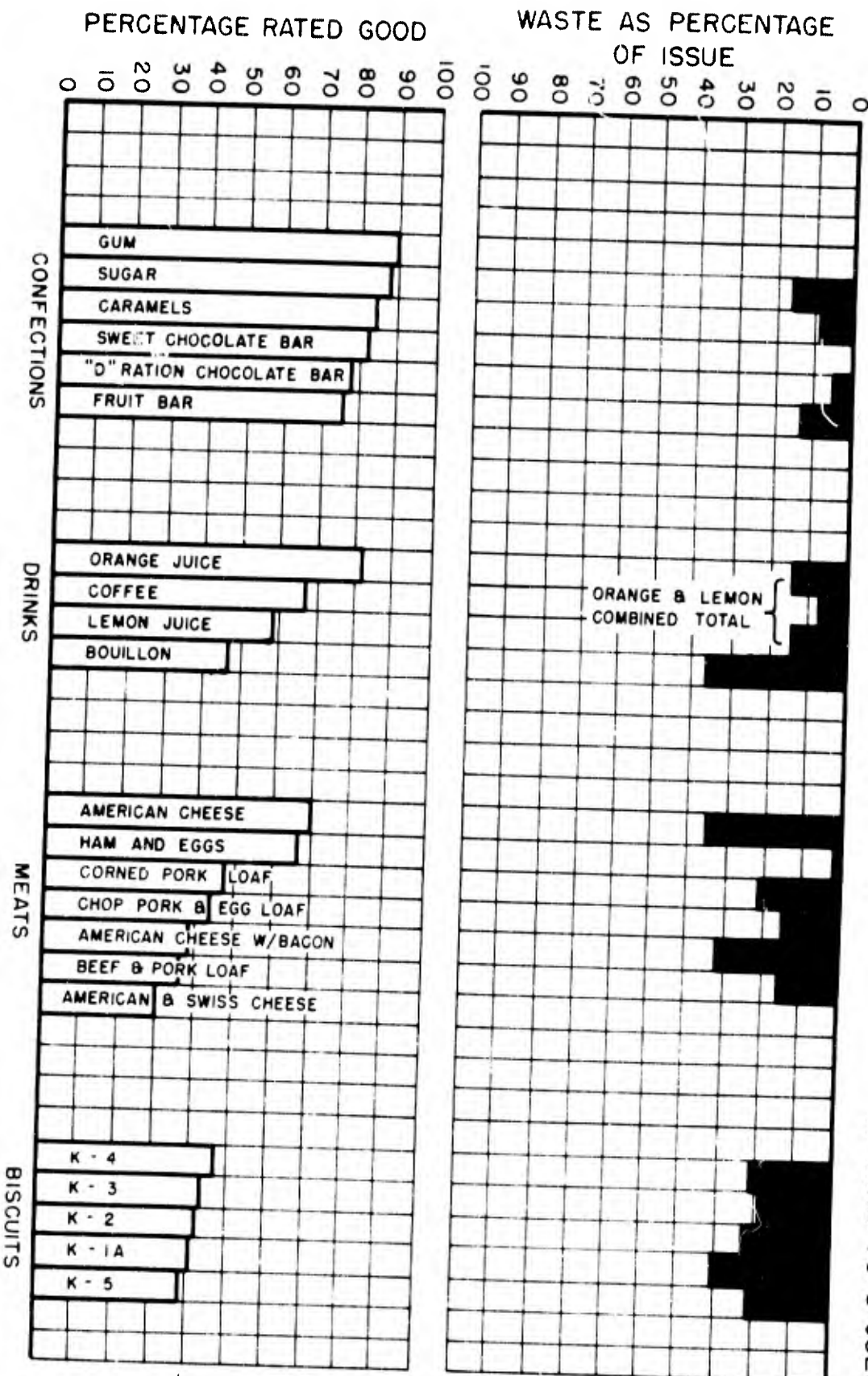


FIG. 5

FIG 5

Appendix D †
Inclosure #4a

ACCEPTABILITY AND WASTE

"K" RATION

COMPANY E

ISSUE = 1 1/2 RATIONS

23 JULY TO 11 AUGUST

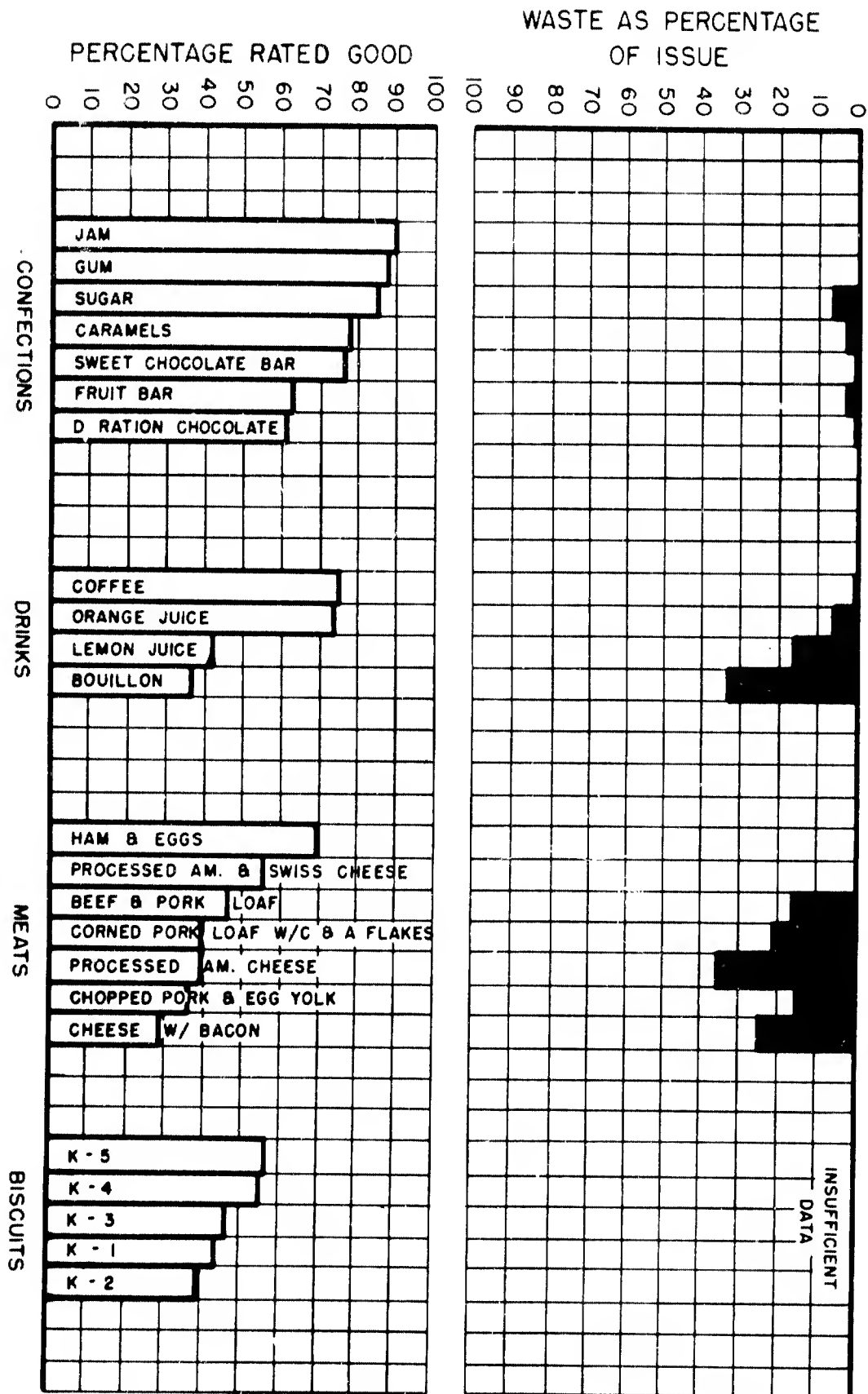
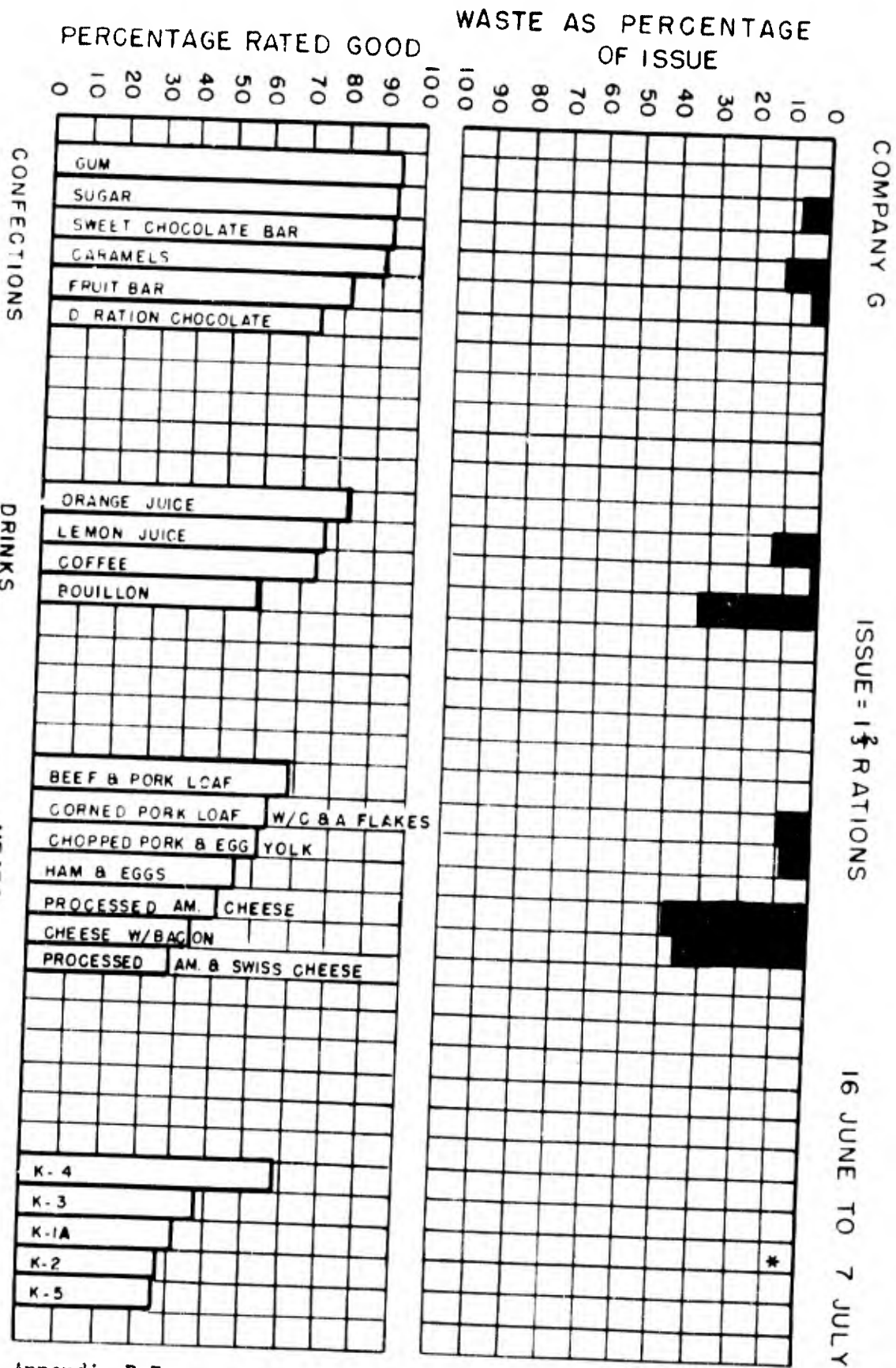


FIG. 6

Appendix D I
Inclosure #4a

FIG. 6

ACCEPTABILITY AND WASTE
"K" RATION



COMPANY G
ISSUE = 13 RATIONS
16 JUNE TO 7 JULY

FIG. 7
* INSUFFICIENT DATA

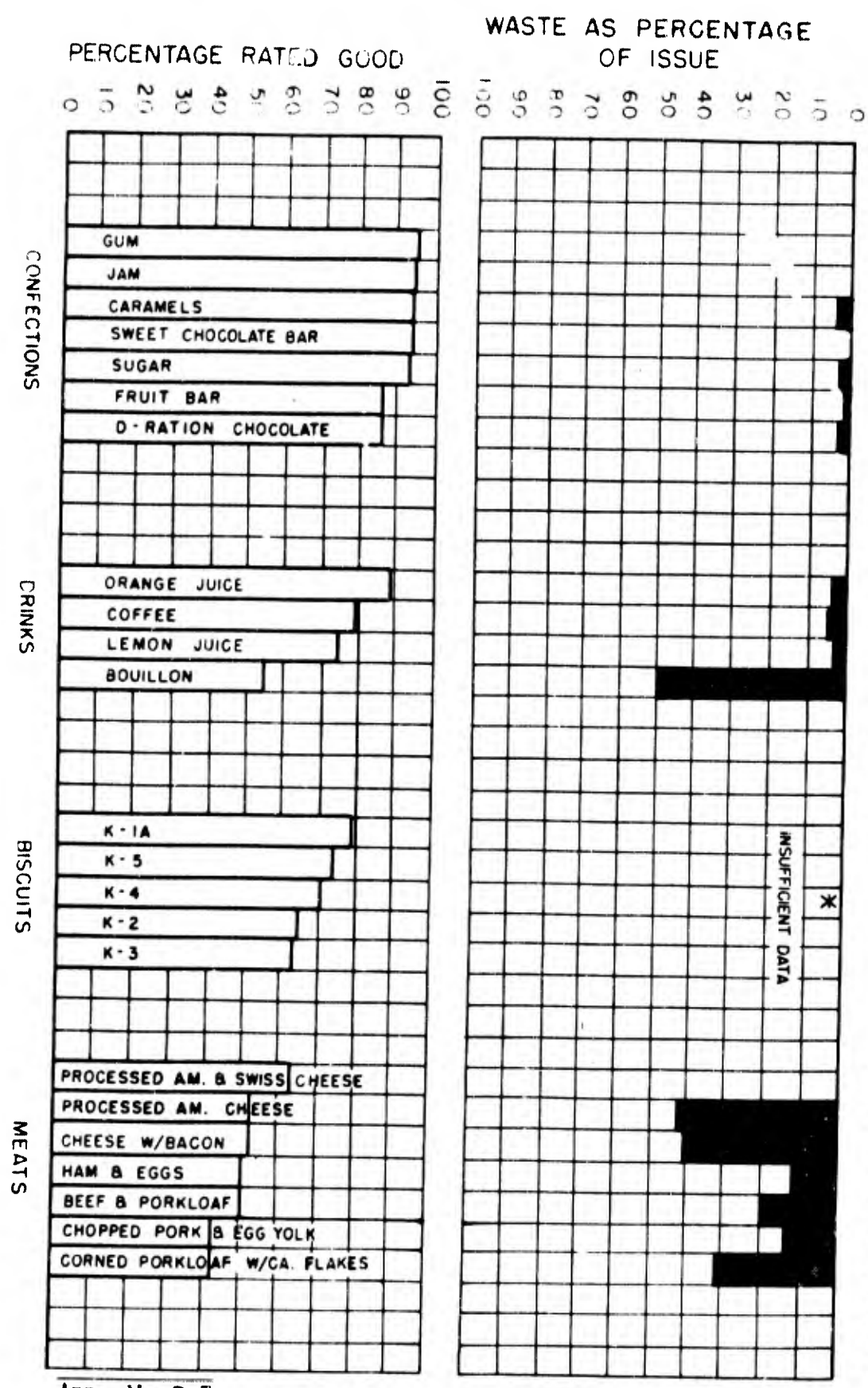
FIG. 7

Appendix D I
Inclosure #4a

ACCEPTABILITY AND WASTE

"K" RATION

COMPANY X
ISSUE = 1 2/3 RATION
28 JULY TO 4 AUGUST



Appendix D I
Inclosure #4a

FIG 8

ACCEPTABILITY AND WASTE

"K" RATION

COMPANY Y

ISSUE = 1 RATION

20 JULY 10 30 JULY

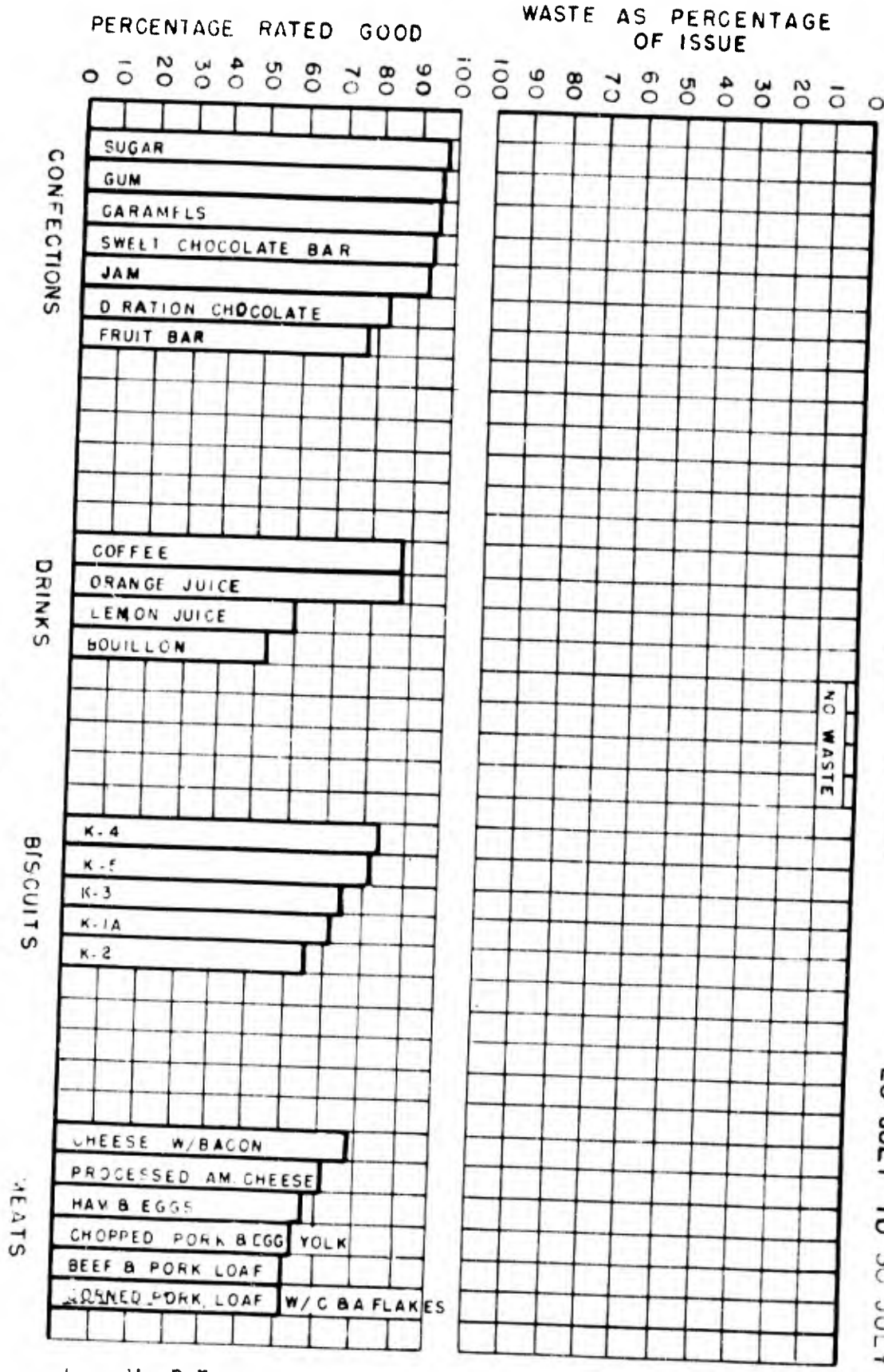


FIG. 9

FIG. 9

Appendix D I
Inclosure #4a

ACCEPTABILITY AND WASTE

"K" RATION

COMPANY Y

ISSUE = 1 1/2 RATIONS

31 JULY TO 8 AUGUST

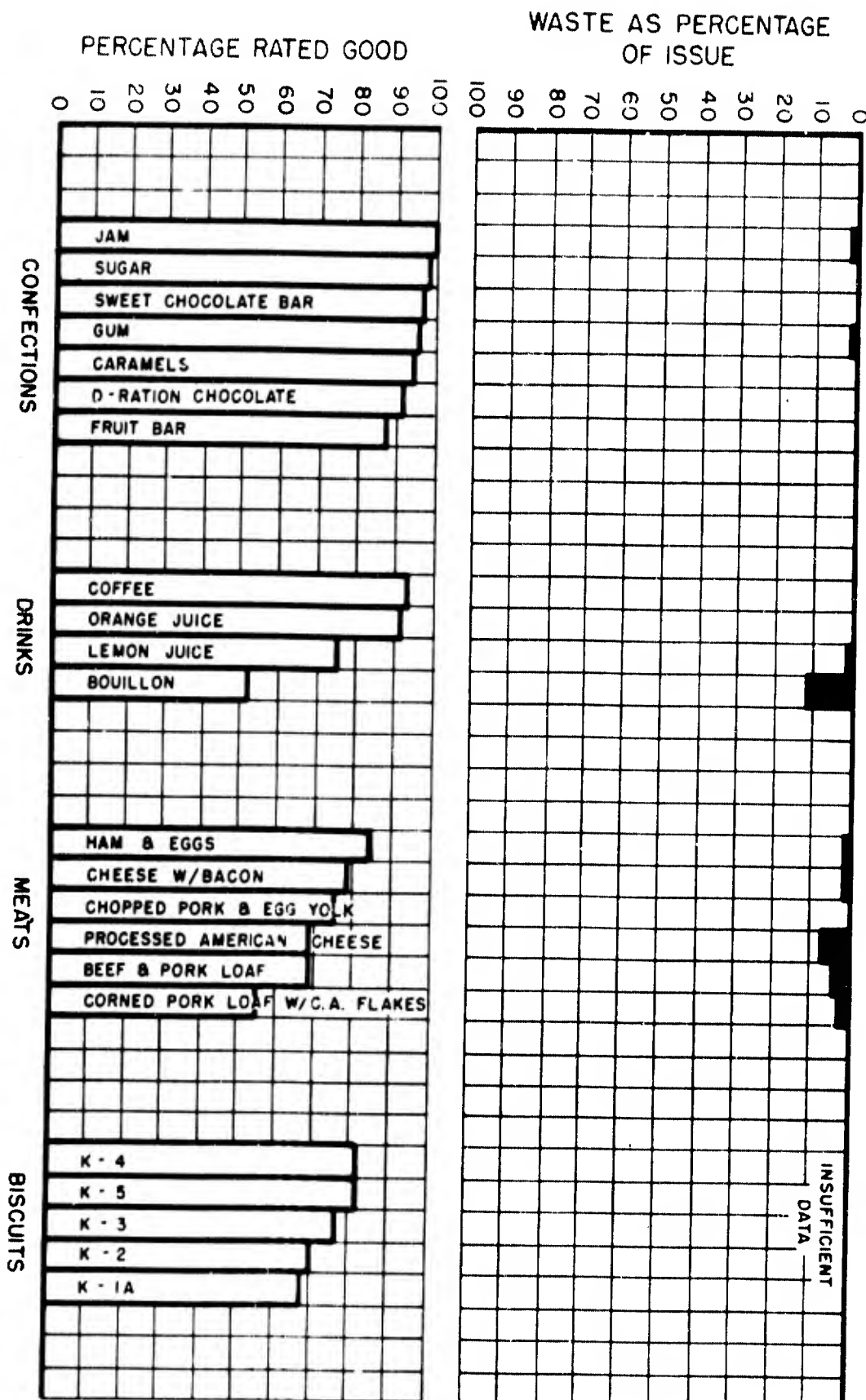


FIG. 10

FIG. 10

Appendix D I
Inclosure #4a

10. CANADIAN ARMY MESS TIN RATION:

a. Introduction

This ration was designed as an emergency combat ration to be used for a period of a few days. It was included in this test because of its previous comparison with the American Army emergency rations in the Canadian Army Winter Trials.* It is of interest because it contained sardines, tea and pea soup which were in no other ration in the present test. This was the only ration where the same menu was repeated every day without any variation.

b. *Company Tested*—Only X Company used the Canadian Army Mess Tin Ration, so no comparison with other companies is possible.

Company	Week of Test Period Used	Basis of Daily Issue Per Man
X	1, 2 and 3	1-1/3 ration

c. *Basis of Issue*—In order to have the calorie issue approximately equivalent to that of other companies during Period I, the Mess Tin Ration was issued 4 rations to 3 subjects. This gave an average issue of 4640 calories per man daily.

d. *Preparation and Consumption*—Subjects ate individually or pooled their food and ate in groups of the 3 men who drew rations together. Sterno and tripods were issued for the first week only—afterwards wood fires and make-shift stoves were used for heat. No utensils were issued for preparation of food. Men had their regular field mess gear so the wooden utensils were not used regularly. Average time required to prepare and eat a meal was breakfast, 28 minutes; dinner, 30 minutes; supper 37 minutes.

Some men ate the sardines cold; others preferred pouring off the oil and heating them. Pork loaf and spiced beef cooked with cheese, or cut up in the pea soup offered variation. The biscuits were generally eaten with butter and jam, but they were also used in the pea soup and in puddings made with jam or chocolate. The most successful use of milk-and-sugar-powder was in the chocolate drink. A few mixed it with cold water and used it as a beverage. Hard candy was sometimes dissolved in water for a drink or used to flavor tea. The chocolate bar was used as a candy or added to the chocolate drink. Coffee was better if 2 packages were used instead of 1, to a canteen cup of water.

e. General Acceptability

- (1) *Confections and Spreads* — All items in this class had high acceptability ratings and low return. Jam, hard candy, butter and the chocolate bar head the list. Sugar and cheese were rated somewhat lower. Returns were negligible except for butter and cheese of which about 10% of the issue was not used.
- (2) *Beverages* — The acceptability rating of the beverages shows an interesting difference from total consumption and waste figures in that tea was rated good 75% of the time whereas 30% was returned unused, and coffee was rated good only 55% of the time while less than 20% was returned. The discrepancy in scores and waste is accounted for by the fact that about a quarter of the men did not use tea after a few trials and therefore did not rate it. The trends in consumption in Fig. 11A & B indicate a reduction in tea consumption and an increase in that of coffee as the test progressed. Pea soup and the milk-and-sugar-powder were low in acceptability, and the waste return and unopened packages were very high. This ration differed from all U. S. Army rations tested in that no beverage was intended for use as a cold drink.
- (3) *Meats*—In general the consumption of meat products was high, except for sardines, but all were rated fairly low. There was a marked decrease in consumption of sardines during the test. Spiced beef was rated slightly higher than pork loaf.

* R.C.A.M.C. Report on Cold Weather Operational Trials of Rations, Prince Albert, Saskatchewan, Canada, 2 Jan.—3 March 1944.

- (4) Biscuits—Biscuits had a low acceptability rating. Approximately 33% of those issued were returned. This is slightly more than the extra fraction of ration issued. Consumption showed a definite increase throughout the test.

All items ordinarily served hot were preferred hot, and the cheese cooked in a stew was well received. The chocolate bar made an excellent drink. Ratings by meals show minor variations.

For the type of activity of this test the men preferred the single box for a day's meals to the three which contain the K Ration. The fiber cap for the jam worked excellently, as did that for the butter as long as the weather was cool enough to prevent melting.

American name brand cigarettes were greatly preferred to the MacDonald and the Sweet Captain. The wooden spoon and fork were not used much because mess gear was available though they were looked upon with favor. Matches and can opener were very satisfactory.

f. *Suggestions for Improvement*—One of the most common suggestions was that the sardines be eliminated entirely or packed in tomato or mustard, instead of olive oil. Some subjects complained of the sardines' saltiness. Numerous complaints were made of the butter's messiness in hot weather, and its tendency to spurt out when the can was opened. Biscuits were rated hard and tasteless; there were too many in the ration. (The basis of issue was 1-1/3 rations). The milk-and-sugar-powder and the chocolate drink at times had a waxy taste from the container. Some milk-and-sugar-powder was rancid and curdled in water. Tea and coffee were considered too weak. It was almost universally agreed that the sugar was insufficient. Most men used only part of the salt. A common complaint was the peculiar color left on the cheese by the foil wrapping. About 5% of the cheese was moldy and spoiled, although surface mold was no indication that it was spoiled. The mold had a decided effect upon acceptability because the subject usually took an instant aversion to it, and discarded the cheese entirely. In rare cases a tainted can of pork loaf was found. At the start of the ration period no spoiled butter was noted, but as the weather became warmer, rancid butter was found.

Other suggestions for improvements were:

- (1) Remove 1 box of biscuits and improve taste and texture.
- (2) Increase the quantity of sugar.
- (3) Replace pea soup with a variety of other soups.
- (4) Add a vegetable to the ration.
- (5) Replace the sardines with a can of beans.
- (6) Issue more coffee and tea.
- (7) Vary the items in the ration to avoid monotony.
- (8) Improve the wax containers of the milk-and-sugar-powder, the chocolate drink and the foil wrapping of the cheese.
- (9) If possible, improve the opener for sardines.

g. *Summary and Conclusion*—The ration was considered a satisfactory combat or emergency ration but because of monotony and certain items unusual in American diets, inadequate for any extended length of time. During the last week, when given their choice of C, K and Canadian Mess Tin Rations, and items from those rations, no one in X Company chose the Canadian Mess Tin Ration as a whole ration. Some chose the jam and butter during the item choice period.

TABLE 11
RELATIVE ACCEPTABILITY OF CANADIAN MESS TIN RATION ITEMS
AND THEIR TREND IN ACCEPTABILITY

Items	Score*				
	Days 1-6	Days 7-11	Days 12-16	Days 17-22	Entire Period
Spreads & Sugar					
Jam	2.98	2.98	2.95	2.91	2.96
Butter	2.95	2.92	2.89	2.91	2.90
Sugar	2.90	2.80	2.74	2.71	2.79
Cheese	2.71	2.69	2.68	2.61	2.67
Confections					
Hard Candy	2.92	2.94	2.90	2.88	2.91
Chocolate bar	2.82	2.84	2.83	2.81	2.82
Drinks					
Tea	2.79	2.77	2.77	2.61	2.73
Chocolate drink	2.53	2.74	2.76	2.60	2.67
Coffee	2.46	2.51	2.50	2.42	2.47
Pea soup	2.29	2.48	2.43	2.35	2.30
Milk & sugar	1.92	2.16	2.28	2.24	2.17
Meat Items					
Spiced beef	2.61	2.61	2.61	2.48	2.57
Pork loaf	2.57	2.55	2.54	2.44	2.52
Sardines	2.35	2.17	2.21	2.10	2.22
Biscuits	1.95	2.03	2.17	2.20	2.08

* See par. 7 for method of scoring.

TABLE 12
RELATIVE ACCEPTABILITY OF CANADIAN
ARMY MESS TIN ITEMS COLD VS. HOT

Item	Score Eaten Cold	Score Eaten Hot
Meat & Cheese		
Sardines	2.21	2.23
Pork loaf	2.45	2.57
Spiced beef	2.47	2.65
Cheese	2.66	2.71
Drinks		
Chocolate bar	2.82	2.84
Tea	2.67	2.76
Coffee	2.35	2.50
Chocolate drink	2.51	2.72
Pea soup	2.23	2.41

TABLE 13
RELATIVE ACCEPTABILITY OF CANADIAN ARMY
MESS TIN WHEN EATEN AT DIFFERENT MEALS

Item	Score When Eaten At		
	Breakfast	Dinner	Supper
Spreads & Sugar			
Jam	2.94	2.95	2.97
Butter	2.91	2.88	2.91
Sugar	2.74	2.82	2.81
Cheese	2.77	2.67	2.65
Confections			
Hard candy	2.91	2.91	2.91
Chocolate bar	2.83	2.82	2.83
Drinks			
Tea	2.74	2.72	2.74
Chocolate drink	2.74	2.57	2.65
Coffee	2.47	2.48	2.45
Pea soup	2.51	2.43	2.38
Milk & sugar	2.13	2.21	2.17
Meat Items			
Spiced beef	2.56	2.54	2.60
Pork beef	2.50	2.52	2.53
Sardines	2.29	2.20	2.15
Biscuits	2.12	2.07	2.15

ACCEPTABILITY AND WASTE
CANADIAN ARMY MESS TIN

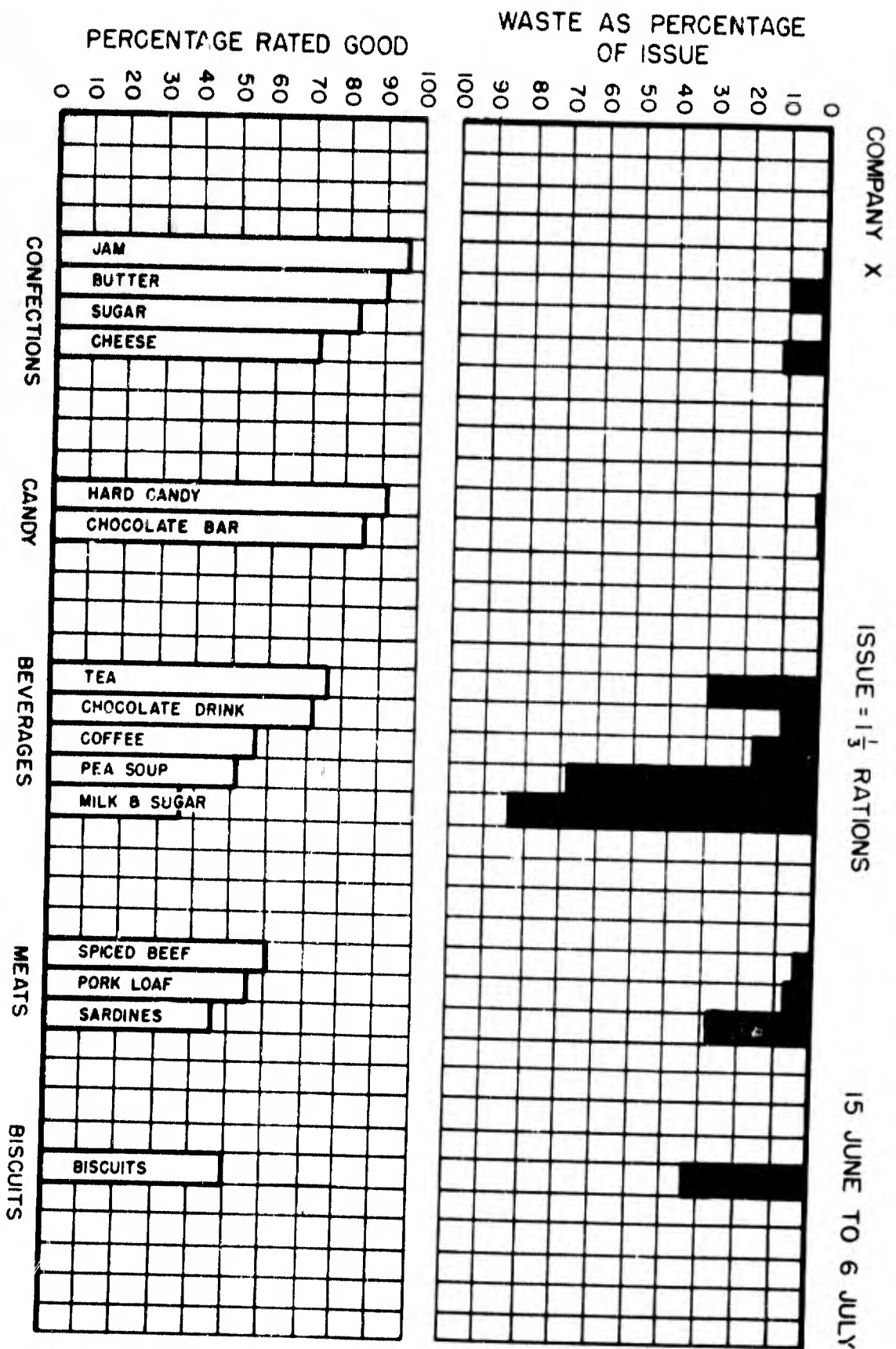


FIG. 11

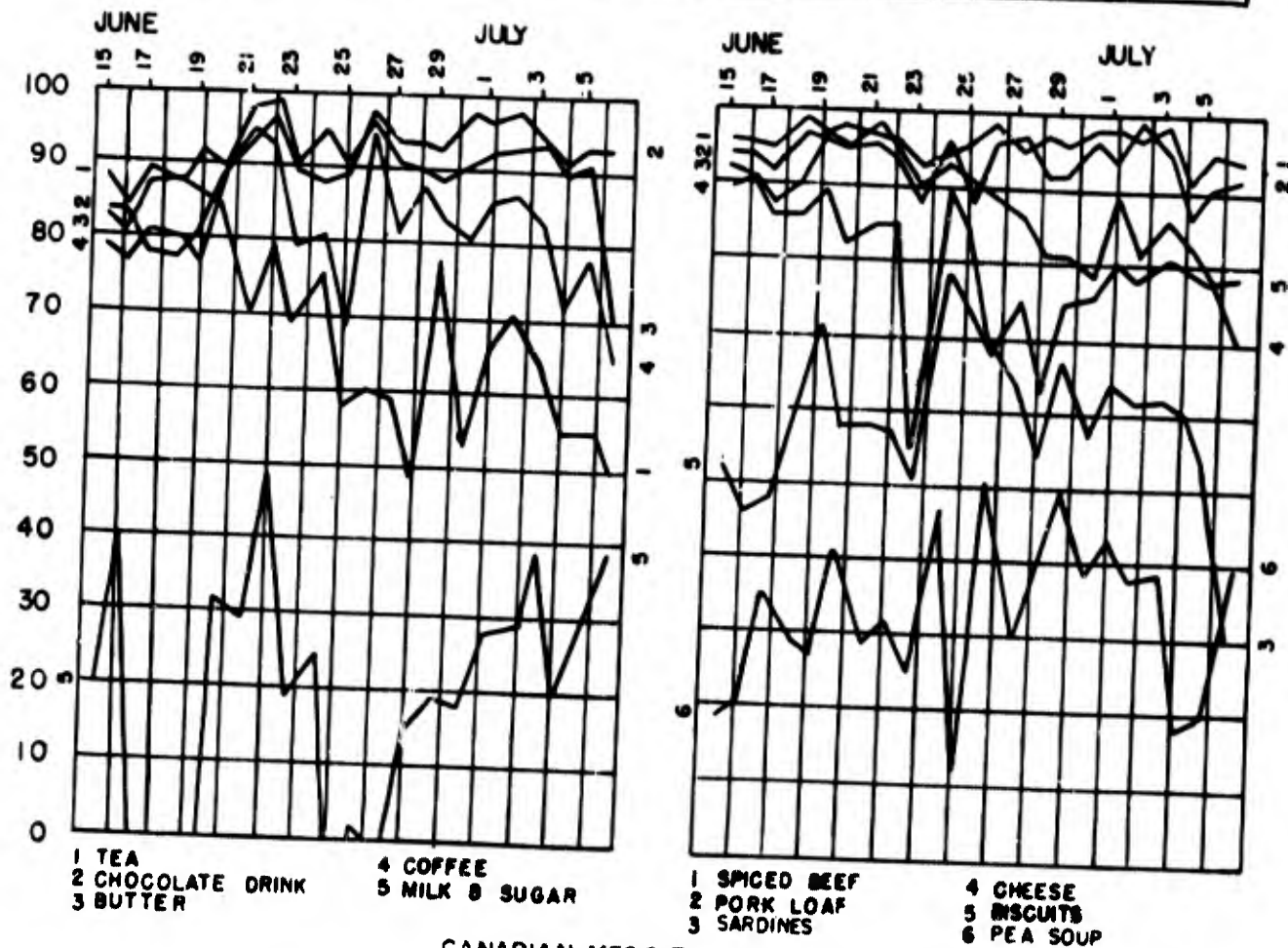
FIG. 12

Appendix D I
Inclosure #4a

**FIG. 110.
CANADIAN ARMY MESS TIN RATION**

TREND IN ACCEPTABILITY OF THE ITEMS
BY PERIODS (6-5-5-6 DAYS)

ITEM		PERIOD 1	PERIOD 2	PERIOD 3	PERIOD 4
SPREADS & SUGAR	JAM	2.98	2.98	2.95	2.91
	BUTTER	2.95	2.92	2.89	2.85
	SUGAR	2.90	2.80	2.74	2.71
	CHEESE	2.71	2.69	2.68	2.61
CONFECTIONS	HARD CANDY	2.92	2.94	2.90	2.88
	CHOCOLATE BAR	2.82	2.84	2.83	2.81
DRINKS	TEA	2.79	2.77	2.77	2.61
	CHOCOLATE DRINK	2.58	2.74	2.76	2.60
	COFFEE	2.46	2.51	2.50	2.42
	PEA SOUP	2.29	2.48	2.43	2.35
	MILK & SUGAR	1.92	2.16	2.28	2.24
MEAT ITEMS	SPICED BEEF	2.61	2.61	2.61	2.48
	PORK LOAF	2.57	2.55	2.54	2.44
	SARDINES	2.35	2.17	2.21	2.10
BISCUITS	BISCUITS	1.95	2.03	2.17	2.20



CANADIAN MESS TIN RATION
PER CENT CONSUMED

FIG. 110.

11. 10-IN-1 RATION:

a. Introduction

The 10-in-1 Ration was designed as a support area ration to be used where it is not practicable to use the B Ration. It is not used in forward combat zones, because issue, breakdown and preparation require too much time and equipment. It is an intermediate ration between the C and K, and the B Ration. It is the purpose of the ration to serve the men a hot meal twice a day and to furnish a variety of menus. The lunch menu is compact and easily carried in a mess packet.

In most support areas, troops are able to supplement rations by food acquired from the natives, the Red Cross and purchases from post exchanges. With this reserve available, the items which are not acceptable will not be eaten, regardless of calorie content. Therefore a prime consideration in a support as well as combat ration should be acceptability.

b. *Companies Tested on Ration*—The 10-in-1 Ration was issued to H, G, X and Y Companies, under varying circumstances. H Company subsisted on it for the entire 57 days of the test, G, X Y Companies subsisted on it for the 14-day Period II. G Company had been on K Ration, X on Canadian Mess Tin and Y had been on Experimental C Ration prior to the change.

Company	Week of Test Period Used	Basis of Daily Issue Per Man
H	1, 2, 3, 4, 5, 7 and 8	1-1/4 ration
H	6 and 7	1 ration
G	4 and 5	1-1/4 ration
X	4 and 5	1-1/4 ration
Y	4 and 5	1-1/4 ration

c. *Basis of Issue*—The 10-in-1 Ration was issued 10 rations to 8 men at all times in all companies except for the 10 day period that H Company used the 10-in-1 Ration issued 10 rations to 10 men.

One of the features of the 10-in-1 Ration is the variety offered by the use of 5 different menus. This was an important factor in high rates of acceptability of 10-in-1 when test subject had been on K, C, and Canadian Mess Tin Rations.

Two methods of issue were employed. The normal method was issuance of the complete menu for the following day, after the supper meal had been eaten. Breakfast was eaten in the bivouac area, and usually lunch was eaten in the field. For supper, the men returned to the area. The second method of issuance was employed during the 4 day march and remaining 3 days of test. The complete menu was issued before supper so that the men could eat supper and breakfast in the bivouac area, and carry only lunch on the march. When variations were used in components of the ration, the boxes were opened by the subjects and new items were exchanged for old items under supervision of the observers. Individual allotment of ration was not necessary as group eating was practiced.

d. *Preparation and Consumption*—The food was heated by two means: (1) By the 20 Men Field Cooking Set, (stove, two-burner, Coleman) and (2) by cooking over a pit fire. Utensils consisted of a frying pan, 1 and 2 gallon pots, and a deep fat fryer. All groups used the stoves at first, but since it took approximately an hour to cook meals, some groups expedited preparation by cooking over pit fires. Acceptability varied significantly when method of preparation was changed. It was difficult to boil water on the stove in the large containers, due to small flame. The open pit fire would boil water in a short time, and it was found that Nescafe, Barrington Hall Coffee and cocoa in the 10-in-1 Ration were most acceptable when prepared in boiling water. (Because of the altitude the boiling point was around 195°F.)

The test subjects ate in groups of 8, 16 or an entire platoon; most in groups of 8, but there were 3 of 16, 1 of 40 (a platoon) in H Company. The larger groups prepared their food faster because of the number of stoves and utensils. The platoon leader assigned 1 person per 8 men to cook, and the squad alternated at performing the duty of K.P. The average time for all men to eat breakfast, 30 minutes; dinner, 19 minutes; and supper 33 minutes.

e. *General Acceptability*

- (1) *Evaporated milk* led the list in ratings, and practically none was turned in. The great majority of all subjects liked coffee with milk.
- (2) *Jam* was well received and none was turned in except when the product contained an excess of crystallized sugar. *Army Spread* was acceptable.
- (3) *Beverages* had a high rating and low return. Coffee was invariably rated best of the drinks, followed closely by cocoa. The powdered lemon and orange were much less popular probably because there was insufficient sugar to sweeten them. Waste on these items appears low because no effort was made to collect liquid waste; only unopened packages.
- (4) *Vegetables*—There was some variation in the ratings and consumption of the vegetables in this ration. Generally corn was rated highest, followed by peas, tomatoes, snap beans and lima beans.
- (5) *Meats*—Bacon and roast beef were rated high and figured very little in the waste. In the next group corned beef, ham and eggs, pork sausage, English stew and meat and rice were grouped with very little to indicate a real preference among them. At the bottom of the list of meat products are grouped those components peculiar to the K Ration. This was true whether the previous ration was K or something else. Dehydrated meat items in the supper units were prepared with difficulty and were not well received.
- (6) *Confections*—These were rated lower by men eating the 10-in-1 Ration than by men eating any other. Peanuts were rated high but the quantity did not satisfy even 8 men. Other ratings were only slightly lower. In spite of the percentage rated good and of the scores of average ratings, the confection group as a whole did not appear in the waste.
- (7) *Cereal*—Though the waste was relatively low, the score of acceptability for cereals was not high. In a special questionnaire, H Company rated Quaker shredded wheat first followed by Quaker oat premix, General Mills premix, General Foods premix and Pillsbury cereal premix in order.
- (8) *Biscuits*—Types I and II as described in Appendix B were rated highest, followed by K-4, K-5, whole wheat, C, K-1A, K-3 and K-2. Types I and II were substituted for Type C in H Company during Period III and were much more acceptable. Sweet cookies were well accepted when tried for a time during the last test period.

Variations with meals, and changes in acceptability hot and cold followed the trends found with other rations.

f. *Suggested Changes*—The following suggestions summarize test subjects' and observers' remarks:

- (1) Sausage is flat tasting and flavorless (when eaten cold).
- (2) Pork and egg yolk in large can is not as good as that in small can.
- (3) Wax beans are flat in taste. More seasoning would help.
- (4) More grape and orange drinks would be highly acceptable.
- (5) Amount of coffee in ration should be doubled.
- (6) More varieties of beverage needed on luncheon menu.
- (7) More sweet chocolate bars added and D Ration and fruit bars reduced.
- (8) Menu #2 should contain sugar.
- (9) Ketchup and pepper would aid in making food more palatable.
- (10) Baked beans would be better than several of the meat items.
- (11) A salted biscuit would be highly acceptable.
- (12) A soup would be highly acceptable in supper menu.
- (13) More chewing gum should be added to ration.

- (14) Quaker Oats Company cereals would be highly acceptable even if they were in every menu.
 - (15) Type I and II Biscuits should be used in place of Type C Biscuit.
 - (16) In the new Supper Menu #5, chocolate bars and cocoa are on the same menu; chocolate bars should be replaced by another confection.
 - (17) Dehydrated meats should be replaced by prepared meat items.
 - (18) A larger package of sugar should be placed in K lunch unit.
 - (19) The K meat and egg and K meat items should be replaced by more palatable meat items. Egg and meat items should not be used in the K unit because these items should be hot when eaten, and this is not usually possible.
 - (20) A vegetable, pudding or fruit item would increase the acceptability of the K unit considerably.
 - (21) Halazone tablets could be distributed at the company commander's discretion, instead of enclosed in rations because of the waste.
- g. Summary and Conclusion**—The 10-in-1 Ration is an excellent ration and is of sufficient nutritional value to sustain a soldier's strength while he is undergoing physical exertion similar to that experienced in actual combat.

TABLE 14
TREND OF ACCEPTABILITY OF 10-in-1 ITEMS (H COMPANY)

ITEM	(Score by 5 Day Periods)*										
	1	2	3	4	5	6	7	8	9	10	11
MEATS											
Fork sausage	2.53	2.35	2.49	2.28	2.33	2.26	2.21	2.20	2.34	2.25	2.17
Bacon	2.74	2.73	2.74	2.69	2.69	2.78	2.76	2.77	2.79	2.82	2.71
Ham & eggs	2.61	2.41	2.29	2.22	2.16	2.30	2.19	2.21	2.27	2.25	2.23
Fork & egg yolk	2.44	2.37	2.19	2.08	2.14	2.11	2.07	2.19	2.22	2.22	2.25
Egg & meat (K)	2.44	2.22	2.13	2.01	1.97	1.97	1.98	1.98	2.03	1.96	1.97
Cheese (K)	2.24	2.26	2.15	2.21	2.09	2.15	2.10	2.19	2.00	2.17	2.24
Meat Product (K)	2.38	2.04	1.84	1.82	1.72	1.78	1.85	1.86	1.55	1.70	1.81
Meat & rice	2.55	2.29	2.41	2.45	2.32	2.41	2.14	2.11	2.19	2.16	2.15
Stew, English	2.49	2.56	2.43	2.39	2.26	2.25	2.20	2.13	2.09	2.16	2.34
Corned beef	2.79	2.70	2.68	2.65	2.64	2.60	2.56	2.74	2.67	2.76	2.77
Roast beef	2.70	2.81	2.73	2.77	2.81	2.76	2.78	2.82	2.82	2.87	2.73
Corned beef hash	2.20	2.42	2.41	2.46	2.36	2.27	2.16	2.26	2.13	-	2.06
BEVERAGES											
Coffee, soluble	2.82	2.88	2.88	2.90	2.90	2.89	2.90	2.89	2.91	2.91	2.87
Lemon powder	2.27	2.19	2.12	2.11	2.06	2.07	2.01	1.99	1.97	1.96	1.97
Orange powder	2.42	2.39	2.24	2.30	2.19	2.27	2.32	2.30	2.05	2.25	2.29
Cocoa	2.71	2.66	2.66	2.74	2.67	2.54	2.44	2.58	2.63	2.77	2.74
BISCUITS											
Biscuits, Type 1	-	-	-	-	-	-	-	2.40	2.54	2.72	2.27
Biscuits, Type 2	-	-	-	-	-	-	-	2.42	2.47	2.68	2.41
Biscuits, C	1.87	1.68	1.71	1.74	1.79	1.85	1.88	-	-	-	-
Biscuits, whole wheat	1.92	2.04	2.13	1.88	2.15	1.91	1.92	-	-	-	-
Biscuits, K-1A	2.00	1.86	1.79	1.75	1.77	1.95	1.74	1.83	1.85	1.81	1.98
Biscuits, K-2	1.59	1.63	1.58	1.61	1.60	1.69	1.61	1.65	1.64	1.67	1.59
Biscuits, K-3	1.75	1.70	1.74	1.78	1.77	1.82	1.85	1.85	1.85	1.90	1.91
Biscuits, K-4	1.97	1.82	2.38	2.39	2.33	2.38	2.24	2.41	2.38	2.44	2.35
Biscuits, K-5	1.86	2.41	2.46	2.53	2.45	2.51	2.37	2.23	2.49	2.42	2.55
CEREAL											
EVAPORATED MILK	2.35	2.38	2.48	2.47	2.38	2.47	2.49	2.51	2.59	2.62	2.62
SPREADS											
Jam	2.90	2.87	2.88	2.85	2.85	2.80	2.82	2.84	2.86	2.88	2.85
Army Spread	2.69	2.70	2.69	2.73	2.78	2.72	2.77	2.77	2.77	2.80	2.77
VEGETABLES											
Tomatoes	2.84	2.90	2.73	2.84	2.81	2.73	2.75	2.71	2.72	2.76	2.68
Snap beans	2.70	2.77	2.76	2.74	2.76	2.72	2.63	2.51	2.59	2.57	2.64
Peas	2.82	2.79	2.85	2.83	2.76	2.73	2.71	2.79	2.71	2.75	2.81
Corn	2.81	2.92	2.80	2.89	2.86	2.87	2.87	2.87	2.88	2.90	2.84
Lima Beans	2.53	2.69	2.76	2.78	2.68	2.57	2.53	2.62	2.26	-	2.64
CONFECTIONS											
Peanuts	2.82	2.77	2.81	2.74	2.71	2.74	2.54	2.74	2.64	2.68	2.55
Fruit bar	2.45	2.50	2.44	2.46	2.41	2.41	2.40	2.37	2.40	2.38	2.34
Hard candy	2.77	2.60	2.58	2.66	2.66	2.61	2.65	2.58	2.56	2.50	2.55
Chocolate bar	2.53	2.59	2.71	2.72	2.74	2.58	2.66	2.63	2.59	-	2.67
Caramels	2.77	2.76	2.76	2.69	2.74	2.69	2.60	2.63	2.54	2.61	2.55
Sweet Chocolate	2.58	2.65	2.59	2.57	2.55	2.56	2.60	2.57	2.62	2.72	2.66

Appendix D I
Inclosure #4a

* See par. 7 for method of scoring.

TABLE 15
RELATIVE ACCEPTABILITY OF
10-in-1 ITEMS
(Companies G, H, X and Y)

Item	Score
<i>Meats</i>	
Bacon	2.82
Roast beef	2.82
Corned beef	2.75
Ham & eggs	2.52
Pork sausage	2.51
Stew, English	2.48
Meat & rice	2.47
Corn beef hash	2.44
Pork & egg yolk	2.41
Cheese product	2.31
Egg & meat	2.30
Meat product	2.09
<i>Beverages</i>	
Coffee	2.90
Cocoa	2.74
Orange powder	2.46
Lemon powder	2.37
<i>Biscuits</i>	
Biscuit, Type 1	2.48
Biscuit, Type 2	2.50
Biscuits, K-5	2.49
Biscuits, K-4	2.45
Biscuits, Whole Wheat	2.24
Biscuits, C	2.20
Biscuits, K-1A	2.11
Biscuits, K-3	2.04
Biscuits, K-2	1.91
<i>Cereal</i>	2.63
<i>Evaporated Milk</i>	2.92
<i>Spreads</i>	
Jam	2.90
Army Spread	2.78
<i>Vegetables</i>	
Corn	2.89
Peas	2.83
Tomatoes	2.81
Snap beans	2.77
Lima beans	2.72
<i>Confections</i>	
Peanuts	2.79
Caramels	2.75
Hard candy	2.73
Chocolate bar	2.73
Sweet chocolate	2.69
Fruit bar	2.57

TABLE 16
DIFFERENCES AMONG COMPANIES IN ACCEPTABILITY OF
DIFFERENT 10-IN-1 FOOD GROUPS

Group	Score				
	G	H	X	Y	All
Meats	2.66	2.34	2.78	2.65	2.50
Beverages	2.83	2.61	2.85	2.82	2.71
Biscuits	2.48	2.01	2.57	2.36	2.22
Cereal	2.81	2.49	2.84	2.63	2.63
Spreads	2.90	2.80	2.88	2.90	2.84
Vegetables	2.87	2.74	2.92	2.89	2.81
Confections	2.79	2.55	2.88	2.78	2.67

TABLE 17
ACCEPTABILITY OF 10-IN-1 ITEMS EATEN
COLD VS. HOT
(G, H, X & Y Companies)

Item	Score	
	Cold	Hot
<i>Meats</i>		
Pork sausage	2.09	2.51
Bacon	2.66	2.83
Ham & eggs	2.46	2.52
Pork & egg yolk	2.21	2.42
Egg & meat	2.25	2.61
Meat product (K)	2.06	2.38
Meat & rice	2.27	2.48
Stew, English	2.27	2.49
Corned beef	2.67	2.75
Roast beef	2.50	2.83
Corned beef hash	2.04	2.45
<i>Drinks</i>		
Coffee	2.69	2.90
Cocoa	2.42	2.82
Cereal	2.48	2.71
<i>Vegetables</i>		
Tomatoes	2.85	2.79
Snap beans	2.57	2.78
Peas	2.63	2.84
Corn	2.59	2.90
Lima beans	2.46	2.73

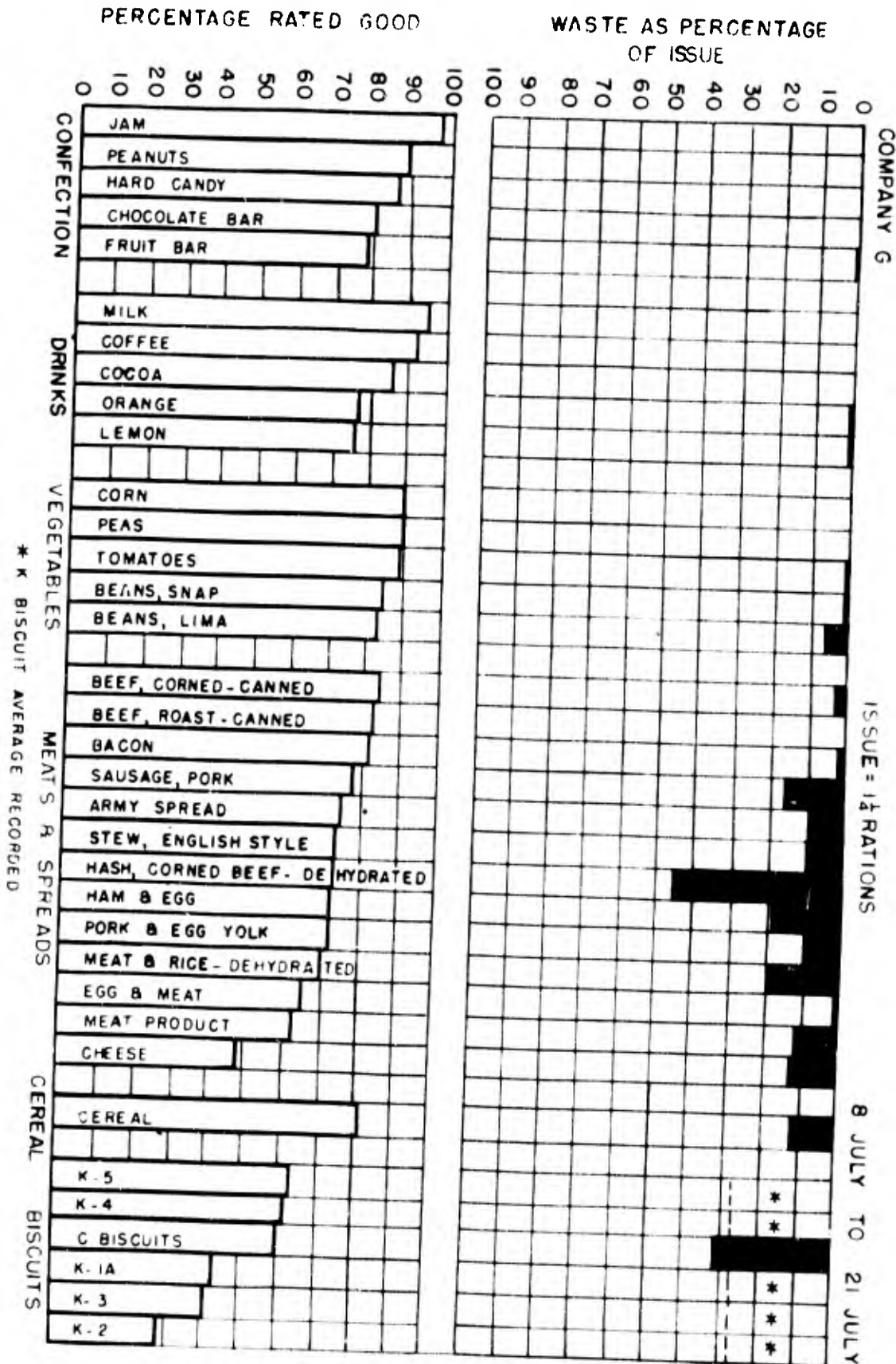


FIG. 12

* K BISCUIT AVERAGE RECORDED

Appendix D I
Inclosure #4a

FIG. 12

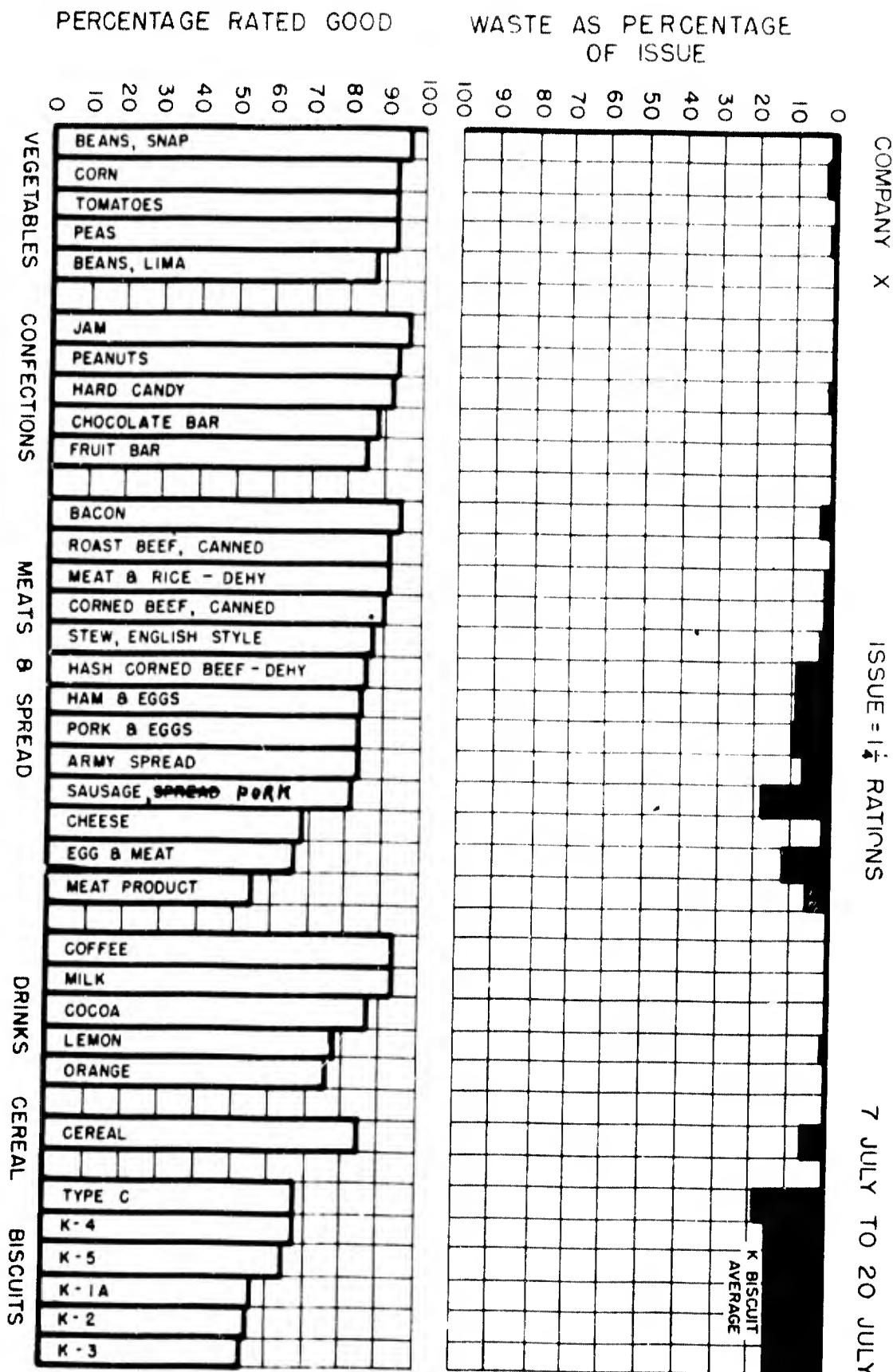
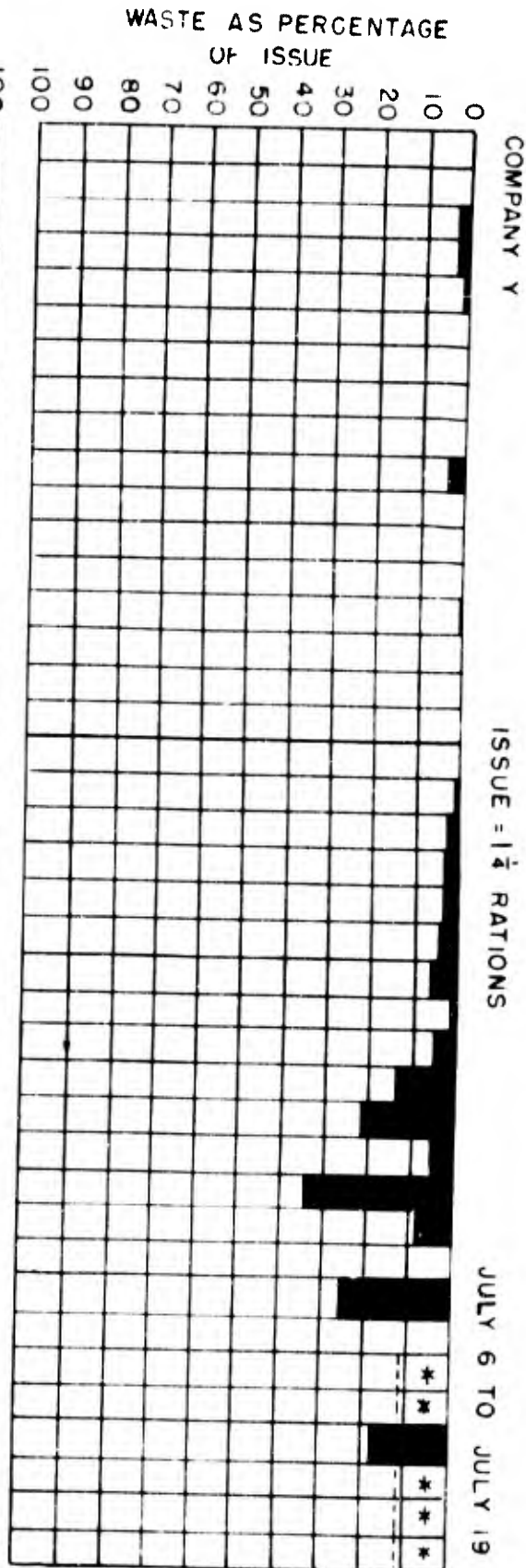
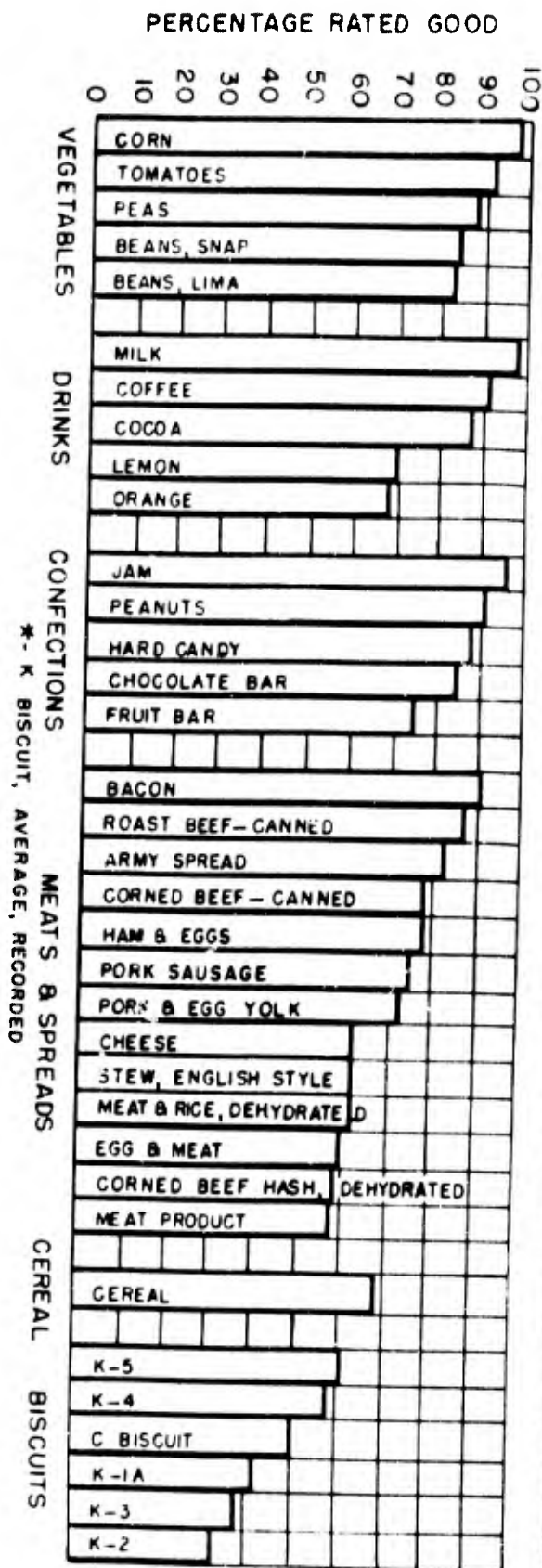


FIG. 13

FIG. 13

Appendix D I
Inclosure #4a



ACCEPTABILITY AND WASTE

10-IN-1 RATIONS

ISSUE - 1/4 RATIONS

JULY 6 TO JULY 19

FIG. 14

FIG. 14

Appendix D 1
Inclosure #4a

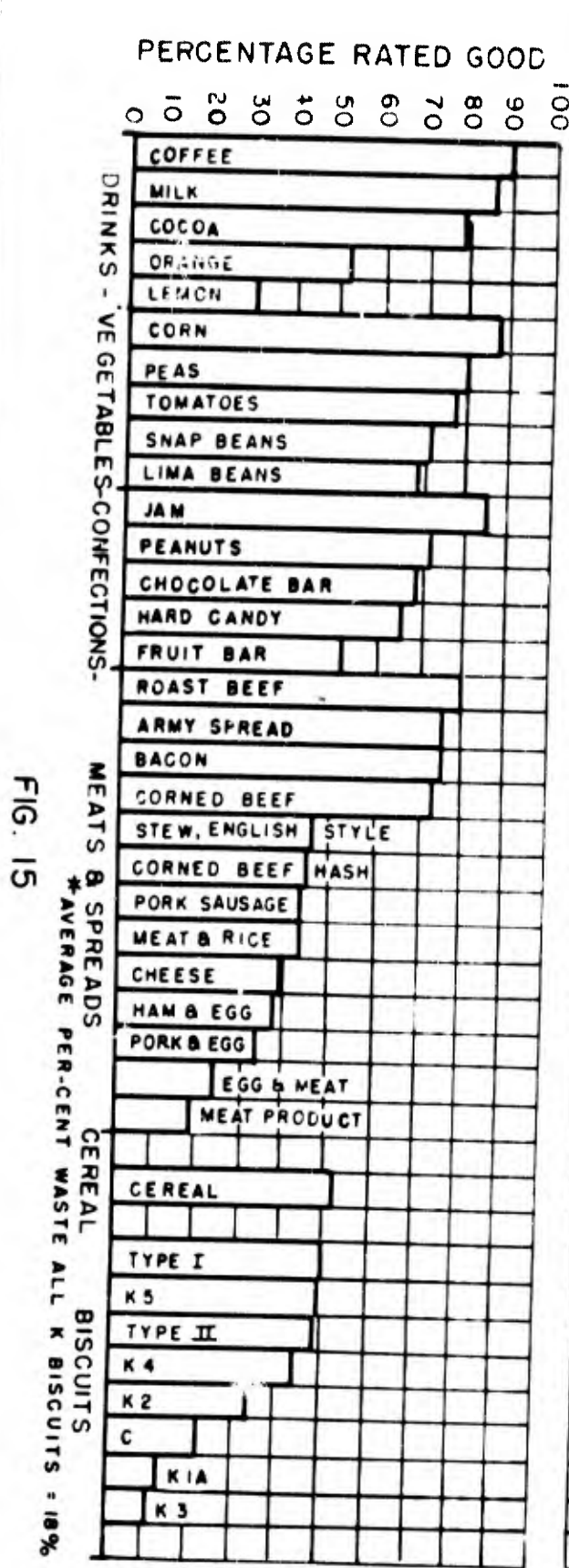


FIG. 15

Appendix D I
Inclosure #4a

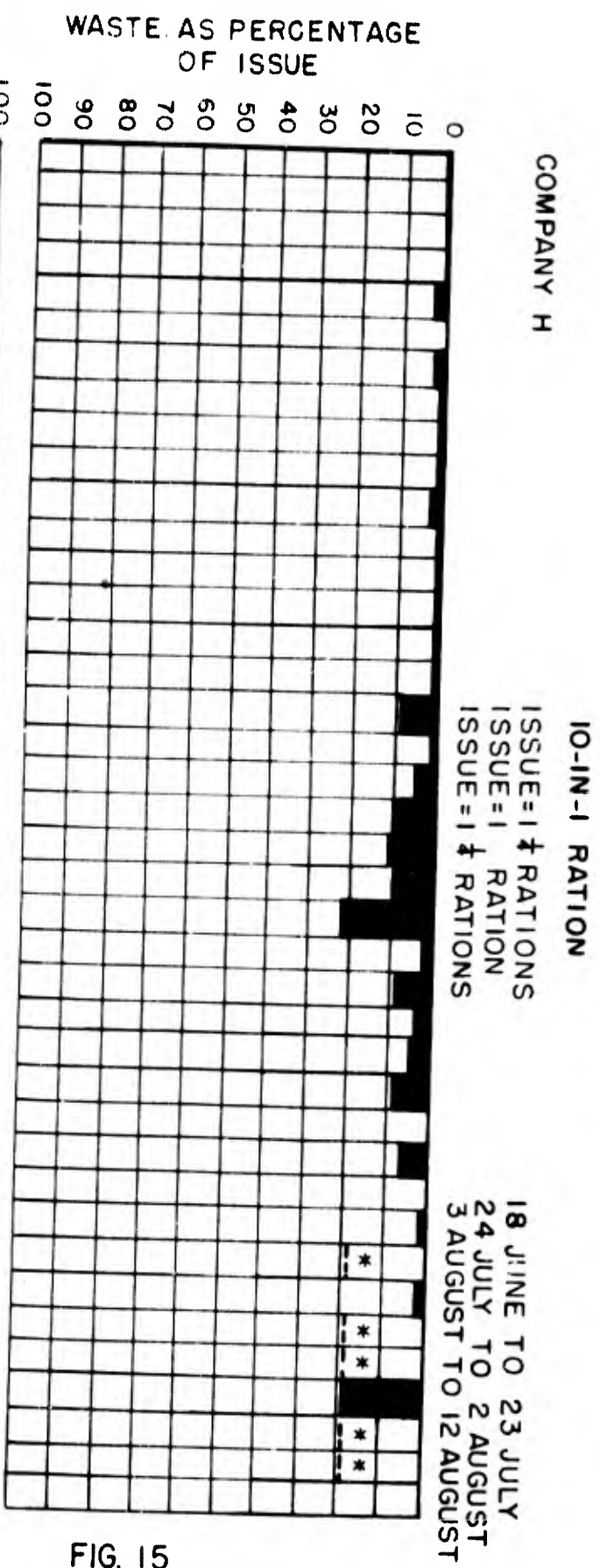


FIG. 15

ACCEPTABILITY AND WASTE

12. U. S. ARMY FIELD RATION B SUPPLEMENTED:

a. *Introduction*

The ration consists of canned, dehydrated and processed items, and is designed as a support area and interior zone ration. In overseas areas it corresponds to the normal garrison ration or Field Ration A in the United States. Wherever local conditions permit it is customary to supplement the B Ration with fresh vegetables, fruit, and meat. In order to assure the best possible diet for the control group in this test, the usual Field Ration B was supplemented with a large variety of frozen meats, fresh potatoes and onions, fresh oranges and additional quantities of canned fruit and sugar.

b. *Companies Tested*—The control F Company subsisted on this ration throughout the entire test. In addition, E Company used this ration during Period III following 3 weeks on K ration.

Company	Week of Test Period Used	Basis of Daily Issue Per Man
F	1, 2, 3, 4, 5, 6, 7 and 8	4800 calories
E	4 and 5	4800 calories

c. *Basis of Issue*—In order to have calorie issue approximately equivalent to that of other companies during Period I, and optimal for use on the control diet, this ration was always issued at an average level of 4800 calories per man per day.

d. *Preparation and Consumption*—Food components of the supplemented B Ration were trucked from Camp Carson to the supply dump refrigerator truck at F Company, and were issued to the kitchens daily for preparation. Rations were prepared in quantity for each company as a unit and cooked on standard gasoline Field Ranges (M-1937) by company cooks supervised by especially trained mess personnel from A.S.F. Food Service Program. Men used the regular field mess gear and washed it in the prescribed field manner. The approximate time required to eat meals including standing in mess and laundry lines was breakfast, 25 minutes; dinner, 30 minutes; supper, 30 minutes.

Consumption by individuals was variable, depending on appetite. Sufficient food was always prepared to allow second helpings. Accurate consumption data were obtained for each company as a whole. Average nutrient intake per man per day is listed in Table 18. It will be noted for both E and F Companies that the average nutrient intake is well above the liberal allowances recommended by the National Research Council. E Company, following 3 weeks on K ration, consumed on the average about 7% more of the ration than did F Company.

e. *General Acceptability* (This ration was not one of the test rations).

Ratings of Likes and Dislikes—The comment of all men eating this supplemented B Ration was most favorable. Many stated that it had more variety and was better prepared than the Field Ration A eaten in camps. Few items were not universally accepted. Some of the less acceptable were: powdered eggs in any form, corned beef, cold cereals, sausage, salmon, bean soup, string beans, carrots, beets, spinach and sauerkraut. Canned vegetables were less well liked than meats, fruits and puddings; while drinks of all types were very well consumed. Contrary to previous experiences Carter's Spread was well received.

f. *Suggestions for Improvement*—One of the most common suggestions was that powdered eggs either be eliminated from the menu or used only in small amounts as components of pastry, baked products or French toast. Despite all efforts of highly trained personnel they were never rendered very acceptable. An attempt should be made to use a higher grade product, more stable under storage for considerable periods of time. Certain products were of inferior quality that contributed to their lack of acceptability. These were corned beef, canned string beans, canned sausage, canned peas and canned corn. Other items such as carrots, salmon, sauerkraut and spinach never have been popular with American soldiers and might be served less frequently to avoid waste. The use of cold dry cereals with evaporated milk for breakfast in an area where the morning temperature ranged in the vicinity of freezing is believed to account partly for their lowered acceptability. Hot cereals served occasionally were preferred.

Appendix D I
Inclosure #4a

g. *Summary and Conclusion*—In its highly supplemented form, this ration was considered extremely well suited as a control ration and would undoubtedly meet with favor in any theatre at war as a rest area or support area ration. Comments of the men in E Company who had previously subsisted on K Ration for 3 weeks were highly favorable.

TABLE 18
AVERAGE NUTRIENT INTAKE OF SUPPLEMENTED B RATION (PER MAN PER DAY)

Ration Cycle*	Cal.°	Pro. gm.	Ca gm.	Fe mgn.	Vit. A I. U.	Vit. B ₁ mgn.	Vit. B ₂ mgn.	Niacin mcgm.	Vit. C mgn.
Co. E 14 days	4,360	149	1.14	28.0	9,625	2.24	3.12	33.8	115
Co. F 2d	4,020	130	.84	26.1	8,240	2.14	2.49	28.7	141
3d	3,790	126	.92	24.3	7,890	2.04	2.62	28.3	115
4th	3,780	122	.94	23.7	8,710	1.93	2.53	26.6	81
5th	4,140	126	.94	25.5	6,520	2.16	2.62	29.8	94

* Cycle consist of 10 days, except in case of E Company

° Calories issued were 4,800 per man, per day; difference between issue and consumption due to kitchen and plate waste.

APPENDIX D

Section II

WEIGHT CHANGES AND CALORIE CONSUMPTION

Company	Ration			Consumption		Weight Change Lbs. per. Wk.
	Kind	Issue	Duration	Calories	Trend	
Y	C Exper.	1-1/3	3 weeks	2910	slight increase	-0.0
X	C Exper.	1-1/3	1 week	3937	level	-0.4
G	C New & Exper.	1	3 weeks	3173	level	-1.2
E	K	1-2/3	3 weeks	3199	increase	-1.9
E	K	1-2/3	3 weeks	4161	level	-1.3
G	K	1-2/3	3 weeks	3250	increase	-0.9
X	K	1-2/3	1 week	3833	level	0
Y	K	1	11 days	2884	level	-1.3
Y	K	1-2/3	10 days	4429	level	0
X	Mess Tin	1-1/3	3 weeks	3427	decrease-increase	-1.7
H	10-in-1	1-1/4	5 weeks	4120	-	-0.8
H	10-in-1	1	10 days	3920	-	-0.6
G	10-in-1	1-1/4	2 weeks	4400	-	+0.1
X	10-in-1	1-1/4	2 weeks	4420	-	+0.7
Y	10-in-1	1-1/4	2 weeks	4580	-	-0.1
F	Supp. B	4800 cal.	10 days	4020	-	-0.6 approx.
F	Supp. B	4800 cal.	3 weeks	3785	-	-0.4 approx.
F	Supp. B	4800 cal.	10 days	4140	-	-0.4 approx.
E	Supp. B	4800 cal.	2 weeks	4360	-	+1.1

1. INTRODUCTION:

Change in body weight gives the best available measure of calorie balance. Loss of body weight indicates a negative balance, whereas gain indicates the opposite. While it is recognized that water loss may account for some change in weight for short periods, it is not believed that changes in water metabolism were of any great significance in the present test except perhaps during the first week.

Since it is not known exactly what proportions of fat, protein and carbohydrates are lost from the body for a specific quantity of weight loss, certain basic assumptions must be made about the relationship of weight lost and calories ingested. It is generally believed that the chief constituent lost by the body during a period of negative weight balance is fat, but that some protein and carbohydrate are lost also. Students of metabolism have used the standard of 1 gram of weight loss equalling 8 calories (i.e. the loss of one pound indicates a negative balance somewhere in the neighborhood of 3200 to 4000 calories).

2. METHODS OF WEIGHING:

In order to have conditions of weighing comparable in all companies, the practice was as follows: All men were weighed in the morning before breakfast. They urinated prior to their assembly at the weighing point. Weighing was usually done in the recreation tent in the bivouac area, a platoon at a time. Men removed all clothing except socks and shorts. Subjects were weighed on field scales of 300 lbs. capacity. Care was taken to see that they were level, and were checked before use for accuracy. Ordinarily 2 scales were employed to expedite weighing. Each company was weighed on the morning of their fitness test days, and, after the first week, twice during every week of the test.

3. RELATIONSHIP OF INITIAL BODY WEIGHT TO LOSS OF WEIGHT.

Changes in body weight during a period of standardized exercise and energy expenditure depend on the initial status (obese, normal or underweight). Since the basal energy output for larger men is greater than for small, and the cost of some types of work is similarly greater for heavy men, the weight trend for a group of men on a fixed work schedule and a fixed ration intake will be influenced by the distribution of

light, medium and heavy men within the group. Consequently the weight changes for subjects grouped according to initial weights are more meaningful than averages for a whole company. This may be seen in the series of charts of weight loss for each company in which the men were distributed by 10-pound class intervals (Figs. 1 to 6). The weight loss is higher for all heavy men than it is for those about the mean, regardless of ration. In some instances light men actually gained weight. The pattern of trends for the entire battalion is given in Table 1. Table 2 gives the distribution of weight losses for all companies in 3-pound classes.

These data were analyzed further by multiple regression methods with reference to height as well as initial weight. The within-company partial correlation of weight loss and initial weight independent of height was 0.66 and the partial correlation of weight loss and height independent of initial weight was -0.27 . Both of these correlations are highly significant ($P < 0.01$.) The first correlation means that among men of similar height in the same company, the heavier men generally lost more weight. Among men in the same company of similar initial weight, the shorter ones tended to lose more weight than the taller ones. In other words, the men who were above average weight for height tended to lose more weight during the test.

Differences in weight loss between different companies might occur from abnormal distribution. If a larger number in a given company were heavy for their height, the expected weight loss would be great, even though the mean company weight were the same as another company with a normal weight distribution curve, or one with a preponderance of light men. While there are slight differences in the distribution for each company (Table 3) the general agreement of the pattern is such that variations between the companies would not affect the weight loss.

4. CALCULATIONS OF CALORIES CONSUMED:

Methods used in calculating individual and company calorie consumption have inherent inaccuracies.

a. Data upon which the calorie consumption calculations were based may be inaccurate because of sampling and other random errors.

b. There is a variation in weight in specimens of the canned and packaged components. Another variation is the quantity lost in the container and mess gear which could not be checked accurately in the field.

c. The item consumption figures may be inaccurate. This is probably not of significance since the internal checks of preferences, quantity eaten and waste returned, agree in a satisfactory manner.

d. The work actually done may have increased in difficulty during later stages of the test, and large variations may have occurred from one company to another and in the same company from time to time even when the scheduled activity was the same. As the physical condition of the men improved, there was a tendency for the officers to require more vigorous work; but this was a gradual and somewhat irregular change. It is not certain that level of energy expenditure did not alter significantly in any company during the test, and it undoubtedly varied somewhat from company to company.

5. OBSERVATIONS:

The average weights of men who took all tests and were weighed on each test day are given by companies in Table 4. The weights for the morning of Test 2, the first day at Topside and last day on the pre-test ration, are used as control weights for comparison.

All companies lost weight between Test 2 and Test 3, E and X Companies losing more than F.

Between Tests 3 and 4, all companies lost weight, and none differed in their loss from F Company.

In Period II, between Test 4 and Test 5, significant gains were recorded for E, F, H and X Companies, with E gaining more than F, and H gaining less.

All companies lost weight from Test 5 to Test 6 (Period III) with E, G and Y losing more than F.

During the 8 weeks of the test, all companies lost weight, and all lost significantly more than F Company.

6. WEIGHT CHANGE BY RATION, AND BY CALORIE CONSUMPTION:

Weight loss or gain is determined by the relationship of calorie intake to expenditure of energy. A regimen of hard work leads to a loss of weight when the calorie intake is less than the calorie expenditure.

Appendix D II

Inclosure #4b

a. E Company ate K Ration (1-2/3 rations per man per day) for the periods I and III, and used B Ration during the 2 weeks of Period II as its support area ration. The initial weight loss common to all companies for the Period I was marked in E Company. During the first week when the average calorie consumption was about 3000 calories, the weight loss was particularly sharp. There was a steady rise during Period II when the subjects were on the Supplemented B Ration. Again during Period III on K Ration there was a sharp fall in mean weight. If we assume that the energy expenditure week by week was reasonably constant, as would be expected from the program of activity, the loss of weight during the last 3 week period is paradoxical, since the calorie consumption was much higher during the last period than during the first period on K Ration. (The difference in consumption is to be explained by the variation in items available during the last period, and by the practice of concocting mixtures out of items which had a low acceptability during the earlier stages of the test.) There was a general trend downward of mean weight of all companies while on K Ration.

b. The weight changes in F Company on the Supplemented B Ration cannot be interpreted for the entire period, because calorie intake was calculated for only 4 of the 6, 10-day cycles of this ration. Figure 2 and Table 2 indicate a sharp initial weight loss during the first week; and a more gradual decrease during the last 2 weeks of Period I, when the average calorie consumption was 4020 a day. During the next two cycles calorie consumption averaged just under 3800, and there was an insignificant rise in weight. The remainder of the ration test witnessed another significant fall in weight. For the first 10 days of Period III the calorie consumption rose to about 4140 calories per day. Lack of information regarding the calorie consumption for the last partial cycle precludes drawing any conclusion about its relationship to weight loss. During short intervals there was no consistent relationship of changing calorie consumption to changing weight. The underlying trend of weight loss throughout the test occurred in all companies. Figures on calorie consumption for F Company were obtained from all men eating the ration. Weight averages were obtained from the same group of men.

c. G Company showed a generally consistent relationship between calorie consumption and weight change. During Period I, the weight loss was fairly constant in rate. K Ration was consumed during this period at an average of 3625 calories per man per day. The weight decline actually ended before the period was completed. When the 10-in-1 Ration was issued as an 8-in-1 (10 rations to 8 men) during Period II there was a slight gain in weight. The calorie consumption increased to an average of 4400 daily. During Period III, the subjects ate New C Ration, one ration per man with a calorie consumption of about 3300 daily. There was a fairly constant weight loss slightly greater than that for Period I. The calorie intake averaged about 325 per man/day less during the last period than during the first.

d. H Company was on the 10-in-1 Ration for the entire test period. For 10 days of Period III it was issued as a 10-in-1; at all other times as an 8-in-1 (10 rations to 8 men). Weight loss was gradual and regular for Period I, while the calorie consumption averaged just over 4000 calories. When the basis of issue was reduced the weight loss occurred more rapidly, and continued even during the last 11 days of the test when the average calorie consumption had increased to 4650 over the 3925 level of the preceding 10 days. The behavior of H Company shows some inconsistencies in the relationship of weight change to calorie consumption.

e. While on Canadian Mess Tin Ration, X Company had the most precipitous initial drop in weight of all companies, a loss which continued throughout Period I in spite of a gradual rise in calorie intake, which averaged 3580 calories daily for the period. When 10-in-1 Ration was eaten, calorie consumption rose to an average 4425 daily, and a gain in weight followed. The 3 one-week divisions of Period III witnessed a gradual decrease in weight while the calorie consumption ranged between 3800 and 3900. Experimental C Ration was eaten for 1 week, K Ration the second week, and during the final week, the almost unanimous choice was Experimental C Ration, with a few items from the K and Canadian Mess Tin Rations during the last 3 days. The trends of calorie consumption and weight changes agree fairly well.

f. Y Company which has the least weight loss during Period I also had the lowest calorie intake. No definite reason can be advanced for this discrepancy. Loss of weight continued, but more slowly, during Period II when 10-in-1 (10 rations to 8 men) was eaten at an average level of almost 4600 calories daily. Loss continued at a more rapid rate again when the K Ration was issued and consumed at the rate of about 2900 calories per man per day (one ration); though the mean weight rose during the last 3 days of

the restricted issue period when the men were rather inactive. In spite of the increased consumption of calories (4350) during the last 10 days, the weight did not increase. Y Company thus exhibits anomalous behavior in regard to calories and weight.

Figs. 1-6 give the weights by 10-pound classes on the main test days. Bi-weekly weighings reflect changes within the periods. These have been plotted in Fig. 6 for Y Company for the entire test to reveal changes within the main test periods. The table of weights presents these data for all companies. Between 19 July and 27 July there was a sharp weight loss, best seen in the heavier men but present in all groups. This was the period of issue of one K Ration per man per day.

Another trend which appeared in all companies during Period III was the weight loss during the 4 day march (2-6 August in this company). This decrease in weight had been overcome to some extent during the rest period preceding the final test.

7. A COMPARISON OF THE CALORIE INTAKE OF THE LARGE AND SMALL MEN:

Since there was a constant tendency for heavy men to lose more weight than light (Figs. 1-6) the calorie intake of extremes in these 2 groups was studied in all companies with individual calorie data. The 10 heaviest men and 10 lightest men in E, G, X and Y Companies were selected. The average calorie consumption of these groups on different rations, issues and periods are given in Table 5. Contrary to what might have been expected on the basis of size (weight), in all instances when the difference is significant, the heavy men had a lower calorie intake than the light men. Several reasons may be advanced to explain this finding.

a. The light men may be those with higher thyroid activity, with higher resting and working energy expenditure.

b. Assimilation may be better in the heavy men. It is a common observation that some light men eat large quantities while the heavy men are not always those who eat most.

c. The activity of the light men may be greater than that of the heavy. None of these speculations is supported by data obtained in this test, and no final explanation can be offered. The quantity of food (calories) eaten varied significantly from person to person, but there was no correlation between body weight and calorie consumption in the subjects studied in this test.

8. VITAMINS AND PLACEBOS:

Table 6 shows the weight trends of the groups in F Company given vitamins and placebos for Period III. There was no significant difference in weight changes for these 2 groups during this period.

TABLE 1

DISTRIBUTION OF WEIGHTS AND WEIGHT LOSSES

INITIAL WEIGHTS	Weight Gain					Weight Loss															Distribution of Initial Weights
	+8	+6	+4	+2	0	-2	-4	-6	-8	-10	-12	-14	-16	-18	-20	-22	-24	-26	-28	-30	
221-230											1				1						2
211-220																					2
201-210									1			1								1	6
191-200										2		5	1								17
181-190											1	1	1	5	2	2	3	4	1		22
171-180			2	2	3						8	5	7	9	8	7	8	7	2	1	70
161-170					8																111
151-160		1	1	10	6																141
141-150			1	4	10																141
131-140		2	2	10	11																121
121-130		1		4	8																50
111-120			1	1	3																9
Distribution of weight Changes	6	7	31	49	36	122	118	102	74	51	34	26	15	11	6	1	3	3	1	2	

TABLE 2
DISTRIBUTION OF WEIGHT CHANGE
Test 2 to Test 6 (All Companies)

Range of Weight Change (pounds)	Percent of Men
+9 to +12	0.2
+5 to +8	0.8
+1 to +4	7.4
-0 to -3	33.0
-4 to -7	34.1
-8 to -11	11.8
-12 to -15	7.1
-16 to -19	3.6
-20 to -23	1.2
-24 to -27	0.8

TABLE 3
INITIAL COMPANY WEIGHTS

Weights	E Company	Y Company	X Company	H Company	G Company	F Company
221 - 230		1				1
211 - 220		1				1
201 - 210		0	1	3		2
191 - 200	3	1	4	1	1	4
181 - 190	7	3	4	5	4	1
171 - 180	10	13	12	9	10	11
161 - 170	17	18	24	18	22	13
151 - 160	14	21	27	27	23	26
141 - 150	25	34	22	24	30	25
131 - 140	22	22	17	26	14	23
121 - 130	5	13	17	12	8	5
111 - 120	2	2	2	1	2	3

TABLE 4
AVERAGE COMPANY WEIGHTS AT TIME OF FITNESS TESTS

Company	1	2 Control	3	4	5	6	Loss
E	153.5	153.9	150.1	148.1	151.5	146.4	7.1
F	155.2	155.8	154.5	153.3	154.1	152.7	2.5
G	152.5	152.6	151.4	149.7	<u>150.0</u>	146.5	6.0
H	150.4	150.9	149.8	148.0	<u>147.2</u>	145.3	5.1
X	151.6	152.4	148.4	147.1	148.6	147.8	3.6
Y	151.1	150.7	150.0	148.9	<u>148.6</u>	146.0	5.1

Underlined numbers indicate that the change was not significant

TABLE 5
AVERAGE CALORIE CONSUMPTION

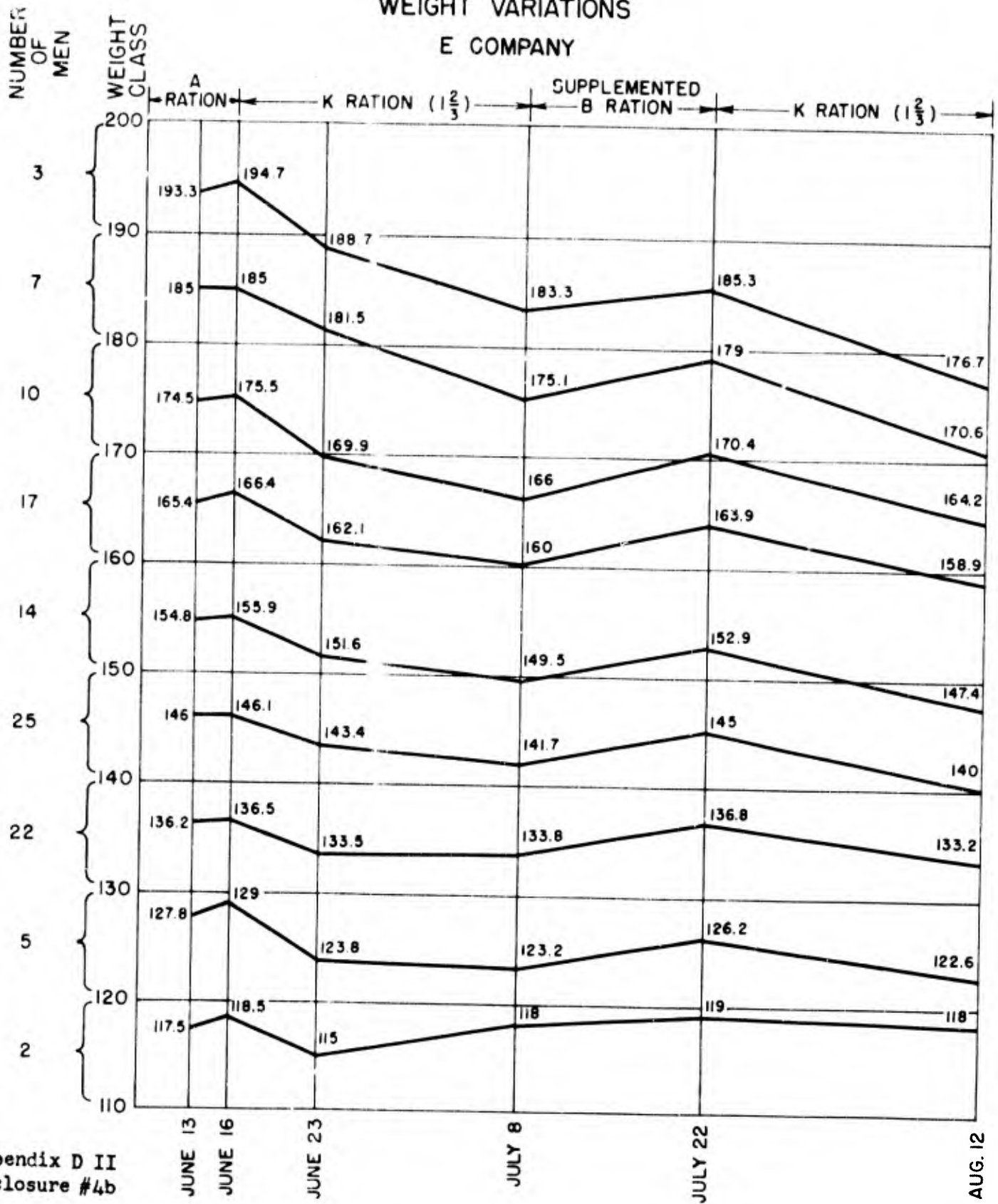
Period	Company	Ration	Issue Rations/man/day	10 Heaviest Men	10 Lightest Men
I	E	K	1-2/3	3025	3200
III	E	K	1-2/3	3900	3850
I	G	K	1-2/3	2725	3175
III 11 days	Y	K	1	2825	2775
10 days	Y	K	1-2/3	4000	4075
III 7 days	X	K	1-2/3	3425	4025
I	Y	C (Exp.)	1-1/3	2825	2750
III 14 days	G	C (New)	1	3125	3100
7 days	G	C (Exp.)	1	3225	3250
III 7	X	C (Exp.)	1-1/3	3725	3950
III 7	X	C (Exp.)	1-1/3	3800	4025
I	X	Choice Mess Tin	1-1/3	3275	3450

TABLE 6
F COMPANY VITAMIN VS. PLACEBO WEIGHTS
AT TIMES OF FITNESS TESTS

Test	Placebo	Vitamin
1	155.4	155.0
2	156.1	155.4
3	154.8	154.1
4	153.8	152.8
5	155.0	153.0
6	153.4	152.0

Line indicates period of vitamin administration.

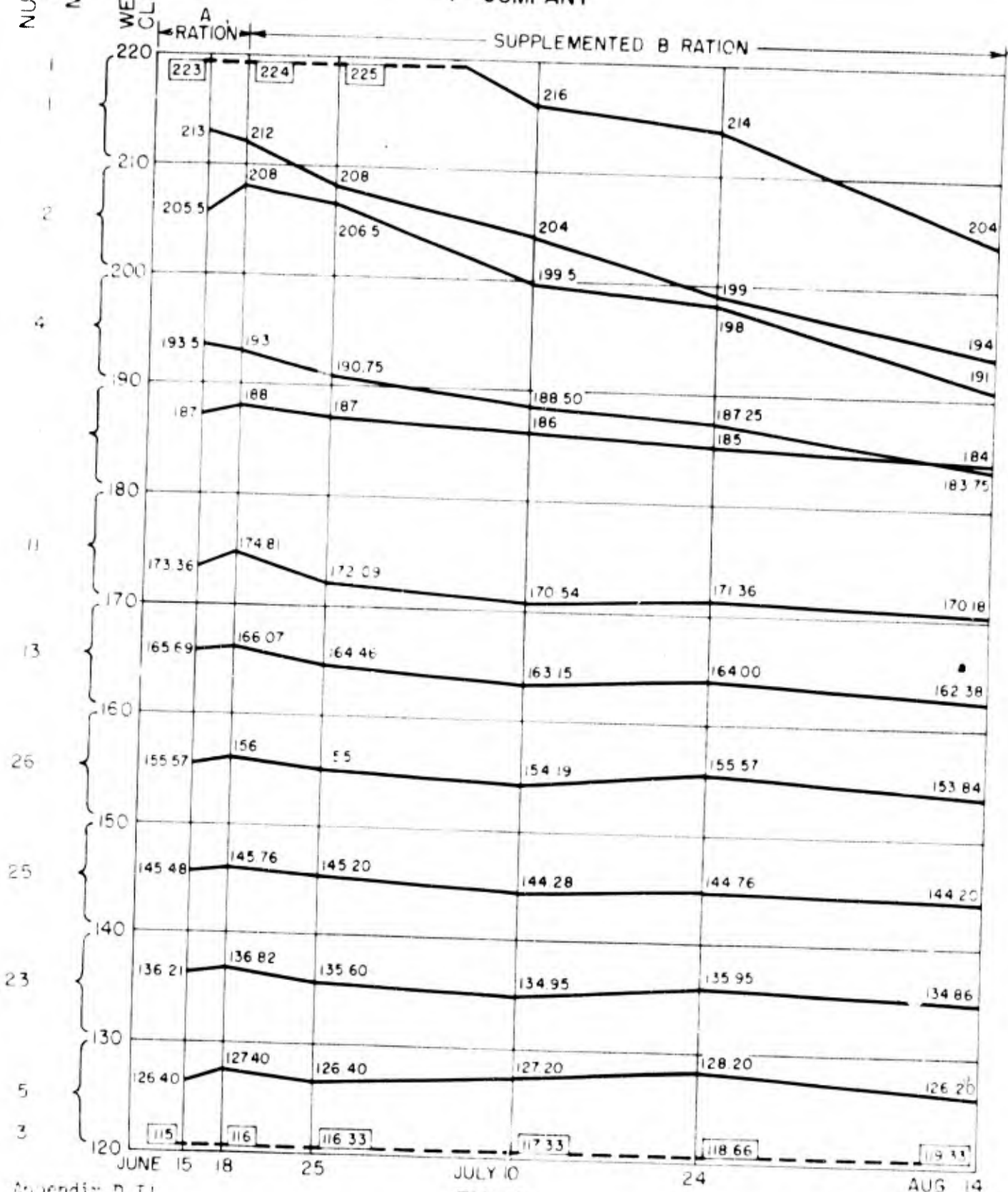
FIG. 1
WEIGHT VARIATIONS
E COMPANY



Appendix D II
Inclosure #4b

NUMBER OF MEN

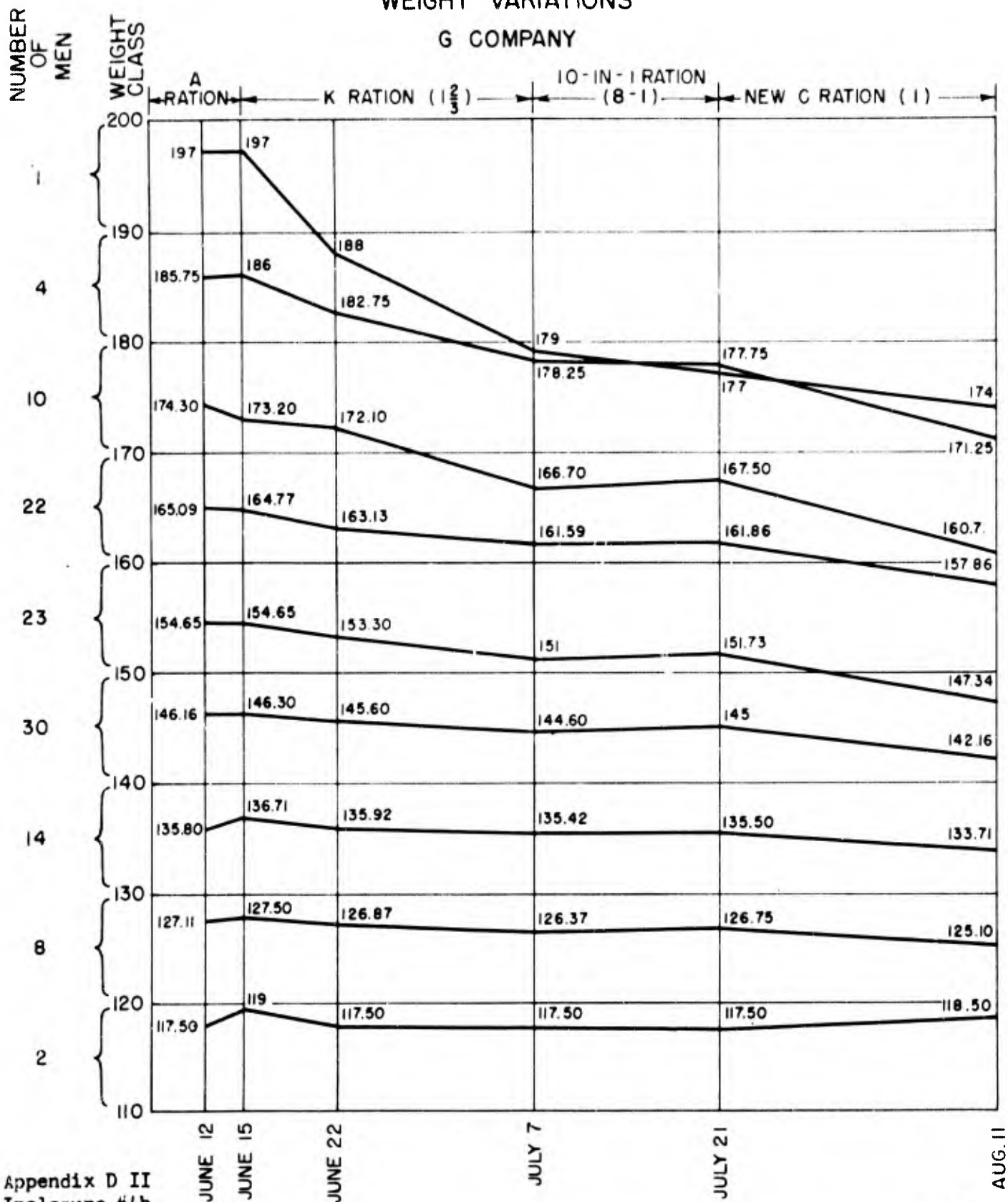
WEIGHT VARIATIONS F COMPANY



Appendix D II
Enclosure #4b

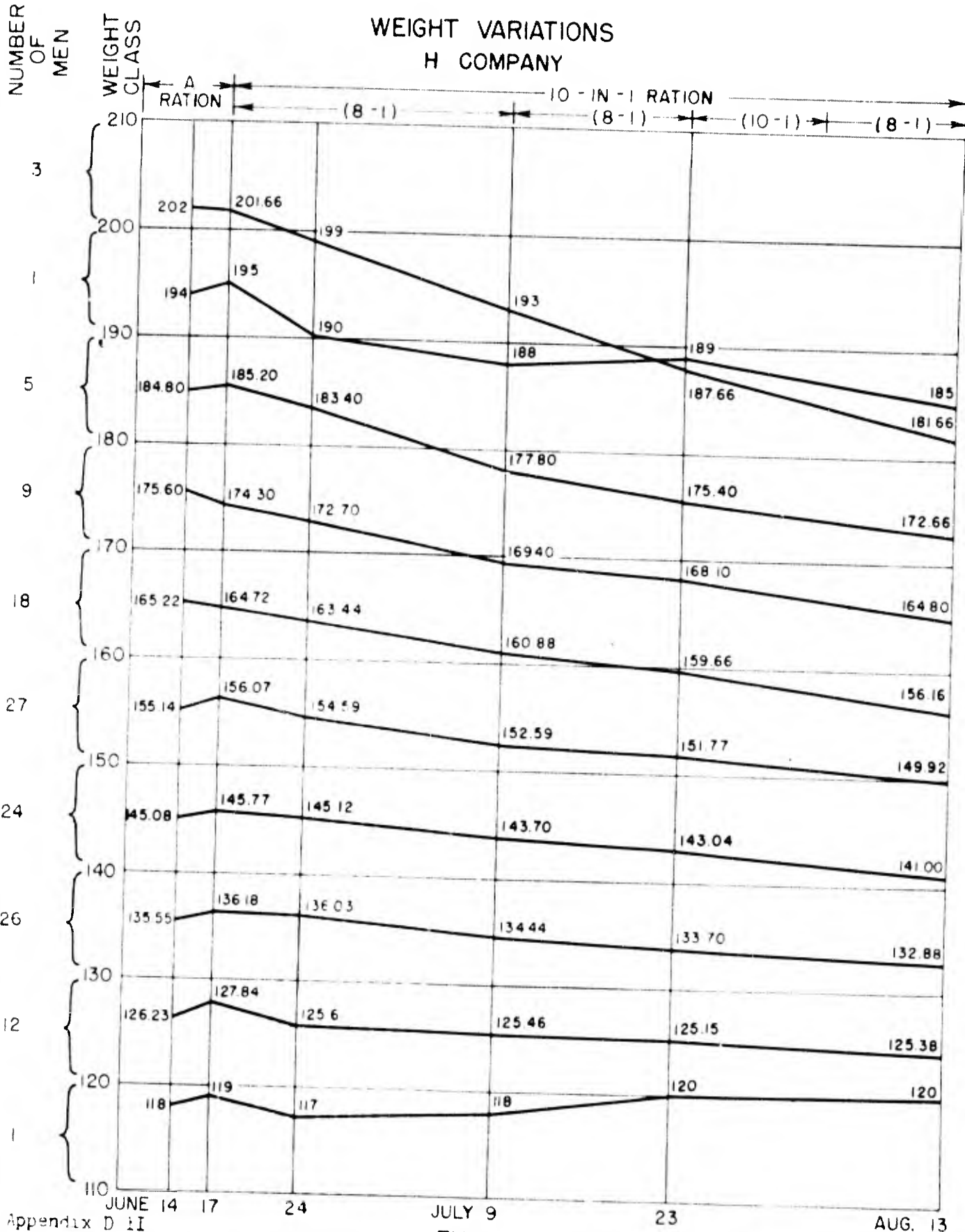
FIG. 2

FIG. 3
WEIGHT VARIATIONS
G COMPANY



Appendix D II
Inclosure #4b

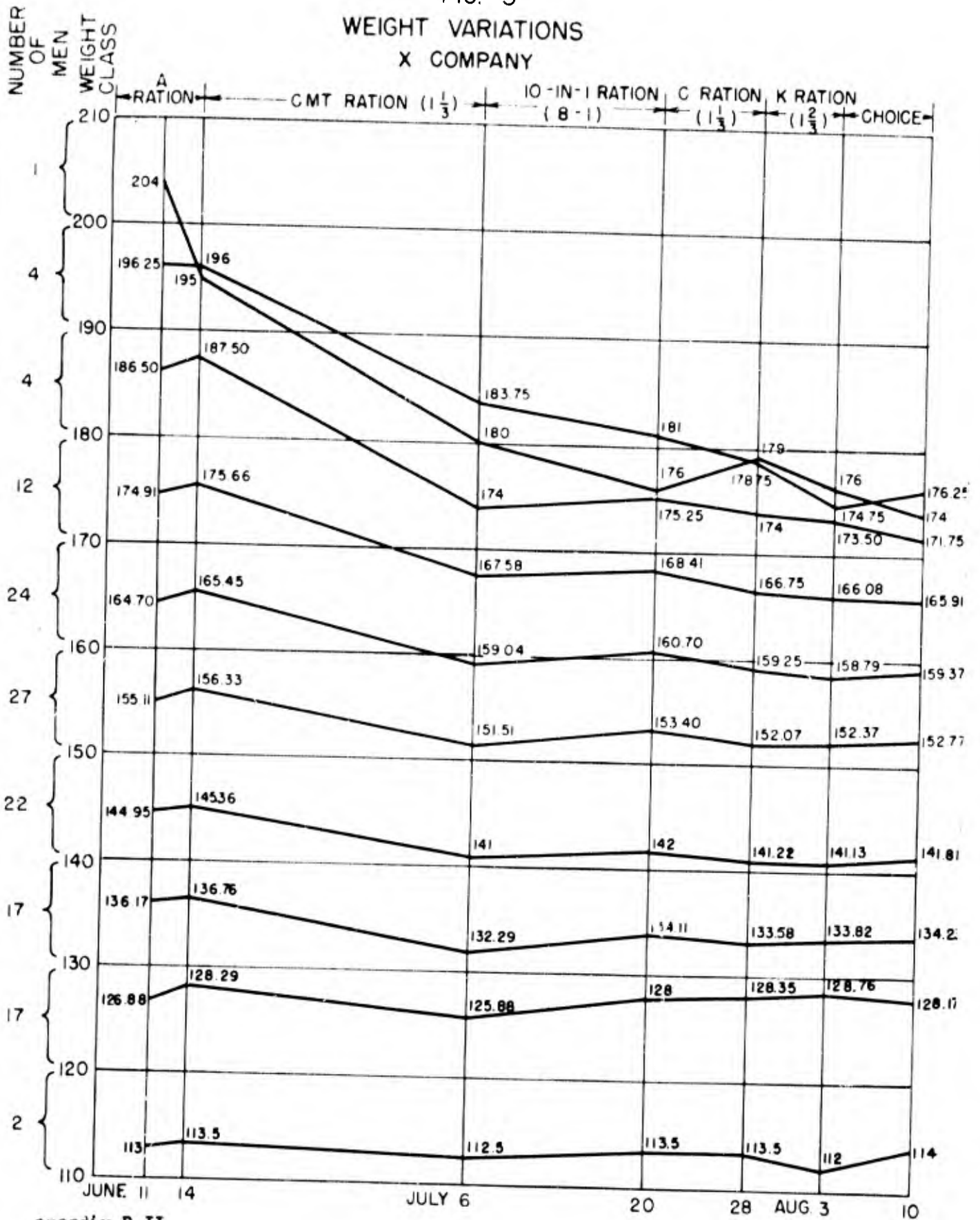
WEIGHT VARIATIONS H COMPANY



Appendix D II
Inclosure #4b

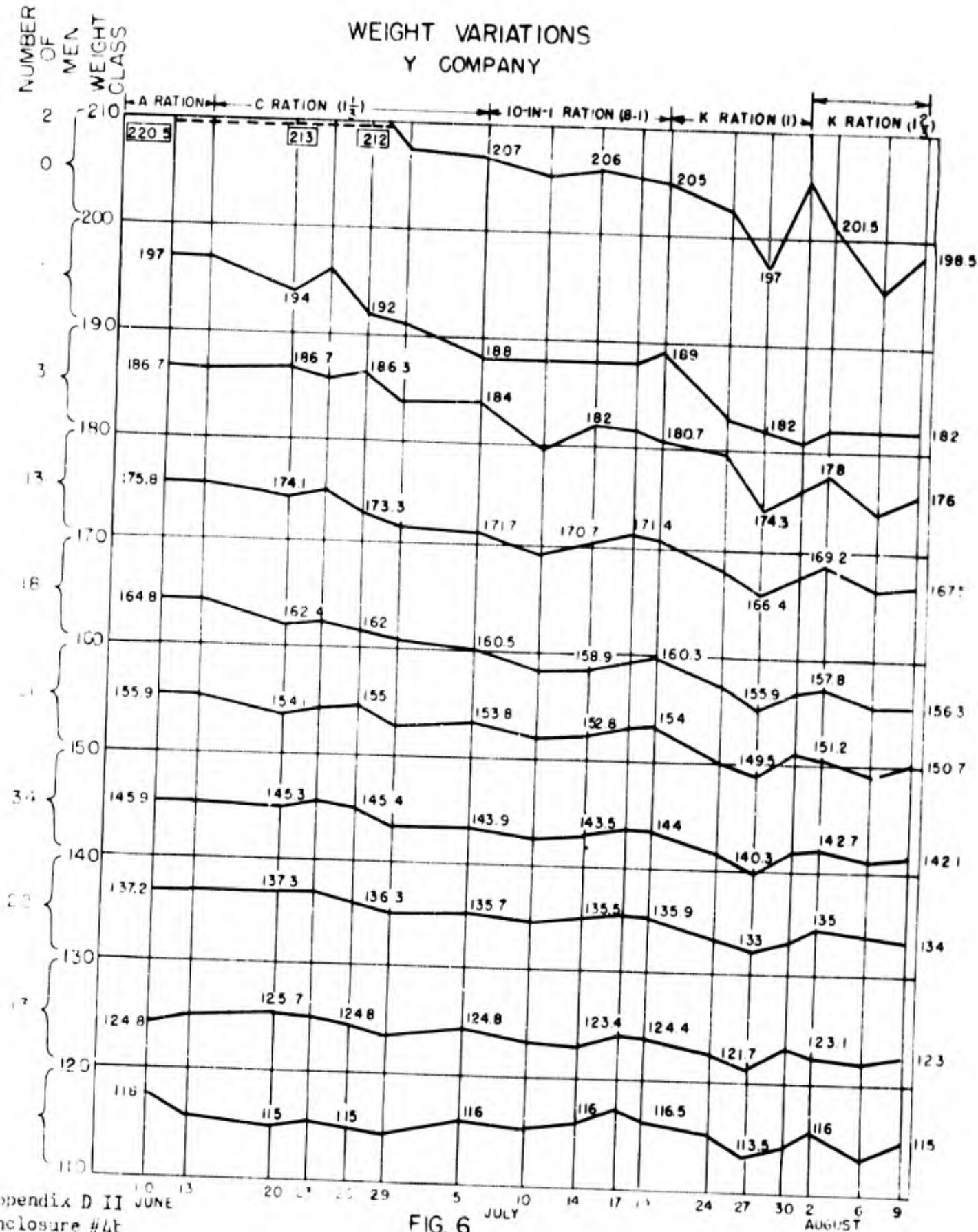
FIG. 4

FIG. 5
WEIGHT VARIATIONS
X COMPANY



Appendix D II
Inclosure #4b

WEIGHT VARIATIONS Y COMPANY

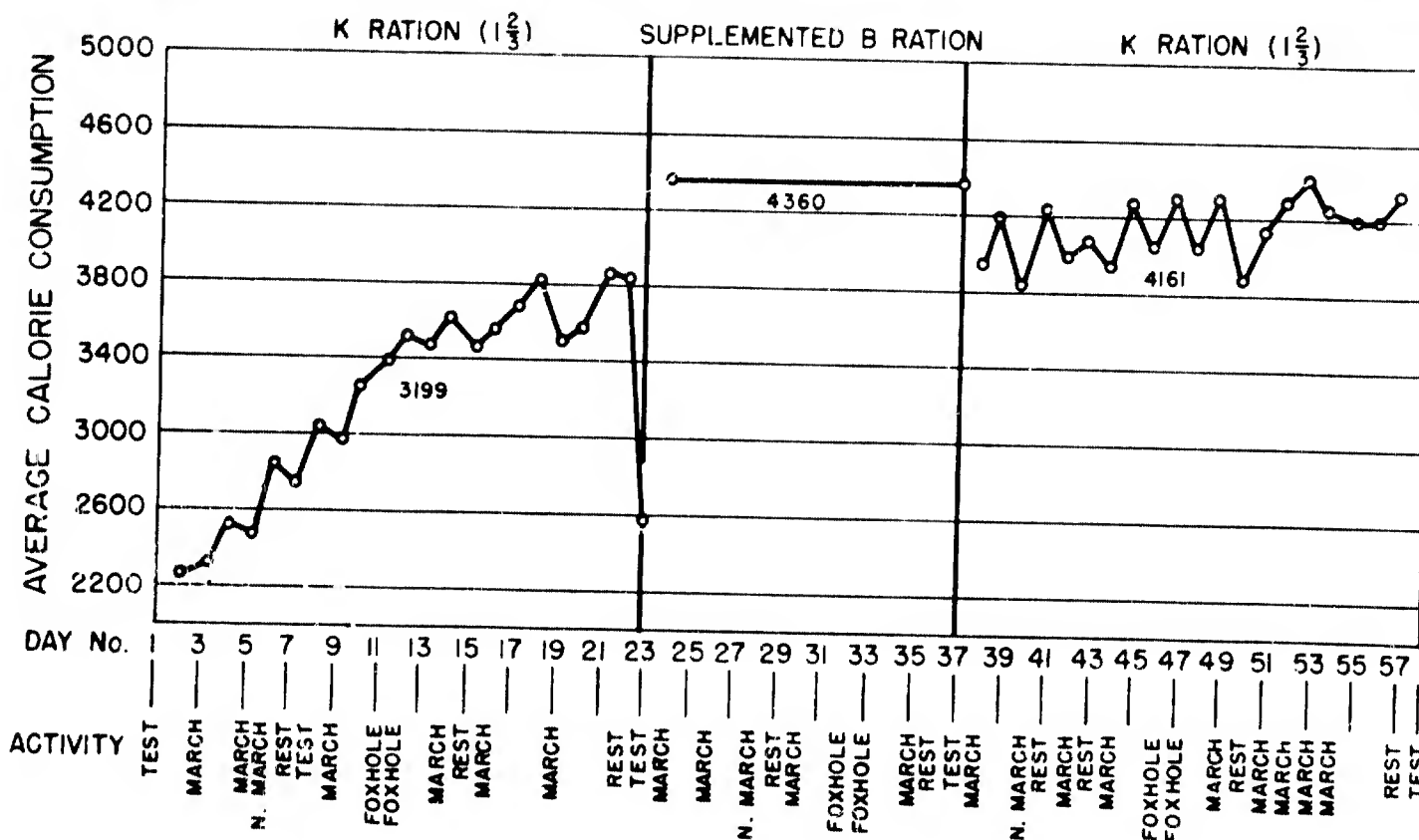
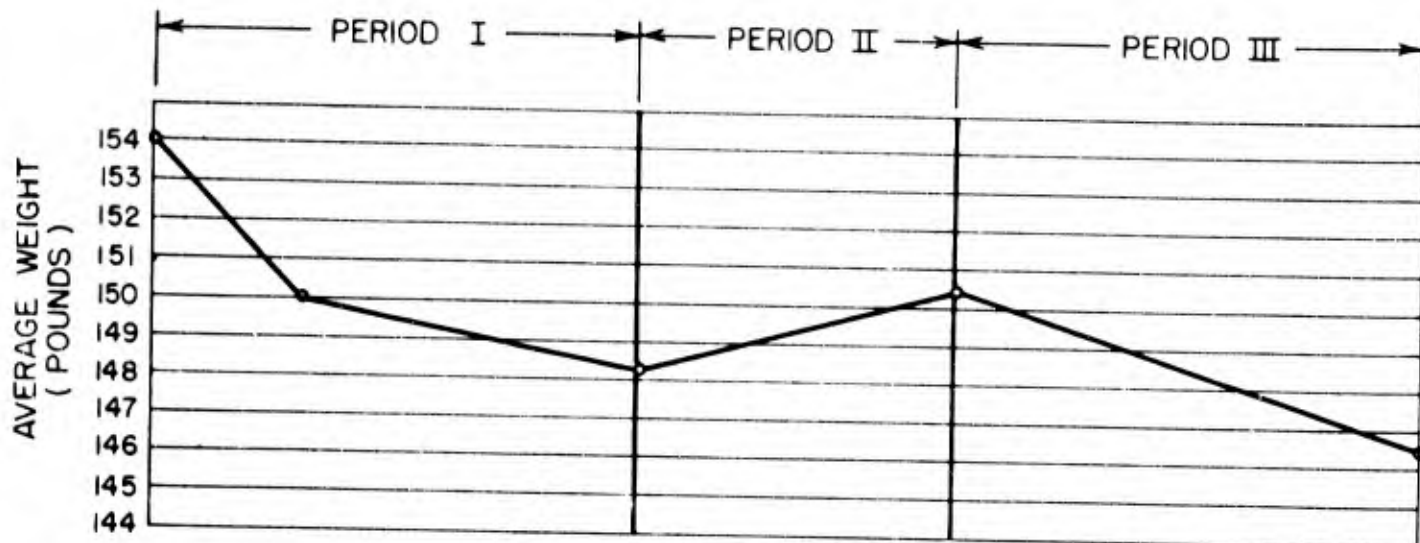


Appendix D II
Inclosure #4t

FIG. 6

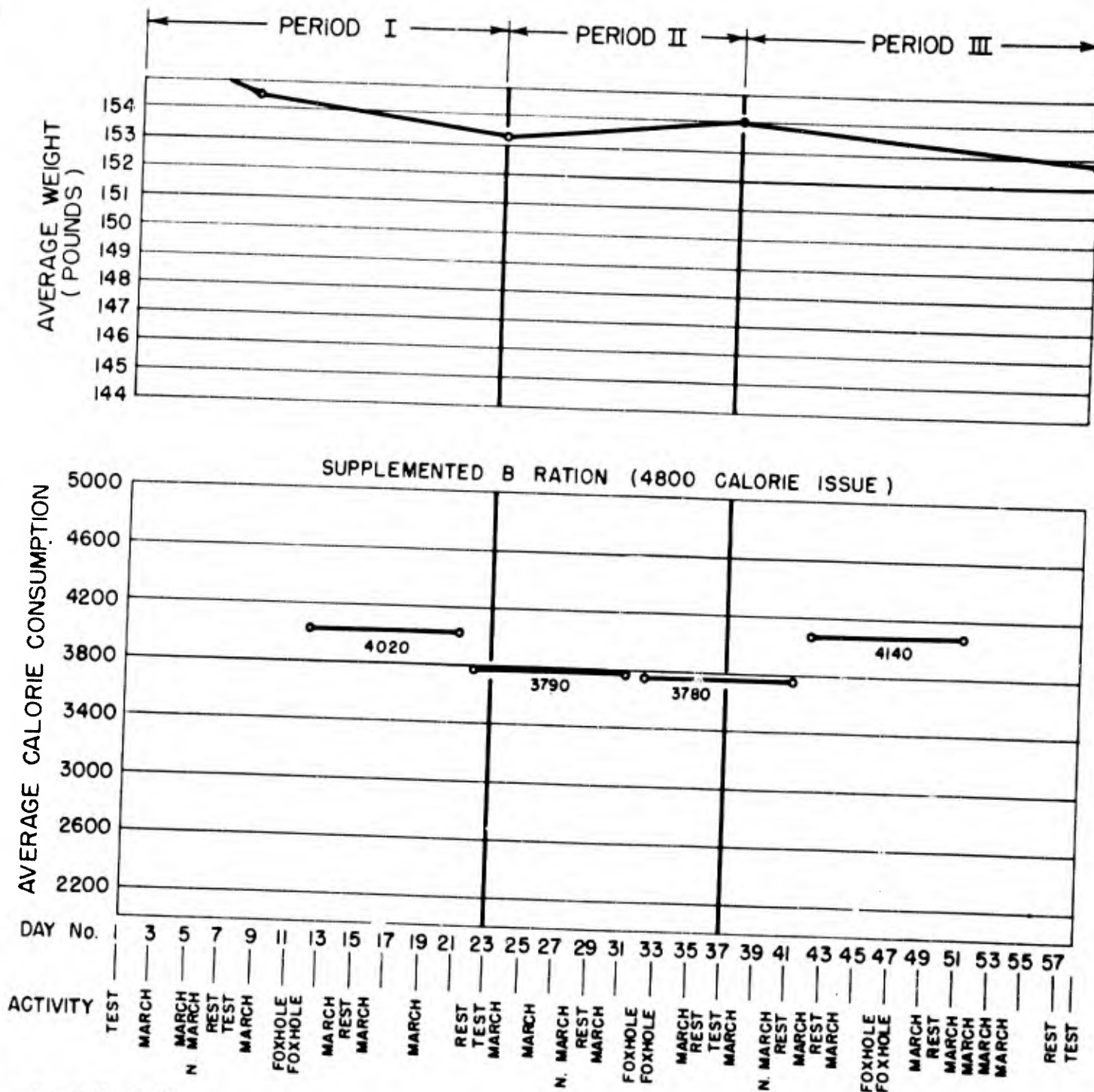
FIG. 7
TRENDS IN AVERAGE WEIGHT AND CALORIE CONSUMPTION

COMPANY E



TRENDS IN AVERAGE WEIGHT AND CALORIE CONSUMPTION

COMPANY F (CONTROL)

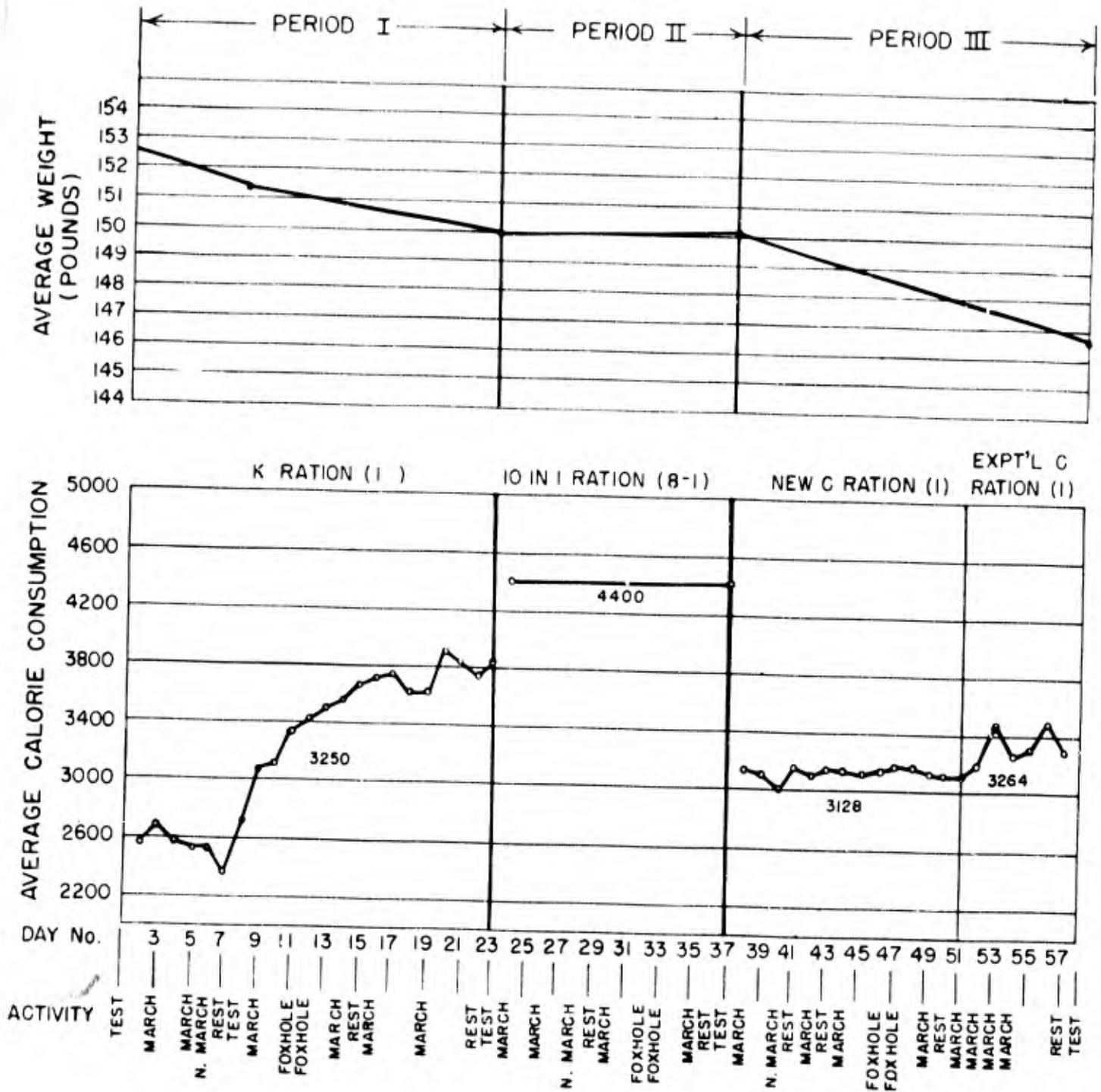


Appendix D II
Inclosure #4b

FIG. 8

TRENDS IN AVERAGE WEIGHT AND CALORIE CONSUMPTION

COMPANY G

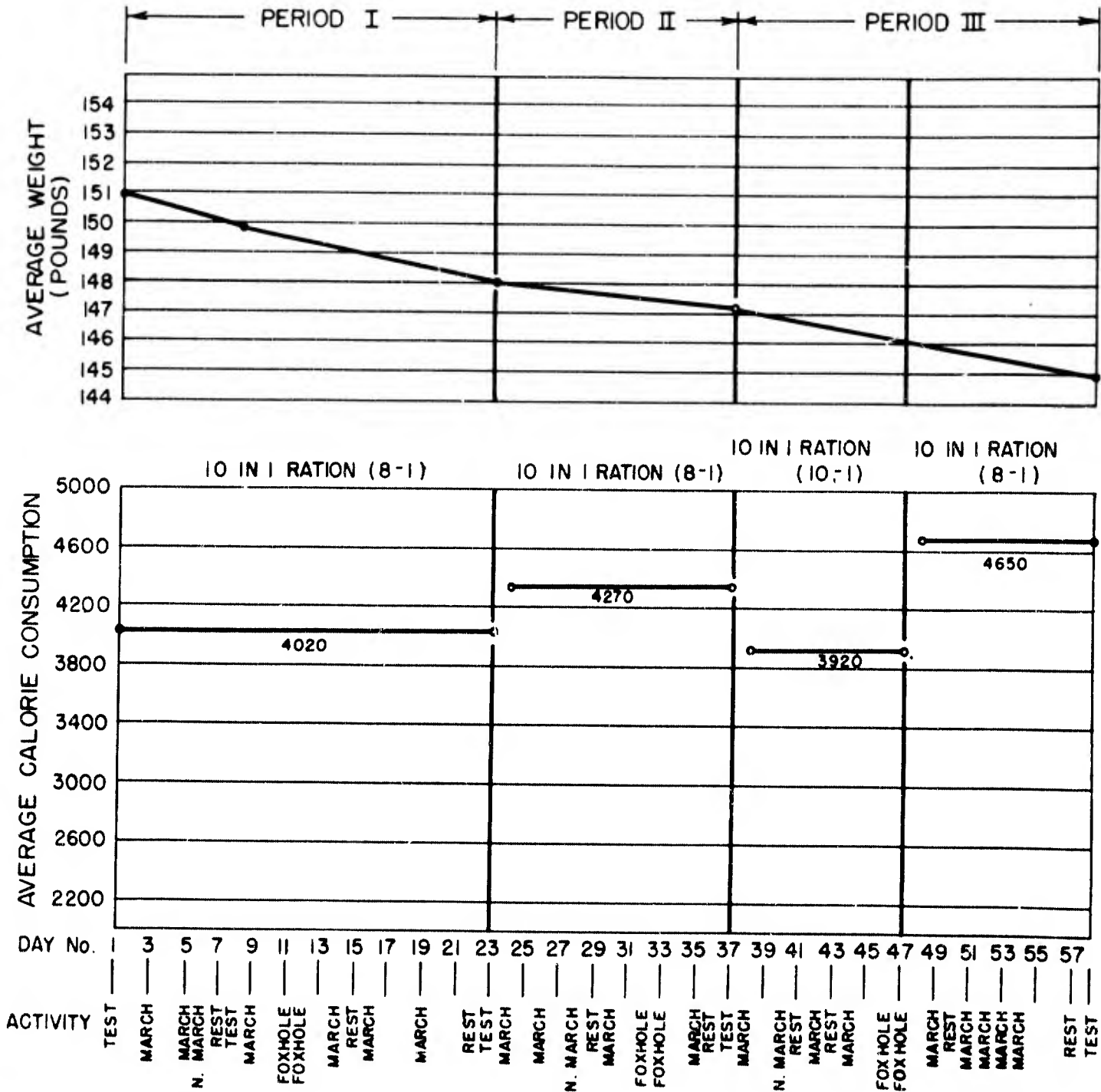


Appendix D II
Inclosure #4b

FIG. 9

TRENDS IN AVERAGE WEIGHT AND CALORIE CONSUMPTION

COMPANY H



Appendix II
Inclosure #4b

FIG. 10

TRENDS IN AVERAGE WEIGHT AND CALORIE CONSUMPTION

COMPANY X

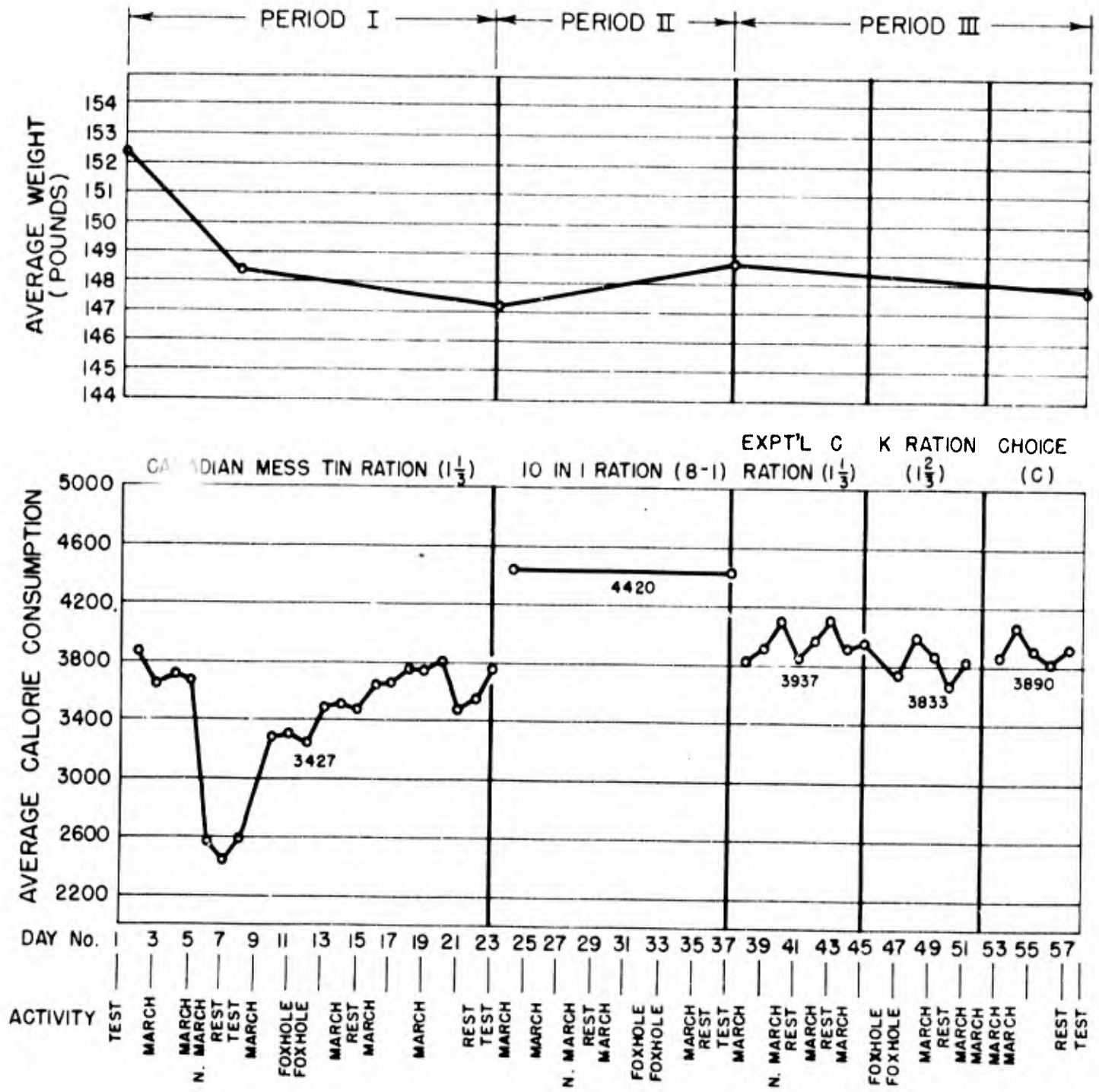
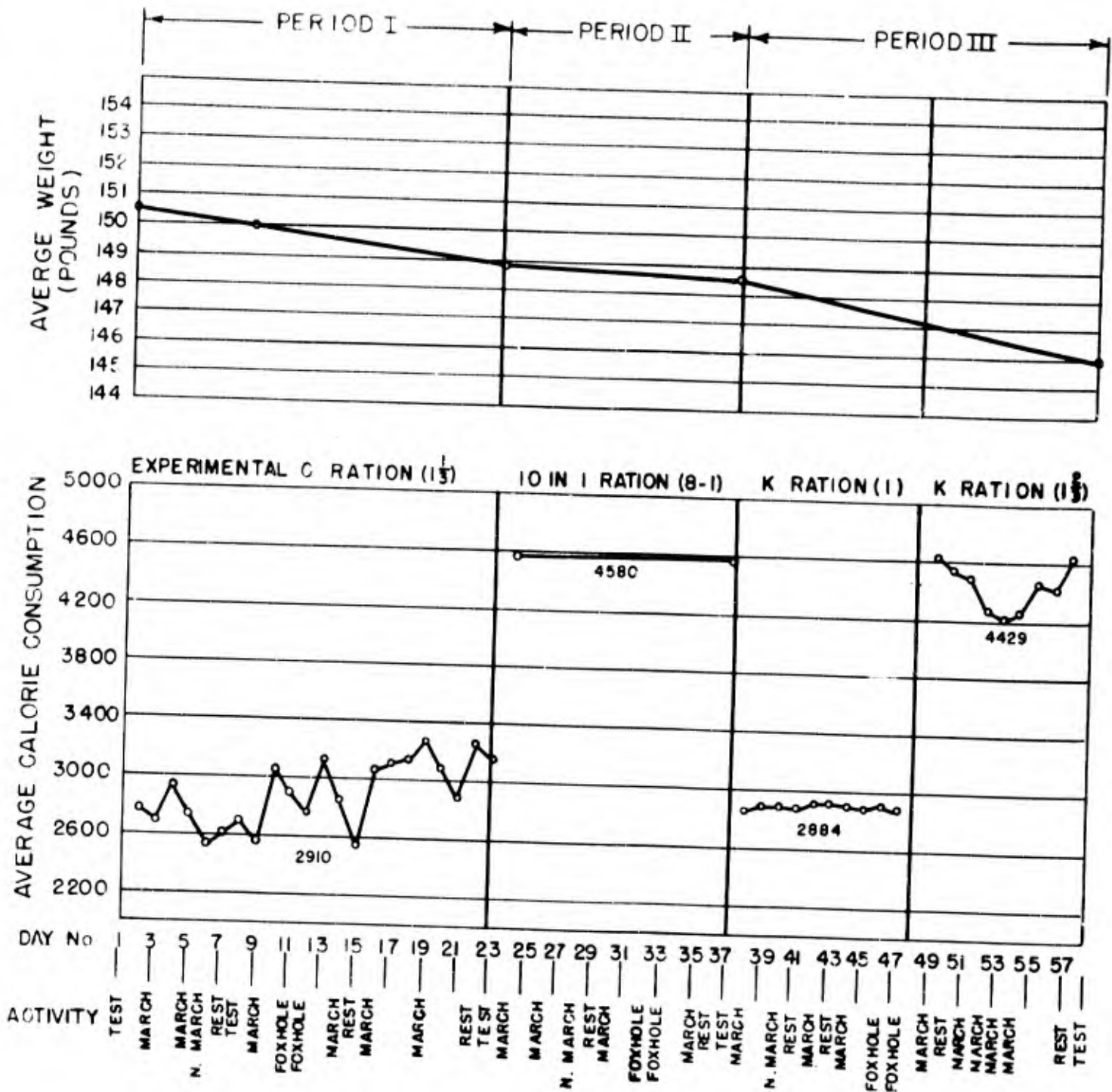


FIG. II

Appendix D II
Inclosure #4b

TRENDS IN AVERAGE WEIGHT AND CALORIE CONSUMPTION

COMPANY Y



Appendix D II
Enclosure (4b)

FIG. 12

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APPENDIX D

Section III

PHYSICAL FITNESS TESTS SUMMARY OF RESULTS

	Co.	Ration	Issue	Period Eaten	Results
Combat Rations	Y	C (Exp.)	1-1/3	3 weeks	Improved more than controls Improved more than controls Improved as much as controls Improved (no controls for period) Improved as much as controls
	C	C (New & Exp.)	1	3 weeks	
	E, G	K	1-2/3	3 weeks	
	Y	K	1	11 days	
	X	Mess Tin	1-1/3	3 weeks	
Support Rations	H	10-in-1	1-1/3	5 weeks	Improved as much as controls Not measured Improved (controls)
	H	10-in-1	1	10 days	
	F	Supp. B	4800 cal.	8 weeks	

I. INTRODUCTION:

Nutrition is one of the factors upon which fitness is dependent. It has often been said that an army moves on its stomach. In order to maintain performance and fitness, troops must be properly nourished. Therefore, in a test of rations, it is essential to gauge the physical fitness of the men. It is fully realized that due to numerous factors which may influence performance, the results of the following fitness tests cannot be considered as absolute. Every effort was made to follow a rigid set of standards so that external factors would be kept constant within practicable limits. (A detailed description of the Harvard Fatigue Laboratory Step Test, the Army Air Forces Test and the Army Ground Forces Test and the techniques and paraphernalia used will be found in Methods and Procedure at the end of this appendix. Hereafter the tests will be referred to as the Step Test, AAF Test and AGF Test respectively).

Because physical fitness is compounded of many parts which are not all measurable or subject to control, its definition has not been agreed upon generally. The basic attributes required for physical fitness are:

- a. A physique or anatomical structure permitting various functions to be performed.
- b. A physiologic state compatible with carrying out the designated exercise.
- c. Motivation or will-to-do which directs the person to carry out the task.

Each of the above categories can be the limiting factor in performance, and no test has been devised which accurately separates the different factors. To some extent, compensation can make up for deficiency in one or another of the above categories. Thus strong motivation may make for better performance with relatively poor physique and physiologic state, than that which may occur with poor motivation but with good physique and physiologic status. Excellent physiologic state may partially mask relatively poor physique, provided motivation is good. To some extent, an excellent physique may cover a deficit in physiologic status. If the will-to-do is impaired, no fitness test will assess physique or physiologic status.

From the military standpoint, physical fitness and motivation are both of supreme importance, and although good performance is the final criterion, the factors which contribute to it are all worthy of closest scrutiny.

Many tests have been devised to give an estimate of physical fitness. Each effectively measures only the particular type of exertion used in the test. Since no single fitness test is entirely satisfactory, it was decided to apply a battery of 3 fitness tests, with a total of 10 different components, in this study. Not only was this systematic approach used, but the platoon and company officers and the observers rated individual soldiers on overall fitness. This rating was based on the officer's opinion of the subject's fitness as a soldier, and therefore took into account morale as well as physical condition.

In addition to the part played by the state of nutrition, physical fitness is affected by a number of environmental factors, of both the internal and external environment of the subject. The motivation and morale, state of rest or fatigue, degree of training, presence of disease or convalescence, and recent alcoholism all influence fitness. Performance is affected by the external environment in many ways. Clothing, heat, cold, wind, rain, and altitude are of marked importance. Specific tasks such as running are naturally affected by clothing, shoes, soft or firm terrain, dust or mud, grade and wind. Such simple exercises as chinning are affected by the size of the horizontal bar, its height from the ground, whether the bar can be held readily in the grip, and whether the palms face front or back. When such factors have had an effect on performance in these tests, specific mention is made.

2. RESULTS:

a. *General*—An elaborate analysis of results of the complete series of fitness tests will not be presented at this time; only the trends and changes by test, company and ration period will be discussed. A complete study of the tests, including the individual components and a critique of the scoring systems will be the subject of a future report.

In this discussion the scores are used for purposes of comparison rather than as indices of absolute rating of good, fair or poor fitness, or as expression of a percentage of hypothetically perfect fitness. It was the stated belief of the battalion and line officers that their troops were in excellent physical condition and had very high morale at the end of the test, and that all companies had made overall improvement in both during the course of the test, regardless of their total ration experience, though 1 company had had a period of somewhat low morale and poor performance (see paragraph d).

Data used in computing company means were obtained only on men who engaged in all components of every test on every test day (Table 1). Thus failure to complete the 4-mile march in the AGF Test reduced the subject's score, but failure to do the march because of a sprained ankle or to do the chins in the AAF Test because of an injured hand eliminated this subject from inclusion in any of the company means. Such a subject was required to take what tests he could for the sake of morale, and he continued as a regular test subject, engaging in all routine activity and subsequent fitness tests. His scores in later tests were included in the platoon averages (Table 2). Table 1, d, and Table 3 show very good agreement between the average scores of those subjects who engaged in all tests, and the averages of all subjects who took a particular group of tests, regardless of whether any were dropped from the test later, took only part of later tests, or who had failed to undertake any earlier series of tests. In Table 1 there are slightly higher scores than in Table 3, especially in the earlier tests. The early scores of the 36 men dropped from the test for medical reasons were in close agreement with the company means (Table 4). This indicates that the trends of improvement are not artifacts produced by subsequent elimination from the test of men initially unfit and with low scores.

b. *Step Test*—The Step Test was done 6 times by all companies, and an additional time by Y Company. A comparison between scores for Test 1 done at Camp Carson and for Test 2 done 3 days later at Topside shows a decrease in all company means. The decreases for E, G and X were significant (See Tables of crude data and statistical analysis). The decrease in scores scarcely indicates the increased subjective distress in breathing at higher altitude (2700 feet higher). The actual score gives a totally erroneous picture. Pulse rates were higher in Test 2 than in Test 1, but the differences were less than would have been anticipated from the dyspnea and general feeling of distress caused by the exercise.

All companies showed significant increases in score from Test 2 to Test 3 (7 days later). This test was run in an attempt to determine the effect of acclimatization to altitude, before any very large changes from rations might have been expected. It was interpolated into the schedule as an extra day. G. and X Companies, which had decreased most from Test 1 to Test 2 showed significantly greater improvement than F Company. It is impossible to assign this improvement to a single factor, and there is no objective method of proportioning the responsibility to the several probable factors:

- (1) Acclimatization to altitude, if the only factor, might have brought the scores back to the initial level.
- (2) The learning curve, overshadowed by the effects of altitude in Test 2, might be showing its effect.

- (3) Actual fitness undoubtedly improved during the week of hard training and regular hours.
- (4) Morale with regard to the Step Test improved. It was looked on universally as the toughest and most disagreeable of the lot, and the tendency to make the left calf sore was very annoying to some subjects. It may have made some reduce effort in order to spare their legs.

The trend of improvement in all companies but F continued between Test 3 and Test 4 (2 weeks later). F Company showed a decrease (not statistically significant) which occurred because of an increase in pulse rates with no decrease in time of exercise. The company officers all thought the men were in better condition than 2 weeks before. A large breakfast of pancakes and molasses was blamed for this change by the soldiers and officers of the company.

Period I thus witnessed a general increase in score on the Step Test in all companies regardless of ration. Improvement from Test 1 to Test 4 was greatest in those companies with the lowest initial score. Changes from Test 4 to Test 5. (Period II) show a tendency for continued improvement but at a slower rate. The scores for E, F and Y Companies increased significantly; the others held their own or improved only slightly.

Y Company improved significantly from Test 5 to its extra test 12 days later. All companies improved their scores from Test 5 to Test 6, and none differed from F in this regard. The relative position of all companies ended as it began except for E Company which changed from 4th to 6th place. All scores increased from Test 2 to Test 6. G, X and Y improved more than F.

The distribution of scores for all companies, and for the battalion on Test 2 is given in Table 8. Curiously there was no score of 85 on any test. Neither 85 nor 100 can be achieved by any man who completes the 5 minutes of work which most subjects did. The scoring grid has only 3 possible combinations of time and pulse rates which give a score of 85, and none was satisfied in this series of tests (See scoring table for Step Test in Methods and Procedure).

c. *Army Air Forces Test*—A comparison of the scores on Test 1 and Test 2 shows a decrease in all company means except for F Company which showed a trifling increase. The changes for F and E Companies were not significant, the others were significant. In addition to the effect of increased altitude, the shuttle run was completed in slower time because of (1) the sandy track and (2) the use of heavier shoes. The slight increase in F Company's score, and the only moderate reduction in E Company's score were brought about by a decided increase in the number of sit-ups accomplished; the time on the run was slower. Increase in sit-ups appeared to be an effect of a rapidly learned knack rather than any true improvement in physical fitness (See Table 6).

Differences between AAF Test scores on Test 2 and Test 3 are in notable contrast to the differences between Step Test scores. X Company was the only one to show a significant increase—others remained constant or had minor fluctuations. While it would appear that the effect of increased altitude had been overcome in the Step Test, scores of the AAF Test remained about the same. The changed conditions of track and shoes interfered with performance so that Test 2 rather than Test 1 gives a better baseline for subsequent comparison.

Real improvement occurred in all company scores from Test 3 to Test 4 though E Company was the only one to parallel the improvement in F Company. It is of interest to compare the opposing trends shown on Step Test scores, (decrease) and AAF Test scores (increase) by F Company. This serves as a warning against too great dependence upon a single test as an index of fitness. Physical condition certainly did not improve in the morning between tests in the 2 platoons taking the Step Test first, and decrease in the other 2 taking the AAF Test first, to cause the divergent trends. It appeared that physical fitness had definitely improved in all companies, regardless of ration, during Period I; increase in Step Test scores was rapid initially, then slow, whereas in the AAF Test it was minimal during the 1st week, and increased during the last 2 weeks.

The trend of increase continued from Test 4 to Test 5 (Period II) in all companies, though at a declining rate. None of the companies differed significantly from F in this regard.

Y Company improved significantly in score from Test 5 to its extra test, 12 days later.

The general trend of improvement continued in all companies but F from the 5th to 6th Tests. F Company scores decreased significantly. An insignificant downward trend appeared in Y Company's score

from its extra test to the final one, though its overall improvement from Test 5 to 6 was significant. The scores of all companies throughout the test showed a consistently parallel course, regardless of the ration tested. The distributions of all company and battalion AAF Test scores on Test 2 are given in Table 8.

d. *Army Ground Forces Test*—The AGF Tests were not run at Camp Carson so the initial effect of altitude cannot be ascertained on this battery of tests.

Scores for E Company decreased from Test 2 to Test 3. All other companies improved, though G Company increased less than F Company. The 2 companies on K Ration (E and G) were not eating as much during the 1st week as subsequently, though it is by no means certain that their morale also was not poor during Test 3.

From Test 3 to Test 4 all companies improved, and all others improved more than F Company.

From Test 4 to Test 5, F, H and Y Companies improved while X Company decreased in scores.

Y Company showed no improvement from Test 5 to its extra test.

E, G and X Companies improved while F decreased from Test 5 to Test 6. The 3 companies which improved from Test 4 to Test 5 did not improve from Test 5 to Test 6. The companies which did not improve from Test 4 to 5 did improve from Test 5 to 6.

With these exceptions noted, all companies showed a consistent and significant improvement from Test 2 to Test 6.

AGF Test score distributions of the company and battalion on Test 2 are shown in Table 8.

e. *Sum of The Scores of The Three Tests*—The total scores for the 3 tests were recorded for each test (Tables 1, d, 2 and 3). These scores tend to increase in a much smoother manner than do those of the component parts presented above. All companies improved significantly from 1 test to the next except E Company from Test 2 to 3, X Company from Test 4 to 5, F Company from Test 5 to 6, and Y Company from its extra test to Test 6. The scores are closer together in Test 6 than in Test 2.

f. *Effect of Different Rations on Fitness*—From the foregoing discussion of improvement in scores of the various fitness tests throughout the course of the ration trials, several points emerge. There was a strong trend towards improvement in fitness regardless of ration, and regardless of changing from one ration to another or staying on the same ration throughout. If any ration as issued and consumed had any ill effect on fitness, it was lost in the general improvement in fitness which occurred during the arduous program of activity. The only possible conclusion is that all of the rations when eaten *under the circumstances of this test*, were adequate for maintenance of physical fitness and activity normal for troops in arduous training.

g. *Other Measures of Fitness*—In addition to the standard fitness tests, other activities throw light on the physical condition of the men. Ability to make a good score on the rifle range was retained throughout and in some companies improved regardless of ration. No ill effects of any of the rations tested were seen in rifle firing (See Appendix D, Section IV). Even more impressive was the increased ability to complete the marches. During the early stages of the test there were numerous casualties on the marches. About 80% of these were from trauma (blisters, sprains, strains) and 20% from exhaustion or physical inadequacy. On the last march (90 miles in 4 days), several companies finished with all men who started; and the only casualties were from injury (strained muscles and ligaments, sprained ankles). In the whole battalion, only 3 men failed to finish the 4 mile march (AGF Test) on time during Test 6. No one who worked with the battalion could fail to be impressed by the remarkable change which took place in the subjects during their period of hard work in the test area away from the distractions of a permanent post. A miscellany of army specialists, most of whom thought that they were being reduced, at least in glamor, by their assignment to infantry, were transformed into a tough outfit, able to carry out arduous tasks, greatly improved in physical condition and with high morale.

h. *Officers' Ratings of the Test Subjects' Fitness*—It has been our contention that an alert, interested officer who has worked and lived with his troops long enough to be familiar with them can give a better evaluation of their fitness (physical and mental) than any fitness test yet devised.* An attempt was made, therefore, to obtain a roughly quantitative estimate of each subject's fitness on the regular test days from the company

*Armored Medical Research Laboratory Report on Project #5, Sub-Project #5-29 - Development of Tests to Evaluate Physical Fitness in Men. 10 March 1944.

and platoon line and noncommissioned officers. Ratings of good, average and poor were given. The subject's all around ability as a soldier as well as the more strictly physical attributes of fitness were taken into consideration. Since the cadre of line officers and key noncommissioned officers had not been with the subjects prior to the beginning of the ration trials, this opinion was not recorded until the officers had gotten to know the men. Changes in officer personnel during the test (See Table 2, Appendix A) and the utilization of different men to do the ratings have reduced the consistency of results to some degree.

Table 7 presents the data on the relationship of fitness ratings to the sum of the scores on the 3 fitness tests for the last 3 to 5 tests on all but F Company. The data on ratings from this company were lost somewhere in the process of transcribing and sending to Omaha. The ratings were consistently high in this company, which had been organized before the others. There is good general agreement between the officer rating and sum of scores on the various tests. Some companies consistently rated men high, and some low which prevents any comparison of different companies, but the trends follow the actual scores on fitness tests. This validates the concept of a good line officer's ability to judge fitness in his troops. Information of this type is obviously not of a strictly quantitative nature, and better standardization of the meaning of the 3 grades of fitness would probably have given more comparable results. It was the specific purpose of our procedure to get an estimate from the officer without any special coaching as to how to arrive at his opinion.

i. *Observers' Ratings of Test Subjects' Fitness*—Ratings of physical fitness were made by the observers in all companies and recorded on the daily ration questionnaires (See Appendix C) during part of test. Though the data are not complete the observers' ratings of fitness were always lower than those given the men by their own line and noncommissioned officers, and showed poor agreement with the actual fitness test scores.

Examples of ratings of physical fitness:

Company	Observers' Percentage			Officers' Percentage		
	Poor	Average	Good	Poor	Average	Good
G	13	30	57	1	43	56
H	17	38	45	3	14	83
X	7	77	16	0	16	84

The observers had no previous experience in infantry organizations, had not commanded troops and were not familiar with fitness testing prior to the ration trials. This indicates that more is required than mere acquaintance with troops to appraise their fitness. The capacity to make sound judgments on physical fitness is acquired or developed by the experience of exercising command.

j. *Relation of Age to Fitness Test Scores*—It is well known that after a certain age physical fitness decreases with increasing years. It has never been determined how much of this decline is owing to lack of exercise and training and how much is a natural phenomenon of aging. Data from Test 2 and Test 6 on the relationship of age to fitness for the 3 tests are presented in Figure 5. Before training there is a decline of fitness beginning in the middle twenties. It is strongly suggested from these figures that 1 of the factors contributing to the higher scores made by F Company was the larger proportion of men in the age groups which tended to have higher scores on fitness tests. The improvement which took place in all groups was somewhat higher in the older men so the effect of age has almost been lost by the last test.

k. *The Effect of Vitamins on Fitness*—For a study of possible effects on the changes in the eyes found on clinical examination, F Company on Supplemented B Ration was divided into 2 groups. Platoons 1 and 3 were given 3 placebos daily and platoons 2 and 4 were given 3 U. S. Army vitamin tablets daily for the last 3 weeks of the test. No significant differences in the scores of any of the fitness tests were discovered (See Table 9).

3. METHODS AND PROCEDURE

Because variation in procedure may alter scores on fitness tests we have outlined in detail the exact methods used. Every effort was made to follow the directions laid down by the originators of each test. Mimeographed sheets used as guides by all observers and by company officers are copied below.

a. Step Test

- (1) The Subjects line up in front of the stepping platform. They should be stripped to the underwear and should wear rubber soled shoes or no shoes at all.

- (2) One observer calls the rhythm. (A simple pendulum consisting of a weight on a string 39 inches long helps in keeping time.) At the signal "Start" each subject places one foot on the platform, steps up placing both feet on the platform, straightens the legs and back, and immediately steps down again, bringing down first the same foot he placed up first. At exactly 2-second intervals the signal "Up!" is given, and rhythm is maintained by giving the count: Up!-2-3-4 Up!-2-3-4, etc. The subject should "lead off" with the same foot each time, and not try to alternate feet. However, 1 or 2 changes of "lead off" during the test are immaterial (See Appendix F). He must not touch anything with his hands, but may move his arms freely.
- (3) Begin counting the time when the subject starts exercising and exercise him for 5 minutes, continuously, unless he stops before then from exhaustion. If he falls behind stop him after he has been unable to keep up the pace for 20 seconds. Note the duration of his effort to the nearest second. All men are stopped at 5 minutes if they can go that long.
- (4) When the subject stops, start counting the time, and have him sit quietly on a chair.
- (5) Beginning exactly 1 minute after he stops, count the number of heart beats for exactly 30 seconds. The base of the neck is the easiest place to find the pulse after exercise.
- (6) Record the duration of effort and the number of heart beats in the 30-second period beginning 1 minute after he stops. No other observations are necessary.

b. *Army Air Forces Test*—The AAF Test is composed of 3 elements: the sit-up, the pull-up or chin, and the shuttle-run.

- (1) *Directions*—The test subjects are to wear regulation field uniform and shoes throughout the entire test. Jacket is to be kept on if 2-piece uniform is used.
- (2) *Sit-up*—The subject begins the test lying supine on the ground or floor with hands placed behind head. He sits up, then extends his hands to touch his toes, keeping his knees straight, and then resumes the supine position. This is repeated as long as he can continue or up to 114 times when the test is discontinued. No counter-weight may be placed on the knees or legs. The number of complete sit-ups are recorded.
- (3) *Pull-up*—The subject grasps the bar with the palms facing inward and hangs free with arms fully extended, then pulls himself up so that his chin is *above* the level of the bar, and lets himself down to the full extent with arms completely extended, not bent. This is repeated as many times as possible. No kicking is permitted. The number of *complete* pull-ups is recorded.
- (4) *Shuttle-run (300 yards)*—Two poles are set up in level ground 60 yards apart. The timer is at 1 pole, the subject at the other. At the starting signal, the timer starts the watch, or records the time if no stop watch is on hand, and the subject starts his run. The poles must be rounded, but not touched. Five lengths of 60 yards constitute the test run. The time in seconds is recorded; fractions of seconds are converted to the next full second.

c. *Army Ground Forces Test*—This test is a battery of 6 different tests. Men pass from one event to the next without pause. Events are run in the order listed; men are in field uniforms throughout the entire test. During Event F (4 mile march) men are in field uniform and carry full field equipment. In recording results on score sheets record *time* or *number* of performances; actual scoring will be computed by the statistical team.

(1) *Procedure*

- (a) *Push-ups*—From the leaning rest position, lower body by bending arms at elbow until chin and chest are near the ground, keep body straight and raise body by straightening arms. Repeat exercise as many times as possible. There is no cadence or time limit. Body must remain straight and stiff. Push-ups accomplished by bending or rocking body will not be counted. Record number of push-ups.
- (b) *300 yard run*—Terrain should be level, but not ideal for running. Run 150 yards round marker, return to starting line; record time in seconds, raising fractions of seconds to the next full second.

- (c) *Burpee*—From position of attention, bend to squatting position, place hands on ground inside knees and at same time extend legs straight to the rear, recover the squatting position and then to position of attention. Repeat exercise as many times as possible in 20 seconds. Record number of *complete* Burpees.
- (d) *75 yard pig-a-back*—Men should carry men approximately their own weight. Men who fall down try again later. Record time in seconds raising fractions of seconds to next full second.
- (e) *70 yard zig-zag*—The ability to run, crawl, creep and jump. At the end of each run "hit the ground", except for the last two. The jumps are 5 feet center to center, and in line. Islands on which to jump should be 2 feet in diameter. Six jumps, landing on both feet in each island (5 islands) are required to cross this 10 yard stretch. Direction of the course changes 45 degrees each 10 yards. Record time in seconds, raise fractions of second to next full second. (See Figure 6 for diagram.)
- (f) *4 mile march*—As each group completes tests (a) to (e) inclusive, it assembles with full field equipment and marches over a 4 mile measured course. The march should be completed in 50 minutes. For straggling during the 1st mile, cut 8%; 2d mile, cut 6%; 3d mile, cut 4%; 4th mile, cut 2%. Over 50 minutes, for each minute or fraction thereof, up to 5 minutes, cut 5%. Men who do not finish the 4 miles are scored zero (0) for the event. Record the time (accumulated) at the finish of each mile.

d. Scoring Table of Step Test

Instructions: (1) Find the appropriate line for duration of effort; (2) then find the appropriate column for the pulse count; (3) read off the score where the line and column intersect; and (4) interpret according to the scale given below.

DURATION OF EFFORT	HEART BEATS FROM 1 MIN. TO 1-1/2 MIN. IN RECOVERY										
	40- 44	45- 49	50- 54	55- 59	60- 64	65- 69	70- 74	75- 79	80- 84	85- 89	90 over
0 - 29"	5	5	5	5	5	5	5	5	5	5	5
0'30" - 0'59"	20	15	15	15	15	10	10	10	10	10	10
1' 0" - 1'29"	30	30	25	25	20	20	20	20	15	15	15
1'30" - 1'59"	45	40	40	35	30	30	25	25	25	20	20
2' 0" - 2'29"	50	50	45	45	40	35	35	30	30	30	25
2'30" - 2'59"	70	65	60	55	50	45	40	40	35	35	35
3' 0" - 3'29"	85	75	70	60	55	55	50	45	45	40	40
3'30" - 3'59"	100	85	80	70	65	60	55	55	50	45	45
4' 0" - 4'29"	110	100	90	80	75	70	65	60	55	55	50
4'30" - 4'59"	125	110	100	90	85	75	70	65	60	55	50
5'	130	115	105	95	90	80	75	70	65	65	60

Interpretation: The score is an indication of general physical fitness on the day of measurement. Physical training usually, but not always, improves the score. A man with a poor score will work poorly in any climate unless trained.

Below 50 - Poor General Physical Fitness
 50 - 80 - Average General Physical Fitness
 Above 80 - Good General Physical Fitness

e. Scoring Table Army Air Forces Test

SIT-UPS		PULL-UPS		5 x 60 yds. SHUTTLE-RUN		Sum of Scores	P. R.
No.	Score	No.	Score	Sec.	Score		
114	100	23	100	35	100	300	Excellent
108	98	22	99	36	95	290	
102	96	21	97	37	90	280	
96	94	20	94	38	88	270	
90	92	19	90	39	85	260	
84	88	18	86	40	83	250	
78	83	17	82	41	80	240	
72	78	16	78	42	78	235	
70	75			43	75	230	
69	74					225	
66	73	15	74	44	74	224	Very Good
63	72	14	70	45	72	220	
60	71			46	70	215	
57	70	13	66	47	67	210	
54	68			48	64	205	
51	66	12	62			200	
50	64					195	
						190	
49	63			49	63	189	Good
48	61	11	58	50	62	185	
45	58			51	60	180	
42	55	10	54	52	58	175	
39	52			53	55	170	
36	51	9	50	54	52	165	
33	49			55	50	160	
31	47	8	47	56	47	155	
						150	
						145	
						140	
30	46	7	44	57	46	139	Poor (Unsatisfactory)
27	43	6	41	58	44	135	
24	40	5	38	59	42	130	
21	37	4	35	60	40	125	
20	34			61	38	120	
				62	36	115	
19	33			63	34	110	Very Poor
18	30	3	32			105	
15	27					100	
12	25	2	29	64	33	99	
9	22			65	25	90	
6	13	1	26	66	22	80	
3	5			67	20	70	
				68	18	60	
				69	15	50	
				70	13	45	
		0	0	71	10	40	

Instructions: The appropriate numbers are totaled and the final fitness rating is read from the last column.

Appendix D III
Inclosure #4c

f. Scoring of Army Ground Forces Test.

Event	Scoring	Weighing Factor	Weighed Score
(1) Push-ups	3% for each push-up	1	
(2) 300 yd. run	45 secs. or under score 100%. Deduct 4% for each sec. (or fraction) over 45 secs.	2	
(3) Burpee	9% for each complete Burpee	1	
(4) 75 yd Pig-a-back Run	20 secs. or under score 100%. Deduct 4% for each second (or fraction) over 20 secs.	2	
(5) 70 yd. Zig-Zag Run	30 secs. or under score 100%. Deduct 4% for each second (or fraction) over 30 secs.	1	
(6) 4 Mile March	For straggling during 1st mile deduct 8%; during 2nd mile 6%; 3rd mile 4%; 4th mile 2%. At finish deduct 5% for each minute (or fraction of minute) over 50 minutes, up to 5 minutes. Failing to finish score zero. Penalties for straggling are additive and are added to penalty for failure to finish on time. Straggling shall be construed as more than 1 minute late at each mile marker except at finish where men must be on time.	3	

A. The score achieved on each event is multiplied by its weighing factor to give the weighed score for the event.

B. The weighted scores are added, divided by 10 (the sum of the weighing factors) to give the final score for the Army Ground Forces Test.

C. Assessment of Fitness Rating from final score.

Below 70	Unsatisfactory
70-77	Satisfactory
78-87	Very satisfactory
88-94	Excellent
94 or over	Superior

g. *Precautions*—Because scrupulous attention to detailed management of the tests was enforced, it is believed that the tests are comparable from time to time in one group, and that comparisons between companies are valid. Certain precautions were followed.

(1) *Step Test*

- (a) The platform must be 20 inches high.
- (b) The rhythm should be maintained as closely as possible. It is easy to distinguish between those unable to keep pace from exhaustion and those who merely have a poor sense of rhythm. Only exhausted men should be stopped before 5 minutes. Those with a poor sense of rhythm can be kept to the pace by a tap on the elbow every 2 seconds.
- (c) Times must be followed strictly.
- (d) The subjects must straighten legs and back at each step.
- (e) Observers unaccustomed to counting rapid pulse must practice before they can expect to obtain accurate results.

(2) *AAF Test*

- (a) *Sit-ups*—The men were made to take their positions so that their bodies were level, and their heads were not on a higher or lower level than their feet. Some of the tricks that it was necessary to forbid were:
 - (1) Swinging arms forward before reaching the sitting position.
 - (2) Raising feet to meet hands, and rocking to the sitting position.
 - (3) Lifting buttocks off the ground and bouncing to the sitting position.
 - (4) Taking definite rest periods during the exercise.

- (b) Pull-ups—The man was made to hang free from the bar with the arms fully extended before he commenced the exercise. Arms were extended at the end of each chin. Struggling or kicking was not allowed.
- (c) 300 Yard Shuttle Run—There was a tendency on the part of the men to remove excess clothing unless continually checked.
- (d) General—Some men tried to slip out of line and take extra rest between exercises. This was not permitted. Subjects were given only time enough to catch their breath. The routine was exactly followed on each test.
- (3) AGF Test
- (a) Push-ups—Constant vigilance was required to insure that the subjects straightened their arms completely when they raised their bodies, and that the body was kept straight and rigid at all times. No rocking up was allowed.
- (b) Burpee—There was a tendency to combine movements, and the legs were often thrown backwards at the same time the subjects were bending down. Others failed to kick their legs straight back, but only moved them a short distance, and there was also a tendency not to straighten to attention. Observers counted only Burpees which were properly completed.
- (c) Pig-a-back—Every attempt was made to have the men carry another man of approximately equivalent weight. This was facilitated by the subject numbering system (See Appendix A).
- (d) 70-Yard Zig-Zag Run—No diving was allowed. Subjects were made to perform the particular type of exercise required throughout each 10-yard interval. To aid in this, strings were run across the track at the starting and finishing markers of the crawl and creep. The men had to go under these strings. This was not initiated until the last group of test days, but was found to be of value. The subjects were instructed to jump in broad jump fashion when they jumped from island to island in the zig-zag. This was never accomplished by all the men, and systematic scoring penalties were used on men who failed to do this properly.
- (e) 4-Mile March—The packs were weighed before each march. The pack plus rifle was required to weigh 28-30 lbs. All subjects were checked at each mile, so that there was no chance of a man failing to walk the whole distance.

h. *Calorie Expenditure in Different Parts of the Fitness Tests*—A calculation of the expenditure of calories on the 10 different exercises of the 3 fitness tests was carried out on selected subjects. These data, calculated as additional cost over and above the average expenditure for very light activity (100 cal/hr.), are given for the usual performance in total work done:

		TIME OF DURATION OR NO. OF TIMES EXERCISE IS COMPLETED
Step Test	61 calories	5 minutes
Sit-ups	35 calories	100 sit-ups
Chin-ups	7 calories	10 chin-ups
300 Yard shuttle run	21 calories	60-70 seconds
Push-ups	6 calories	20 push-ups
300 Yard Run	22 calories	60-70 seconds
Burpees	10 calories	20 seconds
Pig-a-back	12 calories	20 seconds
Zig-Zag	14 calories	30 seconds
4 Mile road march, pack and equip- ment (30 lbs.)	448 calories	50 minutes
TOTAL	636 calories	

i. *Equipment*—The equipment listed below was used at Topside, and does not include that which was used during the preliminary tests at Camp Carson. This equipment was sufficient to test 150 men in a day with comparative ease.

- 4 Step Test Boxes—these boxes should be sturdy and without “give” and 20 inches high \pm $\frac{1}{2}$ inch and at least 14 inches in depth
- 4 Lead Balls—2-3 lbs. in weight to serve as pendula
- 1 Ball Twine
 - Nails, assorted
- 4 2"x4" uprights for pendula gallows—10' long each
- 4 2"x2" arms for pendula gallows—2' long each
- 2 2"x6" uprights for chinning bar, 10' long each
- 1 Steel Pipe (1") for chinning bar, 4' long
- 16 Stakes—course markers, 3' high
- 1 Roll muslin—to be used in making flags in marking courses
- 1 Tape Measure, (50')
- 5 Islands—square—2'x2'
- 5 Stop Watches
- 6 Clip boards
- 6 Chairs and preferably 2 tables
- 2000 Physical fitness data sheets

j. *Disposition of Equipment and Management of Tests.*

- (1) Step Test—Four boxes were placed on level ground in a straight line, approximately 10 feet apart. Large rocks were placed in the boxes to stabilize them. Several thicknesses of paper or a shelter-half were put on the ground when it was damp.

Gallows constructed from 10 feet lengths of 2 inch x 4 inch plank were sunk about 5 feet in the ground in front of each box. In order for the pendulum to swing in easy sight of the exercising subject, the gallows arm was 7 feet from the ground. A chair was placed beside each box. Two tables with chairs used in tabulating were placed on the opposite side of the pendula from boxes. (See Fig. 6).

- (2) AAF Test—An area of smooth level ground was marked off for sit-ups. A latrine fly was doubled and placed on the ground to protect the men from the dust, dirt or mud.

Approximately 20 feet away, the chinning bar was erected. The uprights were sunk in the ground approximately $1\frac{1}{2}$ feet, allowing 4 feet between the 2 uprights. Lateral strutting prevented swaying. The bar was anchored firmly in the uprights. Tape wrapped around the bar reduced slipperiness. A box was provided for the short men to reach the bar.

In the close vicinity, a 60 yard course was indicated by stakes to which muslin had been attached. This was level ground, but the surface was loose and soft, and not ideal for running (for diagram of arrangement, see Fig. 6).

- (3) ACF Test—A level area was marked off so that the men could pass from one exercise to another without interference (Fig. 6). Stakes were used as markers for the runs and march. All starting and finishing posts were indicated by a muslin flag. The 5 islands used in the zig-zag were sunk to ground level so that they did not slip out of position. Ideally, the 4 mile march should have been a continuous circuit, but lack of a level road necessitated the use of a 1 mile stretch with 2 slight rises. Subjects went back and forth for 2 round trips.

k. *Assignment and duties of personnel.*

(1) Introduction—In order to prevent variations in procedure and scoring, 1 tester was assigned to a permanent post. There was some change for relief of observer personnel. The permanent assignments were:

Tests	Assignment	Responsible Observers
All	Supervision	Officer in charge
Step Test	Box 1	1 Observer Officer, H Company
	Box 2	1 Observer Officer, E Company
	Box 3	Assistant to Officer in charge
	Box 4	Officer in charge
AAF Test	Sit-ups	1 Officer and 1 enlisted man, F Company
	Chins	1 Officer, X Company, 3 enlisted men, E, H, and X Companies
	300 Yard Run	1 Officer, X Company, 1 enlisted man, F Company
Relief		1 Officer, G Company, 1 enlisted man, G Company
AGF Test	Push-ups	1 Officer, F Company, 1 Officer and 2 enlisted men from company tested
	300 Yard Run	1 Officer and 1 enlisted man, G Company
	Burpees	1 Officer and 1 enlisted man, X Company
	Pig-a-back	1 Officer, H Company, 1 enlisted man, E Company
	Zig-Zag	1 Officer and 1 enlisted man, E Company
	4 Mile March	2 Officers and 2 enlisted men, Company Tested

(2) The officer in charge or, in his absence, his assistant had final responsibility for the entire fitness testing program including laying out the testing area; getting equipment in shape and ready for use on testing days; arranging any changes in the schedules for testing, blood letting, or medical examinations (See Table 33, Appendix A); establishing program for observers and making the final decision as to whether certain men should take the test or not. He took his turn running specific tests. The senior officer of the company being tested was responsible to the officer in charge for the smooth operation of the test in his company. On the evening before or the morning of the test days, he arranged with the officer in charge, the details of the test day and the allocation of men to specific tasks. He was responsible for the distribution and handling of data sheets, and he alternated with the second officer observer of his company in helping to test the other 5 companies. The second observer officer assisted his senior officer, and acted as a relief man with the other company observer officers.

The above schedule was made for Y Company's test day. It remained the same except that the officer and enlisted man from Y Company took the positions held by the officer and enlisted man of the company tested on successive days. It was not always possible to have all the observer personnel shown above. It was possible, however, to make use of the junior officers and noncommissioned officers of the company being tested. There were also officers and enlisted men from the observer headquarters who helped whenever it was necessary. During the first phases, the Test Commanding Officer supervised the tests at Camp Carson, and then set up the arena at Topside. For 3 days tests were going on in 2 places, requiring 2 teams with constantly changing personnel. The detailed scheme was used for all subsequent tests.

1. *Schedule of Tests*—Table 33, Appendix A, indicates the general program that was followed in testing. There were certain variations from this regime in order of testing, but it provides the basic plan followed in most cases. The order of testing, time of test, meals and rest periods were always kept constant for each company, once the initial test had established the precedent. Most of the test subjects ate sparingly at breakfast and lunch on test days.

Appendix D III
Inclosure #4c

m. *Routine Testing Day*—On the morning of the test day, immediately after the men had urinated they assembled by platoons and were weighed. Two scales were set approximately two-thirds of the way down the tent. The platoon came into the tent in 2 groups. The first half in ascending consecutive order on one side (numbers 1-18) and the second half in ascending order 19-36) on the other side. In the tent they removed all clothing except for shorts and socks. At a table between 2 scales, 2 enlisted men recorded the weights read by the officers. The third enlisted man kept the record forms in the proper order and the platoons coming through on schedule. As soon as the weights were recorded, subjects picked up their clothing and proceeded to the far end of the tent where they dressed. Following weighing, the subjects were transported to the test area, where a timed specimen of urine was collected. Then they had breakfast of the test ration of that period. After breakfast, the testing program began according to the schedule outlined in Table 33, Appendix A.

The Step Test and the AAF Test were run in the morning, and the AGF Test in the afternoon. Two platoons took the Step Test before taking the AAF Test, and 2 did the reverse. One hour was allowed as a rest period between the 2 morning tests. Special forms were made for the recording of scores of the various components of the fitness tests as well as the final scores. These forms also contained space for the subject's name and number, weight and rating by officer (See Appendix G).

- (1) *Step Test*—The platoon was divided into 4 equal groups on a progressive number basis (1-9, 10-18, 19-27, 28-36). Each group took its position in front of its box, and was run through in order. The appropriate forms separated into 4 groups, were on the tables and held in position by stone weights or clip boards. Four officer observers processed the subjects through the test. Two enlisted men when available were used to tabulate. The subjects did not carry their form sheets during this test. Upon completion of test, subjects retired to a rest area, (Fig. 6) and waited until it was time to take the AAF Test.
- (2) *AAF Test*—Enlisted observers were used to count sit-ups and chins. An officer supervised and also tabulated sit-ups. The forms in numerical order were given to the officer. He started the number of men he wished on sit-ups. As they finished, the subject's number and total sit-ups were reported. The officer tabulated the sit-ups on proper form, then gave it to the subject who proceeded to the chinning bar, where he gave the sheet to the scribe who recorded the number of chins, and returned the form to the test subject. He then proceeded to the 300 yard run. The enlisted man observer took the forms, and sent the men to the starting points in correct order. An officer observer at the other end of the track gave the starting signal and timed the man. This time was recorded by the enlisted man.

In order to maintain a steady flow of subjects it was found necessary to start varying numbers on the sit-ups. A subject occasionally required more than 10 minutes to attain a perfect score, and if there were many high scorers in a platoon, it was of advantage to have 6 or 8 doing sit-ups simultaneously. It was also found to be an advantage to run 2 men at 10 or 15 second intervals in the shuttle run.

- (3) *AGF Test*—The platoon was lined up in 2 rows of odd and even numbers in progression upwards. The record sheets were held by the officer observer who supervised. Enlisted observers counted the number of push-ups and reported to the officer who recorded the results. Upon completion of the push-ups, the subject was given his form, which he took to the enlisted observer who tabulated for the 300 yard run. The officer observer started and timed the subjects. After the run, the man was given his form and reported to the Burpee area. The forms were collected by the officer responsible for starting and stopping this exercise. He recorded results reported by enlisted observers, who counted the number of Burpees. Two or 3 subjects did this exercise simultaneously. The forms were returned to the subject who then reported to the pig-a-back area. There, the enlisted observer tabulated and the officer was responsible for pairing the subjects off according to weight and timing the run. Two or 3 pairs ran at 10 second intervals. On finishing, the men who did the running reported their test numbers, and the officer reported the time to the enlisted observer. After both men of the pair had run, their records were returned to them and they reported to the zig-zag area. The

enlisted observer collected the forms at the starting post of the zig-zag. The officer stood at the finishing post from which he signaled the start and clocked the time. Groups of 4 or 5 subjects lined up and ran through at 15 second intervals. Observers were posted along the course to see that the test subjects complied with the conditions stipulated. Following the completion of this exercise, the subjects crossed the road to a rest area and remained there for about 30 minutes, until the start of the march. The 4 mile march required an officer and enlisted man at each end of the mile stretch. Their watches were synchronized. It was necessary to note which men were straggling at the completion of each mile, and how many minutes they were late at the completion of the 4 miles. This was tabulated on special sheets opposite the test subject's number and the scores later were entered on the physical fitness forms. The officer observers of the company being tested were responsible for the general supervision throughout the day, and processed the men through the 4 mile march.

n. *Local Environmental Factors Influencing Performance*—The necessity of moving the test subjects from Camp Carson (altitude 6100 ft.) to the Topside area in the Tarryall Valley, (8700-9000 ft.) required attention to the effects of altitude on performance. Because acclimatization to altitude might cause improved performance without any change in the physical fitness, 2 of the battery of 3 tests were done at Camp Carson (AAF Test and Step Test). These were then repeated on the 1st day at Topside, and again a week later in an attempt to evaluate the effects of increased altitude on performance. Two factors besides change in altitude influenced the scores: (1) Most of the men wore service shoes during the shuttle run at Camp Carson, while combat shoes were worn regularly at Topside, and (2) the course at Camp Carson was on a packed gravel parking lot; at Topside on a loose sandy roadway.

The tests were not designed to be carried out at high altitudes, and therefore have certain defects not present at low elevations. It was apparent to all company officers and observers that the scores on the tests done the 1st day at Topside did not reflect the acute distress caused by exertion. The acute dyspnea and rapid respiratory rates with large pulmonary ventilation were out of proportion to the slightly higher pulse rates and slightly worse scores on the tests. Ability to carry out another task immediately after the Step Test was good at Camp Carson, but much impaired after the 1st test at Topside. The effects of increased altitude appear to have been largely overcome after a week at Topside.

o. *Tetany*—Hyperventilation tetany was observed 6 times in association with the performance of fitness tests. Its manifestations were severe with marked carpo-pedal spasm, Chvostek's and Trousseau's signs. It was invariably precipitated by some trivial though painful injury or followed a cramp in the abdomen. It was noted occasionally in marches at altitudes above 10,000 feet.

p. *Effect of Initial Score on Subsequent Improvement in Score*—A covariance analysis showed that there is a highly significant relationship between initial score (sum of 3 tests) and subsequent improvement in score. The "within company" correlation between score on the second examination and improvement from the 2d to the 6th examination was 0.61 ($P < .01$). In other words, men with high initial scores tended to improve less than company mates with low initial scores. The question therefore arises as to whether the greater improvement of other companies as compared to F Company was due to the higher average initial score of the latter company. A covariance analysis showed that such is the case, for when mean improvements are adjusted for difference in initial score, F Company improvement did not differ significantly from the average of the other 4 companies or from the average of any single company.

Test of Significance of Difference Between F Company and all Other Company Mean Improvements in Score Test 2 to Test 6.

Source of Variation	Errors of Estimate		
	D/F	Sum of Squares	Mean Square
Total	590	135,590	
Between Adjusted Means	1	296	296*
Within Groups (Error)	589	135,294	230

* $F = 296/230 = 1.29$; not significant.

It is of interest to compare the actual mean improvements with the improvements adjusted for initial score.

Company	Improvement Test 2 to Test 6	
	Actual	Adjusted
E	39.0	37.5
F	29.9	38.4
G	41.8	42.0
H	40.4	42.7
X	46.3	41.2
Y	41.9	37.6

Insofar as the scores represent fitness, the originally more fit group has less potential improvement before reaching peak fitness when all are subjected to the same program of physical activity.

Appendix D III
Inclosure #4c

TABLE 1

a. Mean Scores on Step Test

Day No.	D-3	D	D+7	D+22	D+36	D+47	D+57	Improvement Test 2-6
	1	2	3	4	5		6	
E Co.	69.9	<u>66.4</u>	<u>71.0</u>	<u>74.6</u>	<u>79.0</u>		79.6	13.2
F Co.	72.6	<u>72.1</u>	<u>76.9</u>	<u>75.3</u>	<u>80.5</u>		<u>83.7</u>	11.6
G Co.	73.4	<u>70.2</u>	<u>78.7</u>	81.2	<u>82.7</u>		<u>86.8</u>	16.6
H Co.	72.9	<u>72.3</u>	<u>79.2</u>	79.7	79.3		<u>85.9</u>	13.6
X Co.	69.6	<u>62.9</u>	<u>71.7</u>	<u>77.5</u>	77.3		<u>83.1</u>	20.2
Y Co.	68.4	<u>66.9</u>	<u>72.3</u>	<u>73.9</u>	<u>77.0</u>	81.8	<u>82.9</u>	16.0
Battalion Average	71.1	68.5	74.9	78.0	79.3		83.7	15.2

b. Mean Scores on AAF Test

Day No.	D-3	D	D+7	D+22	D+36	D+47	D+57	Improvement Test 2-6
	1	2	3	4	5		6	
E Co.	40.2	39.5	38.4	<u>46.2</u>	<u>48.9</u>		<u>51.9</u>	12.4
F Co.	47.5	47.6	48.2	<u>57.2</u>	<u>60.7</u>		<u>56.9</u>	9.3
G Co.	41.7	<u>39.1</u>	39.1	<u>41.7</u>	<u>44.9</u>		<u>48.9</u>	9.8
H Co.	43.2	<u>38.3</u>	39.5	<u>45.8</u>	<u>50.5</u>		<u>51.8</u>	13.5
X Co.	40.9	<u>36.5</u>	<u>39.5</u>	<u>42.2</u>	<u>44.0</u>		<u>48.0</u>	11.5
Y Co.	42.4	<u>34.8</u>	35.7	<u>40.9</u>	<u>43.6</u>	47.6	<u>46.1</u>	11.3
Battalion Average	42.7	39.3	40.1	46.6	48.8		50.6	11.3

c. Mean Scores on AGF Test

Day No.	D-3	D	D+7	D+22	D+36	D+47	D+57	Improvement Test 2-6
	1	2	3	4	5		6	
E Co.		75.2	<u>72.1</u>	<u>86.0</u>	85.9		<u>88.7</u>	13.5
F Co.		82.0	<u>86.2</u>	<u>89.4</u>	<u>93.6</u>		<u>91.0</u>	9.0
G Co.		75.3	<u>77.0</u>	<u>85.9</u>	86.1		<u>90.9</u>	15.3
H Co.		78.4	<u>81.9</u>	<u>89.2</u>	<u>92.3</u>		91.7	13.3
X Co.		74.0	<u>77.3</u>	<u>85.0</u>	<u>83.6</u>		<u>88.6</u>	14.6
Y Co.		73.4	<u>78.6</u>	<u>83.9</u>	<u>89.2</u>	88.8	<u>88.0</u>	14.6
Battalion Average		76.4	79.0	86.6	88.5		89.8	13.4

d. Mean of the Sum of Scores on Three Tests

Day No.	D-3	D	D+7	D+22	D+36	D+47	D+57	Improvement Test 2-6
	1	2	3	4	5		6	
E Co.		181.1	181.5	<u>206.8</u>	<u>213.7</u>		<u>220.1</u>	38.9
F Co.		201.7	<u>211.3</u>	<u>221.9</u>	<u>234.8</u>		<u>231.7</u>	30.0
G Co.		184.6	<u>194.8</u>	<u>208.8</u>	<u>213.8</u>		<u>226.3</u>	41.7
H Co.		189.0	<u>200.6</u>	<u>214.6</u>	<u>222.2</u>		<u>229.4</u>	40.0
X Co.		173.4	<u>188.5</u>	<u>204.7</u>	205.0		<u>219.7</u>	46.1
Y Co.		175.1	<u>186.6</u>	<u>198.6</u>	<u>209.9</u>	218.2	<u>217.0</u>	42.1
Average of totals		184.2	193.9	209.4	216.6		224.0	39.8
Average of 3 tests		61.4	64.6	69.8	72.2		74.7	13.3

The dates of tests may be found by referring to Table 30, Appendix A. All except Test #1 were done at Topside.

Underlined scores show statistically significant differences from the score of previous test (excluding Y Company scores on D+47 day).

TABLE 2

PHYSICAL FITNESS TEST SCORES

Platoon Averages of Total Scores (3 tests) of all Men Who Took
Any Group of Tests

PLA- TOON	No. of men	2nd Test 1st Day Topside	No. of men	3rd Test 1 Week	No. of men	4th Test 3 Weeks	No. of men	5th Test 5 Weeks	No. of men	6th Test 8 Weeks
<u>E Co.</u>										
1st	30	172	30	171	24	196	24	214	25	208
2nd	29	182	29	186	27	213	24	223	23	231
3rd	31	177	31	178	29	196	23	213	26	207
4th	31	185	31	186	30	209	27	212	28	226
	121		121		110		98		102	
<u>F Co.</u>										
1st	32	206	31	218	30	220	29	237	26	237
2nd	33	205	33	216	33	233	31	232	26	228
3rd	30	196	30	206	30	220	30	229	28	233
4th	20	193	29	212	28	219	27	239	24	231
	124		123		121		117		104	
<u>G Co.</u>										
1st	34	184	34	189	32	205	31	202	27	226
2nd	32	177	32	190	29	202	27	217	27	223
3rd	34	181	34	193	33	199	29	213	32	227
4th	33	187	33	191	32	219	31	220	27	232
	133		133		126		118		113	
<u>H Co.</u>										
1st	34	177	34	190	35	211	33	223	32	225
2nd	36	187	36	200	34	215	35	224	32	228
3rd	32	189	32	201	29	218	30	221	26	232
4th	36	182	35	189	31	203	30	215	31	229
	138		137		129		128		121	
<u>I Co.</u>										
1st	35	167	35	176	34	192	34	192	33	208
2nd	32	171	32	188	31	204	32	206	31	225
3rd	34	172	34	189	33	201	31	201	32	212
4th	35	184	35	201	35	213	32	217	32	235
	136		136		133		129		128	
<u>J Co.</u>										
1st	34	158	33	175	33	188	32	208	30	214
2nd	35	166	34	183	32	198	32	202	28	215
3rd	34	180	33	185	33	195	33	210	30	215
4th	29	167	29	182	27	201	26	210	26	219
	132		129		125		123		116	

TABLE 3

MEANS OF SUM OF SCORES OF THE THREE TESTS (ALL MEN WHO TOOK TEST)

Company	2nd Test	3rd Test	4th Test	5th Test	6th Test
E	179	180	204	216	218
F	200	213	223	234	232
G	182	191	206	213	227
H	184	195	212	221	229
X	173	189	203	204	220
Y	168	181	196	208	216

TABLE 4

COMPARISON OF FITNESS IN MEDICAL CASUALTIES AND MEN COMPLETING TEST PROGRAM

	Test No. 1		Test No. 2		
	Step Test	AAF	Step Test	AAF	AGF
Medical Casualties	71.4	41.7	68.3	40.1	73.8
Men Who Completed Program	71.1	42.7	68.5	39.3	76.4

TABLE 5

COMPANY LOW, HIGH AND AVERAGE SCORES OF PHYSICAL FITNESS TESTS FOR FIRST COMPLETE TEST DAY AT TOPSIDE (TEST #2)

Co.	Step Test			AAF Test			AGF Test			Totals		
	L	H	A	L	H	A	L	H	A	L	H	A
E	30	95	66	17	61	40	56	97	75	63	227	181
F	30	95	72	28	82	48	52	98	82	133	255	202
G	25	115	70	21	60	39	12	99	75	142	241	185
H	30	115	72	27	59	38	18	96	78	65	239	189
X	15	115	63	10	66	37	53	98	74	119	239	173
Y	25	90	67	20	52	35	32	97	73	79	221	175

TABLE 6

F COMPANY AVERAGES AAF TEST

	Test 1	Test 2	Test 3	Test 4
Number of Sit-ups	42.9	64.8	71.9	89.3
Number of Chins	8.4	7.7	8.1	8.9
Time of Run in Seconds	58.0	66.1	66.2	61.3
AAF Score	47.3	47.6	48.1	57.1

Appendix D III
Inclosure #4c

TABLE 7
TEST SCORES AND OFFICERS' RATING OF FITNESS

Sum of Three Fitness Scores	Officers' Rating of Subjects (Percentage)			Number Rated
	Poor	Fair	Good	
Below 100	80	20		5
101 - 110			100	1
111 - 120	25	50	25	8
121 - 130	20	50	30	20
131 - 140	28	39	33	18
141 - 150	13	37	50	45
151 - 160	13	54	33	63
161 - 170	3	49	48	73
171 - 180	9	37	54	105
181 - 190	2	27	71	174
191 - 200	4	29	67	263
201 - 210	2	22	76	389
211 - 220	1	19	80	384
221 - 230	1	16	83	334
231 - 240	0	12	88	264
241 - 250	1	7	92	108
251 - 260	0	12	88	37
260+	0	0	100	19

Data from E Company Tests 3, 4, 5 and 6; G Company Tests 2, 3, 4, 5 and 6; H Company Tests 4, 5 and 6; X Company Tests 3, 4, 5 and 6; and Y Company Tests 4, 5, 6 and Special Test.
Appendix D III
Inclosure #4c

TABLE 8
DISTRIBUTION OF SCORES ON FITNESS TEST 2

		AGP Test										AAF Test										Step Test																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
		15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	Total	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	Total	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	Total																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
	E				3	2	1	7	7	10	2	18	29	20	17		2	3					9																					44																							102																								190																								127																								145																								81																								46																								24																								10																								12																								18																								17																								17																								17																								20																								20																								17																								17																								22																								22																								21																								21																								27																								27																								20																								21																								15																								15																								6																								16																								27																								30																								27																								38																								12																								6																								46																								28																								96																								175																								168																								115																								36																								8																								3																							

Class Interval = 5

Classes recorded under last number in Interval

TABLE 9

F COMPANY FITNESS SCORES VITAMIN VS. PLACEBO

Step Test

Test	Placebo	Vitamin
1	72.6	72.7
2	72.8	71.3
3	77.4	76.3
4	77.5	72.9
5	80.2	80.8
6	85.4	81.9

AAF Test

Test	Placebo	Vitamin
1	46.9	48.2
2	47.3	48.0
3	48.3	48.1
4	56.5	58.0
5	60.6	60.8
6	57.2	56.6

AGP Test

Test	Placebo	Vitamin
2	81.4	82.7
3	85.5	87.0
4	88.3	90.7
5	93.4	93.8
6	90.6	91.4

Sum 3 Tests

Test	Placebo	Vitamin
2	201.5	202.0
3	211.2	211.4
4	222.3	221.6
5	234.2	235.4
6	233.3	229.8

Vitamins and placebos were given during Period III indicated by the line between Test 5 and Test 6.

Appendix D III
Inclosure #4c

PHYSICAL FITNESS TESTS

AVERAGE COMPANY SCORE BY PERIOD-STEP TEST

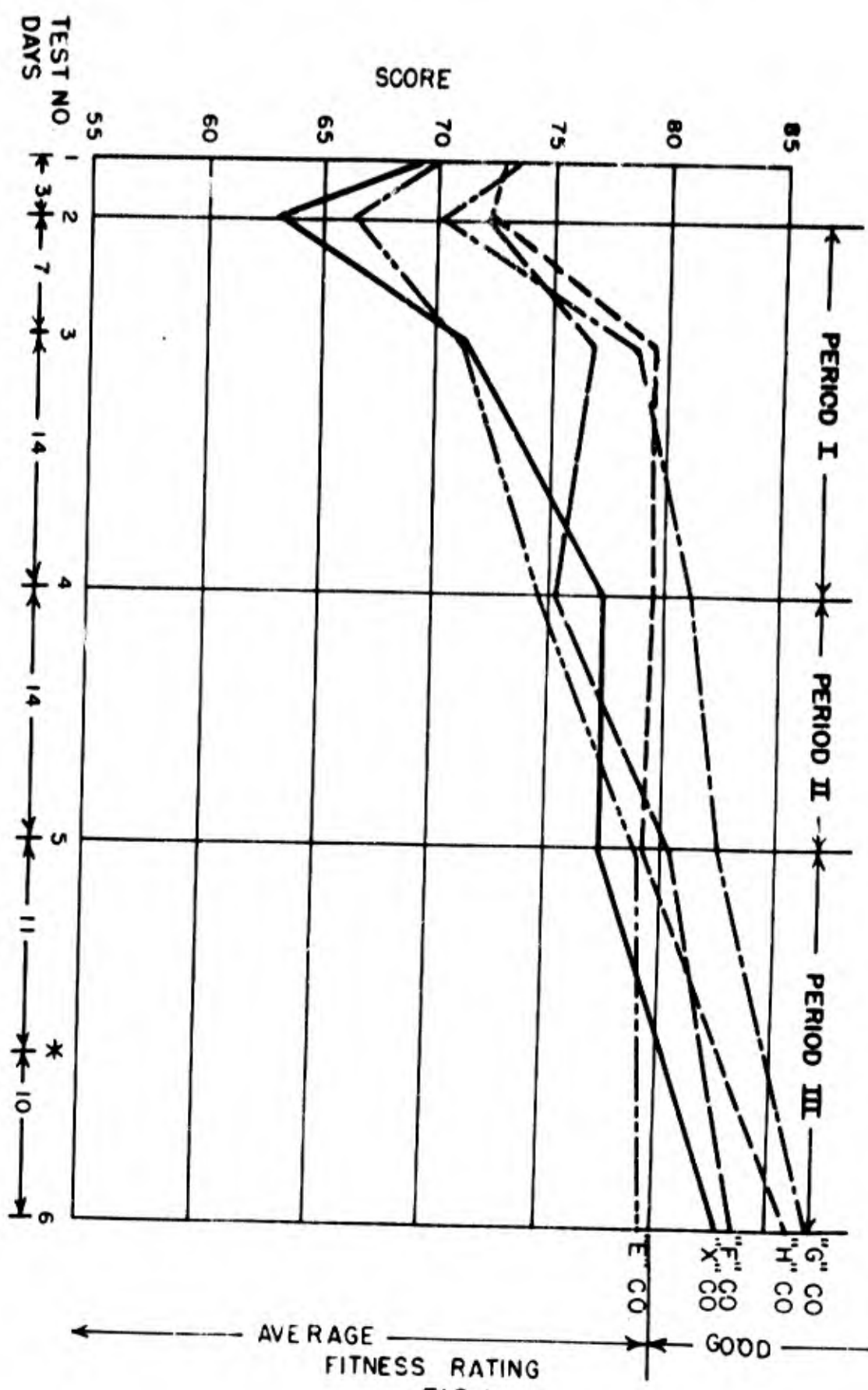


FIG. 1
Appendix D III
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* "Y" CO ONLY

AVERAGE FITNESS RATING
FIG. 1

**PHYSICAL FITNESS TESTS
AVERAGE COMPANY SCORE BY PERIOD - A.A.F. TESTS**

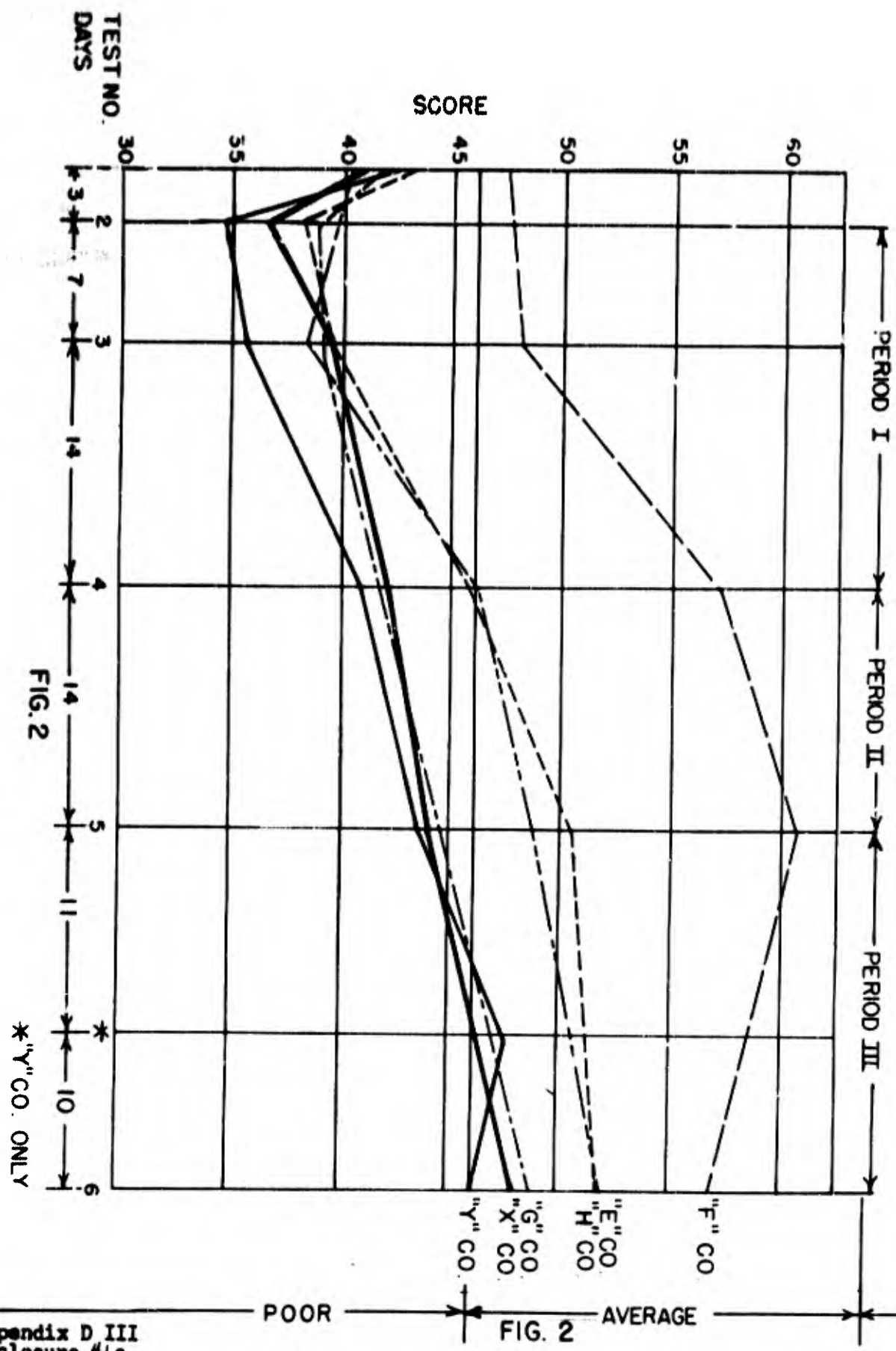


FIG. 2

FIG. 2

Appendix D III
Inclosure #4c

PHYSICAL FITNESS TESTS

AVERAGE COMPANY SCORE BY PERIOD—A.G.F. TESTS

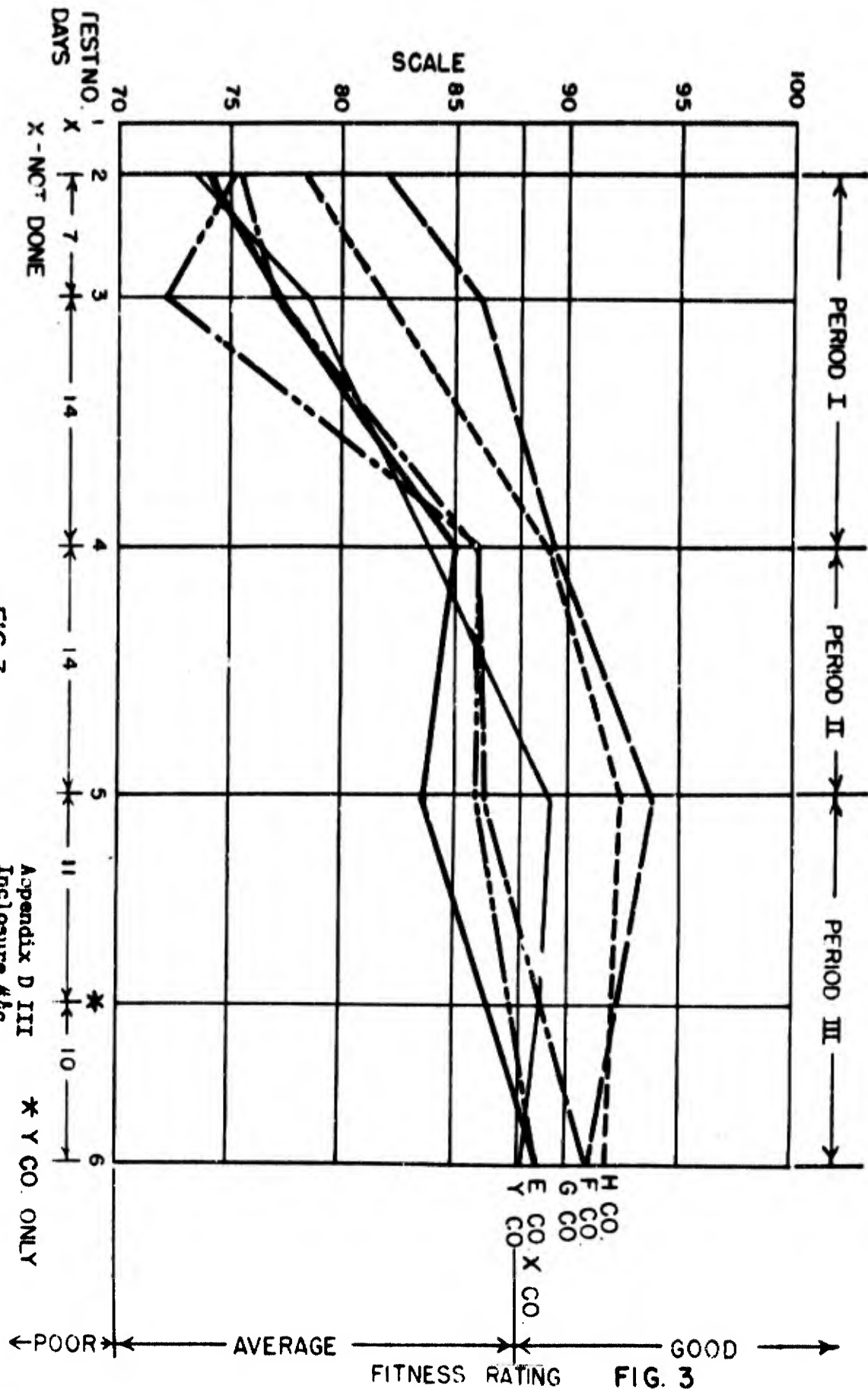


FIG. 3

FIG. 3

PHYSICAL FITNESS TESTS
COMPANY AVERAGE - SUM OF SCORES OF THREE TESTS

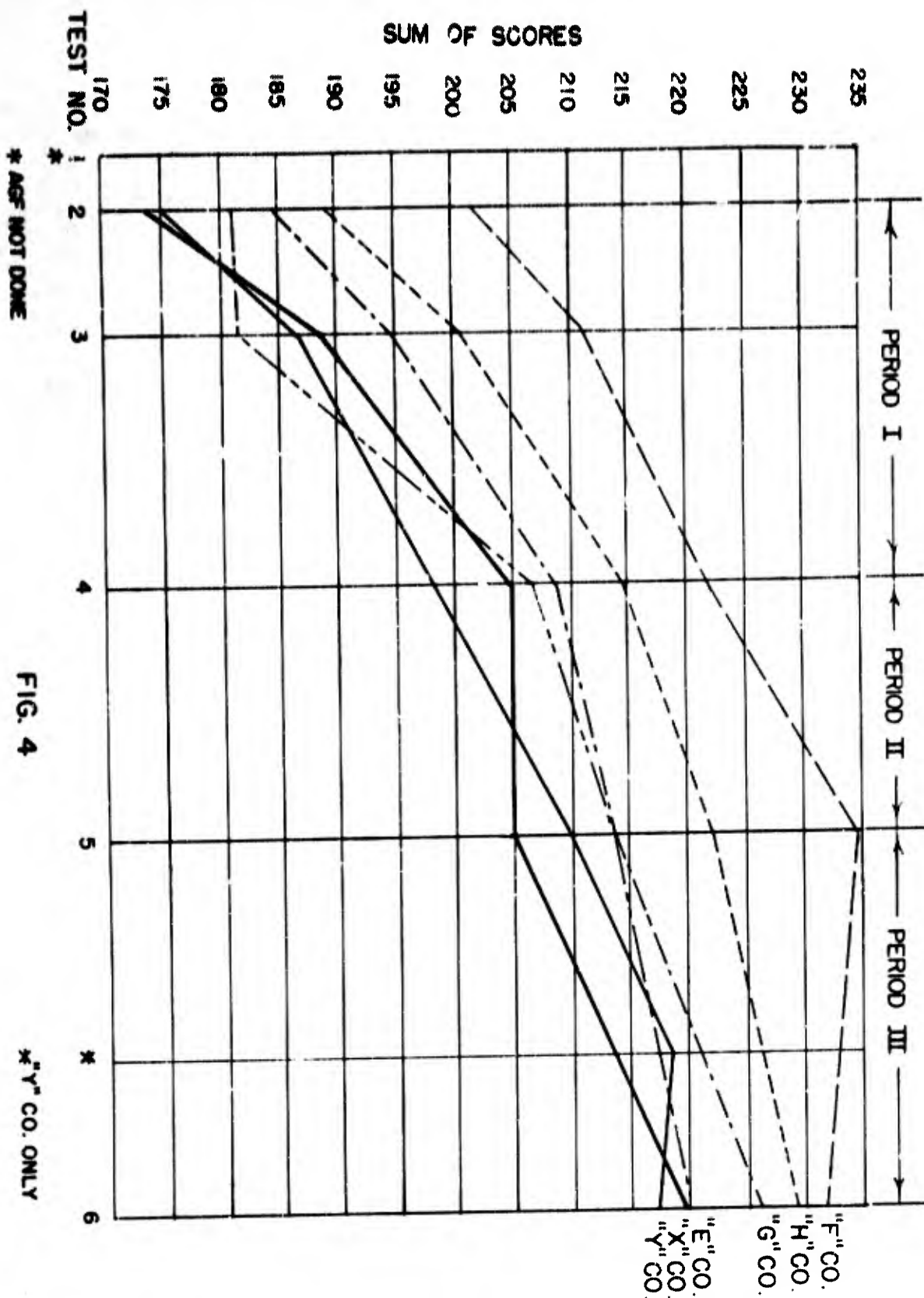


FIG. 4

Appendix D III
Inclosure #4c

FIG. 4

COMPARISON OF FIRST AND LAST FITNESS TEST AT TOPSIDE IN RELATION TO AGE

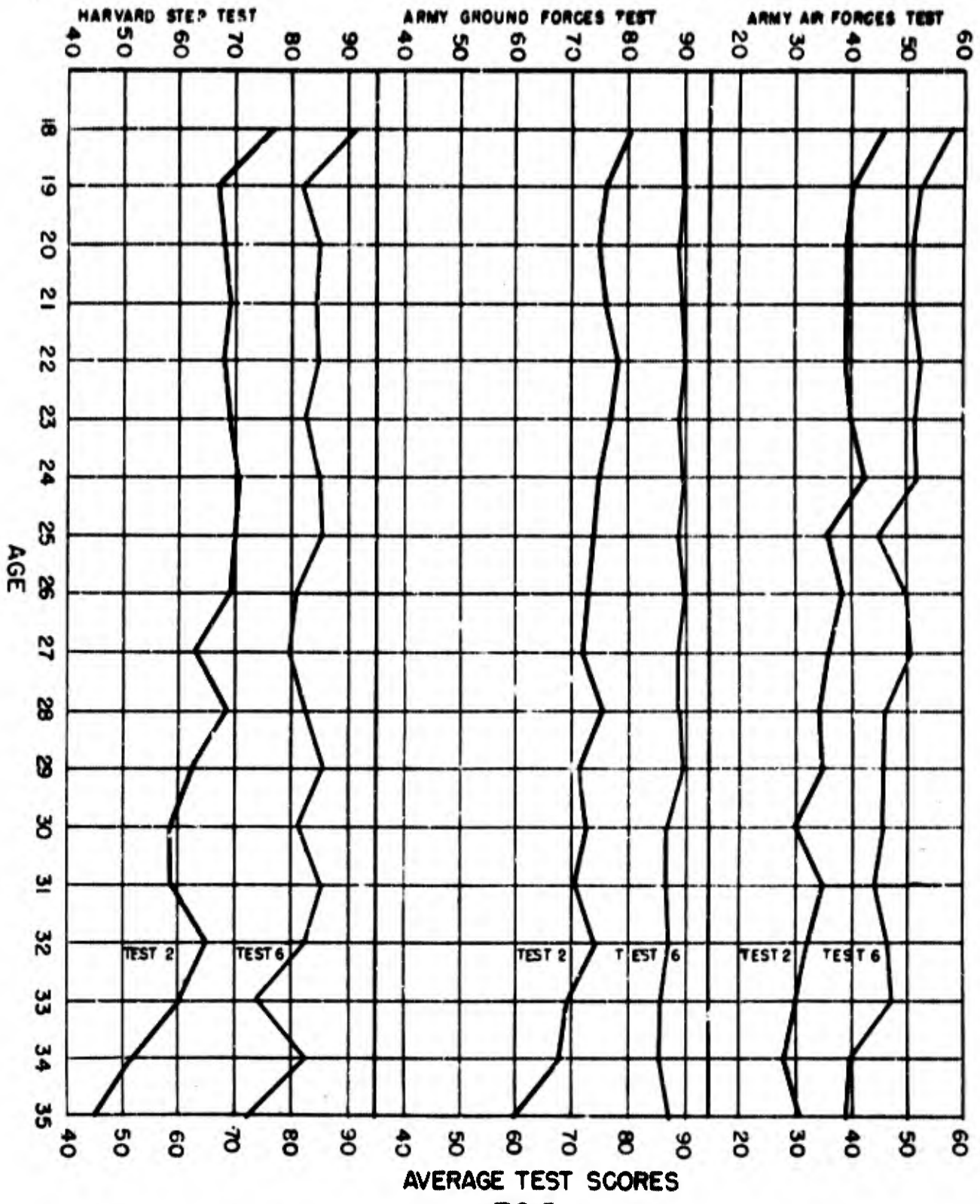
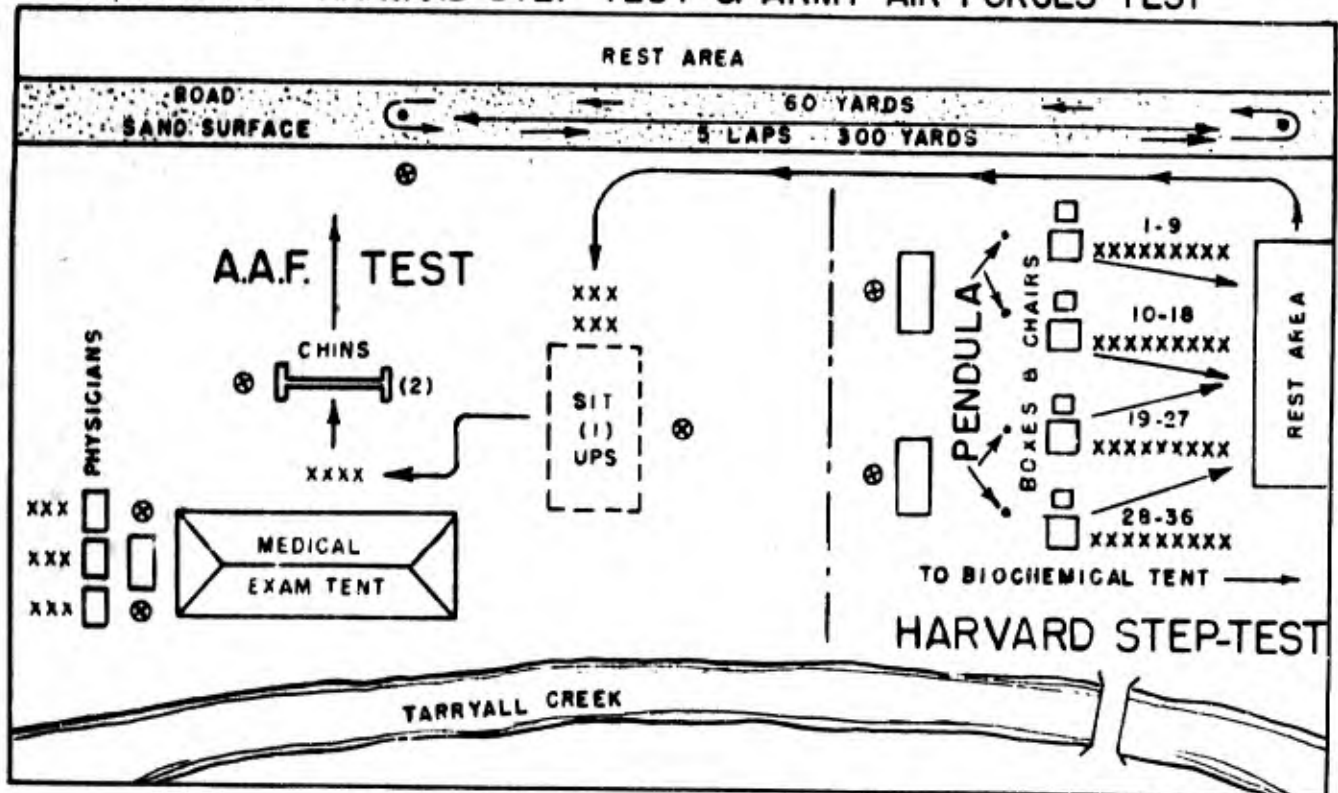
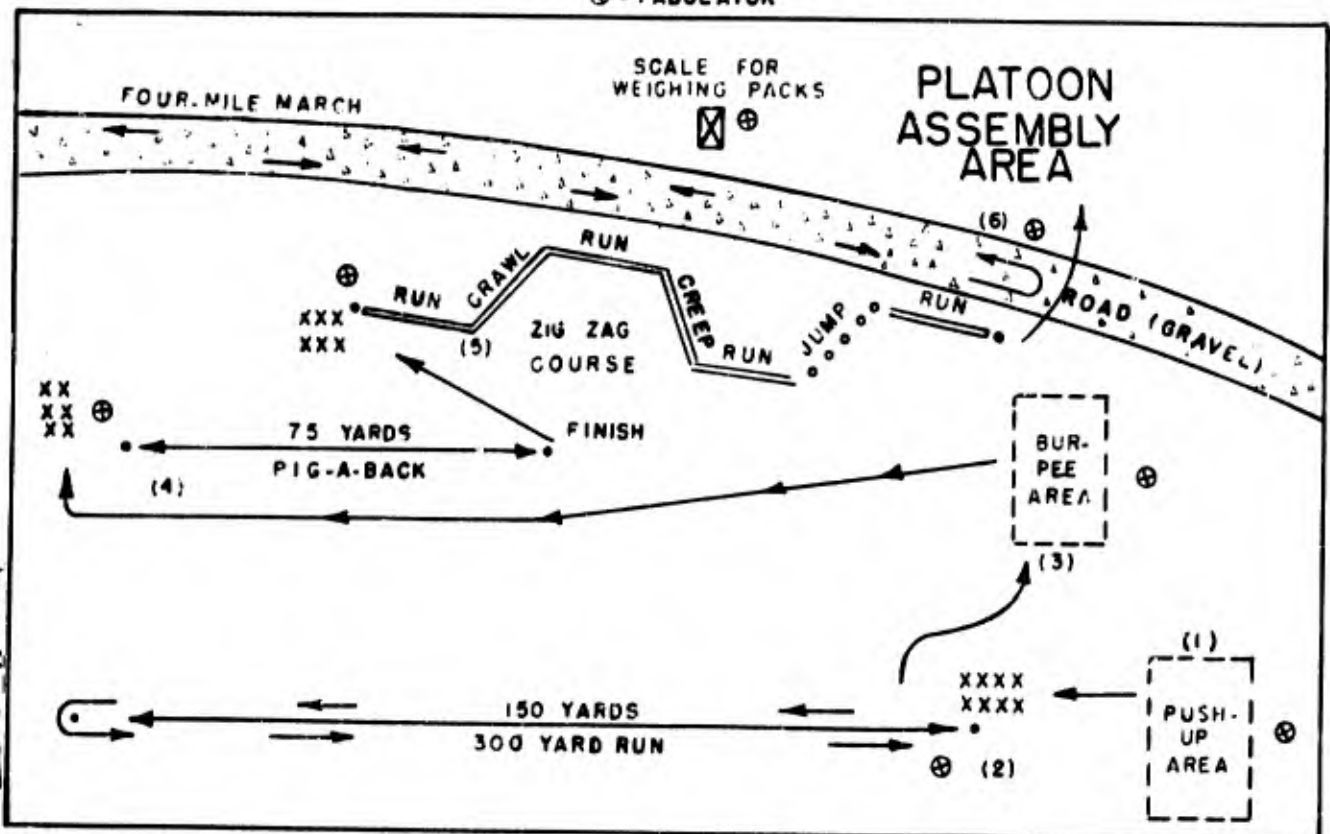


FIG. 5

FIG. 6
 AREA OF HARVARD STEP TEST & ARMY AIR FORCES TEST



AREA OF ARMY GROUND FORCES TEST
 ⊕ - TABULATOR



Appendix D, III
 Inclosure #1c

APPENDIX D
Section IV
RIFLE FIRE
SUMMARY OF RESULTS

Co.	Ration	Issue	Time	Scores
Y	C (Exp.)	1-1/3	3 weeks	no change
G	C (New)	1	2 weeks	increase
G	C (Exp.)	1	1 week	increase
X	C (Exp.)	1-1/3	3 weeks	no change
E	K	1-2/3	3 weeks	increase
E	K	1-2/3	3 weeks	slight increase
G	K	1-2/3	3 weeks	slight decrease
X	K	1-2/3	1 week	no change
Y	K	1	11 days	increase
Y	K	1-2/3	10 days	no change
X	Mess Tin	1-1/3	3 weeks	slight decrease
H	10-in-1	1-1/4	47 days	no change
H	10-in-1	1	10 days	no change
G	10-in-1	1-1/4	2 weeks	no change
X	10-in-1	1-1/4	2 weeks	no change
Y	10-in-1	1-1/4	2 weeks	no change
F	B Supplemented	4800 cal.	8 weeks	increase
E	B Supplemented	4800 cal.	2 weeks	no change

Infantrymen must be able to handle their basic weapon, the M-1 rifle, with ease and skill. For this reason, one of the criteria of fitness of the test subjects on various rations was the score on the rifle range. A true picture of the effects of rations on the men's ability to fire accurately could be obtained only if the environmental conditions did not affect accuracy, and if the men were well enough trained for practice to have no significant effect on performance.

Each company constructed a combat firing range in a suitable location near its bivouac area. Because the range sites had to be selected on the basis of suitable terrain and security for the bivouac, it was impossible to have them conform to a standard. Thus differences in direction of fire (sunlight), color and contrast of background and elevation of targets from firing line influenced the visibility of the targets and preclude any direct comparison of scores between companies. Firing was accomplished before marching at around 0700 hours and after marching at around 1600 hours. Sunlight was thus an important factor in the visibility of targets in morning and afternoon firing, and there was a definite seasonal change as the summer advanced. Furthermore, the temperature in the morning 35-40°F was decidedly cooler than in the afternoon 70-75°F, which affected comfort, relaxation and degree of steadiness during firing.

No attempt was made to assign men to different companies on the basis of skill or amount of practice with the rifle, so there were probably significant differences in the firing accuracy of the companies. All companies did have these factors in common:

1. All ranges were of similar length with the targets placed from 250 to 500 yards away.
2. All men fired the M-1 rifle with calibre .30 ball ammunition from the prone position.
3. Regulation prone silhouette targets of light tan color were used by all companies.
4. All men were familiar with the rifle and were accustomed to firing for record.

After plotting the scores obtained before marching, against those obtained after marching for each company, it was apparent that no company consistently scored better or worse in the morning or afternoon. These results were in contrast to the subjective feeling of most men who felt more relaxed after the marches, and believed that they could fire better and more accurately.

The morning and afternoon scores for each company are presented in Fig. 1. With the exception of E and F Companies, which improved as the test progressed, all other companies show no significant change. It is interesting to note that the average score for all companies is in the vicinity of 30% hits, except for X Company with an average of approximately 25% hits, and F Company with an average of 45% hits. The probable explanation for this lies in range location, target visibility and proportion of trained marksmen in a company.

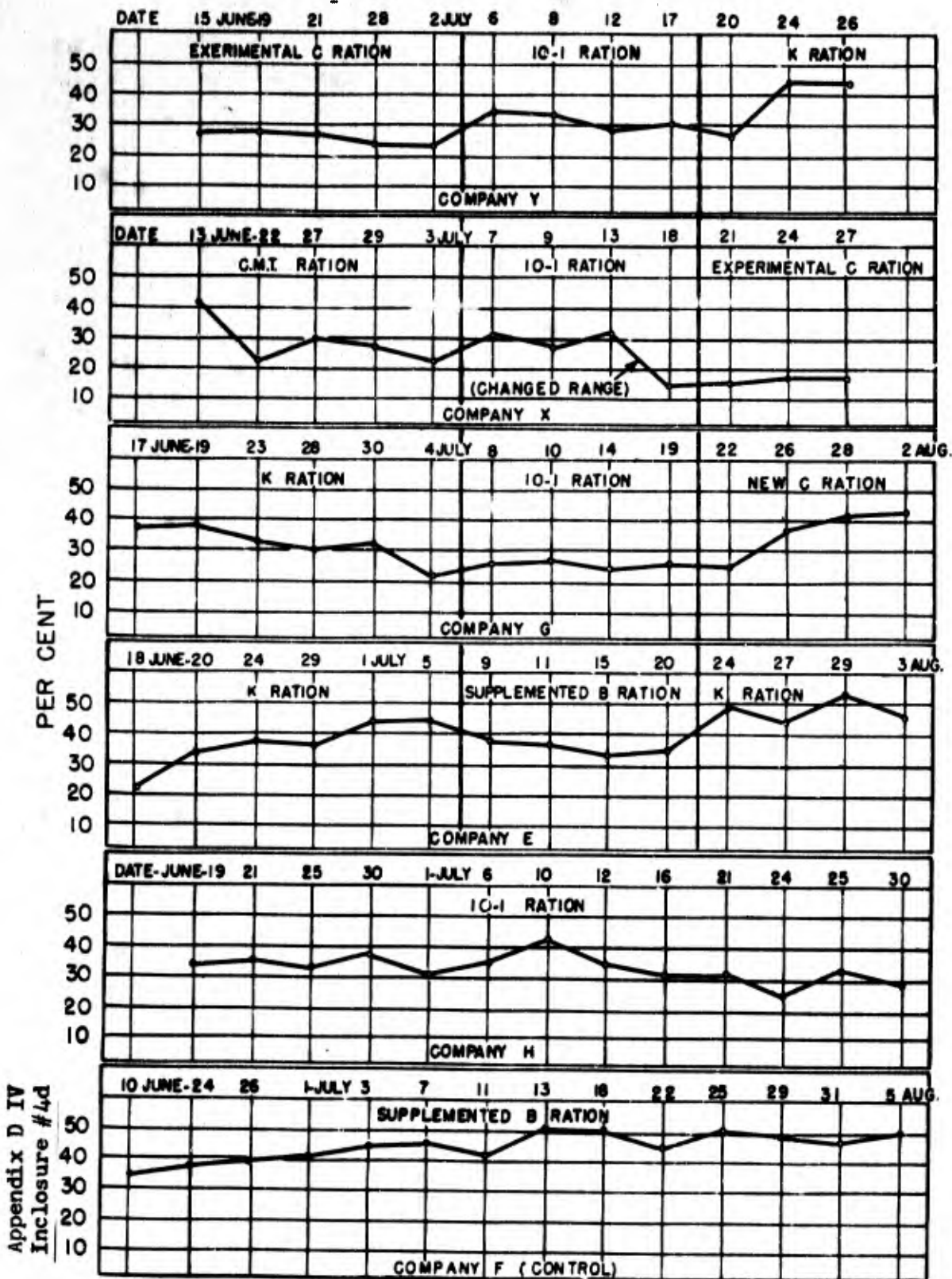
The wide fluctuations in score for pre-march and post-march firing, and the lack of consistency in their relationship to each other makes a detailed analysis of the scores too hazardous to attempt. It can be stated definitely that rifle score by company did not improve consistently with any tested ration. The only group which showed a regular improvement was F Company but if only morning or only afternoon records are used (Fig. 1) great variation is seen. On the other hand, there was absolutely no indication of deterioration on any ration, even during periods when the men were restricted to one ration/man/day, and the average improvement in score of 5 companies which could be compared over the 8-week period (X Company changed its range) was from 31 to 42 percent hits. The results are summarized at the beginning of this section, and the actual figures for men firing and percentage of hits are given in Table 1.

TABLE 1
RIFLE FIRING

	Y Company			X Company			G Company			E Company			H Company			F Company					
	Date	M.F.	% H.	Date	M.F.	% H.	Date	M.F.	% H.	Date	M.F.	% H.	Date	M.F.	% H.	Date	M.F.	% H.			
AM	6-15	143*	29	6-18	139	51	6-17	138*	39	6-18	127*	21	6-19	127*	32	6-20	125*	24	6-20	125*	38
PM	6-15	143*	25	6-18	139	33	6-17	138*	35	6-18	125*	24	6-19	127*	36	6-20	124*	36	6-20	124*	31
AM	6-17	143*	27	6-22	139*	23	6-19	127	38	6-20	118	29	6-21	132	32	6-22	120	32	6-22	120	38
PM	6-17	143	28	6-22	139*	21	6-19	127	38	6-20	106	38	6-21	122	37	6-22	116	37	6-22	116	37
AM	6-21	137	33	6-27	137	33	6-23	127	30	6-24	113	38	6-25	135	33	6-26	110	38	6-26	110	38
PM	6-21	136	22	6-27	137	27	6-23	112	35	6-24	111	37	6-25	138	34	6-26	108	40	6-26	108	40
AM	6-28	131	31	6-29	138	29	6-28	119	29	6-29	115	37	6-30	137	38	7-1	116	42	7-1	116	42
PM	6-28	131	18	6-29	138	26	6-28	116	32	6-29	115	36	6-30	134	37	7-1	115	40	7-1	115	40
AM	7-2	133	24	7-3	137	24	6-30	123	32	7-1	109	39	7-1	136	32	7-3	105	43	7-3	105	43
PM	7-2	133	25	7-3	135	22	6-30	118	31	7-1	109	49	7-1	136	30	7-3	102	46	7-3	102	46
AM	7-6	133	36	7-7	140	36	7-4	122	26	7-5	114	42	7-6	133	35	7-7	117	48	7-7	117	48
PM	7-6	133	34	7-7	140	28	7-4	108	17	7-5	114	47	7-6	131	36	7-7	113	43	7-7	113	43
AM	7-8	131	33	7-9	140	26	7-8	111	24	7-9	106	40	7-10	131	44	7-11	116	44	7-11	116	44
PM	7-8	131	35	7-9	140	30	7-8	110	28	7-9	106	36	7-10	128	41	7-11	112	41	7-11	112	41
AM	7-12	133	26	7-13	140	37	7-10	111	30	7-11	109	39	7-12	131	33	7-13	115	53	7-13	115	53
PM	7-12	133	32	7-13	140	30	7-10	112	24	7-11	109	36	7-12	126	38	7-13	110	49	7-13	110	49
AM	7-17	130	30	7-18	140	15	7-14	112	25	7-15	108	30	7-16	130	27	7-18	114	60	7-18	114	60
PM	7-17	130	33	7-18	138	13	7-14	112	24	7-15	108	38	7-16	126	37	7-18	112	40	7-18	112	40
AM	7-20	127	27	7-21	140	17	7-19	116	23	7-20	110	33	7-21	126	27	7-22	114	46	7-22	114	46
PM	7-20	127	29	7-21	140	15	7-19	113	29	7-20	110	38	7-21	125	37	7-22	111	44	7-22	111	44
AM	7-24	130	46	7-24	140	21	7-22	111	24	7-24	102	49	7-24	129	25	7-25	110	63	7-25	110	63
PM	7-24	130	45	7-24	140	16	7-22	108	28	7-24	102	50	7-24	128	26	7-25	100	38	7-25	100	38
AM	7-26	130	50	7-27	140	18	7-26	108	40	7-27	102	45	7-27	135	34	7-29	111	49	7-29	111	49
PM	7-26	130	39	7-27	140	18	7-26	103	37	7-27	102	45	7-27	126	34	7-29	107	50	7-29	107	50
AM							7-28	107	41	7-29	104	49	7-30	133	30	7-31	102	45	7-31	102	45
PM							7-28	105	44	7-29	104	60	7-30	129	29	7-31	100	49	7-31	100	49
AM							8-2	115	46	8-3	108	46				8-5	107	53			
PM							8-2	115	46	8-3	108	46				8-5	107	53			
AM								115	42		108	47					106	47			

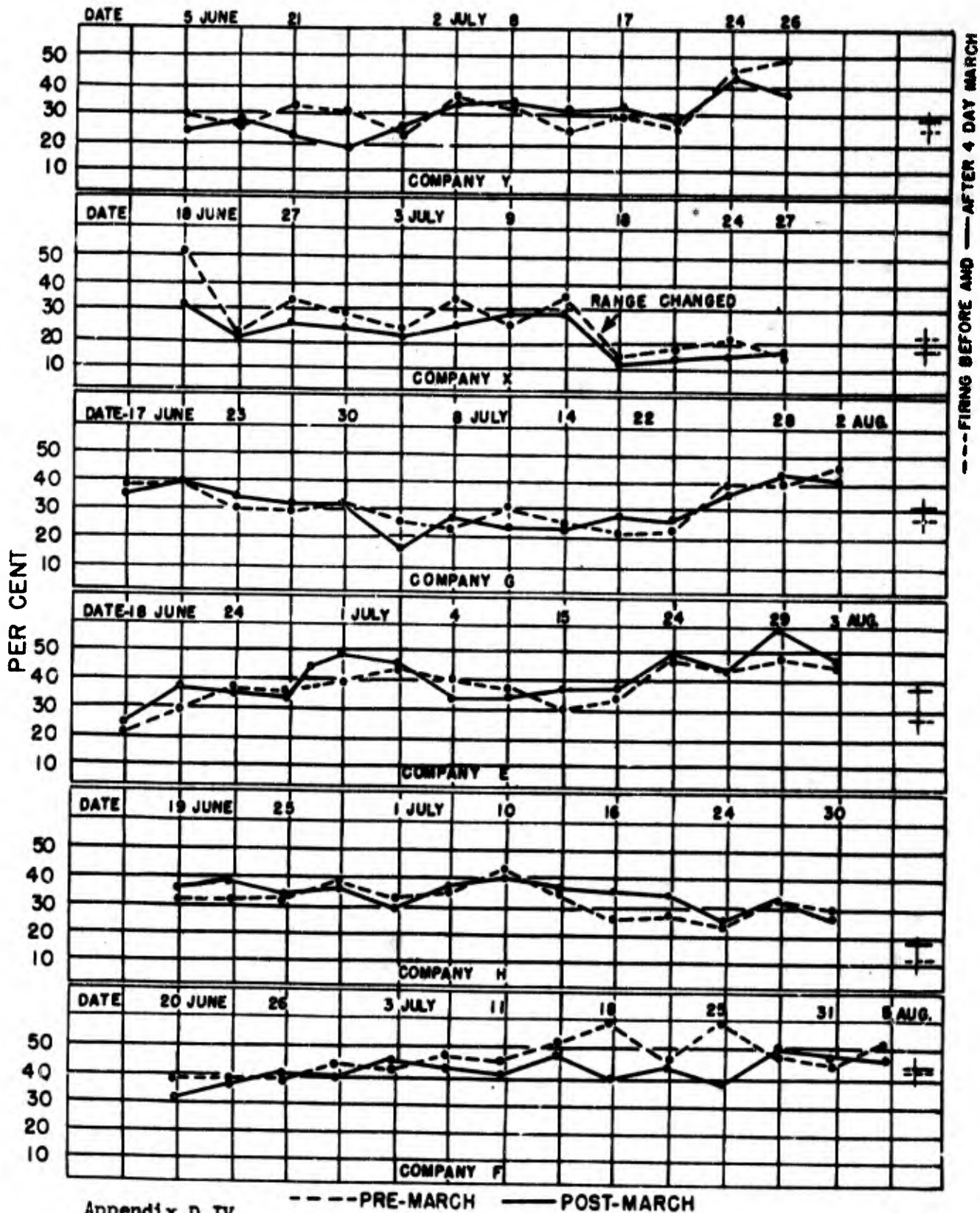
M.F. = Number of Men Firing % H. = Percentage of Hits
* = 24 Rounds per Man; at all other times 12 rounds were fired

FIG. I
AVERAGE FIRING SCORES
 EXPRESSED IN HITS AS PER CENT OF ALL ROUNDS
 FIRED MORNING AND AFTERNOON, COMBINED



Appendix D IV
 Inclosure #4d

AVERAGE FIRING SCORES EXPRESSED IN HITS AS PER CENT PRE- AND POST-MARCH FIRING



Appendix D IV
Inclosure #4d

FIG. 2

(145)

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APPENDIX D

Section V

NUTRITIONAL STATUS AS DETERMINED BY PHYSICAL EXAMINATION SUMMARY OF RESULTS

No vitamin deficiency disease ascribable to the rations appeared in any company on any ration during the test.

1. INTRODUCTION

One of the measures of the nutritional adequacy of a ration is its ability to maintain health and to prevent the occurrence of the manifestations of deficiency disease detectable on physical examination. Although few of the physical signs of deficiency disease are specific in the mild and early stages, they do occur, they have significance and they may be present when other evidence, such as laboratory tests, are negative. Therefore, physical examinations were made of all the men in all companies at the beginning and at the end of the test. In addition, the first 3 platoons of all companies were examined at the end of Period I and Period II. The examinations were performed by a team of 14 physicians especially trained and experienced in nutrition. Their names appear in Table 1, Appendix A. All but 5 were present at more than 1 series of examinations. They were all familiar with the criteria listed below which were used as guides for interpretation. As a rule the examiners worked in teams of 2 men each, 1 man examining the eyes and the other the rest of the body. Inter-team consultation was frequent and positive findings were usually checked by several examiners.

The physical examinations were concerned only with signs of deficiency disease. The subjects were not questioned about symptoms. The abnormalities sought are listed and defined as follows:

2. CRITERIA, STANDARDS, AND DEFINITIONS of Physical Findings for Use in Examinations for Nutritional Status.

a. Vitamin A

- (1) Eyes — Lack of tearing; dryness of conjunctivae and sclerae of a grade deemed significant by the examiner.

Conjunctivitis — Characterized by the usual signs of inflammation — redness, injection and swelling, and graded slight, moderate, or severe. Slight will be redness and injection of conjunctivae with little or no swelling or photophobia and minimal involvement of the bulbar conjunctivae (sclerae). Moderate is of greater extent with some photophobia. Severe will include swelling and blepharospasm. Degree of lachrymation will be significant in relation to conjunctivitis as will photophobia. Purulent conjunctivitis to be noted.

Local (or general) thickening of sclera characterized by loss of translucency, loss of sheen, elevation and pigmentation, and graded slight, moderate, or severe. Slight to be interpreted as one localized area in either eye, or diffuse thickening of significant grade according to judgment of examiner; moderate, 2 to 4 localized areas without significant elevation or pigmentation, or, moderate diffuse thickening; severe, characteristic Bitot's spots, and/or gross diffuse thickening, folds. Note pterygia and pingueculae.

Cloudiness or steamininess of cornea, localized or general, otherwise unexplained. To be recorded merely as involvement of cornea.

(2) Skin

- (a) Follicular hyperkeratosis consisting of at least several grouped papules, present in at least one of the sites of predilection (the lateral surfaces of arms, thighs, and lower abdomen)

as well as in any other location, without any consistent folliculitis (infection). Other features to be considered in forming clinical judgment are dryness of the skin, degree of sweating relative to environment, and broken hairs. To be graded slight, if papules small and confined to approximately one-third of thighs, arms or abdomen; moderate, if papules larger, even though confined to any two of above sites; severe, if papules large (25 mm.) and involve above and additional areas.

(b) An acneform eruption consisting of numerous (more than 5-4) red papules simulating acne but with little actual infection (pus), distributed over trunk and arms with little or no involvement of face. To be graded slight if not more than 6, or if confined to back, chest, or arms; moderate, if 10-20, or involving two or more of above areas; severe, if in greater number in all areas.

b. Vitamin B₂ (Thiamin)

- (1) Muscular weakness, lower extremities. To be determined during physical fitness tests.
- (2) Muscle tenderness (bilateral). To be determined by pinching belly of gastrocnemius with force adjudged by examiners not to cause pain in normal subjects and to be graded slight, moderate, or severe according to judgment of examiner.
- (3) Nerve tenderness (bilateral). To be determined by pressure over peroneal nerve at head of fibula with force adjudged by examiner not to cause pain in normal subject. Distinction to be made from paraesthesia. To be graded slight, moderate, or severe according to judgment of examiner.
- (4) Loss of vibratory sense (bilateral). To be tested over internal malleolus with tuning fork (256). To be recorded present or absent.
- (5) Loss of reflexes (bilateral). Ankle and knee (patellar) reflexes to be tested sitting and kneeling, without reinforcement. To be recorded present or absent for each site.
- (6) Muscle atrophy (bilateral). Atrophy of muscles of lower extremity (thigh and leg) otherwise unexplained. Presence of atrophy, and absence of other cause, to be determined by judgment of examiner.
- (7) Edema. Pitting edema of sacrum and legs (shins) and feet as determined by palpable depressions from pressure of fingers of degree to be judged by examiner. Recorded present or absent.

c. Riboflavin

- (1) Eyes - Presence of vascularization of cornea as determined by slit lamp (hand or large) of significant grade. Latter to be defined as penetration of cornea in at least three quadrants of one eye with formation of loops and twigs, at least 25% of vessels to contain blood. To be graded mild (criteria above); moderate, if process is bilateral and extends nearly to pupil; and severe, if there is posterior vascularization or opacities.
- (2) Skin - A dermatitis of the face (alar folds, malar area and forehead) and ears clinically characteristic of the dermatitis of riboflavin deficiency, with or without large, dry comedones. To be recorded present or absent.
- (3) Mouth
 - (a) Radiating fissures (not scars) at the corners of the mouth, in the absence of false teeth (plates). To be recorded present or absent.
 - (b) Redness and grayish desquamation of the vermilion border of lips, with or without ulceration and crusting, not localized as with trauma, herpes, etc. To be recorded present or absent.

d. Niacin

- (1) Skin-Symmetrical, bilateral, dermatitis of exposed areas as hands, feet, neck or face, (or of scrotal or anal areas), with active or subsiding inflammation of chronic inflammatory changes char-

acterized by induration or atrophy, roughing, desquamation and pigmentation. Recorded present or absent, chronic or acute, and slight, moderate, or severe by extent and activity.

(2) Mouth

- (a) Glossitis – A redness and inflammation of tongue with atrophy of papillae involving at least tip, and if sides also tip of tongue, to be graded slight, if including no more than tip and edges to 0.5 cm. without complete atrophy; moderate, if greater in extent or degree or with complete atrophy; and severe, if includes ulceration, infection, edema, etc.
- (b) Stomatitis – Inflammation similar to the glossitis but only if accompanied by glossitis. To be recorded present or absent.

e. Vitamin C (Ascorbic Acid)

- (1) Skin – Petechial or purpuric eruption otherwise unexplained in judgment of examiner. To be graded slight, if limited to small areas as about ankles, waist, etc.; moderate, if more extensive; and severe, if extensive and large, or associated with similar lesions in mucous membrane or spontaneous bleeding (except from gums).
- (2) Mouth – Gingivitis, characterized by and recorded as either:
 - (a) Acute redness and inflammation of dental margin, with or without swelling of interdental papillae, with or without bleeding, spontaneous or on slight trauma.
 - (b) Chronic thickening, lividity, and retraction of gums.
 - (c) A combination of both.

Also to be recorded, the presence or absence of deposits of tartar, cervical fillings, dental work, debris and infection in such relation to the above charges as to possibly account for their occurrence. The latter to be recorded as present or absent without particular designation.

- (3) Muscle tenderness (See Thiamin).
- (4) Edema (See Thiamin).

f. Protein

- (1) Edema (See Thiamin).

3. RECORDING OF DATA:

The data were recorded on a form especially designed for that purpose from which they were transferred to punch cards for machine record analysis. The physical examination form included in Appendix F was followed, except that night blindness (19) was not tested and 37 was interpreted as chronic gingivitis, not the gingivitis of pellagra.

4. CHECK ON SUBJECTIVE ELEMENT:

Because of the large subjective element in any examination which depends wholly on inspection, a substantial error might be expected. Therefore, to check the consistency of interpretation of individual findings, every tenth man was seen independently by each individual examiner at all examinations. A separate form was filled out for each different team's findings.

5. VITAMIN ADMINISTRATION:

During the last 3 weeks (Period III) F Company on the Supplemented B Ration was divided; 2 platoons were given 3 U. S. Army vitamin tablets* daily and the other 2 were given placebos of identical appearance. None of the test subjects knew that they were getting anything other than vitamins. The clinical observers were not aware of which group was receiving vitamins.

6. RESULTS:

The results, obtained from only the 513 men examined every time, are summarized in the accompanying tables and described below. For simplicity, the data have been analyzed in groups of signs relating to a specific deficiency. It must be emphasized, however, that these signs are not specific or pathognomonic,

*See Appendix D, Section VI for details.

and while they are considered here as definite indications of a given deficiency, such indication is not absolute.

a. The signs of *Vitamin A Deficiency* sought were dryness of the eyes, macroscopic changes in opacity of the sclera and cornea, conjunctivitis, follicular hyperkeratosis, and acneform eruption. The percentage of subjects in each Company with one or more of these signs at each examination and the number of men examined is shown in Table 1. No man showed all of these signs at any examination. No classical xerophthalmic lesions were found. Subjects with the eye signs and one skin sign and those with the skin signs and one eye sign in each examination are listed in Table 2. The number of men examined in each case is the same as in Table 1. It is apparent that no classical Vitamin A deficiency signs were present at the beginning of the test and none developed during it. Furthermore, the frequency and severity of such signs as did appear, did not constitute a significant hazard to the health and efficiency of the troops. These signs actually decreased in most cases and varied regardless of ration.

b. The signs of *Vitamin B₁ (Thiamin) Deficiency* sought were muscular weakness, loss of tendon reflexes, loss of vibratory sensation, muscle or nerve tenderness, muscle atrophy, and edema. The percentage of men showing one or more of these signs at each examination is shown in Table 3. No men showed all the signs indicated on any examination. The F Company group, maintained on Supplemented B Ration (control group), showed the lowest incidence of these findings; and no significant difference was found after Period IV between the subjects on the vitamin supplement and those on placebos.

There is no statistically significant difference between the incidence of these signs in any of the 6 companies before the start of the test, in spite of the range of incidence. No individual case of thiamin deficiency was found. None of the men with the individual signs of possible deficiency was ill or had his usefulness as a soldier limited by the existence of these signs.

At the end of Period I, G Company, which had subsisted on K Ration for 3 weeks, showed a statistically significant increase in the signs pointing to B₁ deficiency. Signs of low grade Vitamin B₁ deficiency were restricted to scattered findings in but 6 men, only 1 of whom showed more than 1 sign (See Table 4). E Company, however, on K Ration at the same time, did not show this trend nor did E Company differ from F Company. One man in E Company who had nerve tenderness and pedal edema at the start lost these signs while on K Ration. The abnormalities, assuming they represent B₁ deficiency, are not attributable to the ration proper but to the fact that certain individuals may have eaten inadequately or may have had unusually large thiamin requirements. This is borne out by the failure of Y Company to show any increase in signs following its 3 weeks on K Ration. It would appear that K Ration, when issued and consumed as in this test, will not result in the development of signs of Vitamin B₁ (thiamin) deficiency in a significant number of men.

Y Company, on Experimental C Ration during Period I, showed no significant increase in the number with signs of B₁ deficiency over that shown on the initial examination (Table 3a). At the second examination this company did, however, differ significantly in the frequency of signs of thiamin deficiency from F Company. The same is true of G Company, on New and Experimental C Ration in Period III. X Company which had Experimental C Ration for only 7 days in Period III had no special studies, so no comparison with Y and G Companies can be made. The signs of early mild Vitamin B₁ (thiamin) deficiency are less impressive in either Y or G Companies on C Ration than in G Company on K Ration because the signs are scattered among a few men with no single man presenting more than one sign. Neither company on C Ration fared as well as the control F Company though the differences are of questionable significance.

H Company, on 10-in-1 Ration throughout the test, showed no significant increase in the signs of Vitamin B₁ deficiency over initial examination. G, Y, and X Companies on this ration in the 2 weeks Period II compare favorably with E Company on Supplemented B Ration during this period.

X Company, subsisting on Canadian Mess Tin in Period I, showed no significant increase in these signs over those found on the original examination. One man developed bilateral loss of knee jerks. There was no other group on this ration with which to compare X Company. It showed a slightly greater number of signs of thiamin deficiency than were shown by F Company. The differences are represented by signs in only 3 men of the whole company and are not significant.

c. The signs of *Vitamin B₂ (Riboflavin) Deficiency* sought were corneal vascularization, dermatitis, angular fissures of the mouth and cheilosis. The percentage of men showing one or more of these signs (exclusive of corneal vascularization) on each examination are shown in Table 5. Slit lamp examination of the cornea was made by examiners with special experience in the instrument and in the signs of corneal vascularization that may accompany riboflavin deficiency. The hand slit lamp was used with the realization that it might not be a dependable instrument. The results obtained by it were checked by means of the large standard slit lamp at the third and fourth examinations where all positive cases detected by the hand slit lamp and many negative ones were examined with the large slit lamp. The examining personnel were the same throughout. In no instance was the positive finding with the hand slit lamp confirmed nor was any subject who was found normal (negative) with the hand slit lamp found positive (abnormal) with the large slit lamp. No subject was found to have corneal vascularization with the large slit lamp. Therefore, the findings with the small slit lamp have been discarded and no analysis of slit lamp data has been made. Although some instances of corneal vascularization may have been present at the first 2 examinations it is assumed with a high degree of probable correctness that such changes never occurred.

Only 3 cases of the dermatitis of *Vitamin B₂ deficiency* were found. These were on the last examination after Period III, 2 in X Company on the Experimental C and K Rations, and 1 in Y Company on K Ration. Angular fissures of the mouth were found in insignificant numbers in men in G, F and Y Companies.

Cheilosis was interesting because, for a short period, most men had lip lesions believed to be caused by sun and wind. However, there were a few with more cyanotic and inflamed lips which healed poorly and resembled those attributed to *B₂ deficiency*. In no company except F, the control group, was there a significant increase in the incidence of these lesions which, in most subjects tended to disappear during the test. In Period I at a time when the excretion of riboflavin was decreasing rapidly, X Company on Canadian Mess Tin showed a slight but statistically significant increase above the probable mean error in interpretation* of the sign and the lesions subsequently healed rapidly during the 2 weeks on 10-in-1 Ration (See Table 5). Many, but not all, competent and experienced authorities would question the diagnostic value of this sign under the specific circumstances (extensive sun and wind burns) in which it occurred.

d. The signs of *Niacin (Nicotinic Acid) Deficiency* sought were dermatitis, glossitis and stomatitis. The percentage of men showing one or more of these signs on each examination is shown in Table 6. In no instance were all these signs seen in any man. One case of the chronic dermatitis of pellagra was seen in F Company on the first examination and disappeared during the test. One each was reported in G and Y Company after Period III. Four were noted in X Company on the second examination but the severity was not recorded and since there was no evidence of it 14 days later it may be an incorrect recording. No pellagrous stomatitis was observed at any time in any subject.

Two instances of the glossitis of pellagra were reported in E Company and disappeared while on K Ration. None appeared at any time in F Company. Of the total lesions found, 2 were present initially (See Table 6).

e. The signs of *Vitamin C (Ascorbic Acid) Deficiency* sought were petechial hemorrhage, purpura, and gingivitis. No cases occurred which showed all these signs. There were no cases of purpura and only 1 of petechial hemorrhage during the whole test. The chronic lesions of the gums decreased throughout the test period in all groups. Acute changes possibly attributable to *Vitamin C deficiency* decreased continuously throughout the test and there were only 3 such cases in the whole battalion at the end of the test as compared with 97 at the start. There was an increase in the acute lesions in X and Y Companies during Period II at a time when the urinary excretion of *Vitamin C* was decreasing. This is probably attributable to poor oral hygiene. It improved promptly on better attention to hygiene on command of the Battalion Commander. A number of instances of minor injury to the gums resulted from eating hard biscuits.

f. The only sign of *Protein Deficiency* sought was edema, which is also included with signs of *Vitamin B₁ deficiency*. The incidence of edema on the initial examination is given in Table 3a. Edema never occurred as an isolated phenomenon without other neuromuscular signs. It should be emphasized that a deficiency of thiamin, *Vitamin C* or protein may be associated with edema.

*Each 10th man examined by each team. These data were analyzed to show probable error of interpretation by each examiner (See Table 8). They will be the subject of a subsequent report.

g. Comparison of Clinical Findings in Vitamin and Placebo Groups—The clinical data for the F Company vitamin and placebo groups were examined separately to determine if the administration of additional vitamin to men already consuming a liberal diet had any influence on their clinical picture. In Table 7, the percentage incidence of various findings in the vitamin and placebo groups are shown for the examinations just preceding and immediately following the period of vitamin supplementation (Period III). When the incidence of the abnormality looked for is zero or practically so, nothing is reported. During the 3 week period of administration, added vitamins had little if any effect on the incidence of any of the signs which might indicate nutritional deficiencies.

h. Comparison of Results Obtained by Multiple Independent Examinations of Every Tenth Man—Because it is recognized that there is an element of subjectivity in interpretation, especially of early and mild clinical signs, every 10th subject was examined by each clinician at every routine examination. Perfect or almost perfect agreement (99 or 100%) was found in the entire neuromuscular examination; in angular fissures, pellagrous glossitis, stomatitis, and dermatitis; purpura, petechial hemorrhages, dermatitis of riboflavin deficiency, moderate and severe acneform eruption, gross opacities of cornea and dryness of the eye. The greatest differences in ratings occurred in oral hygiene and changes in opacity of the sclera. Agreement was unanimous about severe lesions and those diagnostic of specific diseases while classification of mild and intermediate degrees of the lesions of questionable specificity was less consistent. The findings expressed as percentage of agreement are given in Table 8.

7. SUMMARY.

It appears from these observations that, as far as the occurrences of physical signs of nutritional deficiency is concerned, the various rations tested were adequate for the periods during which they were used and their use did not result in a significant amount of deficiency disease. Certain changes accepted as signs of deficiency states were found on examination. Many were present at the beginning of the test and most of them did not increase in significant degree. In fact, they decreased. Such variations in the number and extent of the signs as occurred are not believed to be significant or to indicate any inadequacy of following; (1) The presence of a number of signs of deficiency at the beginning of the test period capable of persisting or disappearing without necessary reference to the basic adequacy of the respective rations; (2) The lack of specificity of the physical signs in the mild or early forms of deficiency disease; (3) The occurrence of only mild or early signs of deficiencies and the consequent variation in detection and interpretation of such signs from one period to the other and between examiners, without any relation to the diet; (4) The effect of environment on signs of a non-specific character. These factors cause inconstant and inconsistent variations in the incidence of the signs at the various examinations.

A summary of all the physical examination data indicates that men on the control ration generally showed fewer signs of deficiency than those on other rations. This was not true of every sign, or in comparison with all companies. Changes in the skin attributable to Vitamin A deficiency showed a distinct tendency to improve over the whole test in all subjects. The individual periods were probably too short to reflect effects due to the ration because of the lag in appearance of the changes of Vitamin A deficiency. The apparent increase in signs of B₁ deficiency in G Company on the K Ration did not occur in other companies on the same ration. Variations among individuals indicate the influence of idiosyncrasies in food consumption and vitamin requirement rather than a defect in the ration. Furthermore, it should be pointed out that although an increase in positive findings may be statistically significant, that increase may be caused as readily by misinterpretation of questionable signs as by the increased incidence of an actual deficiency. Other signs, except cheilosis, gingivitis and gross eye lesions, were too infrequent to be significant. Cheilosis is a good example of the inconsistency of variations in the signs. It showed an increased incidence only in the control company. Lesions of the gums attributable to Vitamin C deficiency decreased in all companies throughout the test irrespective of ration. In the opinion of the examining physicians, the eye lesions were due to environmental conditions and not to nutritional deficiencies. It is recognized that several signs suggestive of vitamin deficiency are less reliable when there is much exposure to the elements. Supplementation of the control diet with vitamins did not affect the physical signs under consideration.

It is concluded, therefore, that the rations as tested were nutritionally adequate as far as the physical examination of the troops and the appearance of physical signs of nutritional deficiency are concerned.

TABLE 1

PER CENT OF MEN SHOWING SIGNS POSSIBLY DUE TO VITAMIN A DEFICIENCY

Examination Physical Signs	Company					
	E	F	G	H	X	Y
Initial	Dryness of Eyes	0	0	0	0	0
	Scleral Opacities	83	78	63	74	67
	Corneal Opacities	3	1	0	0	0
	Gross Conjunctivitis *	72	77	67	69	39
	Follicular Hyperkeratosis	30	36	31	32	20
	Acneform Eruption	25	18	38	15	12
After Period I	Dryness of Eyes	0	0	0	0	0
	Scleral Opacities	91	97	99	84	89
	Corneal Opacities	0	0	1	1	1
	Gross Conjunctivitis *	93	92	81	82	78
	Follicular Hyperkeratosis	52	44	44	31	39
	Acneform Eruption	7	27	12	0	2
After Period II	Dryness of Eyes	0	0	0	0	0
	Scleral Opacities	87	67	88	73	87
	Corneal Opacities	0	1	0	1	0
	Gross Conjunctivitis *	97	93	90	84	97
	Follicular Hyperkeratosis	29	18	24	22	12
	Acneform Eruption	10	2	1	3	6
After Period III	Dryness of Eyes	0	0	0	0	0
	Scleral Opacities	87	84	96	89	94
	Corneal Opacities	0	1	0	0	0
	Gross Conjunctivitis *	100	94	100	97	97
	Follicular Hyperkeratosis	42	16	34	29	33
	Acneform Eruption	5	9	7	2	2

* Sun, wind and dust considered sufficient to cause this sign.

Appendix D V
Inclosure #4e

TABLE 2

SIGNS OF POSSIBLE VITAMIN A DEFICIENCY

Company	All Signs	All Eye Signs and One Skin Sign	All Skin Signs and One Eye Sign Examination			
			Initial	After Period I	After Period II	After Period III
E	0	0	11	2	1	2
F	0	0	8	11	1	3
G	0	0	13	6	0	3
H	0	0	7	0	0	1
X	0	0	4	1	1	1
Y	0	0	2	6	4	0

TABLE 3a

PER CENT OF MEN SHOWING ANY NEUROMUSCULAR SIGN OR PERIPHERAL EDEMA

Company	Examination			
	Initial	After Period I	After Period II	After Period III
E	5.5	1.4	4.1	4.1
F	1.2	0	0	1.2
G	3.5	10.5	8.1	14.0
H	0	4.7	3.5	1.2
X	2.1	5.3	13.8	5.3
Y	5.4	7.6	9.8	9.8

TABLE 3b

NUMBER OF MEN WITH NEUROMUSCULAR SIGNS AND EDEMA ON INITIAL EXAMINATION

Physical Sign	Company					
	E	F	G	H	X	Y
Muscular Weakness	0	0	0	0	0	0
Knee Jerks Absent	0	0	1	0	1	0
Ankle Jerks Absent	0	0	1	0	1	1
Muscle Tenderness (Calf)	0	0	0	0	0	1
Nerve Tenderness	2	0	0	0	0	0
Vibratory Sense Lost (Malleoli)	1	0	0	0	0	0
Sym. Musc. Atrophy (Extremities)	0	0	0	0	0	0
Pitting Edema (Pretibial)	2	0	0	0	0	3
Pitting Edema (Pedal)	0	0	0	0	0	0
Pitting Edema (Sacral)	0	1	0	0	0	0

Appendix D V
Inclosure #4e

TABLE 4

G COMPANY MEN SHOWING SIGNS OF POSSIBLE THIAMIN DEFICIENCY
ON 2ND EXAM BUT NOT ON 1ST

Subject	Abnormalities present on 2nd exam but not on 1st	Basal Thiamin mcgm/hr		Load Thiamin mcgm/hr		Body Weight mcgm/hr	
		Examination		Examination		Examination	
		1st	2nd	1st	2nd	1st	2nd
G114	Tibial Edema	24	34	385	940	151	151
G125	Pedal Edema	12	15	490	700	162	158
G135	Muscle Tenderness	5	6	350	395	179	178
G137	Pedal Edema	16	16	260	120	190	192
G207	Absent Ankle Jerks	15	24	425	620	143	143
G218	Muscle Tenderness	27	15	370	145	155	152
G304	Absent Knee Jerks	28	17	-	-	135	134
G335	Left K & A Jerks abs	20	37	-	-	149	149
G Company Average		18	21	531	616	152.6	151.4

TABLE 5

PER CENT OF MEN SHOWING ONE OR MORE SIGNS OF POSSIBLE VITAMIN B₂ DEFICIENCY

Company	Initial	After Period I	After Period II	After Period III
E	15	10	3	5
F	2	5	2	11
G	5	10	3	3
H	8	6	1	0
X	3	9	2	6
Y	5	8	3	0

TABLE 6

PER CENT OF MEN SHOWING ONE OR MORE SIGNS OF NIACIN DEFICIENCY

	Examination Physical Signs	Company					
		E	F	G	H	X	Y
Initial	Pellagrous Dermatitis	0	1	0	0	1	3
	Pellagrous Glossitis	1	0	0	0	0	0
	Pellagrous Stomatitis	0	0	0	0	0	0
After Period I	Pellagrous Dermatitis	0	0	0	0	4	0
	Pellagrous Glossitis	1	0	0	0	0	0
	Pellagrous Stomatitis	0	0	0	0	0	0
After Period II	Pellagrous Dermatitis	0	0	0	0	1	0
	Pellagrous Glossitis	0	0	0	0	0	0
	Pellagrous Stomatitis	0	0	0	0	0	0
After Period III	Pellagrous Dermatitis	0	0	1	0	1	1
	Pellagrous Glossitis	0	0	1	0	1	3
	Pellagrous Stomatitis	0	0	0	0	0	0

TABLE 7

PER CENT INCIDENCE OF ABNORMALITIES IN F COMPANY VITAMIN AND PLACEBO GROUPS
BEFORE AND AFTER ADMINISTRATION OF VITAMINS AND PLACEBOS

Abnormality Reported	Group	Before		After	
		Vitamins & Placebos Slight	Placebos Moderate	Vitamins & Placebos Slight	Placebos Moderate
Gross Changes in Scleral Opacity	Placebo	54	15	65	19
	Vitamin	60	11	68	18
Gross Conjunctivitis	Placebo	91	4	85	7
	Vitamin	83	9	89	8
Pterygia	Placebo	2		2	
	Vitamin	0		0	
Pingueculae	Placebo	4		2	
	Vitamin	6		4	
Follicular Hyperkeratosis	Placebo	15	2	15	0
	Vitamin	23	6	21	2
Acneform Eruption	Placebo	2	0	11	2
	Vitamin	4	0	8	2
Cheilosis	Placebo	2		11	
	Vitamin	2		11	
Chronic Gingivitis	Placebo	11		2	
	Vitamin	25		9	
Active Acute Inflammation of Dental Margin	Placebo	7		0	
	Vitamin	15		0	
Oral Hygiene	Placebo	30 G; 63 F; 7 P.*		54 G; 41 F; 5 P.	
	Vitamin	21 G; 67 F; 12 P.		38 G; 58 F; 4 P.	

* G = Good; F = Fair; P = Poor.

Appendix D V
Inclosure #4e

TABLE 8
AVERAGE PER CENT AGREEMENT AMONG EXAMINERS IN CLINICAL FINDINGS IN
THE SAME MEN EXAMINED AT THE SAME TIME

Abnormality Under Examination	% Agreement
<i>Eyes</i>	
Dryness	100
Gross Changes in Scleral Opacity (All Degrees of Severity)	78
Gross Changes in Scleral Opacity (Moderate & Severe)	92
Gross Changes in Corneal Opacity	98
Vascularization	92
Gross Conjunctivitis (All Degrees of Severity)	86
Gross Conjunctivitis (Moderate & Severe)	96
Pterygia	89
Pingueculae	95
<i>Skin</i>	
Follicular Hyperkeratosis (All Degrees of Severity)	81
Follicular Hyperkeratosis (Moderate & Severe)	96
Acneform Eruption (All Degrees of Severity)	84
Acneform Eruption (Moderate & Severe)	98
Dermatitis of Riboflavin Deficiency	100
Petechial Hemorrhages	100
Purpura	100
Pellagrous Dermatitis	100
<i>Lips & Mouth</i>	
Angular Fissures	99
Cheilosis	92
Pellagrous Glossitis (All Degrees of Severity)	98
Pellagrous Glossitis (Moderate & Severe)	100
Pellagrous Stomatitis	100
Chronic Gingivitis	88
Active Acute Inflammation of Dental Margin	87
Good Oral Hygiene	77
<i>Neuromuscular</i>	
Muscular Weakness	100
Absence of Knee Jerks	99
Absence of Ankle Jerks	99
Tenderness of Belly of Calf Muscle	98
Nerve Tenderness	100
Loss of Vibratory Sense	100
Symmetrical Muscular Atrophy in Extremities	100
Pitting Edema (Pretibial)	99
Pitting Edema (Pedal)	100
Pitting Edema (Sacral)	100

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APPENDIX D

Section VI

EFFECT OF DIFFERENT RATIONS ON ALIMENTARY PHYSIOLOGY, WATER CONSUMPTION AND SLEEP

1. INTRODUCTION

An effort was made to collect data on certain aspects of alimentary function, water intake and average number of hours of sleep on the various rations. This information was collected from the daily questionnaires issued each man, and from the observers with each company.

2. *Loss of Appetite, Nausea and Vomiting* occurred occasionally in men on all rations. As a group they appeared about twice as frequently on subjects eating the K Ration as in any other, but they were so uncommon as to be of no importance. It was the impression of all observers that stomach upsets were much less common during the ration trials than they had been in garrison, though this appears to be a result of regular hours and lack of spreeds, rather than an effect solely attributable to the rations tested.

3. *Excessive Flatus*. In general, there was no specific medical complaint associated with any ration except the prevalence of flatus in all subjects eating the Supplemented B Ration, where it was noted more than half of the time. It was particularly noticeable in E Company when they went on this ration after 3 weeks on K Ration. This company recorded excess flatus more than any other, while on K Ration. The trends and differences may be seen in Table 1. Because the rating of excess flatus is a subjective function and differs among companies on the same ration (e. g. E and G Companies on K Ration recorded 38% and 1%, respectively), it is not profitable to draw too rigid comparisons. Flatus was prevalent on Supplemented B Ration but not on any other.

4. The average *Number of Bowel Movements* daily per man in each company is given in Table 2. The range is 1 to 1.3 is not great. Most occurred while the 10-in-1 Ration was used, and least on the Canadian Mess Tin Ration, with an apparent relationship between increased bulk of the ration and increased number of bowel movements.

5. The company *Average Number of Hours Slept* each night did not vary more than $\frac{1}{4}$ hour from one ration to another, and no importance is attached to any of the differences between companies, or between rations (See Table 3).

6. *Water Consumption* varied considerably, as may be seen in Table 4. It is probable that the original data contain inaccuracies, and no attempt is made to draw any conclusions from these figures. Trends indicate that, regardless of ration, men drank more water as the summer advanced and the average temperature increased. This outweighed any effect of change in rations. It was never hot enough for a very large water requirement but the average daily fluid intake was about a gallon per man (See Table 4).

7. *Sick Call*. The battalion surgeon reported that sick call was only half as heavy as at Camp Carson. There were no significant differences between companies, regardless of rations. There were no epidemics of diarrhea or other illness which might have affected ration acceptability, fitness, medical examination, or weight.

H Company on the 10-in-1 Ration had an unusual number of men suffering from hemorrhoids which were also noted in G Company while on the K Ration. It is impossible to evaluate the role of other factors in their cause.

8. CONCLUSIONS.

None of the rations tested caused any important physiological handicap. Aside from excess flatus on the Supplemented B Ration, no noteworthy differences occurred on the various rations tested within the limits of admittedly incomplete data.

TABLE 1

PERCENTAGE OF SUBJECTS EXPERIENCING EXCESS FLATUS

Company	K Ration	10-in-1	C Ration	C.M.T.
E	38	-	-	-
G	1	11	5	-
H	-	22	-	-
X	15	4	9	4

TABLE 2

AVERAGE DAILY NUMBER OF BOWEL MOVEMENTS PER MAN WHILE SUBSISTING ON DIFFERENT RATIONS

Company	New C	Expt.C	K	C.M.T.	10-in-1	All Rations
E			1.14			1.14
G	1.23	1.18	1.16		1.24	1.20
H					1.38	1.38
X		1.38	1.21	1.01	1.30	1.19
Y		1.30	1.09		1.31	1.22
All Companies	1.23	1.30	1.13	1.01	1.34	1.23

TABLE 3

AVERAGE NUMBER OF HOURS SLEPT PER MAN WHILE SUBSISTING ON DIFFERENT RATIONS

Company	New C	Expt.C	K	C.M.T.	10-in-1	All Rations
E			7.36			7.36
G	7.69	7.23	7.32		7.70	7.49
H					7.56	7.56
X		7.53	7.46	7.60	7.80	7.62
Y		7.72	7.73		7.45	7.66
All Companies	7.69	7.59	7.45	7.60	7.60	7.55

TABLE 4

AMOUNT OF FLUID INGESTED ON DIFFERENT RATIONS
Average Number of Canteens (Quarts) per Man per Day

Company	New C	Expt.C	K	C.M.T.	10-in-1	All Rations
E			2.96			2.96
G	4.41	4.57	4.29		4.20	4.33
H					3.71	3.71
X		4.31	4.31	3.34	4.18	3.90
Y		3.51	4.30		3.82	3.87
All Companies	4.41	3.91	3.73	3.34	3.86	3.81

Appendix D VI
Inclosure #4f

APPENDIX D

Section VII

BIOCHEMICAL STUDIES SUMMARY OF RESULTS

(As Judged by Chemical Status of Test Subjects)

Ration	Ration Issue per man per day	Period	Salt	Vitamin B ₁	Vitamin B ₂	Vitamin C	Niacin
C (Experimental)	1-1/3	3 wks.	Adequate	High	Adequate	High	Adequate
C (New)	1	2 wks.	Adequate	Adequate	Adequate	High	Adequate
C (Experimental)	1	1 wk.	Adequate	Adequate	Adequate	High	Adequate
K	1-2/3	3 wks.	Adequate	Adequate	Adequate	Adequate	Adequate
Canadian Mess	1-1/3	3 wks.	Adequate	High	Possibly Low	High	Adequate
Tin					Low	Possibly Low	Adequate
10-in-1	1-1/4	8 wks.	Adequate	Adequate	Adequate	Low	Adequate
B Supplemented	4800 Cals.	8 wks.	Adequate	High	High	High	Adequate

1. INTRODUCTION.

Chemical studies are a valuable adjunct to ration tests, since it is generally accepted that when a diet is seriously deficient in some respect, biochemical changes may precede by a considerable time changes in the subjects' morale or physical fitness, which in turn may deteriorate long before there is diagnostic evidence of deficiency disease. Therefore, it is important to follow the general trend of the body's stores of important substances, especially when tests last only a relatively short period.

2. PROCEDURE

The general organization of the test is described in Appendix A. Chemical observations were made the day of arrival in the test area and at the end of Periods I, II and III. Three platoons from each company were studied, a total of 615 men on the first examination. Losses as described in Appendix A cut this number to 532 by the last examination.

During test periods, 1 company was examined each day. The subjects adhered approximately to the following schedule:

0430 hours	Reveille
0445 hours	Empty bladders into latrine
0450 hours	Drink 1/2 canteen cup water, (1/2 pint) in order to insure diuresis.
0500 hours	Weighing
0615 hours	Empty bladders into paper cups. (This is the "fasting specimen.")
0620 hours	Each man of the first platoon and the first half of second platoon drinks 150 ml. of water containing 5 mg. thiamine hydrochloride, 5 mg. of riboflavin, 50 mg. nicotinamide and 500 mg. ascorbic acid.
0630 hours	Breakfast of the ration appropriate to the test period.
0745 hours	Venepunctures started on Platoon 1.
0915 hours	Venepunctures all completed on Platoons 1, 2 and 3.
1020 hours	First platoon and first half of second platoon empty bladders into paper cups. (This is the "loaded specimen.")

The following chemical estimations were carried out in a field laboratory in the headquarters area:

- a. Whole blood hemoglobin.
- b. Serum protein.
- c. Serum chloride.
- d. Fasting urinary vitamin C (ascorbic acid).

- e. Fasting urinary vitamin B₁ (riamime).
- f. Fasting urinary vitamin B₂ (riboflavin).
- g. Fasting urinary vitamin Factor F₂ (probably N-methylnicotinamide).
- h. Excretion of test dose of vitamin C.
- i. Excretion of test dose of vitamin B₁.
- j. Excretion of test dose of vitamin B₂.
- k. Excretion of test dose of nicotinamide as Factor F₂.

The methods used in the field have been described and discussed in a report to the Office of Scientific Research and Development ("Assessment of Nutritional and Metabolic Condition in the Field" by Johnson, Sargent, Robinson and Consolazio, Serial No. 114, Report No. 28 under Contract OEMcmr-328(May 20, 1944).

3. RESULTS

a. *Biochemical Adequacy of the Rations as Judged by Company Averages*

Interpretation of the results should take into account not only absolute levels on single examinations, but also trends throughout the whole 2 months. We consider that either excessively low values on a single examination or a progressive and continuous drop from examination to examination are suggestive that the ration under consideration is inadequate in the nutrient measured. It may happen that levels fall for a time, and then become relatively constant, lower than they were on the first examination. Unless this new stable level is in a dangerously low range, we consider that the ration is adequate. Interpretation of data will be facilitated by reference to Table 1, which presents normal ranges and levels suggestive of deficiency serious enough to impair morale and physical fitness and to affect general health deleteriously if maintained long enough. They are derived from repeated examination of approximately 50 men in New England, 80 men in Saskatchewan in winter, the present battalion in the Colorado Rockies in summer, and from single examinations of 149 men in the Desert Training Center in summer. The lower levels of normality listed in Table 1 were all found in men whose physical fitness, morale and general health were satisfactory as judged by their line and medical officers. (See the report previously referred to, and also a report to the O.Q.M.G., Oct. 15, 1943, by Johnson, Sargent, Robinson and Consolazio, O.Q.M.G. Report No. 19 from the Harvard Fatigue Laboratory, "The Nutritional Status of Enlisted Men in the Desert Training Area").

A summary of the biochemical data is presented in Table 2 by companies, periods and rations; the averages are for all subjects tested at a given time, regardless of men who dropped out after 1, 2 or 3 examinations. Table 3 presents the same type of data for men who were examined in each of the 4 test periods. It will be seen that the averages are not essentially different.

Judgment of the biochemical adequacy of the various rations as issued and eaten in this test are presented in the Summary of Results, which is based on the data of Tables 2 and 3, the criteria of Table 1, and the first paragraph of this section. The following conclusions are drawn concerning the vitamin C, vitamin B₁, vitamin B₂ and niacin provided by the various rations:

(1) Supplemented B Ration maintained a high level in all respects for 2 months. No satisfactory explanation has been found for the abnormally high hemoglobin level in the first examination. This dropped to a normal level and then remained there. The level of Vitamin B₂ in the fasting urine of the company on this ration was consistently lower than in all other companies, but not dangerously so. The load test fluctuated somewhat erratically, but was always at a safely high level. A possible explanation for these results is that synthetic riboflavin or yeast had been added to all rations except B. In addition, a change was made in the dried eggs in B Ration in the middle of the test. These 2 factors perhaps influenced markedly the levels of Vitamin B₂ in F Company in comparison with the other companies. During 2 weeks on the Supplemented B Ration E Company showed a general increase in vitamin stores.

(2) Experimental C Ration, 1-1/3 rations per day, maintained a high level in all respects for 3 weeks (Y Company).

(3) New C Ration for 2 weeks plus Experimental C Ration for 1 week, 1 ration per day, maintained a satisfactory level in all respects with the possible exception of Vitamin B₁ which took a slight drop. (G Company).

Appendix D VII
Inclosure #4g

(4) K Ration, 1-2/3 rations per day, maintained a high level in all respects for 3 weeks (E, G, and Y Companies).

(5) Canadian Mess Tin Ration, 1-1/3 rations per day, allowed the maintenance of satisfactory levels of Vitamin C, Vitamin B₁, and niacin for 3 weeks (X Company). The results for Vitamin B₂ are difficult to interpret. This company started at a very high level, apparently because their ordinary garrison ration was supplemented by extra milk purchased with company funds. After 3 weeks on Canadian Mess Tin Ration they showed a large drop in stores of Vitamin B₂, but were still at a fairly high level. Many of the test subjects ate but little of the sardines and powered milk issued in the ration. It must be concluded that as eaten, the ration was probably low in Vitamin B₂.

(6) 10-in-1 Ration, 1-1/4 rations per day, was satisfactory for 2 weeks with respect to Vitamin B₁, Vitamin B₂ and niacin (H Company). In this test it did not sustain altogether satisfactorily the level of vitamin C. The statement that 10-in-1 provided relatively low amounts of vitamin C is corroborated by: (a) the fact that 13 test subjects in H Company showed very low levels after 8 weeks, as contrasted with only 2 at the start, at a time when there was an improvement in all other companies; and (b) a downward trend in 2 weeks on 10-in-1 in X and Y Companies at a time when B Ration was improving in the Vitamin C stores of E Company. In the case of G Company, a slight improvement in Vitamin C stores was observed in 2 weeks of 10-in-1.

b. *Biochemical Adequacy of the Rations as Judged by Individual Test Subjects*

A matter of considerable practical importance was established in this test when the biochemical results for individual test subjects were examined, in contrast to the company averages. It is obvious that if a considerable percentage of subjects reaches a dangerously low level, the ration they are eating cannot be considered adequate, even if the group average is satisfactory. Examination of Tables 2 and 3 shows that on the average over the whole 2 months the battalion improved with respect to Vitamin B₁ (as indicated by load test), Vitamin B₂ and Vitamin C; showed no significant change in chloride, serum protein or hemoglobin; and showed a moderate decrease in Factor F₂. With regard to the individual subjects Table 4 lists the percentage of men in each company who were chemically low at the start and at the finish of the test by the criteria listed in Table 1. The following points should be noted:

(1) There were no subjects low in hemoglobin or serum protein.

(2) A tendency in 3 companies for salt stores to be low in the last week was presumably due to the 90 mile march. Sweating may have been more profuse in that week than any other.

(3) Stores of Vitamin C improved in all companies except H, which was on 10-in-1 Ration. A considerable percentage of the battalion was low at the beginning.

(4) Stores of vitamin B₁ were good at the beginning, and improved in the few subjects who were low at the start.

(5) Stores of niacin, as measured by Factor F₂ remained above the danger level in a great majority of subjects, but were apparently not significantly improved.

(6) Stores of Vitamin B₂ were good at the start, but a few men were low at the beginning as well as at the end.

(7) The general conclusion to be drawn is that under the present conditions, the chemical status of the battalion was in general improved by subsistence on the rations tested. The finding can be explained by 2 factors.

(a) The choice of items is limited in the field rations, and food likes and dislikes are less likely to prevent the intake of foods high in vitamins than when the men are on garrison ration.

(b) The test subjects worked harder than they did in camp previous to the test. Their gross intake of food presumably increased during the test, and the intake of many of the vitamins increased accordingly.

c. *Findings in Y Company after Eleven Days of Moderate Calorie Deficiency*

The effects of moderate calorie deficiency were observed in Y Company when they received K Ration (1 ration per day) for 11 days at a time when they were expending about 4000 calories a day. In this company, there were constant complaints of hunger and a progressive loss of weight averaging 4 pounds in

the 11 days (See Appendix D, Section II). They were brought to headquarters area on the 11th day and were subjected to the usual battery of physical fitness tests. In the afternoon, after the last test, specimens of urine were collected from the first 3 platoons. These were examined by the nitroprusside reactions of Rothera. Of 89 specimens, none showed the reaction of true acetone bodies. Therefore, there was no significant degree of acidosis, such as one finds in acute severe calorie deficiency. (See the report of the Prince Albert Canadian Army Winter Ration Trials, 1944, for an example of acute calorie deficiency.) Twenty-one of the 89 specimens showed a positive reaction for the nitroprusside positive substances which appear after ingestion of biscuits containing powdered milk. This percentage is far less than has been seen in previous trials on K Ration.

d. Chemical Effects of Administering U. S. Army Vitamin Tablets to Subjects on Supplemented B Ration

During the last 3 weeks of the test, 3 vitamin tablets were administered daily to every man in Platoons 2 and 4 of F Company, and placebos to every man in Platoons 1 and 3. The whole company continued to receive Supplemented B Ration. At the end of 3 weeks of this regime vitamin load tests were administered to the whole of the first and second platoons, instead of to the whole first platoon and half of the second as had been done on the previous examinations.

The biochemical results are summarized in Table 5. It is clear from the data given in this table that the pills and placebos had been dispensed properly. It is of some theoretical interest that under the present experimental conditions the fasting level was a more sensitive indication that the subjects had been receiving vitamins than was the load test. Statistically significant differences between the groups of subjects were found in fasting urinary ascorbic acid, thiamine, riboflavin and Factor F_2 and small but statistically insignificant differences in the ascorbic acid, thiamine and riboflavin load tests. The nicotinamide load test was actually smaller in the group that had received vitamins. The difference between groups, however, was present also in earlier tests. As has been emphasized above the assay of Factor F_2 is not altogether satisfactory as a measure of niacin metabolism.

The present evidence is suggestive but the conclusions should not be extended to subjects under a regime different from the present one, i.e., a very good diet, high in all vitamins, supplemented with moderate doses of synthetic vitamins over a period of 3 weeks.

e. Reliability of Vitamin Load Tests Repeated at Frequent Intervals

Some of the conclusions in the present test are based on load tests administered to subjects who had already received such tests in the previous 2 or 3 weeks. Such a procedure might be criticised on the theoretical ground that load tests at frequent intervals on the same subjects alter their nutritional status so far as to vitiate the results. This fundamental question was studied in the present test, and the results to be presented below support the view that frequent load tests can be used safely in the case of men with a relatively high daily intake of vitamins in their diet.

The subjects were 96 enlisted men in Company X who had subsisted on Canadian Mess Tin Ration for 3 weeks, followed by 10-in-1 Ration for 2 weeks. The approximate daily intake during the 5 weeks was: ascorbic acid—70 mg.; riboflavin—2.0 mg.; thiamine—1.5 mg.; and nicotinic acid—25 mg. Load tests were administered to 50 of the subjects on the first day of the test, again 3 weeks later and finally at the end of the 5 weeks. A load test was administered to the remaining 46 subjects only once, at the end of the 5 weeks. The vitamin load consisted of an oral dose of 150 ml. of water containing 500 mg. of ascorbic acid, 5 mg. of thiamine hydrochloride, 5 mg. of riboflavin, and 50 mg. of nicotinamide. Urine was collected for an hour in the morning before breakfast; the subjects drank the load, ate their usual breakfast and collected urine for 4 hours after ingesting the vitamins. The reasons for using this short oral test are purely practical. Intravenous or intramuscular injection on a large scale requires apparatus and facilities not readily available in the field; breakfast has to be allowed if the morale of the enlisted man is not to suffer with detriment to the reliability of the fitness tests; a short collection period is necessary because of the difficulty of quantitative collection of urine and also because the men have to be released in time for lunch.

The results for fasting urine are summarized in Table 6. The averages for ascorbic acid, thiamine and Factor F_2 were not significantly different and the average for riboflavin was higher in the group that

had never previously received a load test. The range tended to extend a little higher in the group that had received 2 previous load tests, but the distribution curves were not significantly different.

The results for the load tests were similar to those for the fasting specimens collected before breakfast. The averages for the groups that had and had not received load test were: for ascorbic acid—54 and 61 mg. in 4 hours after the test dose; for thiamine—405 and 400 micrograms in 4 hours; for Factor F₂— 95 and 95 micrograms (quinine units) in 4 hours and for riboflavin—1575 and 1600 micrograms in 4 hours. Inspection of the distribution curves presented in Figure 1 shows a fairly wide spread in both groups, but curves that are very similar in shape.

From this set of observations, it may be concluded that in the case of men on similar diets of reasonably high vitamin content, assays of the fasting urine before breakfast and of oral load tests of short duration are not significantly affected by load tests administered at intervals of 2 or 3 weeks. This conclusion should not be extended without further evidence to subjects on frankly deficient diets or to types of load test different from that used in this study.

f. Statistical Examination of the Data

All data were examined statistically by analysis of variance methods (described more fully in the statistical section). The "error mean square" thereby obtained for each type of chemical analysis was used in calculating the smallest differences required for significance ($P < .05$) between 2 companies on any given test, between 2 tests on the same company and between the trends of 2 different companies from one test to another. These data are presented in Table 7.

Coefficients of variation were calculated for each set of determinations by dividing the mean of the entire set by the square root of the "error mean square". These coefficients (Table 8) give some indication of the relative unexplainable variation in the data.

It will be seen that the results are reasonably consistent. One precaution should be enjoined in the interpretation of the statistical treatment; a sharp distinction must be made between differences that are statistically significant and those that are significant from a purely physiological point of view. It is clear that so long as a given company remained well within normal limits their ration should be regarded as adequate, even though another company showed values that were higher from a statistical standpoint. It has yet to be demonstrated that excessively high levels of nutrients in the body are either necessary or desirable.

4. SUMMARY OF BIOCHEMICAL RESULTS:

a. On the basis of company averages:

- (1) Supplemented B Ration was adequate for 8 weeks in salt, iron, protein, Vitamins C, B₁, B₂, and niacin (See F and E Companies).
- (2) Experimental C Ration was adequate for 3 weeks in the same respects (See Y Company).
- (3) New C Ration was adequate for 3 weeks in the same respects (See G Company).
- (4) K Ration was adequate for 3 weeks in the same respects (See E, G and Y Companies).
- (5) The company on Canadian Mess Tin appeared low in riboflavin intake, but normal in all other respects (See X Company).
- (6) The company on 10-in-1 Ration for 8 weeks showed a progressive decrease in Vitamin C for 5 weeks and then leveled off at this low value. In all other respects, they were normal (See H Company, and for the same trend, X and Y Companies. G Company showed the reverse).

b. On the basis of individual results, the battalion was in better biochemical condition at the end of the test than at the beginning.

c. Adding vitamins to the Supplemented B Ration for 3 weeks led to a significantly increased excretion of vitamins C, B₁, B₂ and perhaps niacin.

d. Under the present test conditions, load tests administered to the same men at intervals of 2 or 3 weeks were demonstrated not to vitiate subsequent assays of vitamin stores as judged by urinary vitamin levels and by load tests.

e. Statistical evaluation of the data demonstrated good internal consistency in the biochemical observations.

TABLE 1

Normal ranges* and levels suggestive of deficiency serious enough to impair morale, physical fitness, and general health if continued long enough.

	Normal Range	Level Suggestive of Serious Deficiency	
		Below	12
Whole blood hemoglobin (Gm./100 ml.)	15 to 18		
Serum protein (Gms./100 ml.)	5.8 to 7.0	"	5.2
Serum chloride (Meq./l.)	96 to 114	"	96
Urinary chloride (Gms. NaCl/hr.)	0.2 to 1.0	"	0.2
Fasting urinary Vitamin C (Mg./hr.)	0.3 to 1.0	"	0.3
Vitamin C load test (Mg./4 hr.)	5 to 150	"	5
Fasting urinary Vitamin B ₁ ($\frac{1}{4}$ /hr.)	2 to 25	"	2
Vitamin B ₁ load test ($\frac{1}{4}$ /hr.)	50 to 800	"	50
Fasting urinary Factor F ₂ ($\frac{1}{4}$ /hr.)	2 to 15	"	2
Nicotinamide load test ($\frac{1}{4}$ /hr.)	20 to 200	"	20
Fasting urinary Vitamin B ₂ ($\frac{1}{4}$ /hr.)	10 to 100	"	10
Vitamin B ₂ load test ($\frac{1}{4}$ /hr.)	200 to 2500	"	200

* See text, page 2, for derivation.

TABLE 2

SUMMARY OF BIOCHEMICAL DATA BY COMPANIES, INCLUDING ALL SUBJECTS

(Each figure in the case of whole blood, serum and fasting urine is the average of approximately 100 subjects. In the case of load tests, each figure is the average of approximately 50 subjects.)

<i>F Company</i>	Start	Supplemented	Supplemented	Supplemented
		B Ration 3 weeks	B Ration 5 weeks	B Ration 8 weeks
Whole blood hemoglobin (Gms./100 ml.)	19.0	16.7	17.1	16.8
Serum protein (Gms./100 ml.)	6.5	5.9	6.1	6.2
Serum chloride (Meq./l.)	103	103	104	107
Urinary chloride (Gms. NaCl/hr.)	0.7	0.6	0.6	0.4
Fasting urinary Vitamin C (Mg./hr.)	0.5	1.0	0.8	0.8
Vitamin C load test (Mg./4 hr.)	38	103	58	103
Fasting urinary Vitamin B ₁ ($\frac{1}{4}$ /hr.)	11	9	17	13
Vitamin B ₁ load test ($\frac{1}{4}$ /hr.)	265	340	620	500
Fasting urinary Factor F ₂ ($\frac{1}{4}$ /hr.)	11	8	6	6
Nicotinamide load test ($\frac{1}{4}$ /hr.)	130	165	120	130
Fasting urinary Vitamin B ₂ ($\frac{1}{4}$ /hr.)	24	17	22	26
Vitamin B ₂ load test ($\frac{1}{4}$ /hr.)	1070	1950	1060	1850

<i>H Company</i>	Start	10-in-1	10-in-1	10-in-1
		3 weeks	(as 8-in-1 except for one week) 5 weeks	8 weeks
Whole blood hemoglobin (Gms./100 ml.)	18.8	16.7	17.4	16.8
Serum protein (Gms./100 ml.)	6.2	6.0	6.3	6.5
Serum chloride (Meq./l.)	102	105	107	107
Urinary chloride (Gms. NaCl/hr.)	0.6	0.5	0.5	0.5
Fasting urinary Vitamin C (Mg./hr.)	0.7	0.4	0.7	0.6
Vitamin C load test (Mg./4 hr.)	32	26	17	23
Fasting urinary Vitamin B ₁ ($\frac{1}{4}$ /hr.)	13	11	11	13
Vitamin B ₁ load test ($\frac{1}{4}$ /hr.)	440	490	550	455
Fasting urinary Factor F ₂ ($\frac{1}{4}$ /hr.)	14	7	8	6
Nicotinamide load test ($\frac{1}{4}$ /hr.)	160	105	120	100
Fasting urinary Vitamin B ₂ ($\frac{1}{4}$ /hr.)	36	22	36	28
Vitamin B ₂ load test ($\frac{1}{4}$ /hr.)	1510	1635	1765	1590

Appendix D VII
Inclosure #4g

TABLE 2 (Continued)

<i>E Company</i>	Start	K Ration (5 bxs./day) 3 weeks	Supplemented B Ration 2 weeks	K Ration (5 bxs./day) 3 weeks
Whole blood hemoglobin (Gms./100 ml.)	--	16.6	17.1	17.3
Serum protein (Gms./100 ml.)	6.5	6.0	6.4	6.2
Serum chloride (Meq./l.)	103	104	107	109
Urinary chloride (Gms. NaCl/hr.)	0.5	0.4	0.8	0.4
Fasting urinary Vitamin C (Mg./hr.)	0.4	0.6	1.2	0.7
Vitamin C load test (Mg./4 hr.)	38	56	125	68
Fasting urinary Vitamin B ₁ (γ /hr.)	14	14	16	16
Vitamin B ₁ load test (γ /4 hr.)	510	610	675	640
Fasting urinary Factor F ₂ (γ /hr.)	11	8	5	5
Nicotinamide load test (γ /4 hr.)	160	130	85	135
Fasting urinary Vitamin B ₂ (γ /hr.)	52	26	30	28
Vitamin B ₂ load test (γ /hr.)	2210	2010	2220	2300

<i>G Company</i>	Start	K Ration (5 bxs./day) 3 weeks	10-in-1 (as 8-in-1) 2 weeks	New C Ration (6 cans/day) 3 weeks
Whole blood hemoglobin (Gms./100 ml.)	17.2	16.9	17.2	17.1
Serum protein (Gms./100 ml.)	6.2	6.0	6.1	6.1
Serum chloride (Meq./l.)	105	106	107	109
Urinary chloride (Gms. NaCl/hr.)	0.5	0.4	0.6	0.5
Fasting urinary Vitamin C (Mg./hr.)	0.4	0.7	0.6	0.8
Vitamin C load test (Mg./4 hr.)	42	41	46	78
Fasting urinary Vitamin B ₁ (γ /hr.)	17	20	17	12
Vitamin B ₁ load test (γ /4 hr.)	515	580	400	360
Fasting urinary Factor F ₂ (γ /hr.)	12	8	6	7
Nicotinamide load test (γ /4 hr.)	115	160	70	95
Fasting urinary Vitamin B ₂ (γ /hr.)	26	27	45	26
Vitamin B ₂ load test (γ /hr.)	1170	1455	1520	1635

<i>X Company</i>	Start	Canadian Mess Tin (4 bxs. for 3 men) 3 weeks	10-in-1 (as 8-in-1) 2 weeks
Whole blood hemoglobin (Gms./100 ml.)	16.5	16.6	16.6
Serum protein (Gms./100 ml.)	6.2	6.0	6.2
Serum chloride (Meq./l.)	105	105	106
Urinary chloride (Gms. NaCl/hr.)	0.8	0.4	0.5
Fasting urinary Vitamin C (Mg./hr.)	0.5	0.8	0.7
Vitamin C load test (Mg./4 hr.)	20	61	54
Fasting urinary Vitamin B ₁ (γ /hr.)	12	18	12
Vitamin B ₁ load test (γ /4 hr.)	250	490	405
Fasting urinary Factor F ₂ (γ /hr.)	13	11	6
Nicotinamide load test (γ /4 hr.)	145	100	95
Fasting urinary Vitamin B ₂ (γ /hr.)	77	51	25
Vitamin B ₂ load test (γ /hr.)	2520	1685	1670

<i>Y Company</i>	Start	Expr. C Ration (8 cans/day) 3 weeks	10-in-1 (as 8-in-1) 2 weeks	K Ration (3 bxs./ day) 11 days	K Ration (5 bxs./ day) 10 days
Whole blood hemoglobin (Gms./100 ml.)	17.2	16.8	16.7	17.1	
Serum protein (Gms./100 ml.)	6.4	6.2	6.6	6.4	
Serum chloride (Meq./l.)	105	107	109	103	
Urinary chloride (Gms. NaCl/hr.)	0.4	0.6	0.5	0.4	
Fasting urinary Vitamin C (Mg./hr.)	0.5	0.6	0.6	0.7	
Vitamin C load test (Mg./4 hr.)	34	112	51	45	
Fasting urinary Vitamin B ₁ (γ /hr.)	9	23	13	18	
Vitamin B ₁ load test (γ /4 hr.)	185	680	390	505	
Fasting urinary Factor F ₂ (γ /hr.)	8	8	5	4	
Nicotinamide load test (γ /4 hr.)	125	125	85	85	
Fasting urinary Vitamin B ₂ (γ /hr.)	32	33	34	38	
Vitamin B ₂ load test (γ /hr.)	1190	1725	1605	1615	

Appendix D VII
Inclosure #4g

TABLE 3
SUMMARY OF BIOCHEMICAL DATA BY COMPANIES INCLUDING ONLY MEN EXAMINED
AT EACH OF THE FOUR TEST PERIODS

<i>F Company</i>	Start	B Ration 3 weeks	B Ration 5 weeks	B Ration 8 weeks
Whole blood hemoglobin (Gms./100 ml.)	19.1	16.7	17.2	17.1
Serum protein (Gms./100 ml.)	6.5	5.9	6.1	6.2
Serum chloride (Meq./l.)	103	103	104	108
Urinary chloride (Gms. NaCl/hr.)	0.8	0.8	0.6	0.4
Fasting urinary Vitamin C (Mg./hr.)	0.5	1.0	0.8	0.8
Vitamin C load test (Mg./4 hr.)	42	102	61	106
Fasting urinary Vitamin B ₁ (γ /hr.)	11	9	16	12
Vitamin B ₁ load test (γ /4 hr.)	280	355	645	545
Fasting urinary Factor F ₂ (γ /hr.)	10	8	5	6
Nicotinamide load test (γ /4 hr.)	150	175	130	115
Fasting urinary Vitamin B ₂ (γ /hr.)	27	21	27	26
Vitamin B ₂ load test (γ /hr.)	1180	2090	1020	1985

<i>H Company</i>	Start	10-in-1 3 weeks (as 8-in-1 except for one week)	10-in-1 5 weeks	10-in-1 8 weeks
Whole blood hemoglobin (Gms./100 ml.)	18.7	16.6	17.4	16.8
Serum protein (Gms./100 ml.)	6.2	6.0	6.3	6.5
Serum chloride (Meq./l.)	102	104	106	107
Urinary chloride (Gms. NaCl/hr.)	0.5	0.5	0.6	0.5
Fasting urinary Vitamin C (Mg./hr.)	0.7	0.4	0.6	0.6
Vitamin C load test (Mg./4 hr.)	34	30	19	24
Fasting urinary Vitamin B ₁ (γ /hr.)	15	10	10	12
Vitamin B ₁ load test (γ /4 hr.)	490	525	510	460
Fasting urinary Factor F ₂ (γ /hr.)	13	6	7	5
Nicotinamide load test (γ /4 hr.)	155	105	115	105
Fasting urinary Vitamin B ₂ (γ /hr.)	44	27	52	31
Vitamin B ₂ load test (γ /hr.)	1435	1725	1775	1605

<i>E Company</i>	Start	K Ration (5 bxs./day) 3 weeks	Supplemented B Ration 2 weeks	K Ration (5 bxs./day) 3 weeks
Whole blood hemoglobin (Gms./100 ml.)	--	16.6	17.2	17.3
Serum protein (Gms./100 ml.)	6.5	6.0	6.4	6.2
Serum chloride (Meq./l.)	103	104	108	109
Urinary chloride (Gms. NaCl/hr.)	0.5	0.4	0.9	0.4
Fasting urinary Vitamin C (Mg./hr.)	0.4	0.5	1.1	0.7
Vitamin C load test (Mg./4 hr.)	34	57	129	73
Fasting urinary Vitamin B ₁ (γ /hr.)	16	13	16	16
Vitamin B ₁ load test (γ /4 hr.)	490	590	695	620
Fasting urinary Factor F ₂ (γ /hr.)	11	7	5	5
Nicotinamide load test (γ /4 hr.)	110	140	85	140
Fasting urinary Vitamin B ₂ (γ /hr.)	52	24	31	27
Vitamin B ₂ load test (γ /hr.)	2200	1990	2280	2280

Appendix D VII
 Inclosure #4g

TABLE 3 (Continued)

<i>G Company</i>	Start	K Ration (5 bxs./day) 3 weeks	10-in-1 (as 8-in-1) 2 weeks	New C Ration (6 cans/day) 3 weeks
Whole blood hemoglobin (Gms./100 ml.)	17.1	16.8	17.2	17.1
Serum protein (Gms./100 ml.)	6.2	6.0	6.1	6.1
Serum chloride (Meq./l.)	105	106	106	106
Urinary chloride (Gms. NaCl/hr.)	0.5	0.4	0.6	0.5
Fasting urinary Vitamin C (Mg./hr.)	0.4	0.6	0.6	0.8
Vitamin C load test (Mg./4 hr.)	45	38	49	83
Fasting urinary Vitamin B ₁ (γ /hr.)	18	21	17	12
Vitamin B ₁ load test (γ /4 hr.)	530	615	420	365
Fasting urinary Factor F ₂ (γ /hr.)	12	8	5	7
Nicotinamide load test (γ /4 hr.)	110.	170	100	95
Fasting urinary Vitamin B ₂ (γ /hr.)	27	25	45	27
Vitamin B ₂ load test (γ /hr.)	1095	1530	1790	1610

<i>X Company</i>	Start	Canadian Mess Tin (4 bxs. for 3 men) 3 weeks	10-in-1 (as 8-in-1) 2 weeks
Whole blood hemoglobin (Gms./100 ml.)	16.6	16.9	16.6
Serum protein (Gms./100 ml.)	6.2	6.0	6.2
Serum chloride (Meq./l.)	105	105	106
Urinary chloride (Gms. NaCl/hr.)	0.8	0.4	0.5
Fasting urinary Vitamin C (Mg./hr.)	0.4	0.7	0.7
Vitamin C load test (Mg./4 hr.)	23	62	54
Fasting urinary Vitamin B ₁ (γ /hr.)	13	18	12
Vitamin B ₁ load test (γ /4 hr.)	265	495	410
Fasting urinary Factor F ₂ (γ /hr.)	13	10	6
Nicotinamide load test (γ /4 hr.)	150	105	95
Fasting urinary Vitamin B ₂ (γ /hr.)	79	49	25
Vitamin B ₂ load test (γ /hr.)	2400	1705	1700

<i>Y Company</i>	Start	Expr. C Ration (8 cans/day) 3 weeks	10-in-1 (as 8-in-1) 2 weeks	K Ration (3 bxs./ day) 11 days	(5 bxs./ day) 10 days
Whole blood hemoglobin (Gms./100 ml.)	17.0	16.8	16.7	17.0	17.0
Serum protein (Gms./100 ml.)	6.3	6.2	6.6	6.4	6.4
Serum chloride (Meq./l.)	105	107	108	103	103
Urinary chloride (Gms. NaCl/hr.)	0.4	0.6	0.5	0.4	0.4
Fasting urinary Vitamin C (Mg./hr.)	0.4	0.5	0.5	0.7	0.7
Vitamin C load test (Mg./4 hr.)	37	120	64	44	44
Fasting urinary Vitamin B ₁ (γ /hr.)	8	23	13	17.	17.
Vitamin B ₁ load test (γ /4 hr.)	195	675	410	530	530
Fasting urinary Factor F ₂ (γ /hr.)	7	8	5	4	4
Nicotinamide load test (γ /4 hr.)	130	125	85	85	85
Fasting urinary Vitamin B ₂ (γ /hr.)	27	34	33	37	37
Vitamin B ₂ load test (γ /hr.)	1140	1755	1730	1715	1715

TABLE 4

PERCENTAGE OF MEN IN EACH COMPANY CHEMICALLY LOW AT BEGINNING
AND END OF TEST

Measurement	Y Company		X Company		G Company		E Company		H Company		F Company	
	Start	End	Start	End of 5 wks.	Start	End	Start	End	Start	End	Start	End
Hemoglobin	0	0	0	0	0	0	lost	0	0	0	0	0
Serum Protein	0	0	0	0	0	0	0	0	0	0	0	0
Serum Chloride	0	4	0	0	0	0	0	0	0	0	2	0
Urinary Chloride	5	1	0	2	3	2	4	2	0	3	1	10
Fasting Urinary Vitamin C	19	0	1	0	1	0	14	1	0	1	7	3
Vitamin C load	0	4	4	0	8	0	6	0	2	12	10	0
Fasting Urinary Vitamin B ₁	1	0	0	0	0	0	0	0	0	0	0	0
Vitamin B ₁ load	8	2	2	0	0	0	0	0	0	0	6	0
Fasting Urinary Factor F ₂	0	0	0	0	0	0	0	0	0	0	0	2
Nicotinamide load	3	4	2	4	4	6	2	2	2	2	8	2
Fasting Urinary Vitamin B ₂	6	0	0	0	1	1	0	1	0	0	2	2
Vitamin B ₂ load	2	2	2	0	2	0	0	0	0	2	0	0

TABLE 5

COMPARISON OF VITAMIN LEVELS IN THE URINE OF PLATOON 2, WHO HAD RECEIVED
VITAMIN PILLS FOR THREE WEEKS AND PLATOON 1, WHO HAD RECEIVED PLACEBOS

	Placebo		Vitamin**	
	Start of Period	End of Period	Start of Period	End of Period
Fasting Urinary Vitamin C (Mg./hr.)*	.8	.8	.8	1.4
Vitamin C load test (Mg./4 hr.)	61	103	59	113
Fasting urinary Vitamin B ₁ *	17	12	14	23
Vitamin B ₁ load test (γ/4 hr.)	670	530	600	570
Fasting urinary Factor F ₂ (γ/hr.) *	6	6	5	3
Nicotinamide load test (γ/4 hr.)	145	130	105	85
Fasting urinary Vitamin B ₂ (γ/hr.)*	21	26	22	56
Vitamin B ₂ load test (γ/4 hr.)	970	1860	1120	2190

* Statistically significant differences between groups in trends between the two tests reported here.

** Over and above the amounts provided by supplemented B Ration, the 3 G.I. vitamin pills provided daily: Vitamin A, 7500 U.S.P. units; Vitamin D, 600 U.S.P. units; thiamine hydrochloride, 3.0 mg.; riboflavin, 4.5 mg.; ascorbic acid, 112.5 mg.; and nicotinamide, 30 mg.

TABLE 6
FASTING URINARY LEVELS IN MEN WHO HAD AND HAD NOT BEEN
SUBJECTED TO VITAMIN LOAD TESTS

(All subjects had subsisted for three weeks on Canadian Mess Tin Ration followed for two weeks by 10-in-1 Ration)

	No Previous Load Test (46 Subjects)		Load Tests 5 and 2 Weeks Previously (50 Subjects)	
	Mean	Range	Mean	Range
Ascorbic Acid (Mg./hr.)	0.6	0.4 to 1.8	0.8	0.4 to 1.8
Thiamine (γ /hr.)	11	6 to 24	12	6 to 42
Factor F ₂ (γ /hr.)	5	2 to 10	6	2 to 17
Riboflavin (γ /hr.)	27	12 to 68	22	8 to 93

TABLE 7
APPROXIMATE LEAST SIGNIFICANT DIFFERENCES REQUIRED FOR SIGNIFICANCE

	Between Companies or between Tests on the Same Company	Between Gains (or losses) of Two Companies
Whole blood hemoglobin (Gms./100 ml.)	.21	.29
Serum protein (Gms./100 ml.)	.15	.22
Serum chloride (Meq./l.)	1.1	1.5
Urinary chloride (Gms. NaCl/hr.)	.08	.12
Fasting urinary Vitamin C (Mg./hr.)	.11	.15
Vitamin C load test (Mg./4 hr.)	16	23
Fasting urinary Vitamin B ₁ (γ /hr.)	2.4	3.3
Vitamin B ₁ load test (γ /4 hr.)	98	139
Fasting urinary Factor F ₂ (γ /hr.)	1.4	1.9
Nicotinamide load test (γ /4hr.)	35	49
Fasting urinary Vitamin B ₂ (γ /hr.)	6.2	8.8
Vitamin B ₂ load test (γ /4 hr.)	336	475

TABLE 8
COEFFICIENTS OF VARIATION OF BIOCHEMICAL DATA

	Coefficient of * Variation (%)
Whole blood hemoglobin (Gms./100 ml.)	4
Serum protein (Gms./100 ml.)	7
Serum chloride (Meq./l)	3
Urinary chloride (Gms. NaCl/hr.)	47
Fasting urinary Vitamin C (Mg./hr.)	50
Vitamin C load test (Mg./4 hr.)	65
Fasting urinary Vitamin B ₁ (γ /hr.)	48
Vitamin B ₁ load test (γ /4 hr.)	45
Fasting urinary Factor F ₂ (γ /hr.)	52
Nicotinamide load test (γ /4 hr.)	46
Fasting urinary Vitamin B ₂ (γ /hr.)	54
Vitamin B ₂ load test (γ /4 hr.)	43

* $\sqrt{\text{Error mean square/mean}}$

EFFECTS OF REPEATED LOAD TESTS

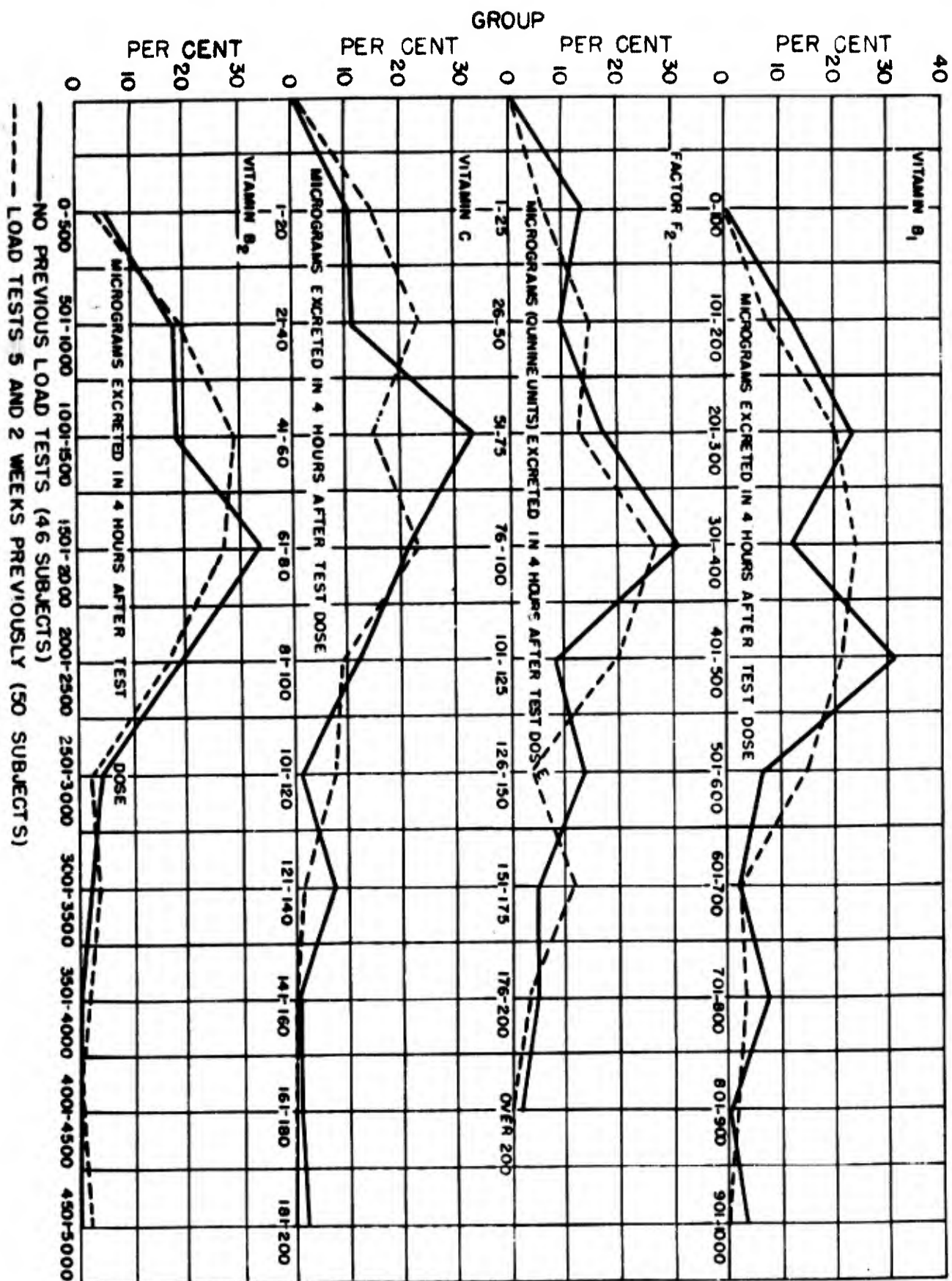


FIG. 1

APPENDIX E
STATISTICAL METHODS AND TABLES OF DATA

1. METHODS

All measurement data (physical fitness and chemical) were treated by analysis of variance methods, and enumeration data (clinical) by chi-square methods. Changes within companies or any differences between companies with respect to physical fitness, clinical, or biochemical findings have been designated in the text as changes or differences only when they were found to be statistically significant ($P < .05$). There were, of course, some differences of statistical significance which could not be considered of any real importance in this test. For example, company average fasting urinary thiamin excretion changed significantly from one test to another but such fluctuations are of no practical consequence since the level at all times was above the level thought to indicate a deficiency state.

The following general procedure was followed in the analysis of variance of physical fitness and biochemical data. The total sum of squares of the data for any series of tests (e.g. AAF Test) was separated into 5 parts attributable to (1) differences among company means, (2) differences among test period means, (3) company by test period interaction, (4) differences among means for different men in the same company, and (5) men by test period interaction within companies. The latter statistic, when divided by its number of degrees of freedom, is an estimate of error appropriate for testing the significance of any apparent difference between any 2 or more means calculable from the particular body of data from which "error" was obtained. The least significant ($P < .05$) differences between means for biochemical tests have been presented in Appendix D, Section VII. The same is true of coefficients of variation. Corresponding data for physical fitness tests are presented in Tables 1 and 2. The detailed analysis of variance of Step Test scores is presented in Table 3 as an illustration of the analysis used on all physical fitness and biochemical data.

The chi-square test of significance of differences among companies, among examinations of the same company on different days, and among relative changes of companies from one test to another was effected by (1) calculating the results to be expected if there were no differences, (2) determining deviations of actual results from expected, (3) dividing squared deviations by expected values, and (4) summing the quotients thereby obtained. The last value is chi-square, and its magnitude is a measure of the probability that differences of the magnitude observed would occur in samples from a homogeneous population.

TABLE 1
LEAST SIGNIFICANT ($P < .05$) DIFFERENCES IN PHYSICAL FITNESS TESTS

	Between companies on same test or between 2 tests on same company.	Between 2 company gains (or losses) from 1 test to another.
Step Test (score)	2.6	3.6
AAF Test (score)	1.3	1.8
AGF Test (score)	1.5	2.1
Sum of scores (3 tests)	3.4	4.8
Body Weight (lb.)	0.8	1.1

TABLE 2
COEFFICIENTS OF VARIATION (%) OF PHYSICAL FITNESS TESTS
($\sqrt{\text{Error mean square}/\text{mean}}$)

Step Test	11.9
AAF Test	10.4
AGF Test	6.2
Sum of 3 Tests	5.9
Body Weight	1.8

TABLE 3
ANALYSIS OF VARIANCE OF STEP TEST SCORES

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Squares*
Total	2,954	643,681	---
Men Within Companies	585	346,831	595
Companies	5	16,695	3,339
Test Periods	4	77,516	19,379
Companies x Test Periods	20	6,597	330
Within Company Men x Test Periods (error)	2,340	96,042	84

*The significance of the various mean squares may be tested by comparing them with "error". Each of these above are significant at the 1% level.

2. SUMMARY QUESTIONNAIRES were discussed in Appendix D, Section I. They were used to get additional information on acceptability, to test the memory of likes and dislikes, and to obtain suggestions and comments which summarized the soldier's reactions to various rations. They were filled out in accordance with the schedule appended below. On the dates underlined a special form of questionnaire for the 10-in-1 Ration was used.

Company	Ration	First	Second	Third
E	K	7 Jul	11 Aug	
G	C, Expt	8 Jul	22 Jul	8 Aug
	C, New	22 Jul	8 Aug	
	10-in-1	<u>8 Aug</u>		
	K	8 Aug		
H	10-in-1	23 Jul	8 Aug	<u>10 Aug</u>
X	C.M.T.	7 Jul	23 Jul	
	10-in-1	21 Jul	<u>9 Aug</u>	
	C, Expt	31 Jul		
	K	4 Aug		
Y	C, Expt	6 Jul	20 Jul	6 Aug
	10-in-1	20 Jul	6 Aug	<u>8 Aug</u>
	K	6 Aug		

Tables 4-13 present the information obtained from summary questionnaires.

TABLE 4
EXPERIMENTAL C RATION MEAT ITEM LISTED AS FIRST CHOICE
WHEN ONLY ONE COULD BE CHOSEN
(Y Company Summary Questionnaires)

Item	Number of Men*		
	6 July	20 July	8 Aug.
Meat & beans	3	3	5
Meat & vegetable hash	2	1	0
Meat & vegetable stew	0	3	0
Meat & spaghetti	0	1	0
Chicken & vegetable	34	35	43
Beans & franks w/molasses	6	5	7
Pork & beans w/tomato	4	3	1
Pork & beans w/molasses	0	0	0
Beef & noodles	2	2	1
Ham & lima beans	27	22	29

*Questionnaires returned by 135, 133, and 135 men on the dates above.

TABLE 5

PREFERENCE RATINGS OF EXPERIMENTAL C RATION MEAT ITEMS
(Reported in Y Company Summary Questionnaires)

Meat Item	Date	Preference (Number of Men*) Rating					
		1st	2nd	3rd	9th	10th	11th
Meat & beans	6 Jul	7	5	4	8	10	15
	20 "	5	3	5	19	8	9
	6 Aug	5	3	3	21	13	10
Meat & vegetable hash	6 Jul	0	2	1	21	32	46
	20 "	0	1	2	18	30	52
	6 Aug	0	1	3	18	34	48
Meat & vegetable stew	6 Jul	2	1	3	28	43	21
	20 "	0	3	1	24	39	28
	6 Aug	0	3	1	31	32	17
Meat & spaghetti	6 Jul	3	5	4	33	19	14
	20 "	2	5	6	26	18	8
	6 Aug	0	4	4	11	18	13
Chicken & vegetable	6 Jul	53	16	18	2	2	3
	20 "	45	14	7	0	3	3
	6 Aug	43	10	10	3	2	5
Beans & franks w/tomato	6 Jul	36	41	23	2	0	0
	20 "	51	34	22	0	3	1
	6 Aug	49	37	20	2	1	1
Beans & franks w/molasses	6 Jul	4	24	36	3	3	0
	20 "	6	36	36	3	0	2
	6 Aug	7	37	40	2	1	0
Pork & beans w/tomato	6 Jul	0	8	13	16	7	3
	20 "	23	11	15	5	4	24
	6 Aug	1	12	27	7	1	2
Pork & beans w/molasses	6 Jul	0	0	5	5	12	14
	20 "	2	12	8	15	8	7
	6 Aug	0	3	8	5	5	3
Beef & noodles	6 Jul	2	4	7	7	5	13
	20 "	2	1	6	15	14	17
	6 Aug	1	3	7	16	18	15
Ham & lima beans	6 Jul	28	29	21	10	3	6
	20 "	18	13	15	8	7	3
	6 Aug	29	24	13	6	2	4

* Questionnaires were returned by 135, 133 and 135 men on the above dates.

TABLE 6

PREFERENCE RATING OF EXPERIMENTAL C RATION BEVERAGES
(Reported in Y Company Summary Questionnaires)

Beverage	Date	Preference (Number of Men)					
		Hot			Cold		
		1st	2nd	3rd	1st	2nd	3rd
Cocoa	6 Jul	94	38	2	56	32	44
	20 "	74	53	1	55	21	24
	6 Aug	62	67	1	65	36	24
Coffee	6 Jul	39	91	4	1	4	22
	20 "	53	70	5	3	1	3
	6 Aug	67	63	0	12	14	26
Bouillon	6 Jul	1	5	98	0	0	1
	20 "	2	5	119	36	4	11
	6 Aug	1	0	129	0	0	2
Orange	6 Jul				63	60	8
	20 "				32	61	31
	6 Aug				49	56	22
Lemon	6 Jul				12	42	57
	20 "				8	47	68
	Aug				4	25	55

TABLE 7

PREFERENCE RATING OF EXPERIMENTAL C RATION BISCUITS
(Reported in Y Company Summary Questionnaires)

Biscuit	Date	Preference (Number of Men)		
		1st	2nd	3rd
Soda Cracker	6 Jul	89	23	23
	20 "	76	16	41
	6 Aug	91	23	18
Neutral Biscuit	6 Jul	15	81	38
	20 "	34	83	16
	6 Aug	26	92	14
Whole Wheat Bis.	6 Jul	30	30	73
	20 "	23	34	76
	6 Aug	15	17	100

TABLE 8

PREFERENCE RATING OF EXPERIMENTAL C RATION CANDIES
(Reported in Y Company Summary Questionnaires)

Candies	Date	Preference (Number of Men)		
		1st	2nd	3rd
Caramels	6 Jul	49	31	28
	20 "	54	28	27
	6 Aug	50	36	27
Hard candy	6 Jul	37	32	29
	20 "	29	27	38
	6 Aug	30	33	24
Jelly beans	6 Jul	26	33	28
	20 "	23	34	27
	6 Aug	22	22	27
Candy coated peanuts	6 Jul	18	23	30
	20 "	29	28	24
	6 Aug	13	25	28
Candy coated raisins	6 Jul	4	14	15
	20 "	5	8	15
	6 Aug	5	14	22

TABLE 9

EXPERIMENTAL C RATION CEREAL ITEM LISTED AS FIRST CHOICE
(Reported in Y Company Summary Questionnaires)

Cereal	6 Jul	20 Jul	8 Aug
General Mills	112	114	100
General Foods	22	18	25

TABLE 10

EXPERIMENTAL C RATION B UNIT LISTED AS FIRST CHOICE
(Reported in Y Company Summary Questionnaires)

B Unit	6 Jul	20 Jul	8 Aug
B-1	14	16	16
B-2	1	0	1
B-3	110	106	103
B-4	2	2	3
B-5	2	3	2
B-6	5	6	7

TABLE 11

OPINION OF K RATION
(Reported in G Company Summary Questionnaires#)

Item	Liked item			Liked best			Should remove from ration			Caused ill effects*		
	8 Jul	22 Jul	8 Aug	8 Jul	22 Jul	8 Aug	8 Jul	22 Jul	8 Aug	8 Jul	22 Jul	8 Aug
Pork & egg yolk	105	76	88	72	52	38	2	5	3	4	2	2
Ham & eggs	-	100	60	0	15	46	-	-	-	-	-	-
American cheese	20	72	16	5	4	6	75	74	47	35	48	21
Am. cheese w/bacon	28	16	24	1	2	1	12	-	46	-	-	-
Pork & beef	9	64	36	0	9	10	-	3	-	-	-	-
Corned pork loaf	98	68	76	30	12	11	15	11	13	3	2	2
Lemon juice	90	44	24	34	5	19	3	14	9	-	-	1
Orange juice	121	120	108	49	26	28	-	-	1	-	-	-
Bouillon	65	48	8	6	3	2	16	67	29	3	6	3
Coffee	92	116	112	46	31	53	1	-	1	-	-	-
Fruit bar	104	68	76	36	15	17	-	7	8	-	1	1
Caramels	120	116	112	38	16	31	2	-	1	-	-	-
Sweet choc. bar	119	120	116	75	57	65	-	-	-	-	-	-
D Ration choc bar	76	116	72	15	11	13	8	7	9	1	-	1
K-1A	22	16	24	2	2	1	25	12	16	-	-	-
K-2	14	20	28	1	0	-	35	13	26	-	-	-
K-3	42	36	36	3	1	-	16	5	9	-	-	-
K-4	107	80	92	28	8	8	4	3	4	-	-	-
K-5	20	32	40	1	1	1	25	8	13	-	-	-
Camels (cigarettes)	-	-	-	1	-	-	-	-	-	-	-	-
Gum	-	-	-	1	-	-	-	-	-	-	-	-
Sugar	-	-	-	-	-	1	-	-	-	-	-	-
Chelsea (cigarettes)	-	-	-	-	-	-	1	-	-	-	-	-

* Questionnaires were returned by 126, 123 and 118 men on 8 July, 22 July and 8 August, respectively.

* Ill effects were constipation, nausea.

TABLE 12
OPINION OF C. M. T. RATION ITEMS

Item	6 July			22 July		
	Good	Fair	Poor	Good	Fair	Poor
Sardines	24	53	58	17	55	55
Pork loaf	62	58	15	50	64	13
Beef	72	59	4	64	58	5
Cheese	79	45	11	73	43	11
Butter	118	15	2	118	8	1
Biscuits	25	76	34	27	52	48
Sugar	102	23	10	105	17	5
Jam	134	0	1	125	2	0
Milk & sugar powder	20	62	53	19	63	45
Candy	124	10	1	113	14	0
Chocolate bar	115	18	2	106	18	3
Tea	66	50	13	76	35	9
Coffee	44	59	29	62	44	14
Chocolate drink	96	29	9	99	24	3
Pea soup	26	40	68	22	36	57

TABLE 13
PREFERENCE FOR 10-IN-1 ITEM AND MENU
(Reported in Y Company Summary Questionnaires)

First Choice	Item	20 Jul	6 Aug
Breakfast meat	Pork sausage meat	14	15
	Bacon	96	82
	Ham & eggs	17	32
	Chopped pork & egg yolk	6	2
Beverage	Coffee	78	78
	Cocoa	51	52
	Lemon	1	0
	Orange	0	2
	Grape	2	2
Supper meat	Dehydrated meat & rice	6	6
	English style stew	13	13
	Canned corned beef	41	33
	Roast beef	70	81
	Dehydrated corned beef hash	3	2
Menu number	Menu #1	3	7
	Menu #2	26	22
	Menu #3	19	22
	Menu #4	85	81
	Menu #5	0	2
Dinner biscuit	K-1A	12	13
	K-2	12	16
	K-3	46	22
	K-4	21	71
	K-5	38	12
Supper dessert	Peanuts	46	31
	Fruit bar	13	6
	Hard candy	23	10
	D Ration choc. bar	30	24
	Tropical sweet choc. bar	19	60

Appendix E
Inclosure #5

3. Acceptability Data from the daily questionnaires are presented in Tables 14-27 in more detail than in Appendix D, Section I.

TABLE 14
ACCEPTABILITY OF EXPERIMENTAL C RATION GROUPS BY COMPANIES*

Item	G Company 4-10 Aug				X Company 21-27 Jul 5-9 Aug				Y Company 14 Jun - 5 Jul			
	G	F	P	Total	G	F	P	Total	G	F	P	Total
Meats	79	16	5	2456	88	11	1	3732	65	29	6	7933
Cereals	91	9	1	850	94	6	1	1808	82	16	2	2504
Drinks	83	11	5	2344	91	8	2	5038	79	15	5	7973
Confections	97	2	1	4875	97	2	1	10187	94	6	1	13159
Crackers	91	8	1	3243	87	12	1	6650	69	25	6	10585

* Figures represent per cent. G = Good; F = Fair; P = Poor.

TABLE 15
RELATIVE ACCEPTABILITY OF EXPERIMENTAL C RATION ITEMS DURING ALL PERIODS
(G, X & Y Companies)

Item	G	F	P	Total
Meats				
Meat & beans	68	26	5	1871
Meat & vegetable hash	55	31	14	1251
Meat & vegetable stew	64	30	6	1340
Meat & spaghetti	75	21	4	1600
Chicken & vegetables	86	13	1	2159
Beans & franks w/tomato	88	12	1	1126
Beans & frankfurters	84	14	1	1058
Pork & beans w/tomato	79	19	2	980
Pork & beans	76	21	4	1087
Beef & noodles	70	25	6	1601
Ham & lima beans	81	16	2	2048
Cereals				
General Mills	90	9	1	2799
General Foods	86	13	1	2245
Drinks				
Coffee	79	17	4	5220
Cocoa	95	5	1	3206
Lemon juice	83	14	3	2853
Orange juice	94	6	1	3021
Bouillon	49	21	30	1055
Confections				
Sugar	97	3	1	8028
Jan	98	2	1	4943
Candy coated peanuts	94	5	1	2936
Candy coated raisins	93	6	1	2741
Caramels	96	3	1	4280
Jelly beans	96	4	1	2648
Hard candy	93	6	1	2645
Biscuits				
Cream center cookie	98	2	0	2095
Compressed choc. cookie	95	4	1	2034
Concentrated fruit cake	90	8	2	181
Plain biscuits B1 or B4	71	24	5	5538
Plain biscuits B2 or B5	71	26	3	5471
Plain biscuits B3 or B6	80	17	3	5159

Figures in the "Total" column give number of times an item was rated. Per cent figures may not total 100 because each was calculated to the nearest whole number.

Appendix E
Inclosure #5

TABLE 16
TREND IN ACCEPTABILITY OF EXPERIMENTAL C RATION ITEMS
(Y Company)

Appendix E
Inclosure #5

Item	14-19 Jun				20-24 Jun				25-29 Jun				30 Jun - 5 Jul			
	G	P	P	Total	G	P	P	Total	G	P	P	Total	G	P	P	Total
Meats																
Meat & beans	47	46	7	296	43	42	16	229	48	43	9	139	44	48	8	191
Meat & vegetable hash	31	49	20	197	33	47	20	98	34	44	23	62	25	45	30	64
Meat & vegetable stew	41	49	10	191	38	43	19	103	45	49	6	63	29	52	19	79
Meat & spaghetti	61	31	9	282	50	40	10	167	57	34	9	150	56	34	10	126
Chicken & vegetables	83	15	2	351	79	19	2	252	85	14	2	338	93	16	1	347
Beans & franks w/tomato	76	23	1	182	82	17	1	153	84	16	0	193	90	9	1	151
Beans & frankfurters	70	27	3	131	76	22	2	130	76	22	2	143	80	17	3	178
Pork & beans w/tomato	67	31	3	117	52	40	8	105	66	30	4	148	77	22	2	181
Pork & beans	59	32	10	135	54	36	10	125	63	36	1	89	63	32	5	135
Beef & noodles	56	40	4	238	52	36	12	178	54	37	9	138	55	32	13	161
Ham & lima beans	76	21	3	313	76	20	4	232	80	18	3	265	82	17	1	337
Cereals																
General Mills	74	21	5	334	80	18	2	287	91	7	2	323	90	10	1	443
General Foods	63	32	5	221	72	25	4	250	81	18	1	251	86	13	1	345
Drinks																
Coffee	55	32	13	635	68	26	6	595	75	21	5	603	77	19	4	769
Cocoa	88	11	1	475	94	6	1	393	96	4	0	423	97	3	1	508
Lemon juice	74	20	6	412	77	18	5	349	83	15	3	325	88	10	2	384
Orange juice	88	11	2	430	90	10	1	381	93	7	1	376	94	6	1	471
Bouillon	37	20	43	179	23	25	53	89	37	29	34	79	45	27	28	97
Confections																
Sugar	94	6	1	735	95	4	1	725	97	3	1	746	96	4	1	1012
Jam	96	4	1	608	97	3	0	538	98	2	0	603	98	2	1	739
Candy coated peanuts	88	11	1	367	88	12	1	298	95	6	0	312	93	7	1	435
Candy coated raisins	86	12	2	341	86	12	3	314	88	10	2	331	91	8	1	415
Caramels	91	8	1	499	94	5	1	456	96	4	1	479	95	4	1	609
Jelly beans	88	11	1	344	96	4	0	289	94	6	1	287	96	4	1	366
Hard candy	88	11	1	332	94	6	0	302	95	5	1	293	96	4	1	383
Biscuits																
Cream center cookies	95	5	1	239	97	3	0	207	100	1	0	230	100	1	0	324
Compressed choc. cake	87	10	4	215	91	8	1	180	95	5	1	221	98	2	0	280
Concentrated fruit cake	78	19	3	31	86	10	5	21	93	7	0	14	89	7	4	27
Plain biscuits B1 or B4	46	41	13	741	56	34	10	657	64	30	6	657	70	24	6	827
Plain biscuits B2 or B5	47	50	8	756	58	37	6	675	64	32	5	671	68	28	4	815
Plain biscuits B3 or B6	63	32	5	700	69	26	5	644	76	20	4	673	81	15	4	780

TABLE 17

DIFFERENCES IN ACCEPTABILITY OF EXPERIMENTAL C RATION ITEMS
IN TWO PERIODS (X Company)

ITEM	21 - 27 July			5 - 9 Aug.		
	G	F	P Total	F	F	P Total
<u>Meats</u>						
Meat & beans	92	8	100	89	11	100
Meat & vegetable hash	76	20	96	71	24	95
Meat & vegetable stew	81	18	99	78	20	98
Meat & spaghetti	93	7	100	91	9	100
Chicken & vegetables	94	6	100	95	5	100
Beans & franks w/tomato	99	1	100	96	4	100
Beans & Frankfurters	98	2	100	95	5	100
Pork & beans w/tomato	97	3	100	94	6	100
Pork & beans	91	8	99	92	8	100
Beef & noodles	89	11	100	78	18	96
Ham & lima beans	89	9	98	80	18	98
<u>Cereals</u>						
General Mills	94	5	99	95	5	100
General Foods	94	6	100	93	7	100
<u>Drinks</u>						
Coffee	85	13	98	93	7	100
Oocoa	96	4	100	97	2	99
Lemon juice	89	9	98	92	8	100
Orange juice	98	2	100	97	3	100
Bouillon	71	16	87	66	28	94
<u>Confections</u>						
Sugar	97	3	100	98	2	100
Jam	99	1	100	99	1	100
Candy coated peanuts	97	2	99	98	2	100
Candy coated raisins	97	1	98	97	2	99
Caramels	99	1	100	98	2	100
Jelly beans	99	1	100	98	2	100
Hard candy	94	6	100	96	4	100
<u>Biscuits</u>						
Cream center cookie	98	2	100	100	0	100
Compressed choc. cookie	97	2	99	98	2	100
Conc. fruit cake	98	2	100	88	12	100
Plain B1 or B4	81	18	99	85	15	100
Plain B2 or B5	81	18	99	83	17	100
Plain B3 or B6	88	12	100	98	1	99

TABLE 18

ACCEPTABILITY OF K RATION ITEMS - ALL PERIODS
(K, G, I & Y Companies)

ITEM	G	F	P	Total
<u>Meats</u>				
Chopped pork & egg yolk	53	29	8	90
Ham & eggs	70	27	3	100
Processed Amer. cheese	54	36	10	100
Processed Amer. cheese w/bacon	46	43	11	100
Processed Amer. & Swiss cheese	57	33	10	100
Beef & pork loaf	55	36	9	100
Corned pork loaf w/G & A flakes	54	36	10	100
<u>Drinks</u>				
Lemon juice	65	29	6	100
Orange juice	83	15	2	100
Bouillon	49	37	14	100
Coffee	76	19	5	100
<u>Confections</u>				
Sugar	92	7	1	100
Jam	92	7	1	100
Gum	92	7	1	100
Fruit bar	75	22	3	100
Caramels	88	10	2	100
Sweet chocolate	88	11	1	100
D Ration Bar	73	22	5	100
<u>Biscuits</u>				
K-1A	54	36	10	100
K-2	45	37	18	100
K-3	50	39	11	100
K-4	65	30	5	100
K-5	58	34	8	100

Appendix A
Inclosure #5

TABLE 19
RELATIVE ACCEPTABILITY OF K RATION FOOD GROUPS (E, G, X & Y Companies)

Item	E Company 17 Jun-8 Jul; 23 Jul-8 Aug			G Company 16 Jun - 7 Jul			X Company 28 Jul - 4 Aug			Y Company 2 Jul - 8 Aug		
	G	F	Total	G	F	Total	G	F	Total	G	F	Total
Meats	45	46	9	58	33	9	48	40	12	69	27	4
Drinks	61	32	7	72	22	6	77	19	4	76	17	7
Confections	84	14	2	91	8	1	93	6	1	94	5	1
Biscuits	48	42	10	51	37	12	70	25	4	78	18	4
			21,313			13,147			4,030			11,774

TABLE 20
TREND IN ACCEPTABILITY OF K RATION ITEMS (E Company)

Item	17 - 22 Jun			23 - 27 Jun			28 Jun - 2 Jul			3 - 8 Jul		
	G	F	Total	G	F	Total	G	F	Total	G	F	Total
Meats	44	48	8	44	49	7	47	49	4	41	42	17
Chopped pork & egg yolk	56	40	4	67	33	0	100	0	0	0	100	0
Ham & eggs	47	45	8	52	44	4	85	15	0	36	57	7
Proc. Amer. cheese	52	40	8	40	50	10	36	55	9	30	57	13
Proc. Amer. cheese w/bacon	47	47	6	20	73	7	33	54	13	9	55	36
Proc. Amer. & Swiss ch.	55	42	3	58	42	0	77	23	0	5	1	94
Beef & pork loaf	49	44	7	50	45	5	53	45	2	41	44	15
Corned pork loaf w/c & A Flakes	41	48	11	39	49	12	38	44	18	47	41	12
Drinks	75	23	2	75	20	5	71	24	5	70	27	3
Lemon juice	32	56	12	38	48	14	37	49	14	42	49	9
Orange juice	71	25	4	74	23	3	75	22	3	77	21	2
Bouillon	239	394	239	217	386	217	218	218	218	47	41	12
Coffee	508	508	508	377	377	377	350	350	350	70	27	3
Confections	697	697	697	655	655	655	651	651	651	42	49	9
Sugar	87	12	1	86	12	2	86	12	2	77	21	2
Jam	100	0	0	89	2	9	91	8	1	87	11	2
Gum	88	11	0	88	11	1	88	11	1	89	10	1
Fruit bar	57	34	1	60	33	7	66	29	5	66	29	5
Caramels	78	19	3	77	18	5	76	20	4	80	16	4
Sweet choc. bar	78	19	3	75	24	1	79	20	1	78	20	2
D Ration choc. bar	49	42	9	56	28	16	50	45	5	58	42	0
Biscuits	43	47	10	40	45	15	42	43	15	47	39	14
K-1A	29	36	35	34	56	10	36	42	22	50	38	12
K-2	27	68	5	36	46	18	42	45	13	59	37	4
K-3	57	38	5	55	39	6	52	42	6	58	39	4
K-4	58	38	4	55	39	7	53	37	10	59	39	7
K-5	1033	1033	1033	1047	1047	1047	969	969	969	1019	1019	1019
	643	643	643	151	151	151	704	704	704	643	643	643

TABLE 21

TREND IN ACCEPTABILITY OF K RATION ITEMS
(E Company)

Item	23 - 27 Jul				28 Jul - 1 Aug	2 - 6 Aug				7 - 11 Aug						
	G	F	P	Total		G	F	P	Total		G	F	P	Total		
Meats																
Chopped pork & egg yolk	32	52	16	264	36	51	13	288	36	54	10	358	42	49	9	243
Ham & eggs	67	29	4	426	70	27	3	372	70	28	2	281	70	28	2	369
Proc. Amer. cheese	30	57	13	320	30	59	11	303	45	42	13	317	48	35	17	386
Proc. Amer. cheese w/bacon	24	57	19	202	27	50	23	184	30	49	21	156	37	31	32	74
Proc. Amer. & Swiss ch.	27	46	27	15	25	63	12	8	50	25	25	12	75	14	11	36
Beef & pork loaf	44	48	8	428	45	46	9	371	42	50	8	252	47	47	6	293
Corned pork loaf w/c & A Flakes	37	52	11	221	37	50	13	250	38	51	11	301	46	45	9	206
Drinks																
Lemon juice	67	28	5	693	58	37	5	633	57	37	6	642	53	41	6	750
Orange juice	84	13	3	149	81	18	1	171	85	15	0	194	80	16	4	168
Bouillon	52	30	18	556	46	44	10	534	48	44	8	576	40	41	19	545
Coffee	65	28	7	822	72	26	2	858	71	25	1	922	57	29	14	1009
Confections																
Sugar	94	5	1	1318	91	9	0	1552	90	10	0	1734	95	12	3	1916
Gum	91	8	1	1849	90	9	1	2233	89	10	1	2480	88	11	1	2763
Fruit bar	69	26	5	745	64	33	3	742	66	33	1	799	65	31	4	951
Caramels	90	9	1	809	86	13	1	833	83	16	1	870	81	18	1	975
Sweet choc. bar	85	14	1	722	84	15	1	777	84	15	1	867	82	17	1	954
D Ration choc. bar	78	19	3	90	59	36	5	101	71	21	8	68	58	38	4	73
Biscuits																
K-1A	34	46	20	528	47	38	15	482	46	43	11	551	38	44	13	596
K-2	38	44	18	458	46	42	12	435	45	41	14	503	44	39	17	598
K-3	35	46	19	471	46	43	11	395	51	41	8	460	45	45	10	554
K-4	45	41	14	826	49	43	8	941	49	46	5	1020	50	42	8	1188
K-5	37	45	18	411	40	52	8	566	40	51	9	604	38	52	10	697

Appendix E
Inclouure #5

TABLE 22
TREND IN ACCEPTABILITY OF K RATION ITEMS
(Y Company)

Appendix E
Inclosure #5

Item	20 - 24 Jul				25 - 29 Jul				30 Jul - 3 Aug				4 - 8 Aug				
	G	F	P	Total	G	F	P	Total	G	F	P	Total	G	F	P	Total	
Leads Chopped pork & egg yolk Ham & egg's Proc. Amer. cheese Proc. Amer. cheese w/bacon Proc. Amer. & Swiss ch. Beef & pork loaf Corned pork loaf w/C & A Flakes	58	39	3	449	70	29	1	333	74	25	1	535	75	23	2	350	
	60	37	3	240	74	24	2	329	82	17	1	320	86	14	0	498	
	68	28	4	287	73	21	6	346	75	24	1	338	64	31	5	421	
	72	25	3	317	78	20	2	268	73	23	4	404	71	26	3	307	
	77	23	0	50	81	19	0	43	81	19	0	47	77	23	0	44	
	60	34	6	324	63	30	7	395	68	27	5	375	69	28	3	539	
	61	29	10	340	62	29	9	268	53	33	14	327	56	32	12	207	
	Drinks Lemon juice Orange juice Souillon Coffee	57	32	11	465	63	28	9	333	72	25	3	258	75	19	6	143
		88	10	2	185	88	11	1	325	92	7	1	552	90	9	1	610
		43	30	27	520	50	31	19	606	50	30	20	487	52	30	18	434
85		12	3	692	91	8	1	682	98	6	1	889	93	6	1	855	
61		29	10	340	62	29	9	268	53	33	14	327	56	32	12	207	
Confections Sugar Jam Gum Fruit bar Caramels Sweet choc. bar D Ration choc. bar	96	4	0	1123	97	2	1	1237	98	2	1	1465	98	2	0	1472	
	100	0	0	23	87	13	0	15	100	0	0	8	100	0	0	12	
	96	3	1	1487	96	3	1	1705	97	2	1	1697	96	4	0	1681	
	72	23	5	665	81	15	4	672	86	11	3	569	87	10	3	674	
	95	4	1	644	96	3	1	636	96	3	1	1097	95	4	1	935	
	94	5	1	480	95	3	1	524	97	3	0	519	95	4	1	588	
	84	13	3	191	81	17	2	130	88	6	6	31	94	4	0	16	
	Biscuits K-1A K-2 K-3 K-4 K-5	70	26	4	391	78	22	0	110	67	26	7	949	68	24	8	1499
		60	24	16	62	73	23	4	60	69	21	10	244	71	21	8	348
		81	12	7	85	70	30	0	57	72	23	5	168	81	15	4	237
83		15	2	1316	86	13	1	1588	83	15	2	980	79	18	3	397	
82		16	2	1105	84	14	2	1379	83	15	2	697	78	21	1	102	

TREND IN ACCEPTABILITY OF K RATION ITEMS
(G Company)

Item	16 - 21 Jun				22 - 26 Jun				27 - 31 Jun				1 - 6 Jul			
	G	F	P	Total	G	F	P	Total	G	F	P	Total	G	F	P	Total
Meats																
Chopped pork & egg yolk	57	36	7	887	62	33	5	937	69	28	3	1042	56	30	14	1201
Ham & eggs	67	20	13	30	0	100	0	3	-	-	-	-	33	67	0	6
Proc. Amer. cheese	49	37	14	132	58	29	13	62	60	34	6	50	35	22	43	37
Proc. Amer. cheese w/bacon	55	38	7	625	41	48	11	546	45	43	12	609	36	49	15	824
Proc. Amer. & Swiss ch.	61	29	10	38	30	56	14	27	26	63	11	27	29	42	29	38
Beef & pork loaf	63	30	7	136	67	32	1	66	77	17	6	53	80	18	2	45
Corned pork loaf w/C & A Flakes	68	27	5	747	69	25	6	863	69	25	6	911	54	29	17	1073
Drinks																
Lemon juice	74	24	2	709	79	20	1	696	80	17	3	697	76	21	3	937
Orange juice	80	20	0	174	86	14	0	103	90	10	0	136	76	24	0	123
Bouillon	56	29	15	527	63	29	3	512	66	27	7	587	51	33	16	629
Coffee	70	25	5	811	30	17	3	906	83	14	3	1021	55	20	15	1143
Confections																
Sugar	93	6	1	979	96	4	0	1350	97	3	0	1712	94	4	2	2071
Gum	92	7	1	779	96	4	0	1140	96	3	1	1346	97	3	0	1503
Fruit bar	80	18	2	779	82	17	1	890	84	15	1	1013	82	17	1	1186
Caramels	93	6	1	707	91	8	1	763	92	7	1	840	90	10	0	1080
Sweet choc. bar	88	10	2	689	93	7	0	774	95	5	0	918	93	6	1	1048
D Ration choc. bar	69	19	12	89	70	23	7	158	83	13	4	104	76	21	3	131
Biscuits																
K-1A	32	46	22	256	39	44	17	393	44	46	10	556	43	45	12	664
K-2	29	40	31	54.5	35	43	22	452	43	39	18	506	39	37	24	614
K-3	38	48	14	357	46	42	12	375	55	38	7	390	48	43	9	487
K-4	59	34	7	1011	68	29	3	1152	73	25	2	1406	71	26	3	1672
K-5	33	45	22	522	34	46	20	506	43	44	3	553	33	47	20	730

Appendix E
Inclosure #5

Appendix E
Inclosure #5

TABLE 24
TREND IN ACCEPTABILITY OF K RATION ITEMS (X Company)

ITEM	28 July - 31 July				1 - 4 August			
	G	F	P	Total	G	F	P	Total
Meats								
Chopped pork & egg yolk	35	49	16	378	50	41	9	426
Ham & eggs	46	45	9	254	55	39	6	181
Processed Amer. cheese	52	37	11	288	53	37	10	209
Processed Amer. cheese w/bacon	47	45	8	192	56	36	8	229
Processed Amer. & Swiss cheese	40	43	17	37	74	19	7	87
Beef & pork loaf	48	39	13	326	55	38	7	211
Corned pork loaf w/C & A flakes	37	44	19	195	47	36	17	234
Drinks								
Lemon juice	74	23	3	338	72	26	2	186
Orange juice	90	9	1	414	88	11	1	231
Bouillon	44	35	21	193	62	29	9	243
Coffee	78	18	4	642	81	18	1	543
Confections								
Sugar	92	7	1	1194	93	7	0	992
Jam	95	4	1	524	95	5	0	546
Gum	96	4	0	1056	96	4	0	933
Fruit bar	85	12	3	531	88	11	1	414
Caramels	95	4	1	727	93	6	1	575
Sweet chocolate bar	93	6	1	438	94	5	1	320
D Ration chocolate bar	83	11	6	48	86	12	0	42
Biscuits								
K-1A	57	33	10	150	88	11	1	385
K-2	53	31	16	207	74	20	6	277
K-3	54	36	10	206	70	23	7	257
K-4	70	26	4	960	70	28	2	730
K-5	71	25	4	428	74	21	5	430

TABLE 25
RELATIVE ACCEPTABILITY COLD VS. HOT K RATION ITEMS
(G, X & Y Companies)

ITEM	HOT				COLD			
	G	F	P	Total	G	F	P	Total
Meats								
Chopped pork & egg yolk	44	37	19	2776	56	40	4	8357
Ham & eggs	61	33	6	594	72	26	2	2746
Processed Amer. cheese	54	36	10	3290	56	41	3	508
Proc. cheese w/bacon	45	43	12	6306	52	43	5	1205
Proc. Amer. & Swiss cheese	52	37	11	485	76	19	5	115
Beef & pork loaf	53	37	10	991	56	36	8	3019
Corned pork loaf w/C & A flakes	47	35	18	3010	57	37	6	6445
Drinks								
Lemon juice	65	30	5	8167	79	19	2	197
Orange juice	84	15	1	4895	78	19	3	100
Bouillon	36	32	32	1689	52	38	10	6906
Coffee	50	28	22	1711	80	18	2	12627

TABLE 26

RELATIVE ACCEPTABILITY BY MEALS OF K RATION ITEMS
(E, G, X & Y Companies)

Item	Breakfast				Dinner				Supper			
	G	F	P	Total	G	F	P	Total	G	F	P	Total
Meats												
Chopped pork & egg yolk	53	39	8	9355	51	42	7	718	59	35	6	1060
Ham & eggs	70	28	2	2762	64	28	8	246	74	23	3	332
Proc. Amer. cheese	72	23	5	175	53	37	10	3207	59	37	4	416
Proc. Amer. cheese w/bacon	59	35	6	152	46	43	11	6519	46	44	10	840
Proc. Amer. & Swiss cheese	77	19	4	26	52	37	11	441	68	23	9	133
Beef & pork loaf	64	28	8	112	45	35	20	531	57	37	6	3367
Corned pork loaf w/C & A flakes	65	28	7	277	53	39	8	1160	54	36	10	8018
Drinks												
Lemon juice	76	20	4	127	65	30	5	7216	67	30	3	1021
Orange juice	86	14	0	84	83	15	2	4183	84	14	2	728
Bouillon	77	13	10	273	47	42	11	675	48	37	15	7647
Coffee	76	20	4	12069	67	26	7	587	82	15	3	1682
Confections												
Jam	92	6	2	1734	90	9	1	797	93	6	1	888
Gum	94	5	1	10045	92	7	1	9636	91	8	1	9079
Fruit bar	75	22	3	10842	76	22	2	1039	74	23	3	1044
Caramels	90	8	2	982	89	10	1	11263	85	14	1	2038
Sweet choc. bar	94	5	1	428	85	14	1	1407	88	11	1	9901
D Ration choc. bar	75	23	2	52	67	27	6	177	73	22	5	1207
Biscuits												
K-1A	53	34	13	3087	63	30	7	1698	49	40	11	3501
K-2	42	39	19	3262	52	34	14	773	50	33	17	1824
K-3	51	38	11	1883	50	36	14	839	50	42	8	2110
K-4	65	31	4	7824	67	29	4	4007	64	31	5	7505
K-5	75	21	4	2086	49	40	11	6672	64	30	6	3203

In some instances where an item is rated much higher at one meal than at another (c.p. American cheese at breakfast and dinner) relatively few ratings account for the higher score. Study of the original data shows that these ratings came from a few subjects who liked cheese and ate it for breakfast. Those who did not like cheese well did not eat it for breakfast.

TABLE 27

TREND IN ACCEPTABILITY OF 10-IN-1 ITEMS
(G, X & Y Companies)

ITEMS	Periods (days)		
	1-5	6-10	11-14
<u>Meats</u>			
Fork sausage	2.78	2.81	2.70
Bacon	2.94	2.89	2.89
Ham & eggs	2.84	2.74	2.75
Fork & egg yolk	2.76	2.76	-
Egg & meat (K)	2.62	2.63	2.49
Cheese (K)	2.56	2.49	2.39
Meat product (K)	2.39	2.39	2.36
Meat & rice	2.75	2.70	2.69
Stew, English	2.72	2.66	2.67
Corned beef	2.86	2.83	2.79
Roast beef	2.91	2.87	2.83
Corned beef hash	2.68	2.67	-
<u>Vegetables</u>			
Tomatoes	2.93	2.90	2.90
Snap beans	2.89	2.87	2.87
Peas	2.91	2.90	2.87
Corn	2.94	2.93	2.91
Lima beans	2.85	2.84	-
<u>Drinks</u>			
Coffee, soluble	2.92	2.92	2.91
Lemon powder	2.73	2.72	2.64
Orange powder	2.73	2.67	2.61
Cocoa	2.87	2.83	2.90
<u>Confections</u>			
Peanuts	2.91	2.90	2.88
Fruit bar	2.77	2.76	2.74
Hard candy	2.89	2.87	2.85
Chocolate bar	2.85	2.83	-
Caramels	2.87	2.85	2.84
Sweet chocolate	2.82	2.80	2.77
<u>Biscuits</u>			
C	2.56	2.53	2.52
Whole Wheat	2.52	2.38	2.44
K-1A	2.42	2.35	2.39
K-2	2.18	2.26	2.26
K-3	2.34	2.34	2.36
K-4	2.64	2.60	2.58
K-5	2.60	2.61	2.54
<u>Cereal</u>			
Evaporated milk	2.75	2.81	2.80
Jam	2.95	2.95	2.95
Army spread	2.96	2.96	2.96
Army spread	2.81	2.83	2.84

Appendix E
Inclosure #5

TABLE 28

COMPARISON OF ISSUE, CONSUMPTION AND WASTE
 EXPERIMENTAL C RATION MEAT COMPONENTS
 (Y Company, 1 1/3 Rations, 14 Jun - 5 Jul 1944)

Item	Cans Issued	Unaccounted for	Per cent		
			Total Waste	Full can waste	Plate waste
Meat & beans	1400	3.4	40.9	37.9	3.0
Meat & vegetable hash	1400	3.3	71.6	68.6	3.0
Meat & vegetable stew	1400	9.9	62.6	60.7	1.9
Meat & spaghetti	1396	7.3	46.1	42.4	3.9
Chicken & vegetables	1396	6.3	5.2	3.1	2.1
Beans & frankfurters	1396	5.2	5.4	2.7	2.7
Pork & beans	1300	2.6	18.6	15.8	2.8
Beef & noodles	1300	5.7	42.8	37.8	5.0
Ham & lima beans	1300	6.5	10.5	5.5	5.0

TABLE 29

TIME SPENT IN PREPARING AND EATING RATIONS
 Min/Man/Meal

Average All Meals

Company	Expt. C	New C	K	10-in-1	C.M.T.
E			22		
G	29	30	27	26	
H				28	
X	33		27	27	32
Y	25		23	25	
All Cos	28	30	24	27	32

Breakfast

Company	Expt. C	New C	K	10-in-1	C.M.T.
E			21		
G	29	30	26	27	
H				32	
X	31		26	29	28
Y	24		22	27	
All Cos	27	30	23	30	28

Dinner

Company	Expt. C	New C	K	10-in-1	C.M.T.
E			21		
G	27	28	24	23*	
H				18	
X	29		23	19	30
Y	24		21	18	
All Cos	26	28	22	19	30

Supper

Company	Expt. C	New C	K	10-in-1	C.M.T.
E			25		
G	31	32	30	29	
H				34	
X	38		32	32	37
Y	27		26	30	
All Cos	31	32	27	33	37

* This meal in the 10-in-1 Ration is tantamount to a K Ration dinner.

Appendix E
 Inclosure #5

TABLE 30
AVERAGE COMPANY WEIGHTS

E Company			F Company			G Company			H Company			I Company			Y Company		
Date	No. Men	Aver. Wt.	Date	No. Men	Aver. Wt.	Date	No. Men	Aver. Wt.	Date	No. Men	Aver. Wt.	Date	No. Men	Aver. Wt.	Date	No. Men	Aver. Wt.
Jun 13	130	153.3	Jun 15	129	153.8	Jun 12	139	153.1	Jun 14	141	152.1	Jun 11	145	152.8	Jun 10	146	151.6
16	130	154.1	18	129	153.5	15	139	153.1	17	141	152.5	14	142	153.5	13	146	151.3
23	125	150.3	25	127	153.2	22	133	151.9	24	138	151.3	21	136	149.5	20	144	150.6
28	123	150.4	28	123	152.8	25	131	151.8	27	138	150.1	26	136	148.5	23	140	150.9
Jul 2	123	149.7	Jul 3	122	152.6	Jul 29	129	149.3	Jul 30	138	150.2	Jul 30	135	148.5	Jul 26	137	150.3
5	119	148.6	7	122	152.8	Jul 3	126	149.9	Jul 4	140	150.0	Jul 3	135	148.3	Jul 29	137	149.0
8	117	148.5	10	122	152.2	7	126	150.0	9	140	149.2	6	132	148.1	Jul 5	136	149.1
12	115	150.4	13	122	152.1	10	125	150.9	11	140	146.7	10	132	148.5	10	135	147.9
16	115	150.9	17	122	151.1	14	125	150.1	14	138	147.1	14	131	148.2	14	135	148.2
19	115	151.9	21	122	152.0	18	123	150.5	18	138	145.9	17	130	149.8	17	135	149.0
22	115	151.5	24	121	152.9	21	123	150.4	23	137	148.1	20	130	149.4	19	135	149.0
27	114	149.9	31	119	152.8	24	121	150.6	26	136	147.6	25	130	149.7	24	134	146.8
30	114	148.9	Aug 4	114	152.8	28	122	149.9	Aug 28	136	147.9	31	130	148.6	27	134	145.1
Aug 2	114	148.1	7	114	152.4	Aug 1	121	149.0	Aug 1	136	146.4	Aug 3	130	148.2	Aug 30	134	146.9
5	114	147.9	11	113	152.0	4	119	148.6	3	134	146.3	7	130	147.8	Aug 2	134	147.2
9	109	146.6	14	113	151.3	8	118	146.6	6	128	147.2	10	130	148.6	6	134	145.9
12	109	146.8				11	114	146.9	10	128	145.4				9	133	146.3

Appendix B
Inclosure #5

APPENDIX F PHOTOGRAPHS

1. TABLE OF CONTENTS

- a. Typical Bivouac Area
- b. U. S. Army Ration C, Experimental
- c. U. S. Army Ration K
- d. U. S. Army Ration 10-in-1
- e. Canadian Army Mess Tin Ration
- f. Central Ration Dump, Topside Headquarters
- g. Filling in Questionnaires
- h. Field Issue of Ration and Questionnaires
- i. Field Messing in Bivouac
- j. Field Messing in Fox Hole
- k. Road March
- l. Range Firing
- m. Digging Foxholes
- n. Step Test
- o. Sit-ups, AAF Test
- p. Shuttle-Run, AAF Test
- q. Zig-Zag, AGF Test
- r. Zig-Zag, AGF Test
- s. Chemical Laboratory
- t. Clinical Examination

2. DESCRIPTION OF PHOTOGRAPHS

a. *Typical Bivouac Area*—The typical bivouac area was chosen because of its suitability for camping purposes. Drainage, natural protection against wind and rain were factors that entered into the selection. Although none of the camp sites was in a smooth and cleared area, all were situated in ideal locations for the tests. Snow-capped mountains of the Continental Divide stood out in the background.

b. *U. S. Army Ration C, New*—This picture shows a case of Ration C, new, which contains 8 rations and is packed so that a row of 6 cans contains the food for one man for one day. In the foreground are opened sample cans, 2 meat units and 1 biscuit unit. Also shown are the accessory packet which goes with the ration—toilet paper, matches, cigarettes, halazone tablets and other articles.

c. *U. S. Army Ration K*—The packing case holds 12 rations (36 meals). A sample of the unopened breakfast, dinner, and supper meals can be seen on top of the packing case. Also there is a dinner unit which has been removed from its center camouflage wrapping, exposing the wax-dipped inner carton. The components of the noon meal package can be seen in the foreground.

d. *U. S. Army Ration, 10-in-1*—A 10-in-1 Ration in its outer shipping case has been used as a base upon which to exhibit the contents of a similar case. In the background are 2 of the 4 inner cartons which are packed together in the outer shipping case. In the foreground can be seen the contents of 2 such cartons. The one labeled 'First Half of the Five Rations' contains the food items packed in paperboard. The carton labeled 'Second Half of Five Rations' contains all the canned items. Two of each of these inner cartons packed into the outer case was designed to supply 10 men with a day's food.

e. *Canadian Army Mess Tin Ration*—Showing: The packing case for 24 rations. 2. On top of the case, the cartoon for 1 ration with its component food items exhibited.

f. *Central Ration Dump, Topside Headquarters*—Looking down this ration dump, one can see 3 stacks of 10-in-1 cases segregated by menus. Further away are the Canadian Mess Tin Rations in the heavy cubical packing cases. In the extreme background K Ration cases can be seen.

g. *Filling in Questionnaires*—The sergeant devotes his attention to filling in the form questionnaire concerning his likes, dislikes and quantities of the rations he has just finished eating. Questionnaires were

made as simple as possible to facilitate clear answers, and space was left for the test subject's particular comment. (There were many.)

h. *Field Issue of Rations and Questionnaire*—This group of test subjects on Army Field Ration C draw their next day's meals. They are receiving at the same time their issue of cigarettes. (20 cigarettes per man per day) and the questionnaires to be filled in after they have eaten the ration. The man in the foreground establishes another use for the steel helmet.

i. *Field Messing in Bivouac*—This chow call entails no standing in line—it means opening a can, and getting to work. The food being consumed with obvious appetite and pleasure is the Experimental C Ration.

j. *Field Messing in Foxhole*—This corporal finds living in a small-sized grave no hindrance to eating. His menu for the day is spread on the ground, and he gets to work on the supper unit of a K Ration. Making the best of life, this test subject happily thinks: "at least there's no mess gear to wash!"

k. *Road March*—This is one of the easier road marches, routed over a highway, with the reservoir at one side. Packs and rifles are carried, and a steady pace is maintained. The water at the left looks cool and inviting, which was no consolation to the hikers since swimming was forbidden.

l. *Range Firing*—Each company had its own firing range, and although they were as much alike as possible, natural differences in terrain made it impossible to standardize ranges. As this line is firing, another platoon in the rear is preparing to fire. Range firing was held in the morning and afternoon, before and after marches.

m. *Digging Foxholes*—Foxhole periods played an important part in the training schedule. The troops dug their foxholes, then spent 24 hours in them, rain or shine. In the case of C, K, and CMT Rations, meals were eaten in the foxholes. For B and 10-in-1 Ration, the men withdrew from the foxholes, a platoon at a time, for messing.

n. *Step Test*—This picture shows the various processes of the Step Test in operation. In the foreground the test subject has begun his 5 minutes of stepping, paying strict attention to the swinging pendulum. The officer observer has started this subject as he begins the pulse count on the man exactly 60 seconds after he finished. Behind, the next man is preparing for his turn at the box. The enlisted observer, seated at the table, is keeping the fitness score sheets in order, and recording data on each test subject.

o. *Sit-ups, AAF Test*—Three test subjects are in the process of doing their sit-ups, under the watchful eye of a test observer. If the ground had been damp or dusty, shelter halves or blankets would have been spread on the ground. As many as 8 men can be run at a time, if the necessity arises. The men in the background are waiting their turns at the sit-ups, all confident that they can do at least 10 more than these soldiers.

p. *Shuttle Run, AAF Test*—This man is nearing the turn on the AAF shuttle run. The officer observer with the stop watch checks his time as he completes the run. In the background a 2nd subject, who started his run 10 seconds after the first man began, is coming down the stretch. When the subject has completed the run, the officer will tell him his time, and he will then report it to an enlisted observer, who will enter the time on the fitness score sheet. Note the sandy track.

q. *Zig-Zag, AGF Test*—"All this for 50 bucks a month!" this test subject is no doubt thinking as he starts crawling on his belly in the zig-zag course. The ground was dusty and dry, which added to the discomfort, but most of the test subjects were able to complete the course in less than the 30-seconds required for a perfect score.

r. *Zig-Zag, AGF Test*—The final stage of the zig-zag test, the jumps. The test subjects were required to leap from one island to the next, keeping both feet together. This man is having no trouble, and even appears to be enjoying himself.

s. *Chemical Laboratory*—This photograph shows the interior of the chemical laboratory, established in a hospital ward tent. The portable equipment for analyzing specimens was set up here where the chemical staff did all the determinations and calculations.

t. *Clinical Examination*—The Examiners Group begins work on the physical examination of the test subjects. Outside the tent, the skin, mouth and neurological examinations are done by 3 examiners in the sunlight. Inside the tent the eyes are examined.



Project No. 30

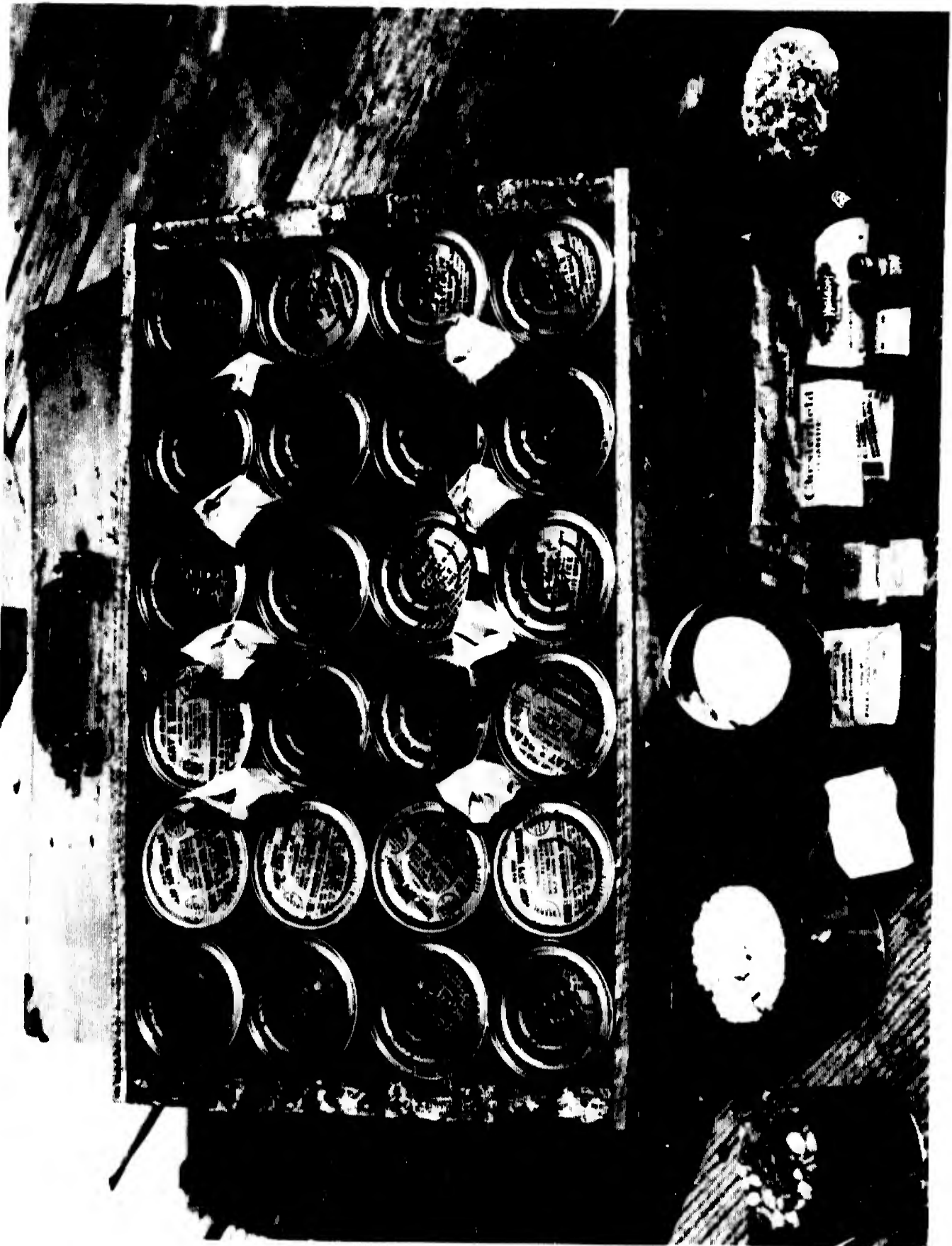
June-August 1944

TYPICAL BIVOQUAC AREA

ARMORED MEDICAL RESEARCH LABORATORY
FORT KNOX, KY.

1

(A)



(B)



CARMELS



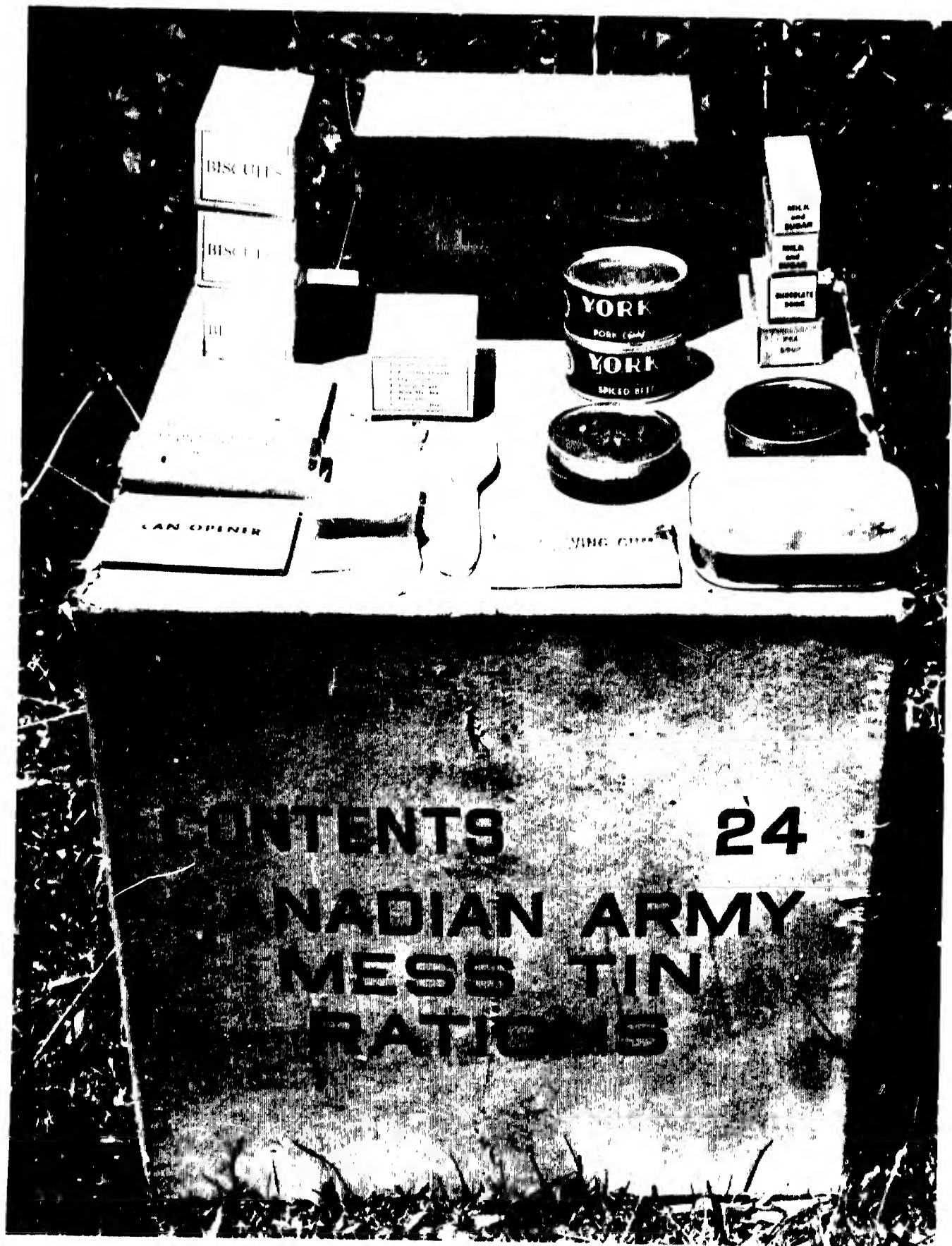
MORNING DIVER
CAUSE MALARIA

12 RATIONS

KEF

WT 45 CU. 1.3

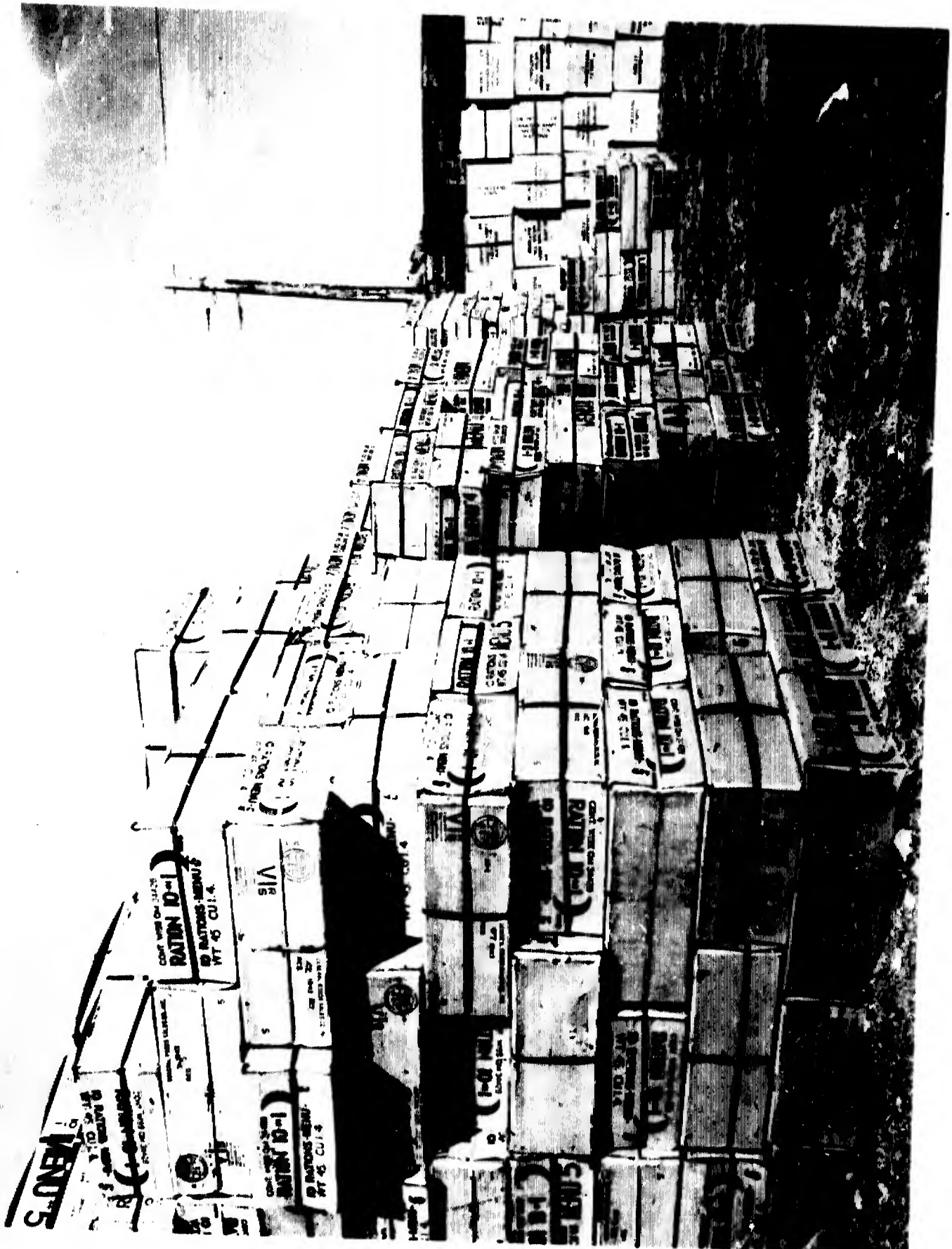




CONTENTS

24

CANADIAN ARMY
MESS TIN
RATIONS



(F)





Project No. 30

June-August 1944

**FIELD ISSUE OF RATION AND QUESTIONNAIRE
ARMORED MEDICAL RESEARCH LABORATORY
FORT KNOX, KY.**

8



Project No. 30

June-August 1944

FIELD MESSING IN BIVOUCAC
ARMORED MEDICAL RESEARCH LABORATORY
FORT KNOX, KY.

= 9



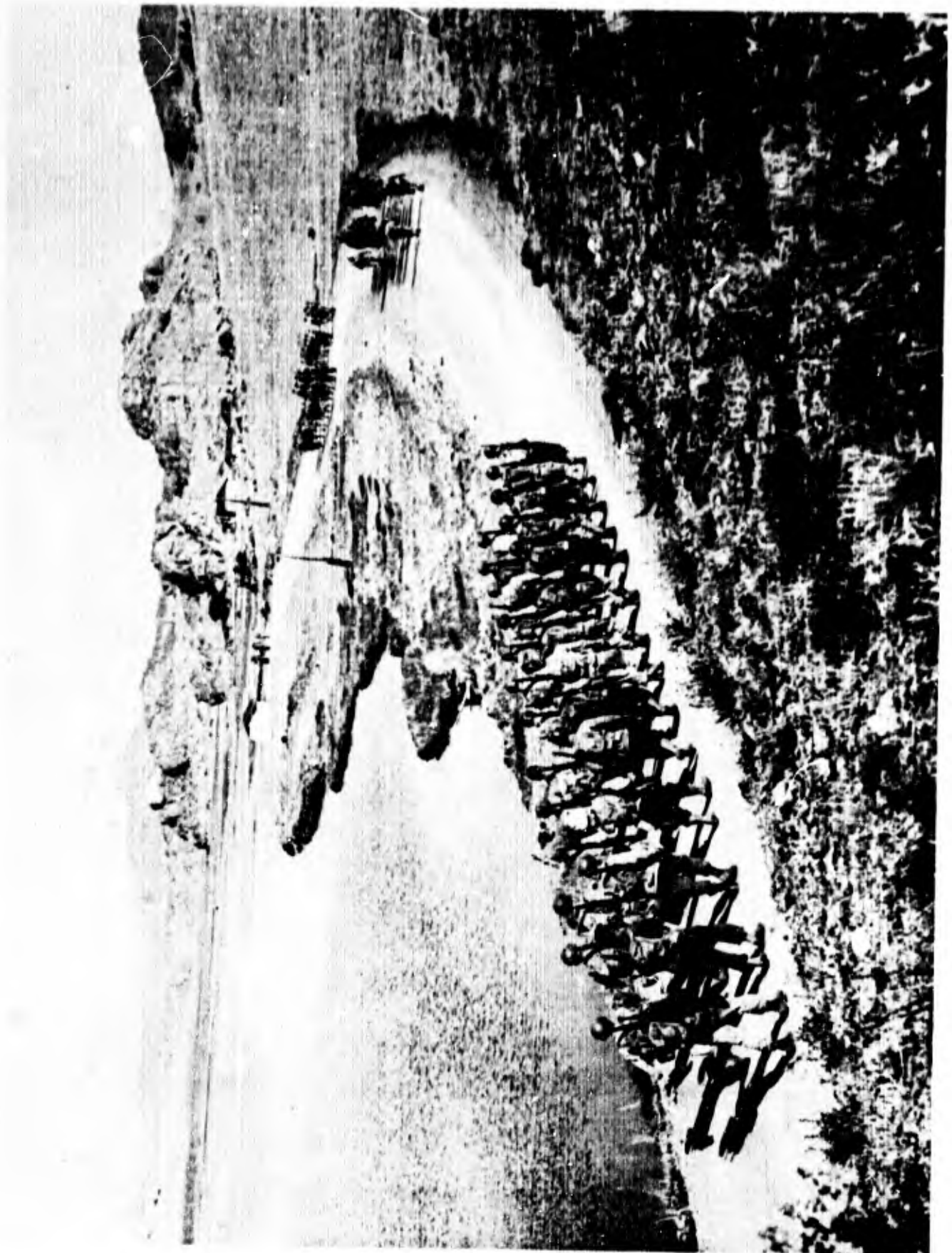
Project No. 30

FIELD MESSING IN FOXHOLE

ARMORED MEDICAL RESEARCH LABORATORY
FORT KNOX, KY.

June-August 1944

10



(K)



(L)



Project No. 30

DIGGING FOXHOLES

ARMORED MEDICAL RESEARCH LABORATORY

FORT KNOX, KY.

June-August 1944

= 13



Project No. 30

June-August 1944

20 INCH STEP TEST

ARMORED MEDICAL RESEARCH LABORATORY
FORT KNOX, KY.

14



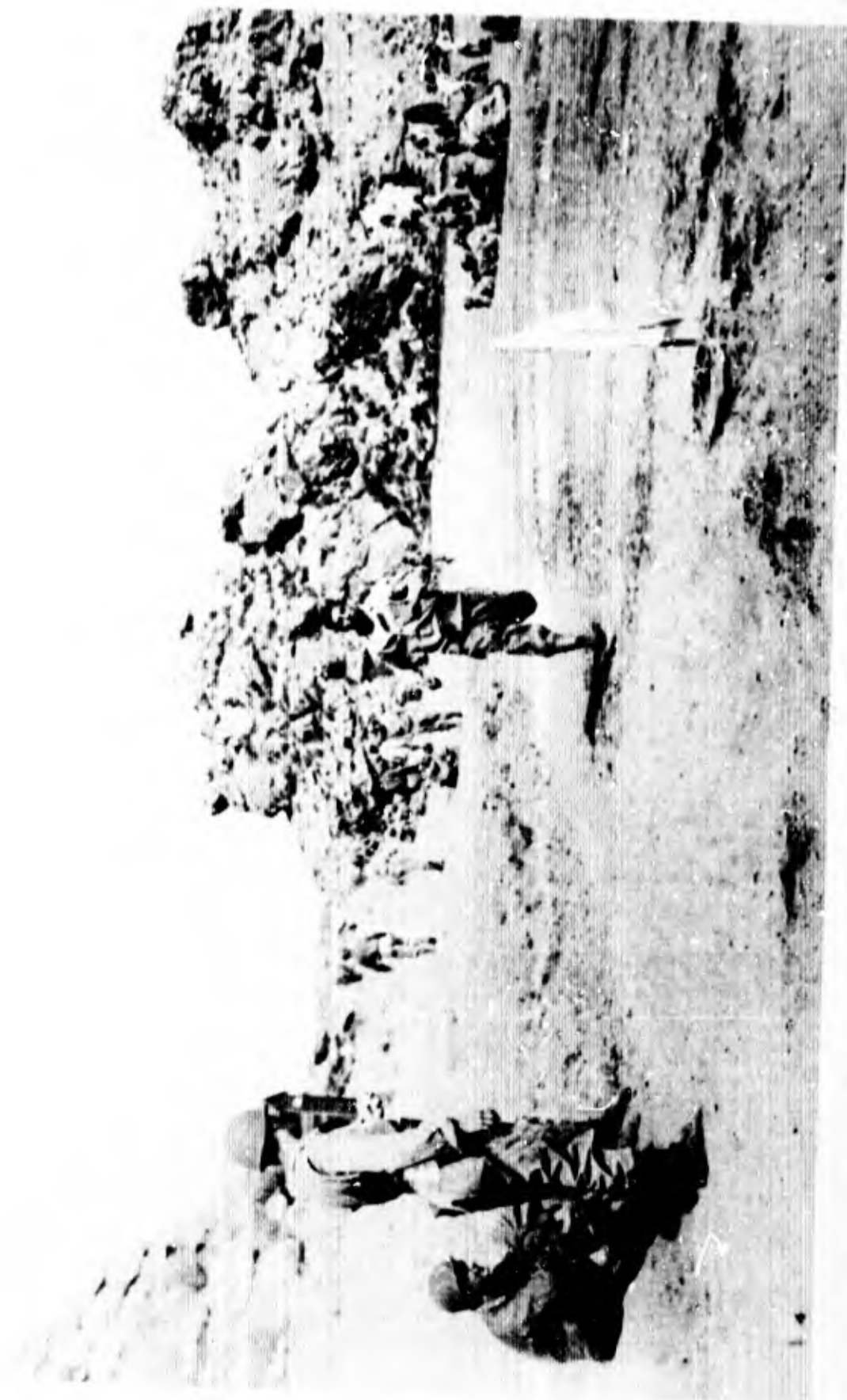
Project No. 30

SIT-UPS, AAF TEST

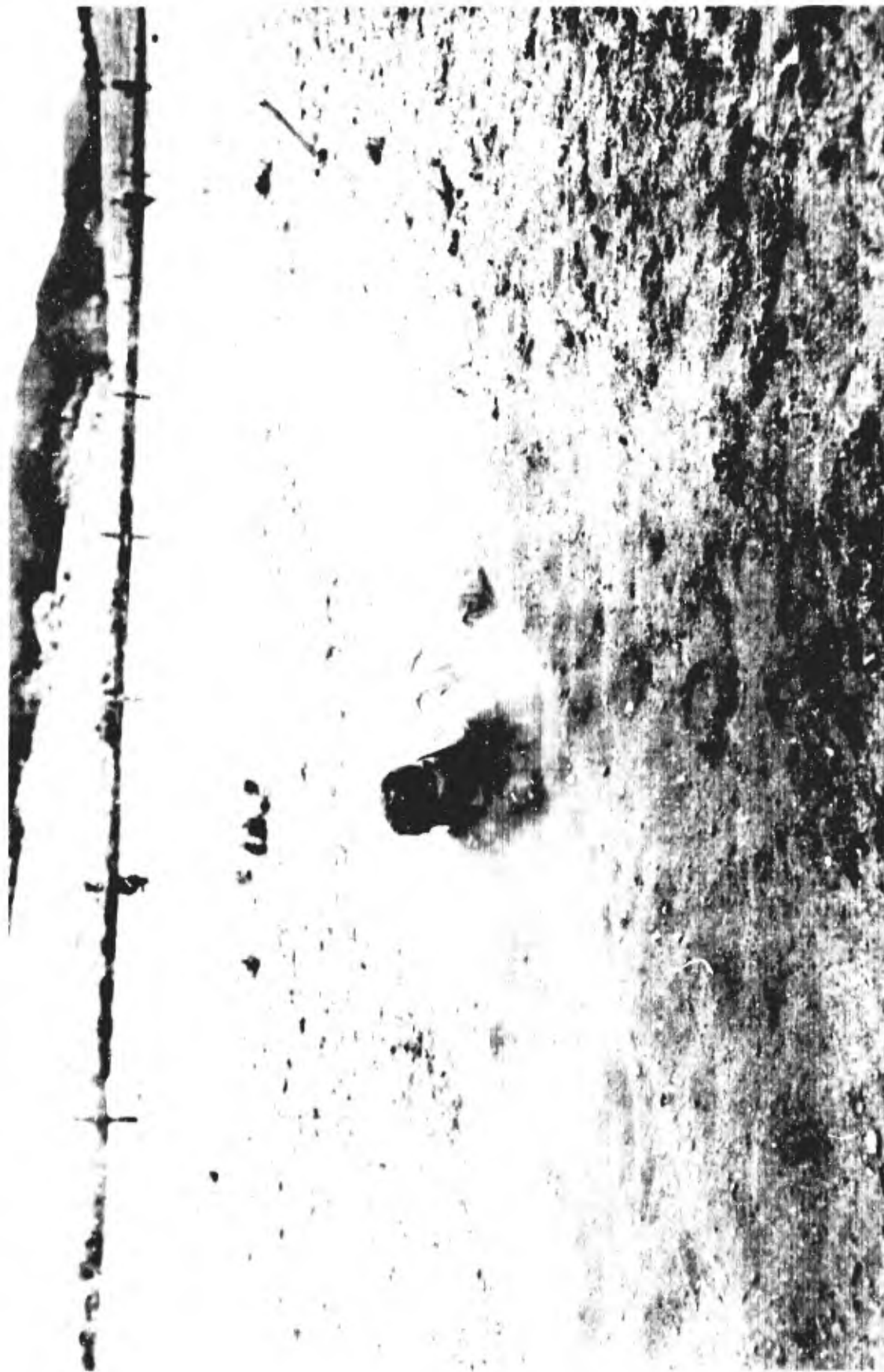
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June-August 1944

15



(P)



Project No. 30

ZIG-ZAG, AGF TEST

ARMORED MEDICAL RESEARCH LABORATORY
FORT KNOX, KY.

June-August 1944

17



Project No. 30

June-August 1944

ZIG-ZAG, AGF TEST

ARMORED MEDICAL RESEARCH LABORATORY
FORT KNOX, KY.

18

(R)



Project No. 30

CHEMICAL LABORATORY

ARMORED MEDICAL RESEARCH LABORATORY
FORT KNOX, KY.

June-August 1944

= 19



Project No. 30

June-August 1944

**CLINICAL EXAMINATION
ARMORED MEDICAL RESEARCH LABORATORY
FORT KNOX, KY.**

20

(T)

APPENDIX G

FORMS AND QUESTIONNAIRES

1. INTRODUCTION

Before the beginning of the ration study it was recognized that the amount of collected data would be massive. Therefore the questionnaires were integrated with a machine records card filing system. The data were readily transported from the questionnaires to the cards by the Machine Records Division, 7th Service Command Headquarters, Omaha, Nebraska. The numbers in the columns and horizontal lines were to aid in punching the cards. The Ration Acceptability questionnaires were originally designed for one ration per man per day. When more than one ration was issued, one questionnaire was filled out after each meal in order to facilitate punching the cards. The number of machine records for the entire test ran well over 100,000.

For each ration studied a questionnaire was designed and a general questionnaire used to record the pertinent facts of a historical nature on each subject. Special forms were used to collect the data from the biochemical tests, the clinical examinations and fitness tests.

In addition to the forms and questionnaires described above, it was necessary to make up a few additional questionnaires after the trials had started and as soon as their desirability became evident. That had been anticipated and a mimeograph machine was brought to Topside so the additional forms could be made in the field by the Tabulating Section.

Several of the actual forms are submitted. The first eight, numbered MR #1 through MR #8 were the machine recorded forms. The others were compiled and tabulated in the field and at Fort Knox, Kentucky. A total of 35 different mimeographed forms were used.

2. LIST OF FORMS.

a. Master Form—In practice the men in a platoon were numbered 1 thru 40 rather than by squads as indicated in paragraph 4 in order to have the numbers related to the weight.

b. Physical Examination Form

c. Physical Fitness Score Sheet—Line 20 was not filled in because it gave no useful additional information.

d. Experimental C Ration Questionnaire

e. New C Ration Questionnaire

f. K Ration Questionnaire

g. Canadian Army Mess Tin Ration Questionnaire

h. 10-in-1 Ration Questionnaire—Data on quantity were not obtained individually on this ration.

i. Biochemical Data Sheet

j. New C Ration Summary Questionnaire

k. K Ration Summary Questionnaire

l. Supplemented B Ration Questionnaire—Two forms were printed to a page to conserve paper. They were issued singly.

m. Data Sheet for calculating calorie consumption on Supplemented B Ration. The form inclosed is in error in columns K & L. "A. P." should be substituted for "E. P." The entry in column K is " $J \times C$ " rather than " $J \times \frac{F}{C}$ ".

1 2 3 4 : Test Subject Number

MR #1

Company
Platoon
Group or Squad
Number

MASTER FORM

Please Print
(Col. 5)

Serial No. _____ Name _____ Age _____
6-13 Last 14-34 First Initial 35-36

State of Origin (abb.) _____ Time in Army (mo.) _____
37-39 40-42

Time on Present Duty (mo.) _____ Combat Experience: Yes No
43-44 45 46

Rank or Grade* _____ COS _____ MOS _____ AGCT _____ No. Yrs. School _____
47-48 49-51 52-54 55-57 58-59

Have you ever lived on C Ration? _____ K Ration? _____ 10-in-1 Ration? _____
(Check if answer is yes) 60 61 62

NOTES

One to be filled in for every test subject.

MASTER FORM GUIDE

1. The numbers below each space to be filled in are to be disregarded by the observers. They are for the guidance of the Machine Records Unit only.
2. This is the only Machine Record Form which will have full name and grade. Others have enough for identification only.
3. All dope on line 4 (COS, MOS, AGCT, & Yrs. School) get from Form 20, Bn. Hq. On AGCT, use actual score rather than Group (I, II, III etc.) into which the score falls.
4. Use letters E, F, G, H, X and Y for Company designation. Platoons are numbered 1 through 4; squads or groups are numbered 1 through 4. The individual numbers run 0 through 9. The test subject number is permanent throughout the test.

* Code of Rank or Grade as follows:

Buck Pvt.	1	Staff Sgt.	8	Captain	15
Pfc	2	Tech. Sgt.	9	Major	16
T/5	3	1st Sgt.	10	Lt. Col.	17
Corporal	4	Master Sgt.	11	Colonel	18
T/4	5	W.O.	12	Brig. Gen.	19
Sgt.	6	2nd Lt.	13	Maj. Gen.	20
T/3	7	1st Lt.	14	Lt. Gen.	21
				General	22

PHYSICAL EXAMINATION
(Col. 5)

MR #2

Da. Mo.

_____ : Test Subject's Number
(Col. 1-4)

_____ : Date
(Col. 6-8)

_____ : ASN _____ : Name _____ : Weight _____
Last First Initial (Col. 9-11)

Eyes:

- (Col. 12) _____ No abnormalities
- (13) _____ Dryness
- (14) _____ Gross changes in opacity sclera (1) _____ slight; (2) _____ moderate; (3) _____ severe
- (15) _____ Gross changes in opacity cornea
- (16) _____ Vascularization (slit lamp) grade 2 or more
- (17) _____ If positive, there is evidence of old corneal injury
- (18) _____ Gross conjunctivitis (1) _____ slight; (2) _____ moderate; (3) _____ severe
- (19) _____ Night blindness
- (20) _____ Night blindness not tested
- (21) _____ Pterygia
- (22) _____ Pingeculae
- (23) _____ Not examined

Skin:

- (Col. 24) _____ No abnormality
- (25) _____ Follicular hyperkeratosis (1) _____ slight; (2) _____ moderate; (3) _____ severe
- (26) _____ Acneiform eruption (1) _____ slight; (2) _____ moderate; (3) _____ severe
- (27) _____ Dermatitis of Riboflavin Deficiency
- (28) _____ Petechial Hemorrhages
- (29) _____ Purpura
- (30) _____ Pellagrous Dermatitis (1) _____ acute; (2) _____ chronic; (3) _____ slight; (4) _____ moderate; (5) _____ severe
- (31) _____ Not examined

Lips and Mouth:

- (Col. 32) _____ No abnormality
- (33) _____ Angular fissure in absence of false teeth
- (34) _____ Cheilosis
- (35) _____ Red glossitis of pellagra (1) _____ slight; (2) _____ moderate; (3) _____ severe
- (36) _____ Pellagrous stomatitis (1) _____ slight; (2) _____ moderate; (3) _____ severe
- (37) _____ Gingivitis of pellagra
- (38) _____ Active acute inflammation of dental margin with or without swelling of interdental papillae with or without bleeding, spontaneous or on slight trauma.
- (39) _____ Oral hygiene good
- (40) _____ Oral hygiene fair
- (41) _____ Oral hygiene poor
- (42) _____ Not examined

Neuro-muscular:

- (Col. 43) _____ No abnormality
- (44) _____ Muscular weakness
- (45) _____ Knee jerks absent (1) _____ rt.; (2) _____ lt.; (3) _____ both
- (46) _____ Ankle jerks absent (1) _____ rt.; (2) _____ lt.; (3) _____ both
- (47) _____ Tenderness of belly of calf muscle
- (48) _____ Nerve tenderness
- (49) _____ Vibratory sense lost on malleoli
- (50) _____ Symmetrical muscular atrophy in extremities
- (51) _____ Pretibial pitting edema
- (52) _____ Pitting edema of feet
- (53) _____ Pitting edema over sacrum
- (54) _____ Not examined

PHYSICAL FITNESS SCORE SHEET
(Col. 5)

MR #3

_____ : Test Subject Matter
(Col. 1-4)

_____ : ASN _____ : Name _____ : Weight _____
Last First Initial (6-8)

		9	1	2	3	4	5	6
Test Number		9	1	2	3	4	5	6
Date (Da., _____ Mo. _____ Yr. _____)	10-14							
Last Ration	15							
Weight to nearest lb.	16-18							
Test Run First— Indicate by No. Harvard-1; AAF-2; ACF-3	19							
How Does Subject Feel after last test; Indicate by No. Poor-1; Fair-2; Good-3	20							
C/o Opinion Subject's Fitness—Indicate by No. Poor-1; Average-2; Good-3	21							
HARVARD	Time—Min., Sec.	22-24						
	Pulse (60-90 Sec.)	25-27						
	Score	28-30						
AAF	Sit-Ups—No.	31-33						
	Chins—No.	34-35						
	Run—Sec.	36-37						
	FINAL SCORE	38-40						
ACF	Push-Ups No.	41-42						
	300 yd.—Run—Sec.	43-44						
	Burpee—No.	45-46						
	75 yd. Pig-a-back Sec.	47-48						
	70 yd. Zig-Zag Sec	49-50						
	4 Mile hike, Mil. 1	51-52						
	2	53-54						
	3	55-56						
	4	57-58						
FINAL SCORE	59-60							
SUM OF THREE SCORES	61-62							

U. S. ARMY FIELD RATION C
(Col. 5)

MR #4

Day: Month:

_____ : Test Subject's Number
(Col. 1-4)

_____ : Date
(Col. 6-8)

_____ : ASN _____ : Name
Last First Initial

MARK IN THE SQUARES BELOW THE PROPER ANSWERS USING (B for Breakfast)
(L for Lunch) (S for Supper) FOR EACH AND EVERY ITEM OF FOOD WHICH YOU
EAT AT EACH MEAL.

Breakfast was prepared and eaten in _____ minutes.
Lunch was prepared and eaten in _____ minutes.
Supper was prepared and eaten in _____ minutes.
(Cols. 10-11)

	WHEN?			TASTE?			HOW MUCH?					HOW?		(PUNCH CODE)	
	BREAKFAST	LUNCH	SUPPER	GOOD	FAIR	POOR	2	ALL (1)	3/4	HALF	1/4	NONE	HOT		COLD
	(Punch Card Col.)			12	13	14	15	16	17	18	19	20	21	22	
MEATS	M-1 Meat and Beans														1
	M-2 Meat & Vegetable Hash														2
	M-3 Meat & Vegetable Stew														3
	M-4 Meat & Spaghetti														4
	M-5 Chicken & Vegetables														5
	M-6a Beans & Frankfurters w/tomato														6
	M-6b Beans & Frankfurters														7
	M-7a Pork & Beans w/tomato														8
	M-7b Pork and Beans														9
M-8 Beef & Noodles														11	
M-9 Ham & Lima Beans														12	
	(Punch Card Col.)			23	24	25	26	27	28	29	30	31	32	33	
CEREALS	Red Label														1
	Blue Label														2
	General M's														3
	General Foods														4
	(Punch Card Col.)			34	35	36	37	38	39	40	41	42	43	44	
DRINKS	Coffee														
	Cocoa														
	Lemon Juice														
	Orange Juice														
	Bouillon														
	(Punch Card Col.)			45	46	47	48	49	50	51	52	53	54	55	
CONFECTIONS	Sugar														1
	Jam														2
	Candy Coated Peanuts														3
	Candy Coated Raisins														4
	Caramels														5
	Jelly Beans														6
	Hard Candy														7
	(Punch Card Col.)			56	57	58	59	60	61	62	63	64	65	66	
CRACKERS	Cream Center Cookie														1
	Compressed Chocolate Cookie														2
	Concentrated Fruit Cake														3
	Plain Biscuits B1 or B4														4
	Plain Biscuits B2 or B5														5
	Plain Biscuits B3 or B6														6

Number of full canteens of water used for eating
and drinking in past 24 hours _____ (Col. 67)
Number of hours slept in past 24 hours _____ (Col. 68-69)
Number of bowel movements in past 24 hours _____ (Col. 70)

U. S. ARMY FIELD RATION C
(Col. 5)

MR #4a

Day: Month:

_____ : Test Subject's Number
(Col. 1-4)

_____ : Date
(Col. 6-8)

_____ : ASN _____
Last First Initial : Name

**MARK IN THE SQUARES BELOW THE PROPER ANSWERS USING (B for Breakfast)
(L for Lunch) (S for Supper) FOR EACH AND EVERY ITEM OF FOOD WHICH YOU
EAT AT EACH MEAL.**

Breakfast was prepared and eaten in _____ minutes.
Lunch was prepared and eaten in _____ minutes.
Supper was prepared and eaten in _____ minutes.
(Cols. 10-11)

	WHEN?			TASTE?			HOW MUCH?					HOW?		PUNCH CODE)	
	(Col. 9)			GOOD	FAIR	POOR	2	ALL (1)	3/4	HALF	1/4	NONE	HOT		COLD
	BREAKFAST	LUNCH	SUPPER												
MEATS	(Punch Card Col.)			12	13	14	15	16	17	18	19	20	21	22	
	M-1: Meat and Beans														1
	M-3: Meat & Vegetable Stew														2
	M-4: Meat & Spaghetti														3
	M-5: Ham-Egg-Potato														4
	M-6: Meat and Noodles														5
	M-7: Pork and Rice														6
	M-8: Frankfurters & Beans														7
	M-9: Pork & Beans														8
	M-10: Ham & Lima Beans														9
															10
														11	
														12	
CEREALS	(Punch Card Col.)			23	24	25	26	27	28	29	30	31	32	33	
	Cereal, Compressed														1
															2
															3
DRINKS	(Punch Card Col.)			34	35	36	37	38	39	40	41	42	43	44	
	Coffee														4
	Cocoa														1
	Lemon Juice														2
	Orange Juice														3
														4	
CONFECTIONS	(Punch Card Col.)			45	46	47	48	49	50	51	52	53	54	55	
	Sugar														5
	Jam														1
	Candy Coated Peanuts														2
	Candy Coated Raisins														3
	Caramels														4
	Hard Candy														5
														6	
CRACKERS	(Punch Card Col.)			56	57	58	59	60	61	62	63	64	65	66	
	Biscuits, Type IV														1
	Biscuits, Type V														2
	Biscuits, Type I														3
															4
															5
														6	

Number of full canteens of water used for eating and drinking in past 24 hours _____ (Col. 67)
 Number of hours slept in past 24 hours _____ (Col. 68-69)
 Number of bowel movements in past 24 hours _____ (Col. 70)

To be filled in by Observer.

Calories Issued _____ (Col. 71-74)

Calories Eaten _____ (Col. 75-78)

Fitness: Good $\frac{\quad}{1}$ Average $\frac{\quad}{2}$ Poor $\frac{\quad}{3}$ Not Noted $\frac{\quad}{4}$ (Col. 79)

Loss of Appetite $\frac{\quad}{1}$ Nausea $\frac{\quad}{2}$ Vomiting $\frac{\quad}{3}$ Excess Flatus $\frac{\quad}{4}$ (Col. 80)

Observer's Initials _____

U. S. ARMY FIELD RATION K
(Col. 5)

MR #5

Day: _____ Month: _____

_____ : Test Subject's Number _____ : Date
(Col. 1-4) (Col. 6-8)

_____ : ASN _____ : Name
Last First Initial

**MARK IN THE SQUARES BELOW THE PROPER ANSWERS USING (B for Breakfast)
(L for Lunch) (S for Supper) FOR EACH AND EVERY ITEM OF FOOD WHICH YOU
EAT AT EACH MEAL.**

Breakfast was prepared and eaten in _____ minutes.
Lunch was prepared and eaten in _____ minutes.
Supper was prepared and eaten in _____ minutes.
(Cols. 10-11)

	(Punch Card Col.)	WHEN?			TASTE?			HOW MUCH?					HOW?		(PUNCH CODE)			
		BREAKFAST	LUNCH	SUPPER	GOOD	FAIR	POOR	2	ALL (1)	3/4	HALF	1/4	NONE	HOT		COLD		
																	(Col. 9)	12
CANNED ITEMS	(Punch Card Col.)																	
	Chopped Pork & Egg Yolk																	1
	Ham & Eggs																	2
	Processed American Cheese																	3
	Processed American Cheese w/Bacon																	4
	Processed American & Swiss Cheese																	5
	Beef & Pork Loaf																	6
DRINKS	Corned Pork Loaf with C & A Flakes																	7
	(Punch Card Col.)																	
	Lemon Juice																	1
	Orange Juice																	2
	Bouillon																	3
CONFECTIONS	Coffee																	4
	(Punch Card Col.)																	
	Sugar																	1
	Jam																	2
	Gum																	3
	Fruit Bar																	4
	Caramels																	5
	Sweet Chocolate Bar																	6
CRACKERS	D Ration Chocolate Bar																	7
	(Punch Card Col.)																	
	1 Package K1A Biscuits																	1
	1 Package K2 Biscuits																	2
	1 Package K3 Biscuits																	3
	1 Package K4 Biscuits																	4
1 Package K5 Biscuits																	5	

Number of full canteens of water used for eating
and drinking in past 24 hours
Number of hours slept in past 24 hours
Number of bowel movements in past 24 hours

(Col. 56)
(Col. 57-58)
(Col. 59)

To be filled in by Observer

(Col. 60-63) Calories Issued _____

(Col. 64-67) Calories Eaten _____

(Col. 68) Fitness: Good ₁ Average ₂ Poor ₃ Not Noted ₄

(Col. 69) Loss of Appetite ₁ Nausea ₂ Vomiting ₃ Excess Flatus ₄

Observer's Initials _____

CANADIAN ARMY MESS TIN RATION
(Col. 5)

MR #6

Day: Month:

_____ : Test Subject's Number _____ : Date
(Col. 1-4) (Col. 6-8)

_____ : ASN _____ : Name
Last First Initial

MARK IN THE SQUARES BELOW THE PROPER ANSWERS USING (B for Breakfast)
(L for Lunch) (S for Supper) FOR EACH AND EVERY ITEM OF FOOD WHICH YOU
EAT AT EACH MEAL.

Breakfast was prepared and eaten in _____ minutes.
Lunch was prepared and eaten in _____ minutes.
Supper was prepared and eaten in _____ minutes.
(Cols. 10-11)

	WHEN? (Col. 9)	TASTE?			HOW MUCH?						HOW?		(PUNCH CODE)	
		GOOD	FAIR	POOR	2	ALL (1)	3/4	HALF	1/4	NONE	HOT	COLD		
														BREAKFAST
(Punch Card Col.)		12	13	14	15	16	17	18	19	20	21	22		
GROUP I	Sardines												1	
	Pork Loaf												2	
	Spiced Beef												3	
	Cheese												4	
	Butter												5	
	Biscuits													6
(Punch Card Col.)		23	24	25	26	27	28	29	30	31	32	33		
GROUP II	Sugar												1	
	Jam												2	
	Milk and Sugar												3	
	Hard Candy												4	
	Chocolate Bar												5	
	Tea												6	
	Coffee												7	
	Chocolate Drink													8
	Pea Soup													9

Number of full canteens of water used for eating
and drinking in past 24 hours _____ (Col. 34)
Number of hours slept in past 24 hours _____ (Col. 35-36)
Number of bowel movements in past 24 hours _____ (Col. 37)

To be filled in by Observer.

Calories Issued _____ (Col. 38-41)

Calories Eaten _____ (Col. 42-45)

Fitness: Good 1 Average 2 Poor 3 Not Noted 4 (Col. 46)

Loss of Appetite 1 Nausea 2 Vomiting 3 Excess Flatus 4
(Col. 47)

Observer's Initials _____

RATION, TEN IN ONE
(Col. 5)

MR #7

Day: Month:

_____ : Test Subject's Number _____ : Date
(Col. 1-4) (Col. 6-8)

_____ : ASN _____ : Name
Last First Initial

MARK IN THE SQUARES BELOW THE PROPER ANSWERS USING (B for Breakfast)
(L for Lunch) (S for Supper) FOR EACH AND EVERY ITEM OF FOOD WHICH YOU
EAT AT EACH MEAL.

Breakfast was prepared and eaten in _____ minutes.
Lunch was prepared and eaten in _____ minutes.
Supper was prepared and eaten in _____ minutes.

Menu Number _____
(Col. 12)

	(Punch Card Col.)	WHEN?			TASTE?			HOW?		(PUNCH CODE)
		Col. 9			GOOD	FAIR	POOR	HOT	COLD	
		BREAKFAST	LUNCH	SUPPER						
BREAKFAST	(Punch Card Col.)	13	14	15	16	17	18	19	20	
	Biscuits, Type C									1
	Biscuits, Whole Wheat									2
	Cereal									3
	Meat Item									4
	Evaporated Milk									5
	Coffee									6
	Jam									7
LUNCH	(Punch Card Col.)	21	22	23	24	25	26	27	28	
	Biscuits, K-1A									1
	Biscuits, K-2									2
	Biscuits, K-3									3
	Biscuits, K-4									4
	Biscuits, K-5									5
	Meat or Cheese Item									6
	Beverage									7
	Confection									8
SUPPER	(Punch Card Col.)	29	30	31	32	33	34	35	36	
	Biscuits, Type C									1
	Biscuits, Whole Wheat									2
	Meat Item (Main Dish)									3
	Vegetable									4
	Beverage									5
	Confection									6
	Army Spread									7

Number of full canteens of water used for eating
and drinking in past 24 hours _____ (Col. 37)
Number of hours slept in past 24 hours _____ (Col. 38-39)
Number of bowel movements in past 24 hours _____ (Col. 40)

BIOCHEMISTRY ()
10

MR #8

Da. Mo. Yr.

----- Test Subject No.
1 2 3 4

5-9

SERIAL NO. _____ NAME _____
Last First Initial

To be filled in by Head of Chemical Section.

Whole Blood:	Hemoglobin	(Gm per 100 ml)	() 11-13
	Blood Sugar	(Mg per 100 ml)	() 14-16
Serum:	Total Protein	(Gm per 100 ml)	() 17-18
	Chloride	(Meq per L)	() 19-21
	Ascorbic Acid	(Mg per 100 ml)	() 22-23
Urine -- fasting:	Chloride	(Gm. per hr)	() 24-25
	Ascorbic Acid	(Mg per hr)	() 26-27
	Thiamine	(Mcg per hr)	() 28-29
	Riboflavin	(Mcg per hr)	() 30-32
	Factor F	(Mcg per hr)	() 33-34
Urine -- after test dose:	Ascorbic Acid	(Mg)	() 35-37
	Thiamine	(Mcg)	() 38-41
	Riboflavin	(Mcg)	() 42-45
	Factor F	(Mcg)	() 46-48
Urine -- qualitative:	Albumin	(01234)	() 49
	Sugar	(01234)	() 50
	Acetore bodies	(01234)	() 51
	N.P.P.U.	(01234)	() 52

TEN IN ONE RATION
SUMMARY QUESTIONNAIRE

Test Subject's Number _____ Date _____

1. Of all the breakfast meats, I prefer: (Write 1, 2, 3 & 4 for first, second, third & fourth choices.)
 - () Pork sausage meat
 - () Bacon
 - () Ham and Eggs
 - () Chopped Pork & Egg Yolk
2. Of all drinks in this rating, I prefer: (Write 1, 2, 3, 4 & 5 for first, second, third, fourth & fifth choices.)
 - () Coffee
 - () Cocoa
 - () Lemon
 - () Orange
 - () Grape
3. Of all the supper meats, I prefer: (Write 1, 2, 3, 4 & 5 for first, second third, fourth & fifth choices.)
 - () Dehydrated Meat & Rice
 - () English Style Stew
 - () Canned Corned Beef
 - () Canned Roast Beef
 - () Dehydrated Corned Beef Hash
4. If I had to live on one menu *only* for a period of two weeks, I would choose Menu Number _____
5. Of all the biscuits in the noon meal, I prefer: (Write in 1, 2, 3, 4, 5, for your first, second, third etc. choices.)
 - () K1A Biscuit
 - () K2 Biscuit
 - () K3 Biscuit
 - () K4 Biscuit
 - () K5 Biscuit
6. Of the supper desserts, I prefer: (Write in 1, 2, 3, etc. for your first, second, third etc. choices.)
 - () Canned Peanuts
 - () Fruit Bar
 - () Hard Candy
 - () D Ration Chocolate Bar
 - () Tropical Sweet Chocolate Bar
7. In regards to my choices listed above, if I were responsible for planning the Ten-in-One Ration, here are some other things I would do: (Include suggestions here as to what you would add, how you would change anything and so forth.)

**"C" RATION (NEW)
SUMMARY QUESTIONNAIRE**

Test No. _____ Serial No. _____ Date _____

1. Place a 1, 2, or 3 before the "M" cans you prefer best HOT. (The one (1) will indicate your first choice, the two (2) your second choice, etc.)

- | | |
|----------------------------|------------------------------|
| M-1 () Meat and Beans | M-7 () Pork and Rice |
| M-3 () Meat and Veg. Stew | M-8 () Frankfurters & Beans |
| M-4 () Meat & Spaghetti | M-9 () Pork and Beans |
| M-5 () Ham-Egg-Potatoes | M-10 () Ham and Lima Beans |
| M-6 () Meat and Noodles | |

2. Place a 1, 2, or 3 before the "M" cans you prefer COLD.

- | | |
|----------------------------|--------------------------------|
| M-1 () Meat and Beans | M-7 () Pork and Rice |
| M-3 () Meat & Veg. Stew | M-8 () Frankfurters and Beans |
| M-4 () Meat and Spaghetti | M-9 () Pork and Beans |
| M-5 () Ham-Egg-Potatoes | M-10 () Ham and Lima Beans |
| M-6 () Meat and Noodles | |

3. If I had only one single "M" can to choose, it would be:

_____ (Indicate by number, M-1, M-3 etc.)

4. Of the HOT drinks, I prefer (Indicate choice by 1 and 2 for first and second choice.)

- () Coffee
() Cocoa

5. Of the COLD drinks, I prefer: (Write 1, 2, and 3 for first, second and third choices.)

- () Lemon
() Orange
() Coffee
() Cocoa

6. Of all the biscuits, the best are: (Write 1, 2, 3 for your choice.)

- () Type IV
() Type V
() Type I

7. Of the candies, I like best: (Write 1, 2, 3 for your choice.)

- () Candy-coated Peanuts and Raisins
() Caramels
() Hard Candy

8. If I had only one single "B" can to choose, it would be:

_____ (The number of the can, B-1, B-2, B-3 etc.)

9. In addition to my choices listed above, if I was responsible for planning the "C" Ration, here are some other things I would do. (Include suggestions here as to what you would add, how you would change anything, etc.)

TOPSIDE, COLORADO
"K" RATION (period 15 June-7 July)

Test Subject No. _____ Name _____ Serial No. _____ Date _____

1. Check the items in the "K" ration which you like or dislike.
 Check also whether you like the items hot or cold, or both.

	Like	Dislike	Hot	Cold
Chopped Pork & Egg Yolk				
Ham & Eggs				
Processed American Cheese				
Processed American Cheese with Bacon				
Beef and Pork Loaf				
Corned Pork Loaf with C & A Flakes				
Lemon Juice				
Orange Juice				
Boullion				
Coffee				
Fruit Bar				
Caramels				
Sweet Chocolate Bar				
D Ration Chocolate				
K IA Biscuits				
K2				
K3				
K4				
K5				

2. What items do you like best?
3. What items would you like to see eliminated?
4. Do any items have a particularly bad effect upon you? If so, what items?
5. What would you like to see added to the ration?
6. If you have any additional suggestions for improving the ration, state them here. (Use space below if you need more room.)
7. Has the ration affected you in any way physically, other than loss of weight? If so, explain fully.
8. How much weight have you lost, if any, since going on "K" ration? _____ lbs.
9. Approximately how much of the ration issued to you do you eat daily?
10. Have you moved your bowels regularly while on the ration? If not, explain.
11. Have you had any unusual bowel movements? Explain fully.
12. If you have anything else to say about the ration, of whatever nature, this is the place to say it.

USA "B" RATION (SUPPLEMENTED)

TEST SUBJECT NO. _____ Da. _____ Mo. _____ DATE

Serial No. _____ Name _____

1. What foods did you *not* eat? _____
2. What foods did you dislike, but eat? _____
3. What foods were excellent? _____
4. Was there more than enough to eat? _____ Just enough? _____ Less than enough? _____
5. How many meals did you miss? _____
6. Which meals? Breakfast? _____ Dinner? _____ Supper? _____
7. Why? _____
8. Number of bowel movements in last 24 hours _____ Was this number unusual for you? _____
9. Did you pass an unusual amount of gas? _____
10. Did you have any stomach upsets? _____

USA "B" RATION (SUPPLEMENTED)

TEST SUBJECT NO. _____ Da. _____ Mo. _____ DATE

Serial No. _____ Name _____

1. What foods did you *not* eat? _____
2. What foods did you dislike, but eat? _____
3. What foods were excellent? _____
4. Was there more than enough to eat? _____ Just enough? _____ Less than enough? _____
5. How many meals did you miss? _____
6. Which meals? Breakfast? _____ Dinner? _____ Supper? _____
7. Why? _____
8. Number of bowel movements in last 24 hours _____ Was this number unusual for you? _____
9. Did you pass an unusual amount of gas? _____
10. Did you have any stomach upsets? _____

