64-13



CIVIL DEFENSE RESEARCH


UNIVERSITY OF GEORGIA
PSYCHOLOGICAL LABORATORIES

## DDC AVAILABILITY

Qualified requestors may obtain copies of this report from the Defense Documentation Center, Cameron Station, Alexandria, Virginia.

Civil Defense Research
Psychological Laboratories
University of Georgia
Athens, Georgia

31 December, 1963

# FINAL REPORT

# SHELTER OCCUPANCY STUDIES AT THE UNIVERSITY OF GEORGIA

1962-1963

Prepared By

John A. Hammes  R. Travis Osborne

In Collaboration With

Donald H. Thor
Thomas R. Ahearn
Rolffs S. Pinkerton
James A. Watson
Mary P. Beussee
Gordon L. Larsen
M. L. J. Crawford
James F. Keith, Jr.
James W. Foughner
Barry Nicora
Joan M. Jaeger



Prepared for
Office of Civil Defense
Department of Defense
under
Contract No. OCD-OS-62-226
Subtask 1521A

## Acknowledgements

OCD Project Coordinator:
Fred Carr

Publicity and Recruitment:
Capt. Robert M. Bowstrom, USN, Retired
Harold V. Clum
William L. Kelly

Instrumentation:
Marshall Williams
Jack Rollins

Physical Fitness Testing:
Avery H. Harvill, Instructor, Department of Health-Physical Education, University of Georgia

Consulting Physicians:
Bolling S. DuBose, Jr., M.D.
Jack R. Palmer, M.D.
Royce Banister, M.D.
Charles T. Young, M.D., Director, University of Georgia Infirmary

Nutritional Analyses:
Paul L. Piercy, Professor and Head, Department of Physiology and Pharmacology, School of Veterinary Medicine, University of Georgia
H. C. Morgan, Assistant Professor, Department of Physiology and Pharmacology, School of Veterinary Medicine, University of Georgia
Marion E. McDonnell, Lt. Col, M.C., Commanding Officer, Fitzsimons General Hospital, Denver, Colorado
C. F. Consolazio, Chief, Bioenergetics Division, Fitzsimons General Hospital, Denver, Colorado
W. N. Pearson, Associate Professor of Biochemistry, School of Medicine, Vanderbilt University, Nashville, Tennessee

Shelter Managers:

Earl Carson
Steve Lamphear
Robert May
Robert M. Kelley
Burrell Taylor

Shelter Medics:

H. Edward Logue, Medical College of Georgia
Harlan Nevin, Medical College of Georgia
Eddie M. Frazier, Jr., Medical College of Georgia
Robert Payne, Medical College of Georgia

Research Film:

Gerard L. Appy, Associate Director, Georgia Center for Continuing Education
Hill H. Bermont, Production Manager and TV Program Director, Georgia Center for Continuing Education
David G. Fisher, TV Producer and Film Director, Georgia Center for Continuing Education

Secretarial Assistance:

Melissa Daniel
Katie Bridges
Jackie Lord

Printing:

Mrs. Lawrence D. Ramspott
Rowland Kraps

And, of course, all of the shelteree volunteers and participants.

## Table of Contents

Abstract

During 1962 and 1963 the University of Georgia Psychological Laboratories conducted a series of tests on the habitability of fallout shelters as presently stocked in accordance with the National Shelter Program. These studies surpassed in austerity all previous shelter research using civilians. Men, women, and children, age 7 - 70 years, participated in two-week confinement tests.

## List of Tables

## List of Figures

# THE RESEARCH PROGRAM

# Chapter 1 - The Project Mission

## I. Introduction

In the summer of 1962 a realistic program for national civil defense was well underway. At that time it was estimated that approximately 235 million spaces were needed by 1967 for nationwide protection from radioactive fallout, in the event of a nuclear war.

The objectives of the National Shelter Program were to locate and mark suitable fallout shelter spaces, and then to stock them with food, water, medical kits, sanitation kits, and radiation measuring instruments. However, the operability of shelters so created and provisioned had never been tested. This task was assigned to the University of Georgia Psychological Laboratories.

The general research mission, therefore, was to appraise minimal survival conditions in public fallout shelters as presently equipped and stocked with emergency supplies. Specifically, the project was to evaluate the interactive effects of such variables as overloading, limited bunks and bedding, emergency sanitation equipment, marginal ventilation conditions, and minimal food and water supplies. A film depicting results was also part of the research mission.

The first phase of the project involved construction of simulated fallout shelter facilities and instruments. The University of Georgia provided a building, administrative office space, shelter operation facilities, and experimental equipment.

Operational responsibility was divided among four task groups: Electronics Design and Development Group, Publicity and Recruitment Group, Pre- and Post-Shelter Behavioral Analysis Group, and an In-Shelter Behavioral Analysis Group.

Following three preliminary pilot studies, four main experimental studies were conducted during the spring and summer of 1963. During these studies, the Psychological Laboratories was visited by Assistant Secretary of Defense Steuart L. Pittman, accompanied by Mr. W. E. Strope, Director for Research, OCD, and Mr. Fred Carr, Project Coordinator.

The results of the experimental tests are presented in the chapters to follow.

## II. Outline of Studies

### A. Pilot Studies

Pilot studies were conducted in the fall of 1962 for purposes of (a) checking out equipment, (b) training observer teams, (c) determining procedures for medical, physical fitness, and psychological testing of shelterees before and after shelter confinement, (d) training shelter managers, and (e) determining in-shelter activity programs. Experimental variables also investigated in these studies are presented in Table 1. Detailed results of these pilot studies are reported in Appendix B.

### B. Experimental Studies

An outline of the four experimental studies is presented in Table 2. A four-day study (ES I), two two-week studies (ES II and ES III), and a one-week study (ES IV) were conducted.

Experimental Study I, the four-day study, was the most austere. The shelterees subsisted on fewer calories (315 cal./person/day) and slept on a concrete floor, which, in the other studies, was covered with corrugated fiberboard. The eight defections occurring during ES I indicated that less austere conditions might persuade a greater number of shelterees to endure the longer stay of the other planned studies.

Experimental Studies II and III, therefore, provided 3/16" thickness of corrugated fiberboard as floor covering and additional food and water. The age ranges were also extended in these studies (7-67 years).

Experimental Study IV was designed as a one-week elementary school occupancy study. Two adults, a shelter manager and a nurse, accompanied twenty-eight children. The OCD carbohydrate supplement was also tested in this study. Space was reduced to 6 sq. ft./occupant, to evaluate greater overcrowding, and in consideration of smaller body size.

Shelter supplies evaluated in the four studies were standard OCD issue as presently stocked. The four types of food ration, viz, the Bulgur wheat wafer, the Nabisco wheat-flour biscuit, the Nebraska wheat-corn-flour cracker, and the carbohydrate supplement were also investigated. Other supplies studied included sanitation kits, medical kits, and various kinds of commode chemicals. Minimal living space and limited conditions of ventilation were investigated, as well as in-shelter activity programs, and psychological and sociological patterns of behavior.

Table 1

Shelter Occupancy Pilot Studies

| | PS I (28-30 Sept. 1962) | PS II (5-7 Oct. 1962) | PS III (12-14 Oct. 1962) |
|---|---|---|---|
| **Shelterees** | | | |
| N | 10 | 10 | 10 |
| Sex | Men, women, children | Men, women, children | Men, women, children |
| Age | 8-63 | 12-52 | 14-42 |
| Number of defections | 0 | 0 | 0 |
| **Shelter Environment** | | | |
| Space/person: sq. ft. | 10 | 10 | 8 |
| cu. ft. | 65 | 65 | 52 |
| Temperature* | opt. | opt. | high |
| Humidity* | opt. | opt. | high |
| Ventilation* | high | high | high |
| **Shelter Supplies** | | | |
| Water | ad lib | ad lib | 1 qt./person/day |
| Food | biscuits/ adjuncts | biscuits/ no adjuncts | 370 cal./person/day survival biscuit |
| Sanitation | flush toilet | chemical | chemical |
| Bunks | 8 persons | 4 persons | No |
| Blankets/person | 3 | 1 | No |
| Bath water | Yes | No | No |
| Coffee | Yes | No | No |
| Cigarettes | Yes | No | No |
| Recreat. supplies | Yes | Yes | No |

*See Appendeces for details

| Experimental Study | Date | Shelterees N | Sex | Age | Defections | Shelter Environ Net Space/Person sq.ft. | cu.ft. | Temp. | H |
|---|---|---|---|---|---|---|---|---|---|
| ES I | 14-18 Dec. 1962 | 30 | Men, women, children | 15-50 | 8 | 8 | 52 | opt. | |
| ES II | 16 Feb.- 1 Mar., 1963 | 30 | Men, women, children | 9-67 | 5 | 8 | 52 | opt. | |
| ES III | 27 Apr.-10 May, 1963 | 30 | Men, women, children | 7-66 | 2 | 8 | 52 | opt. | |
| ES IV | 20-27 July 1963 | 30 | Children, two adults | 7-12 | 11 | 6 | 39 | opt. | |

*Ss requested to consume as few rations as possible

Table

Experimental Shelter

| Shelter Environment | | | | Shelter Supplies | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Space/Person ft. | cu.ft. | Temp. | Hum. | Ventilation cfm/person | Water qt/person/day Consumed* | Food cal/person/day Consumed* | Sanitation | Bunks | Blankets | Ba Wate |
| | 52 | opt. | opt. | 15 (20% fresh air) | 1.3 | 315 cal. Bulgur wafer | chemical toilet | No | No | No |
| | 52 | opt. | opt. | Day: 40 (20% fresh air) Night: 15 (20% fresh air) | 1.4 | 787 cal. Bulgur wafer | chemical toilet | No | No | No |
| | 52 | opt. | opt. | Day: 40 (20% fresh air) Night: 15 (20% fresh air) | 1.0 | 814 cal. Nabisco biscuit | chemical toilet | No | No | No |
| | 39 | opt. | opt. | Day: 40 (20% fresh air) Night: 15 (20% fresh air) | 1.0 | 552 cal. Nebraska cracker + 296 cal. carbo suppl.= 848 cal. | chemical toilet | No | No | No |

Table 2

Experimental Shelter Occupancy Variables

| | Shelter Supplies | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ion on | Water qt/person/day Consumed* | Food cal/person/day Consumed* | Sanitation | Bunks | Blankets | Bath Water | Coffee | Cig. | Recreational Supplies |
| r) | 1.3 | 315 cal. Bulgur wafer | chemical toilet | No | No | No | No | No | No |
| (20% r) 5 sh air) | 1.4 | 787 cal. Bulgur wafer | chemical toilet | No | No | No | No | 1 pk. | No |
| (20% r) 5 sh air) | 1.0 | 814 cal. Nabisco biscuit | chemical toilet | No | No | No | No | 1 pk. | No |
| (20% r) 5 sh air) | 1.0 | 552 cal. Nebraska cracker + 296 cal. carbo suppl.= 848 cal. | chemical toilet | No | No | No | No | 1 pk. adults | paper and pencils |

# Chapter 2 - The Experimental Fallout Shelter

## I. The Simulated Shelter

A simulated fallout shelter (see Figure 1) was constructed within the Psychological Laboratories building. The shelter was of plywood and plasterboard construction on 2' x 4' framing with fiberglas insulation. The floor was of concrete.

The interior dimensions were 25' x 14.5' x 6.5'. The inside walls were painted white, and the floor and exterior painted grey. Within the walls were constructed six observation ports having one-way glass mirrors, and so placed as to give complete viewing of the shelter interior. Small doors at each observation port could be closed when the station was not in use. Two clear glass ports were provided for motion picture cameras.

In one shelter corner a latrine area (4.4' x 4.25') was located as part of permanent construction. This area was equipped for installation of a flush toilet. A small wash basin could also be installed. Water to the toilet and wash basin were controlled and metered from outside of the shelter. Such facilities, however, were used only in pilot studies and not in the main experimental studies.

Within the shelter, a movable wall was constructed, suspended on tracks, to accommodate the shelter space to any number of shelterees. A door in this wall permitted entrance to the occupied section of the shelter, and a large air-tight door provided entrance to the overall shelter area.

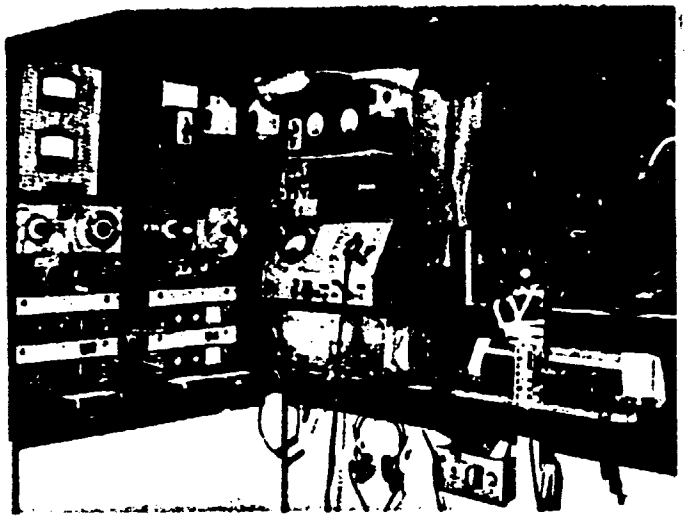
One 6.5' x 3' section of the shelter wall was constructed to be a knock-out safety door. Within this section of wall a means of passing materials into or out of the shelter was provided.

Outside of the shelter at one end was located the main observation and recording room. From this room the interior of the shelter could be viewed through a large one-way vision mirror. This room housed all the recording, control, and communications equipment, while serving as the main observation station.

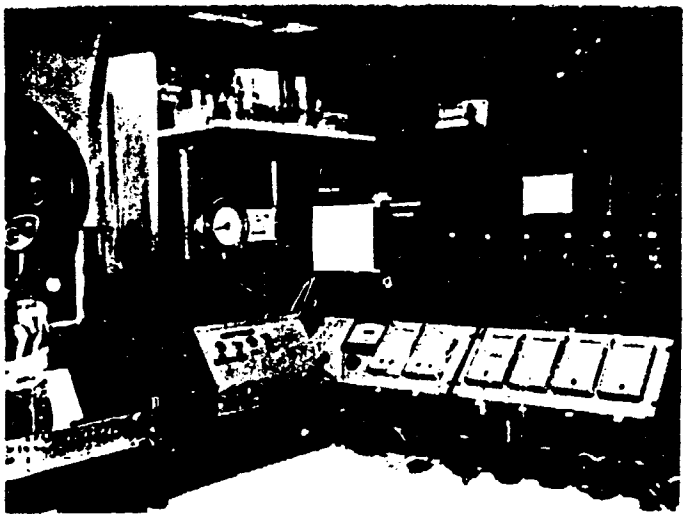
## II. Instrumentation Specifications

### A. Air Conditioning

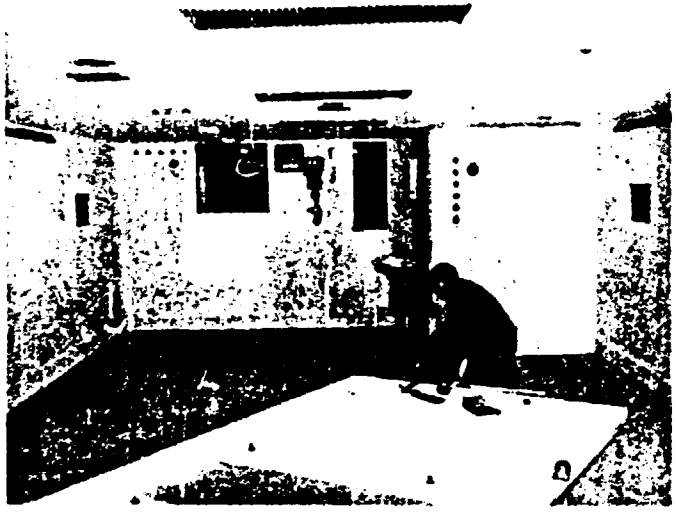
1. The Basic Air Conditioning Unit - A Chrysler AT-500 Series with associated components cooled the shelter space. The blower unit and coils were suspended from the second



A LEFT INTERIOR CORNER OF MAIN OBSERVATION ROOM



B RIGHT INTERIOR CORNER OF MAIN OBSERVATION ROOM



C INTERIOR OF SHELTER

D EXTERIOR OBSERVATION PORTS

FIGURE 1

floor above the main observation room, with the condensing unit located outside of the building. This air-handling system provided 0-1800 cu. ft./min. of fresh and recirculated air in combinations varying to approximately 75% fresh air, the percent of possible fresh air being dependent on the air flow to the room (Fig. 2).

2. Heating - The air was heated by thermostatically controlled electric resistance heaters located in the air supply duct following the cooling unit. Manual switch-controlled electric resistance heaters were located in the air return duct preceding the cooling coils to provide a lower range in the supply air temperature.

3. Filtering - The air supply was filtered through both electrostatic and charcoal filters located in the supply duct.

4. Air Control System - A system of ducts with both motorized and manual dampers, and with thermostats provided control of air flow, fresh and recirculated air mixing, and air temperatures. With this system, air supplied to the shelter space could be set within a range of 0-1800 $\pm$ 15 cu. ft./min., and the temperature set within a range of 36-100° $\pm$ 10° F.

5. Air Flow Indication - For low air volume measurement, two remote-reading indicators were installed in the main observation room. The sensing elements, one in the fresh air and air supply ducts respectively, consisted of vane-operated wire-wound potentiometers which serve as one leg of a modified bridge circuit. These indicators were calibrated in cu. ft./min. with a range of 30-600 cu. ft./min.

For higher air supply demands, Pitot operated remote reading air flow indicators were installed in the same duct locations as the above.

A glass window allowed observation of the supply air damper and manual adjustment of the exhaust air damper to maintain equal air pressure throughout the system.

6. Humidifier - A humidifier unit was located in the air supply duct to maintain the relative humidity lower level. Lower level ranges were 20% - 80% relative humidity.

B. Basic Variable Recording System

Six Rustrak recorders of varying specifications served for permanent recording of environmental and behavioral variables.

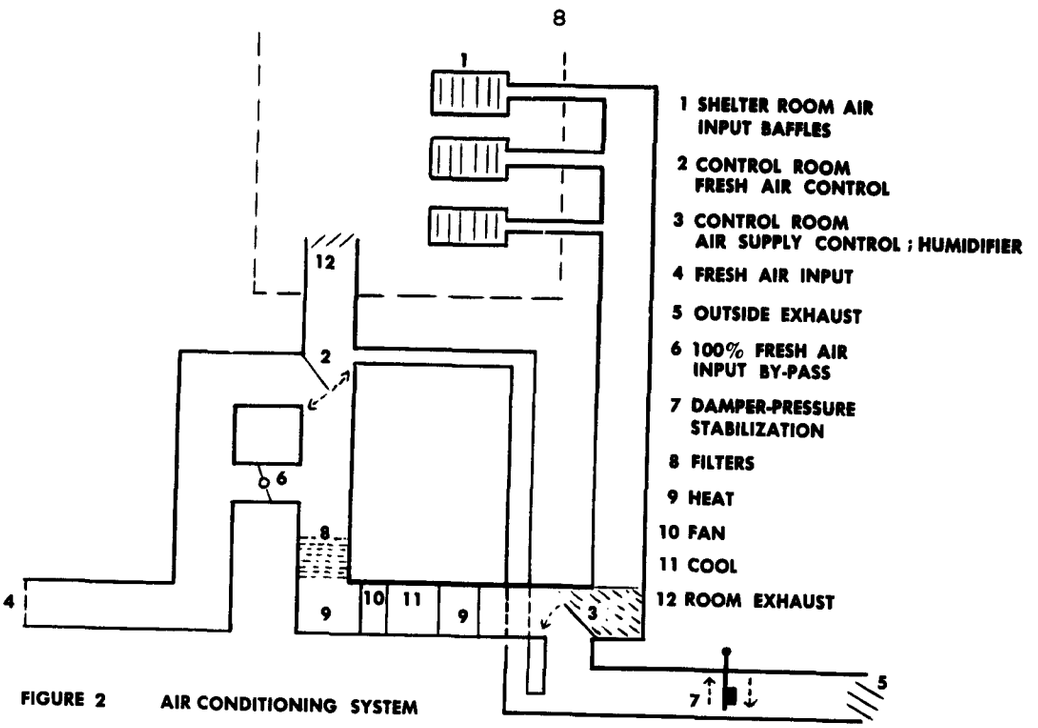



FIGURE 2 AIR CONDITIONING SYSTEM

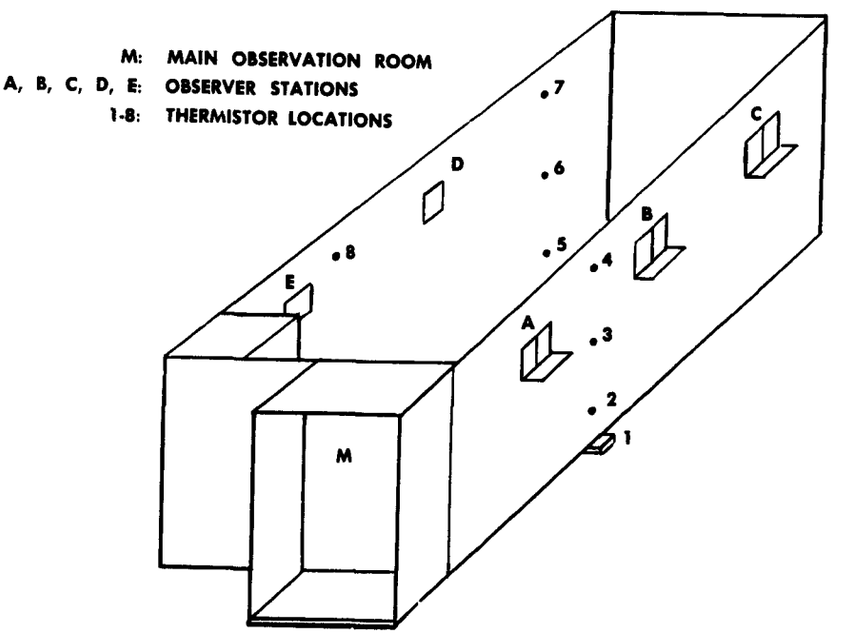



FIGURE 3 LOCATION OF OBSERVER POSTS AND THERMISTORS

This particular type of recording system was selected on the basis of economy and adaptability, and provided permanent recording on pressure sensitive paper tape of temperatures, noise levels, lighting variations, and various shelter events.

C. Specific Variable Control and Recording

1. Temperature - Temperature variations within the shelter were automatically recorded from ten thermistor locations (Fig. 3). Of measures taken, nine were dry bulb temperatures and one a wet bulb temperature. Dry and wet bulb temperatures from one location were continuously recorded on a dual channel recorder. From these recordings the relative humidity and effective temperatures were calculated.

The remaining eight thermistors were programmed in pairs to another dual channel recorder for sampling temperatures for 15-minute intervals each hour.

Ten manually recorded thermistors were installed in wet and dry bulb pairs at various locations. From these a record was maintained of temperature and humidity of outside, shelter, supply, return and exhaust air.

The in-shelter thermistors were installed at various heights and locations in the shelter walls with the 1/8-inch sensitive tip projecting into the shelter room.

2. Noise Level - Noise variations within the shelter were picked up through an eight-inch speaker located in the shelter ceiling and serving as a non-directional microphone. The sound was fed into an amplifier and supplied to a highly dampered meter movement. This meter movement was paralleled with a one milliampere Rustrak recorder, providing a permanent graphic recording of the relative shelter noise variations.

3. General Activity Recording - A new system for recording general motor activity* was installed for measurement of shelteree activity.

The basic system consisted of a low energy ultrasonic

*Peacock, L. J., and Williams, W. An ultrasonic device for recording activity. Am. J. Psychol., 1962, 65, 648-652.

transmitter and receiver with a mechanical counter as an output recorder. A crystal controlled 41 kc oscillator, buffer, and output amplifier supplied a continuous signal to four output transducers. These transducers converted electrical energy into ultrasonic waves which traveled across the shelter space until reflected by some solid object. This reflective action tended to cause waves to be present in nearly all points of the shelter area. A receiving transducer picked up a combination of a portion of all the reflected signals and converting the ultrasonic waves into electrical energy again, capacitively coupled it to a four-stage voltage amplifier. The output of this amplifier was rectified, filtered, and fed to the output amplifier. Due to capacitive coupling between the output amplifier and an integrator which drives a mechanical counter, only input signal level changes caused the counter to operate. Any movement of reflective objects within the ultrasonic field caused a reflected signal level change at the input and thus produced pulses which were counted.

The above briefly described system provided an hourly index of the 24-hour variations in shelteree activity.

4. Illumination Level Recording - Illumination of the shelter was provided by six flush-mount ceiling fixtures, each supplied with one 100-w. lamp. The lights could be controlled individually or collectively from the in-shelter lighting control panel. This panel consisted of six powerstats, each controlling one light, and a master control powerstat allowing simultaneous control of all six lights.

Within the main observation room there was a duplicate lighting control panel, plus control-shift switches. These switches allowed flexible manipulation of the lighting level. By use of the control-shift switches, lighting control could be given to the shelterees or retained in the main observation room. When lighting control was given the shelterees, they could adjust the level of lighting within a maximum illumination level set in the main observation room.

The variations in lighting level were recorded by a Rustrak ammeter calibrated in watts.

5. Shelter Event Recording - The number, duration, and time of day of the following shelter events could be recorded: (1) closures of the latrine door, (2) activation of the toilet, (3) turning on or off of the simulated CONELRAD receiver, and (4) use of the simulated radiation indicator. These events were recorded on a four-channel Rustrak event recorder.

6. Water Measurement - When either the flush toilet or wash basin were used (in pilot studies), a water meter in the supply line indicated the amount of water expended.

7. Oxygen and Carbon Dioxide Measurements - With occupancy studies using low air circulation, the $O_2$ and $CO_2$ contents of the room air were evaluated by Fyrite kits. Air samples were taken from the air return duct of the ventilation system.

8. Simulated Radiation Meter - This unit consisted of two 120-VAC meters, in parallel, controlled by a potentiometer. The scale units were altered to give simulated readings of roentgens/hour. One meter was located on the inside shelter wall and read by actuation of a push-button switch. The switch actuations were recorded on an event recorder located in the main observation room. The reading obtained was set by the potentiometer on the second meter inside the main observation room. Variations in the simulated outside radiation level followed a pre-planned schedule.

9. Simulated CONELRAD Radio Messages - A series of simulated CONELRAD radio messages were programmed in earlier studies through a simulated radio receiver located in the shelter. These messages were pre-recorded and later played on a Roberts 990 tape recorder. The radio receiver could be turned on or off by shelterees. Actuations of this switch were recorded on an event recorder in the main observation room.

10. Audio Recording - Flush mounted within the shelter ceiling were three speakers and within the movable wall two speakers served as microphones for picking up in-shelter conversations. These five speakers were fed to three independent selection units and amplifiers. One selection unit determined which two speakers were connected to the input of a Roberts Model 990 stereo tape recorder. The second selection unit determined the speaker connected to one-half of a headset in the main observation room and at each of the observation stations. The third selection unit determined the speaker connected to the other half of the headset at each observation station. The system permitted either stereo or monaural monitoring and recording from most points in the shelter.

In addition, an observer intercom system connected the six observation stations, including a telephone inside the shelter. All communications between the shelter and the main observation room, or between observers could be recorded on magnetic tape. Comments relating to in-shelter conversations could be stereo recorded for better listening on post-test analysis.

# Chapter 3 - Shelteree Characteristics

## I. Publicity and Recruitment

Initial recruitment procedure involved several organizations. County agents in Athens and surrounding areas were used extensively. Other contacts included the State Jaycees, the State Chamber of Commerce, the Kiwanis Club, the Athens' City Club, the Athens branch of Westinghouse Electric Corporation, and General Time Corporation. The Navy Supply Corps School, Clarke County Welfare, YWCA, Georgia State Employment Service, and the Salvation Army were also of assistance in obtaining shelter volunteers.

An attempt was made to approximate the 1960 census national white population characteristics as closely as possible with regard to age, sex, education and occupation.

Several news releases were prepared and distributed to newspapers, radio and television stations in Athens and surrounding areas. A folder entitled "Door to Survival" was prepared, citing the need for volunteers and presenting a brief outline of the studies. For practical reasons, recruits were solicited within a 100-mile radius of Athens.

The University Department of Public Relations assisted the recruitment effort by providing radio and newspaper material. Members of the Civil Defense Research staff also gave talks in the public schools in and around the Athens area.

All participants were given medical examination screening prior to final selection. In-shelter medics and standby physicians provided any need for medical assistance during actual confinement.

To help determine the most fruitful means of recruitment, there was added to the shelteree application form a question on the means by which shelterees learned about the study. Recruitment efforts among public school students appeared to be the most fruitful mode of contacting interested applicants (see Table 3).

## II. Selected Groups

Recruiting efforts resulted in 1,252 applications. Of this number, 120 paid volunteers (60 males and 60 females) participated in the four experimental studies. Contingent upon experimental variables, shelteree pay ranged in amounts to a maximal $1.00 per hour.

Table 3

Sources of Shelterees' Knowledge of University of Georgia Civil Defense Research

| Source | Study | | | | Total |
|---|---|---|---|---|---|
| | ES I | ES II | ES III | ES IV | |
| School Recruitment | 3 | 8 | 16 | 19 | 46 |
| Other Shelterees | 8 | 7 | 2 | 0 | 17 |
| Civil Defense Research Personnel | 7 | 3 | 2 | 1 | 13 |
| Agriculture Extension Personnel | 1 | 4 | 4 | 0 | 9 |
| Employment Office | 4 | 3 | 1 | 0 | 8 |
| Parents | 0 | 0 | 0 | 8 | 8 |
| Radio Announcements | 3 | 3 | 0 | 0 | 6 |
| Newspaper Articles | 3 | 2 | 0 | 0 | 5 |
| U. of Ga. Personnel | 1 | 0 | 3 | 0 | 4 |
| Indefinite | 0 | 0 | 2 | 2 | 4 |
| | 30 | 30 | 30 | 30 | 120 |

The samples of participants ranged in age from 7-67 and represented a variety of occupations. Detailed characteristics of the selected groups are presented in Table 4. Intellectual characteristics were evaluated differently from study to study. In ES I exploratory tests were evaluated. In ES II the General Aptitude Test Battery was administered; median score 102, range 75-116. The California Short Form Mental Maturity was given in ES III and ES IV. The median score for ES III was 99, range 66-132. For ES IV the median score was 100, range 68-137.

Table 4

Characteristics of Selected Shelterees

| | Study | | | | |
|---|---|---|---|---|---|
| | ES I | ES II | ES III | ES IV | Total |
| **Age** | | | | | |
| 7-15 | 1 | 8 | 10 | 28 | 47 |
| 16-25 | 11 | 4 | 2 | 0 | 17 |
| 26-35 | 8 | 2 | 6 | 2 | 18 |
| 36-45 | 5 | 8 | 5 | 0 | 18 |
| 46-55 | 5 | 3 | 3 | 0 | 11 |
| 56-70 | 0 | 5 | 4 | 0 | 9 |
| | 30 | 30 | 30 | 30 | 120 |
| **Sex** | | | | | |
| Male | 15 | 15 | 15 | 15 | 60 |
| Female | 15 | 15 | 15 | 15 | 60 |
| | 30 | 30 | 30 | 30 | 120 |
| **Occupation** | | | | | |
| Professional | 4 | 3 | 2 | 2 | 11 |
| White Collar | 5 | 1 | 2 | 0 | 8 |
| Skilled Labor | 2 | 5 | 5 | 0 | 12 |
| Unskilled or Semi-Skilled | 2 | 1 | 2 | 0 | 5 |
| Unemployed | 3 | 5 | 1 | 0 | 9 |
| Housewife | 5 | 5 | 7 | 0 | 17 |
| Student | 9 | 10 | 11 | 28 | 58 |
| | 30 | 30 | 30 | 30 | 120 |
| **Educational Level** | | | | | |
| 8 years or less | 4 | 14 | 15 | 28 | 61 |
| 9-12 | 14 | 11 | 8 | 0 | 33 |
| 13-16 | 10 | 3 | 6 | 1 | 20 |
| 16+ | 2 | 2 | 1 | 1 | 6 |
| | 30 | 30 | 30 | 30 | 120 |

# Chapter 4 - The In-Shelter Program

## I. Shelter Manager Training

Since the number of shelter manager candidates who met general criteria for acceptance was relatively small, the process of selecting a shelter manager was easily accomplished. General criteria included estimates of intelligence, personality, adjustment and background experience in leadership.

Each candidate attended a minimum of four training and familiarization meetings with Civil Defense Research Staff members. Actual contact hours varied from ten to twenty-three. Outside preparation on the part of candidates varied, but did not exceed twelve hours. The candidates were generally confident of their ability and saw little need for any extensive preparation. The preparations that were made focused upon reading general Civil Defense literature and preparation of lesson plans for conducting descriptive, explanatory, and preparatory survival schemes.

Meetings with the shelter manager were informal and conversational. It was deemed important to have the candidate fully aware of the importance of his role in the overall research effort. Manager candidate conceptions as well as shelteree conceptions of shelter experience varied widely and the "big picture" was necessarily a part of the introduction. After a briefing on the relevance of the research to future stocking and shelter planning, the candidate was introduced to the experimental shelter and supplies he would find upon entrance. The candidate was familiarized with food and water, medical, radiological, and sanitation units.

Procedural details such as schedules, forms, and areas of responsibility composed another major aspect of the training program. The candidate examined medical, food and water, diary, and other forms that he would be using during occupancy. Entrance, exit, and communication procedures were outlined in detail. Responsibilities to shelterees and to the research effort were also discussed to the mutual satisfaction of the candidate and training staff.

Upon completion of the more mechanical and routine aspects of the training curriculum, the candidate was introduced to problems and difficulties he would likely face during his tenure as shelter leader. He was informed of problems that had occurred in previous studies and the importance of the manner in which he handled problems as they occurred. In nearly all cases he was instructed to use his discretion and not to request solutions from outside the shelter.

Recreation, exercise, training and other shelter activities were final topics in the training sequence. The manager was informed of prior shelteree experiences and instructed to improve upon any suggested aspect as he wished. The candidate was reassured that he was in actuality the shelter leader and was not to follow a blind, preconceived plan of organization or activity. Rather, he was to act according to the situation and to his interpretation of the social milieu.

## II. The In-Shelter Program

Original planning of the shelter occupancy was dictated by the attempt to make the experience realistic. To this end a simulated remote sensing radiation meter and simulated CONELRAD broadcasts were incorporated. However, since what constituted shelter realism was apparently debatable and largely unknown, and the emotional impact of an actual situation not amenable to investigation, both the radiation meter and CONELRAD were omitted after ES I. The reality of the experimental situation was that of limited confinement and isolation. Confinement was terminable at any time on request by any shelteree. Isolation was limited in the sense that only the shelter manager had contact with the outside. All contact was limited as far as possible to the need for communication involving experimental variables.

The shelter program was intended to be largely spontaneous and highly dependent upon the shelter manager and the individuals composing the shelteree group. Once the group had entered the shelter, little or no guidance or direction was given from the outside. Prior to entry only the shelter manager and the nurse (or medical student) were briefed upon what to expect or anticipate. The suggested daily routine follows:

8:00 AM - 12:00 Noon

Lights on
Preparation for the day (shelter and personal)
Food and water distribution
Diary completion (9:00 AM)

Exercise
Training session (30 min.)
Other activities: planning sessions, committee meetings, announcements, morale-building sessions, group gripe sessions, group games, study

12:00 Noon - 4:00 PM

Food and water distribution
Quiet games
Study (adjust lights to suit segmented activity needs)
Rest
Informal activity

4:00 PM - 8:00 PM

Food and water distribution
Exercise
Training session (30 min.)
Special recreational activities

8:00 PM - 12 Midnight

Food and water distribution
Vespers, group discussion
Singing
Diary completion (9:00 PM)
Shelter clean-up and preparation for sleep
Lights off

Type of exercise, variety of training topics, morale improving events, and recreational possibilities were discussed at length with all shelter managers prior to entry. Material such as songbooks, recreation handbooks, and exercise manuals were also made available during training.

The shelter program was intended to be flexible and informal without adhering to a rigid time sequence. Training periods were to occur at times when the greatest number might benefit. Organized lectures and recreational activities were to be implemented at the discretion of the shelter manager.

RESULTS

# Chapter 1 - In-Shelter Experimental Variables

## I. Experimental Variables

The experimental conditions investigated in the four experimental studies have been outlined in Chp. 1, Table 2. The studies represent a progression of evaluation of different food rations, water rations, chemical commode deodorants, sleeping conditions, and activity programs. In ES I, II, and III shelterees were requested to attempt to subsist on less than the allotted rations, if possible. The group could share food and water, as long as the total intake did not exceed the total rations allotted.

### A. Experimental Study I

In Experimental Study I, the four-day occupancy test, the space allotted was 8 sq. ft. and 52 cu. ft./person, with an additional 1 cu. ft./person for storage. OCD's shelter marking standard is 10 sq. ft. of net shelter space/person, plus 1 cu. ft./person for storage. Temperature and humidity were optimal, to avoid confounding such stress effects with those of low caloric diet and low water supply, particularly with shelterees in the age span of 15-50 years. Ventilation was maintained at 15 cfm/person (3 cfm fresh air, 12 cfm recirculated air). Experimental Study I was basically an extended version of Pilot Study III (see Appendix B) with the exclusion of heat stress.

The supplies were OCD issue. Water was stocked in two 17.5 gal. metal drums, to be rationed at 1 quart/person/day. Food supplies consisted of the bulgur wheat wafer, to be rationed at approximately 300 calories/person/day. One Sanitation Kit III, one Medical Kit A, and one Radiological Kit completed the official supplies. Four eight-inch candles, matches, a small bookcase, two Bibles, a small fire extinguisher, a Fyrite kit, and a large plastic garbage can were also part of the shelter supply inventory.

Bunks and bedding were omitted; the shelterees slept on the concrete floor with no floor covering. There were no recreational materials, coffee, cigarettes, or washing water provided. Illumination level was controlled entirely by shelterees.

Clothes, toilet articles and other items brought in by shelterees were limited; for clothes - leisure indoor slacks or trousers, shirt or blouse, undergarments, shoes and stockings, handkerchief; for toilet articles - only small items such as handbag cosmetics and items normally carried on one's person. Items specifically excluded were food, candy or chewing gum, books or magazines, soap, eating or cooking utensils, pillows

or blankets, and cigarettes or tobacco.

Resultant food consumption was 315 cal./person/day, and resultant water consumption was 1.3 qt./person/day.

The stressful austerity of Experimental Study I was indicated by the fact that eight shelterees defected prior to study completion (see Chapter 2), and the endurance estimate of a prolonged stay by the remaining shelterees was two days (see Chapter 3). Details of Experimental Study I may be found in Appendix C.

B. Experimental Study II

Experimental Study II, the first two-week occupancy study, involved experimental conditions surpassing in austerity all previous two-week shelter research studies, with the exception of heat stress. Space allowed per person was 8 sq. ft. and 52 cu. ft., with 1 cu. ft. for storage. Temperature and humidity were optimal. Water ration was 2 qts./person/day and food ration was approximately 1,000 cal./person/day of the bulgur wheat wafer. OCD Sanitation Kit III (25 persons) was used and OCD Medical Kit A (50-65 persons, 14 days). A radiological kit completed the OCD supplies. There were no bunks or blankets. Shelterees slept on a concrete floor and were provided only with a corrugated fiberboard measuring 5' x 2' x 3/16" thick, for a mat. There were no recreational supplies, washing water, or coffee provided. Smokers were permitted to bring in with them one package of cigarettes, or 1 3/8 ounces smoking tobacco with pipe, or five cigars.

Children were permitted to bring textbooks, since their schooling was to be continued during the two weeks' occupancy period. Personal items permitted all shelterees consisted of clothes worn plus one change of underwear and socks or stockings, and toilet articles, e.g., toothbrush, toothpaste, mouthwash, handbag cosmetics. Items excluded were food, candy, soap, shaving gear, eating or cooking utensils, and pillows or blankets.

Water consumption averaged 1.4 qt./person/day and food consumption averaged 787 cal./person/day. Three commodes were sealed off during the study and a fourth started one day prior to exit. Five shelterees defected during this study (see Chapter 2). Details of ES II may be found in Appendix D.

C. Experimental Study III

Experimental Study III was the second two-week occupancy study conducted, and differed from Experimental Study II in the following respects:

1. An in-shelter nurse was substituted for the in-shelter medic of Experimental Study II.

2. Ventilation during the night was 15 cfm/person, and during the day 40 cfm/person. The increase during daylight hours was found necessary in Experimental Study II to keep rising temperature from becoming a stress variable. Temperature was optimal and controlled in Experimental Study III so as not to confound the effects of the stress variables under investigation.

3. Water rations of 1 qt./person/day in Experimental Study I were found to be inadequate, whereas 2 qt./person/day in Experimental Study II were more than adequate for drinking purposes. Consequently, 1.5 qts./person/day were evaluated in Experimental Study III.

4. Food rations of 1,000 calories/person/day of the Bulgur wafer were found to be adequate in Experimental Study II. Rations of 900 cal./person/day were provided in Experimental Study III, in an evaluation of the Nabisco wheat-flour biscuit.

5. The OCD Medical Kit A used in Experimental Study II was abbreviated for use in Experimental Study III.

6. Shelterees, as in Experimental Study II, slept on 3/16-inch corrugated fiberboard pallets, measuring 5' x 2' when opened. However, the amount of corrugated fiberboard available was reduced 50% in Experimental Study III, subsequently covering about 60% of the floor area.

7. The commode chemical Weladyne, used in Experimental Study II, was found to be ineffective under the conditions of the study. In Experimental Study III, different amounts of Weladyne were tested, and a test series of different commode chemicals initiated.

8. Shelterees were not permitted to take in watches or time pieces.

Experimental Study III was similar to Experimental Study II in space, temperature, humidity, absence of bunks or blankets, sleeping on a concrete floor on corrugated fiberboard mats 3/16-inch thick, absence of coffee and washing water. Smokers were permitted to bring in with them one package of cigarettes, or 1 3/8 ounces smoking tobacco with pipe, or five cigars.

Children were permitted to bring in textbooks, paper, and pencil for study purposes, some of which were unavoidably used

as recreational materials, e.g., Robinson Crusoe. The shelter manager brought in a box of colored pencils through a misunderstanding, since no recreational materials were supposed to be provided for the study.

Shelterees were permitted one change of underwear and socks or stockings, and toilet articles such as toothbrush, toothpaste, mouthwash, and handbag cosmetics. Items excluded were wrist watches, clocks, food, candy, soap, shaving gear, eating or cooking utensils, and pillows or blankets.

Water consumption in Experimental Study III averaged 1.0 qt./person/day and food consumption averaged 814 cal./person/day. Five commodes were sealed off during the study. Only two shelterees defected during the two weeks, and Experimental Study III was considered the most successful of the four studies. Details may be found in Appendix E.

D. Experimental Study IV

Experimental Study IV was a one-week occupancy study with elementary school children, the first study of its kind in the U. S. Twenty-eight children, aged 7 through 12, and two adults, a shelter manager and shelter nurse, composed the group. This study differed from previous ones in the following respects:

1. An in-shelter nurse was substituted for a shelter physician. However, a standby physician was on 24-hour call, as in previous studies.

2. The Bulgur wheat wafer was used in Experimental Study II and the Nabisco wheat-flour biscuit in Experimental Study III. The Nebraska wheat-corn-flour cracker was tested in Experimental Study IV.

3. The 3/16-inch corrugated fiberboard pallets used in the previous two studies were again used in Experimental Study IV, and in quantities sufficient to cover the floor.

4. Commode chemical tests initiated in Experimental Study III were continued in Experimental Study IV.

5. Space allotted in Experimental Study III was 8 sq. ft./person, exclusive of storage. In Experimental Study IV, space was reduced to 6 sq. ft./person, exclusive of storage, in consideration of the smaller body size of children.

6. A daily 300-calorie ration of OCD Carbohydrate Supplement Food was added to the food rations of Experimental Study IV. This candy ration, plus 600 calories/day of the cracker, gave a total daily ration/person of 900 calories.

Water consumption in ES IV averaged 1 qt./person/day. Cracker consumption averaged 552 cal./person/day and the carbohydrate supplement 296 cal./person/day, giving a total of 848 cal./person/day. Eleven of the children defected during the study, as well as the original shelter manager, who was replaced by an alternate for the duration of the test (see Chp. 2). Details of the study may be found in Appendix F.

## II. Shelter Supplies Evaluation

### A. Water

In all four studies there were minor complaints about the taste of the water, due to the iodine purification tablets. However, the taste seemed to "improve" as time progressed, presumably because of adaptation. In both studies using the bulgur wafer (ES I and ES II), there seemed to be more water required to reduce thirst than in studies using the Nabisco biscuit or Nebraska cracker.

The water dispensing method appears to be inadequate. The siphon action of the water tube is difficult to maintain. In all studies, shelterees suggested the use of some kind of clip on the end of the hose. The prescribed method of positioning the hose back into the water bag to recover siphon action also creates a hygiene problem, in that dirt is inadvertently introduced into the water supply.

Lack of water for washing was a chief complaint, and chemically treated towelettes were suggested, if the water rations could not be increased.

B. Food

The Bulgur wheat wafer provided the survival ration in ES I and ES II. The Nabisco wheat-flour biscuit was used in ES III, and the Nebraska wheat-corn-flour cracker in ES IV. No adjuncts were supplied in ES I, II, or III. However, in ES IV, the newly prescribed carbohydrate supplement was added to the cracker diet.

A nausea reaction was present in all four studies. This condition should not be attributed to the food alone, nor the water, but probably to a complex of environmental variables involving adjustment to a new environment heretofore unexperienced. Lack of sleep, cramped quarters, new social adjustments - these and other factors could contribute to disturbed gastric processes.

A primary complaint about food was the lack of variety. A complaint specific to the bulgur wafer was the presence of colonic flatus.

In the overall complaint picture, however, food was placed relatively far down the list. In terms of survival, the OCD food rations appeared quite adequate.

With regard to food dispensing, the method of opening food cans could be improved; in ES IV a boy cut his finger while opening a can.

The carbohydrate supplement in ES IV was welcomed by the children.

C. Sanitation Kit

A primary complaint in ES I, II, and III was the ineffectiveness of the commode chemical deodorant, Weladyne-F53. In

ES III and IV a series of other commode chemicals were tested. The commode tests are discussed in the latter part of this chapter.

The drinking cups provided in the sanitation kit were complained of as being too fragile. However, all groups were required to manage with the supply available. The rubber siphon hose used in dispensing water was reported to give a bad taste to the water, but apparently shelterees adapted without difficulty.

D. Medical Kit

The most consumed item in the medical kit was aspirin (see Chp. 3). Items suggested by in-shelter medics and shelterees for possible additional inclusion were: an intravenous or intramuscular sedative for hysteria, a stimulant for depression, an anti-nausea medication, Band-Aids for simple dressings, radiation burn medication, (in addition to the petrolatum jelly and sodium bicarbonate), and antibiotics.

E. Sleep Conditions

Shelterees of ES I slept four nights on a concrete floor. Because of primary complaints of hardness of the floor and bodily aches, a 3/16-inch corrugated fiberboard pallet was introduced in ES II, III, and IV. The complaints continued, but the shelterees nevertheless endured two-week confinement. It would seem, therefore, that bunks are not an absolute necessity.

Shelterees complained also of room temperature changes, and at times individual complaints were contradictory, i.e., what was too hot for one person was too cold for another. Blankets were suggested as a substitute item for corrugated fiberboard, providing both a sleeping surface and a solution for individual reactions to room temperature.

F. Recreational Supplies

No recreational supplies were intended to be included in ES I, II, and III, although children's literature texts, necessary for schooling purposes, were used as recreational items. No books were allowed in ES IV, conducted during the summer, but paper and pencils were purposely included for recreational use. The shelterees in all studies usually improvised playing cards, bingo cards, and checkerboards from the cardboard pallets, and used the walls for sketching. However, they suggested the following items to be included as part of standard shelter supplies: a Bible, song book, cards, checkerboards, an exercise manual, paper, pencils, and a few good books to read. For cleaning the floor, a small broom was suggested.

## III. Commode Chemical Tests

Because of the ineffectiveness of the commode chemical Weladyne-F53 used in ES I and II for eliminating commode odor, a series of commode chemical tests was initiated in ES III and continued in ES IV (see Table 5). Since urine collection in ES II depleted the normal liquid contents of the commode and may have confounded the odor problem, the first commode test in ES III was Weladyne as prescribed. Also, when the mid-study urine collection was taken, water in equal amount was deposited in the commode to compensate for this factor.

Commode Test No. 4 was conducted at the request of the SM, who thought that possibly the presence of tissue paper created a flotation problem and diminished the odor elimination action of the Weladyne.

Shelteree reactions indicated that odor was a problem in all these tests except Test No. 5, in which sodium nitrate was added to the Weladyne. This test proved satisfactory in removing odor as a complaint.

The sixth and seventh commode chemical tests were conducted in ES IV, the one-week study with children. Although commode odor was a primary complaint from the children, staff observers thought it was noticeably less than that experienced with Weladyne. The two adult shelterees in ES IV did not consider commode odor a serious complaint.

## IV. Conclusions

Under the conditions of the experimental design, the following conclusions are indicated:

1. Space

Eight square feet per person, exclusive of storage, although uncomfortable, would appear to be adequate for the community fallout shelter, six square feet per person for children in the elementary school fallout shelter. These conclusions are restricted to optimal temperature and adequate ventilation conditions.

2. Water

Under optimal temperature conditions, 1 qt./person/day of water is adequate for drinking purposes with the Nabisco wheat-flour biscuit and the Nebraska wheat-corn-flour cracker, when no other liquid adjuncts are provided. For the Bulgur wheat

Table 5

Commode Chemical Tests

| Test | Commode Volume | Amount of Water | Commode Chemical |
|---|---|---|---|
| No. 1* | 0 | None | 2-2/3 Oz. Weladyne |
| No. 2* | 0 | To cover contents | 2-2/3 Oz. Weladyne |
| No. 3* | 0 | 1 Qt. | 2-2/3 Oz. Weladyne |
| | 1/3 Full | 0 | " " " |
| | 2/3 Full | 0 | " " " |
| No. 4* | Same as No. 1, with toilet tissue placed in separate container | | |
| No. 5* | 0 | 1 Qt. | 2-2/3 Oz. Weladyne; 0.5 Oz. Sod. Nitrate |
| | 1/3 Full | 0 | " " " " " " " |
| | 2/3 Full | 0 | " " " " " " " |
| No. 6** | 0 | 1 Qt. | 2 Oz. Boric Acid; 1 Oz. Sod. Perborate; 1 Pt. Mineral Oil |
| | 1/2 Full | 0 | 1 Oz. " " 0.5 Oz. " " 0 Pt. " " |
| | 3/4 Full | 0 | 1 Oz. " " 0.5 Oz. " " 0.5 Pt. " " |
| No. 7** | 0 | 2 Qts. | 1.0 Oz. Cupric Sulphate; 4 Oz. Sod. Perborate; 0.5 Pt. Mineral Oil |
| | 1/2 Full | 0 | 0.5 Oz. " " 3 Oz. " " 0.5 Pt. " " |
| | 3/4 Full | 0 | 0.5 Oz. " " 3 Oz. " " 0.5 Pt. " " |

*Conducted in ES III
**Conducted in ES IV

wafer, 1.5 qt./person/day seems to be adequate.

3. Food

Under optimal temperature conditions, it appears that 814 cal./person/day of OCD survival rations without adjuncts are adequate in maintaining good physiological condition over a two-week period.

4. Sleeping Conditions

In the present studies, 3/16-in. thick corrugated fiberboard pallets provided an uncomfortable but adequate sleeping surface. To remove sleep conditions as a primary discomfort, however, blankets could be used. Blankets would have additional advantages of protection against cold temperature conditions, e.g., winter occupancy. There seems to be no need for bunks, unless utilization of vertical space for sleeping is desired.

5. Sanitation

The commode chemical in the present OCD Sanitation Kit is inadequate in removing commode odor as a primary complaint, but is satisfactory when sodium nitrate is added.

The method for dispensing water from the water drums is inadequate in maintaining siphon action. This problem could be solved simply by providing a clip for the hose.

6. Medical Kit

Since Ss were free to leave on the basis of medical complaints, the adequacy of the medical kit could not be fully evaluated. The use of initially healthy shelterees also minimized the use of the medical kit. However, shelterees were asked for suggestions, resulting in the items already discussed.

7. Recreational Supplies

These are not essential for survival, and can be improvised when needed. However, shelterees did suggest helpful items, already discussed.

# Chapter 2 - Shelter Events

A "normal" shelter day of Experimental Study III is presented to give an impression of the routine, administration, and ingenuity of a group of shelterees under austere conditions. The shelter manager for this particular occupancy group was outstanding in his demonstration of leadership ability. Only two of the original thirty occupants in this two-week study left prior to scheduled exit.

A chronological sequence of events is also presented in this chapter.

## I. Typical Shelter Day

No unnecessary movement or talking was to commence until the signal for awakening was given by the shelter manager. His signal was the brightening of the room by the light switches. This generally occurred between 7:00 and 8:00 AM. After typical jokes, complaints, stretching, coughing, teeth brushing, etc., by the group the shelter manager would address them briefly upon what to expect in the way of discomforts, give reassurance, outline some of the day's events, and mention some of the duties and responsibilities as well as the "happy" events that everyone might anticipate. It was noted that direction, although usually brief, was given every two hours or so throughout the day. This assumption of an imaginary pedestal by the shelter manager for a variety of purposes became a habitual act with automatic responsive attentiveness by the group. The shelter manager, in other words, became a human bulletin board, a newspaper, a forecaster, a religious leader, etc.

The completion of diaries was followed by breakfast. Two women distributed biscuits and recorded the number received by each shelteree. The water was siphoned from the water drum into an empty biscuit container. A drinking cup was used as a ladle, and each

shelteree helped himself and made a notation upon the consumption record for each cupful of water.

After breakfast a "schoolroom" was set up for the children with biscuit cartons as desks. Several of the women seemed to enjoy their role as teachers in assisting the children with their study. Meanwhile, the men would gather in another part of the room to converse or debate various topics of interest. The shelter manager occasionally would read to the men from the Bible or from a geography textbook. A formal training session involving some aspect of civil defense or radiological warfare would follow later in the morning.

As the length of stay progressed, more shelterees displayed decreasing energy and the post-lunch rest period became a welcomed relief and brief escape. Lights were dimmed and quiet was maintained for one or two hours.

Exercise periods were never strenuous except for the few young people who held contests for push-ups and gymnastics. The exercises were simple and easy to perform for everyone. Their main objectives were to relieve muscular tension and substitute for lack of normal work and play activity. All shelterees, including the elderly, took part in the exercises.

A favorite game was of a hand-clapping, number-calling nature calling for continual attention on the part of each participant. At times as many as fourteen shelterees engaged in this game. Other absorbing activities included round-robin statements by individuals upon various topics such as personal history, first actions upon leaving the shelter, future plans, etc. Activities such as these were usually very time consuming since each person would spend at least several minutes talking to the group about his own affairs. The leader in nearly all activities of this variety was the manager.

Another method of activating various groups in the shelter was the preparation stage of some unusual event. Various groups would be called upon to present some aspect of a show, circus, banquet, or ceremony. Often more time was devoted to preparation than to the event itself. Having invested the time and effort for preparation, all were obligated to be a good audience or suffer group rejection.

An example of such preparation was the religious service. A children's choir and an adult choir with separate leaders for each and separate rehearsals occupied about half of the shelter population. A special committee organized the service and hand printed programs with wording for hymns. The speakers took great pains in preparing appropriate and convincing sermons with corollary Bible readings. Others helped to "create" the church setting with stage props of water barrels and biscuit containers for pulpit and pews while others decorated the background wall with symbols and green plants. When

the time for the non-denominational service came, all participated wholeheartedly.

Dinner at 5:00 or 6:00 PM was followed by heightened conversation of various sub-groups, active play by children, and occasional singing. At times the shelter manager or some other shelteree would give a talk on some adventure. Other shelterees would perform by story-telling or elaboration of some hobby or particular interest. Later in the evening the shelter manager would recap the day's events, compliment the group and individuals on their cooperative behavior, and attempt to forecast what physical and psychological reactions may be expected to occur. The shelter manager or some designated individual would then lead the group in prayer, reminding the group of God's presence in the shelter and his support of each individual in the shelter. The lights would then be dimmed and one shelteree would read from Robinson Crusoe for approximately a half hour. The shelter became very quiet and by 11:00 PM nearly every person was sleeping.

II. Recreation, Exercise, Training, and Ration Distribution

Perhaps the most uniformly preferred small-group recreational activity among adults was card games such as bridge and poker. Simple conversation among two or more persons was also a favorite pastime with discussion topics ranging widely and at length. Games of a simple hand-clapping and counting variety engaged children and adults alike. Wrestling, gymnastic stunts, and active games were particularly employed by the younger shelterees. The elderly appeared to be happily content to observe the antics of the more youthful and vigorous shelterees. The youngest children were often engrossed in drawing or writing upon a sheet of paper.

Exercise periods were undertaken by all managers with varying degrees of success. Lethargy on the part of some occupants and over-exuberance of others often interfered with attempts of co-ordinated

exercise programs. Individual shelterees were observed on several occasions to be engaged in private exercises.

Although movement was severely restricted in the sense that one could not go for a walk, the amount of exercise necessary for maintenance was sufficient, as evidenced by little or no change in muscular strength or co-ordination after shelter occupancy (see Chp.6).

Training sessions were generally well received since they offered another means of diversion. Lack of attention was not a problem with increased length of time in the shelter. On the contrary, training periods appeared to be more effective as the manager grew more accustomed to his role and audience. Shelteree participation in discussions and analyses of the shelter situation was more obvious during latter phases of confinement.

Although some managers had prepared extensive outlines of civil defense knowledge, such material was often simplified and abstracted to offer more palatable fare for the average shelteree. Because of great variability in intellectual capacity as well as motivation no tests of general knowledge of survival topics were administered. It can be safely assumed, however, that all shelterees gained shelter survival knowledge as well as knowledge of their individual ability to withstand the stresses of confinement in close quarters.

Schedules of food and water distribution as well as sleep schedules offered only minor problems. The shelter manager gauged his judgement of times for retirement and arising as well as food and water distribution upon shelteree behavior. For example, turning on the lights in the morning was the signal for awakening, conversation, and general activity. This time was based upon the shelter manager's judgement that at least half of the shelterees were awake. Food and water were generally distributed four times a day in equal portions at roughly four-hour intervals.

No violent or maladaptive bahavior was evidenced as a result of the confinement experiences. Shelteree participation was more in the direction of sincere and enthusiastic help toward promotion of mutual adjustment to the current environmental situation. The shelterees emerging from their confinement were obviously proud of themselves and their comrades and exhibited many signs of sadness in leaving their new friends.

## III. Chronological Sequence of Events

The following daily summaries were abstracted from observer reports to reflect the chronological sequence of shelter events. Experimental Study III is given here as illustrative of a two-week confinement period:

Sat. 27 April

As the day's testing reached completion, individuals began shelter entrance and at 1630 the shelter was locked. The shelter manager (SM) assumed immediate command and there was no doubt that he had done so. Throughout the study he maintained tight control, tempered with individual contact and understanding. The discipline exercised contributed greatly to the morale of the group and the success of the study.

The early part of the evening was spent by the SM's instructing the group in the use of shelter equipment and supplies. The group listened attentively and followed directions. Biscuits and water were dispensed at 1730. Shelteree #6 (10-year old boy) began to bother the other boys and girls, hitting or pushing them. He also asked many questions of the adults and appeared to be irritating the group as a whole with demands for attention.

Difficulty in maintaining siphon action on the water drum hose led to oral suction, a policy that was followed throughout the study despite outside requests that the prescribed procedure be followed.

Shelterees made a deck of cards. Crayons that SM had taken in with him were passed out to the children, who drew pictures on walls of the shelter. Several snapshots were taken by #12, the psychology student participating in the experiment, as prearranged. Diaries were written at 2010, after which the cardboard mats were distributed for sleeping purposes. The SM ended the day with an impressive prayer service lasting several minutes, in which he spoke personally to God, asking His blessing on the group and help for enduring the shelter stay. Religious activities were a major part of the daily as well as the Sunday program, with grace before each meal and a vesper service before retiring in the evening.

The SM organized the shelterees into a sexually segregated group and assigned sleeping spaces. Lights were dimmed at 2106 and the SM announced there would be a 5-minute period for final conversation, after which silence was to be maintained until he gave the signal to arise in the morning. This decision was accepted by the group without question and maintained throughout the study.

Sun. 28 April

Shelterees arose at 0645 (observer time; shelterees had no time pieces), filled out morning diaries and breakfasted at 0800. Games from 0800-0900 were followed by a SM lecture on nuclear warfare. After lunch the lights were dimmed for an hour's rest period. In the afternoon the shelterees held an impressive

church service, with Scriptural readings and hymns. Biscuit boxes served as an altar. A cross and ferns were sketched on the wall to simulate a church setting.

At 1530 the SM gave a lecture on nuclear weapons. Diaries were completed at 1710 and it was obvious the shelterees had misjudged the time. Their evening time estimate later indicated they were three hours ahead of actual time. After a clean-up session, the group retired at 2020.

Diary data indicated general body aches from the previous night's sleep, and headache complaints. Many shelterees wrote that the church service seemed to unite them in a closer bond than heretofore.

Shelteree #6 (10-year old boy) pestered the other children during the day. Two shelterees, #35 (48-year old woman) and #13 (29-year old woman), appeared listless and withdrawn. The nurse applied a damp bandage to #35's forehead, and conversation indicated nausea reactions throughout the day. Shelterees #12 (27-year old man), and #11 (23-year old woman), and #17 (24-year old nurse), emerged as leaders in recreational activities.

At one point during the day the SM attempted to rig a "clock" by measuring in seconds the drip of water from a hole in a water cup. This method proved unsatisfactory, however, and was abandoned.

A new method of water dispensing was initiated. The SM filled an empty biscuit can with water and shelterees scooped out their rations.

Mon, 29 April

At 0330 most shelterees awoke, thinking it was later than it was. SM told them to sleep for another hour, and everyone slept until 0700. Since the group was still several hours off actual time in their estimates, the correct time was sent in by note at 0745. This procedure was agreed upon previously in the experimental design for time perception evaluation.

Breakfast was followed by exercise and the administration of the Prelinger Self-Concept Test (a personality test). At 0935 a school session was held for the children, after which the group played cards and other games. A SM lecture at 1411 on fallout radiation was followed by the usual rest period. Later in the afternoon the group played charades, "I've Got a Secret," and conducted a talent show, led by #11 (23-year old woman) and #31 (12-year old girl).

Shelteree #17 (24-year old nurse) was ill most of the day, and after a telephone conference with the SM, it was decided to

release her from the shelter. The post-shelter interview indicated a possible pregnancy, later verified (see Defections). The SM gave a pep talk to the group after #17's exit. Shelteree #29 (45-year old practical nurse) took over the nursing duties.

At 1940 the SM sealed off the first commode.

A group sing at 2140 was led by #12 (psychology graduate student) and #21 (46-year old woman). At 2215 shelteree #12 read parts of Robinson Crusoe to the group, from one of the children's school books. At 2305 the shelterees retired.

Tues. 30 April

Rising at 0645, the shelterees breakfasted and SM initiated the day's activities. The usual routine of lectures, exercise, games, rest after lunch, clean-up, diaries, and evening prayer was implemented. A free-drawing test was administered by #12 (psychology graduate student), and the group planned a "May Day" celebration for the next day. A square dance in the afternoon was well received.

Salt was used by most of the shelterees on the biscuits to neutralize the sweet taste, according to the diaries. Headaches and nausea continued.

An "occupied - vacancy" sign was made for the latrine door.

Shelterees retired at 2215.

Wed. 1 May

Shelterees arose at 0700. The day's activities included a lecture on Civil Defense Communications by #18 (back-up SM, 35-year old man), a limbo contest, human pyramid building, autobiographical narratives, and a "May Day" celebration. Shelteree

#31 (12-year old girl) was selected "Queen of the Shelter," and she in turn chose the SM for "King." Shelteree #11 (23-year old woman) organized the "May Day" festivities.

The SM had used a single water liner to the converted water drum commode, and the second liner was used at one time as covering for sleep, and then later cut into strips for the May Pole dance.

Diaries indicated growing awareness of body odor. Shelteree #6 (10-year old boy) was reported by several of the group as being very homesick.

The group retired at 2140.

Thurs. 2 May

Shelterees did not arise until 0830. Exercise, clean-up, and school session for children occupied most of the morning. A noon lecture on Georgia history by #16 (34-year old man) was apathetically received. Games such as "air, fire, earth, and water," "hot potato," and a group sing led by #11 and #19 (41-year old woman) were afternoon events. Shelteree #6 withdrew from group activities throughout the day. He requested to be removed and at 1500 was released from the shelter. Diaries indicated he had antagonized most of the shelterees and they did not sympathize with his homesickness.

The prominent event of the day was a "Womanless Wedding" at 1800. The SM was the bride and #18 was the groom. Other participants were #26, the bride's mother, #9, the flower girl, #12, the preacher, #8, the rejected suitor, #4, the maid of honor, #16, father of the bride, and #2, the best man. It was a "shotgun" wedding tableau.

An evening lecture at 2010 on family fallout shelter preparation by the SM was followed at 2145 by a Robinson Crusoe reading on the part of #15 (30-year old woman). The group retired at 2240.

The second chemical commode was sealed off at 1000. Diaries indicated that both first and second commodes smelled bad. Water dispensing by "dipping" into the biscuit can was continued. Checkerboards were drawn on the cardboard mats for recreational use.

Fri. 3 May

In the early morning, 0615, the SM requested via shelter telephone that room temperature be lowered. At 0830 shelterees arose. A urine collection was made at 1010; the written

instructions were read avidly and passed around by the group, apparently a substitute for the need for news from the outside world. A school session for the children from 1100-1200 was followed by a SM lecture on blast and fallout protection. This lecture, as well as previous ones, was favorable received. An afternoon discussion of rural Civil Defense problems, led by #26 (57-year old man) evoked much interest. Other afternoon events included a sentence-completion test and a talent show. The evening's highlight was a circus, including a two-headed lady, a bearded lady, and clowns, ingeniously contrived. The group appeared to be in high spirits when they retired at 2145.

Sat. 4 May

After awaking at 0800, shelterees breakfasted, cleaned up, and began the day's activities. A radioactivity lecture and first-aid talk were given at 1100 by the SM and #18. In the afternoon a two-hour bingo game was played, using cards made from the cardboard mats. Tobacco supplies began to be depleted. Other complaints centered on odor, constipation, and first bowel movements by many shelterees since entry. Depression set in during the day, and seemed to reach the lowest point during the study at this time.

The group retired at 2100.

Sun. 5 May

Shelterees arose at 0907. The usual morning routine was followed, the lecture given on civil defense research. Close-order drill was used by SM for the afternoon exercise. A sponge bath with handkerchiefs was welcomed by the group. Plans for church service were delayed and the service was not conducted until 2050. The SM seemed to reach his lowest efficiency level on this day. The general group depression appeared to be lifting. A group sing at 2100 was followed by bedtime at 2250.

The third commode was sealed off at 1615.

Mon. 6 May

Shelterees arose late at 0945. The day's activities included a school session, lectures on radiation and fallout shelters, and games such as cards, Twenty Questions, Kitty Cat, Rhythm, Hokey Pokey, and story telling.

Shelteree #18 complained of swollen gums but wished to endure the study. The SM telephoned the watch at 1750 and requested a physical check on #18. It was agreed that a physician should see him the next morning. The SM also requested additional drinking cups to replace those damaged, but this request

was refused.

The group retired at 2137.

Tues. 7 May

Early in the morning, 0355, SM telephoned watch to complain of cold; room temperature was raised accordingly. At 0805 the group awakened. The consulting physician examined #18 at 0905 and judged the gum condition not to be of a serious nature. Shelteree #18 elected to return to the shelter rather than leave.

Lectures during the day centered on shelter stocking and the psychological aspects of nuclear war.

The group appeared to be apathetic and depressed most of the day. Diaries indicated they were looking forward to release on Friday.

At 2100 the SM sealed off the fourth commode.

Wed. 8 May

At 0852 shelterees awakened. The Prelinger Self-Concept Test was administered in the morning. An afternoon lecture on first-aid was given by #29 and #15. The high point of the day was an elaborate "divorce trial," a follow-up on the "wedding" held the previous week. The trial, lasting an hour, involved plantiff and defendant, clerk of court, sheriff, attorneys, and witnesses. The affair was enjoyed by all.

Group spirits seemed to follow a pattern of depression on first arising in the morning, then gradually alleviating to good humor at the end of the day.

The shelterees retired at 2200, after a session of reading Robinson Crusoe, then a period of soft group singing, and an evening prayer.

Thurs. 9 May

The day began at 0715. A urine collection was taken at 0940. At 1015 the Post-Shelter Questionnaire was administered, and in the afternoon a Sentence Completion Test. An evening lecture at 1950 centered on post-shelter rehabilitation.

The significant event of the day was a Farewell Banquet held at 1640. There were songs, testimonials, and party decorations. Plastic water drum liners served as tablecloths. Placemats were made from cardboard, and each setting was ornamented

with paper flowers. Spirits were high, with mixed emotions. A few shelterees cried as Auld Lang Syne was sung. Others exchanged home addresses and made plans for reunion. All felt proud of their shelter endurance and completion of the study. Some of the diaries expressed gratitude for the opportunity of participating in the experiment.

At 2015 the group settled down for the night.

Fri, 10 May

In early morning, 0255, the SM's request for temperature to be raised was granted. The group awoke at 0600. After breakfast, the shelter was cleaned up and shelterees prepared to leave. After instructions by the Project Director over the intercom, the group exited at 0835, and began the day's post-shelter testing.

## IV. Defections

Eight shelterees defected during ES I, the four-day study, prior to the scheduled exit (age, males: 19, 19, 48, 50; age, females: 16, 35, 45, 47). Psychological instability seemed to be the greatest reason, with bodily complaints, e.g., headaches and body aches, being the next major reason.

Five shelterees exited prior to study completion in ES II, a two-week study (age, males: 39, 11; age, females: 10, 12, 13). Primary reasons were aches, nausea, and psychological maladjustment. The defection rate was reduced to two in ES III, the other two-week study (age, males: 11; age, females: 24). One shelteree had concealed a pregnancy and had to be removed because of nausea. The other shelteree was a young boy who could not socially adjust to the group. In the last study, ES IV, eleven of the children exited early, as well as the original shelter manager (age, males: 7, 8, 9, 9, 33; age, females: 7, 8, 8, 8, 9, 11, 11). Homesickness accounted for most of these defections, followed by colds and nausea. The shelter manager apparently could not control the group and requested replacement. Of the twenty-seven defections from all four studies, only six left on the advice of medical consultants.

In view of the different experimental conditions investigated in the several studies, it is difficult to account for differential defection rates in simple terms. ES I was provided with less than half the food supply of the other groups, and slept on an uncovered concrete floor. Motivationally, it could be that volunteers for this four-day study were also less determined to persevere than those volunteering for a two-week study, and subsequently would have a higher defection rate.

ES II and ES III were similar in design, and it is believed that the low defection rate in ES III can be attributed to better shelter leadership and organization, as well as better group cohesiveness.

ES IV, the one-week study with twenty-eight children and two adults, would naturally involve a higher defection rate. The children became homesick for family and familiar surroundings. Several caught colds and resultant fevers indicated removal.

It is difficult to predict what effect would occur from refusal to permit shelterees from leaving, as would be the case under actual nuclear fallout conditions. Perhaps, in such an instance, potential defectees would reconsider their motivation for desiring to leave and adjust by necessity to shelter life.

# Chapter 3 - Shelteree Reactions

## I. Shelter Entrance Questionnaire

This chapter includes the analysis of data obtained from pre- and post-shelter questionnaires, in-shelter diaries and medical records, and sociometric evaluation.

The orientation of the Shelter Entrance Questionnaire was (1) to gain insight into subjects' motivation for participation in studies, (2) to establish sources of their prior acquaintance with and knowledge of the research, (3) to establish participants' preparedness for survival, and (4) to understand what they anticipated to be the discomforts of confinement. The mimeographed questionnaires were administered to the subjects toward the end of the pre-shelter testing program. With the exception of the children in Experimental Study IV, who were assisted individually in completing the form, all shelterees received the questionnaire as a group.

### A. Shelter Entrance Questionnaire Data

Serious purpose and conscientious thought characterized the groups as they answered the questions. Staff assistance was available when questions arose for clarification of the form. It should be noted that the validity of self reports can be questioned, particularly when respondents may think something is to be gained through giving socially desirable answers. This factor may be operative in some aspects of the shelter questionnaires, and is to be considered in evaluating the data.

A modified check-and-rank operation was employed. On several topics, the Ss were given a series of alternatives and requested to check only those items which they considered pertinent and then to rank the selected factors in order of primacy (i.e., the most important factor would be ranked '1', the next most important '2', and so on until all check factors had been ranked). This procedure served a useful end of encouraging serious subject attention to the task. Results indicate a high relationship between frequency of selection and average ranks assigned to factors; therefore, frequencies of selection are the basis for discussion here, and mention is made of only those factors which merited selection by one-half or more (59+) of the shelterees (Total N = 118*).

---

*Since Experimental Study IV consisted primarily of elementary school children, the responses of the shelter manager and shelter nurse are not included in the considerations here.

Table 6 portrays the motivational factors affecting participation in the four experimental studies. The motivational factor most emphasized was the personal desire to be better educated for survival. This factor was followed by the altruistic motive of assisting national defense efforts, the monetary reward gained through participation, a desire to test personal endurance, curiosity, and the wish to assist in research. The participants in these studies evidenced little preparedness for survival, as pictured in Table 7. The factor on which these persons were most prepared was that of knowing the location of a community shelter, and this knowledge was shared more by younger shelterees (i.e., those in school or college) than by older persons.

Recruitment for these studies revealed a variety of potential shelteree sources. The most effective means of soliciting applications were those which involved direct contact of project personnel with interested groups, rather than attempts to inform through "middle-man agents" (radio and newspaper announcements, employment offices, etc.). A large portion of the shelterees, both young and old, reported hearing of the research directly or indirectly through presentations made in public schools.

Participants in the studies did not appear to be unduly cognizant of confinement conditions beyond what they were told in official letters following their selection. Though some impression of shelter living was inevitable, either through formal research channels or informal contacts with previous shelterees, subjects often commented after the completion of a study that their preconceptions were distorted from what they actually experienced. A pre-confinement discomfort scale, derived from pilot study data, was included in the Shelter Entrance Questionnaire in the form of a series of factors which might possibly prove bothersome or uncomfortable. The only factor selected by more than one-half the shelterees was "sleeping conditions" (see Table 8). This, along with lack of bathing facilities, odors, lack of fresh air and lack of exercise were anticipated discomforts for at least one-third of the shelterees. Though the selection frequency here was smaller, comparison of this scale with the discomfort scale completed following the studies (see Table 13) indicates a high relationship between anticipated and actual discomforts of shelter living.

B. Conclusions

1. Shelterees reported the desire to learn more about survival was a primary motivation for participation.

2. Shelterees evidenced little knowledge or preparedness for survival, with less than half aware of the location

Table 6

Major Factors Cited as Motives for Participation in the Shelter Occupancy Studies

| Factor | Frequency of Comment | | | | |
|---|---|---|---|---|---|
| | Study I (N=30) | Study II (N=30) | Study III (N=30) | Study IV (N=28) | Total Mention |
| "I wanted to learn more about survival." | 24 | 28 | 22 | 26 | 100 |
| "I wanted to help the national defense effort." | 21 | 25 | 21 | 26 | 93 |
| "I wanted the money paid for taking part." | 26 | 20 | 21 | 20 | 87 |
| "I wanted to see if I could take it." | 17 | 16 | 21 | 20 | 74 |
| "I was curious." | 21 | 14 | 11 | 26 | 72 |
| "I wanted to help the University of Georgia." | 14 | 11 | 18 | 24 | 67 |

Table 7

Preparedness for Survival by Shelter Occupancy Participants

| Question | Frequency of Affirmative Answers | | | | |
|---|---|---|---|---|---|
| | Study I (N=30) | Study II (N=30) | Study III (N-30) | Study IV (N=28) | Total Mention |
| Do you have a family fallout shelter? | 0 | 0 | 1 | 3 | 4 (3.4%) |
| Have you participated in civil defense classes? | 3 | 3 | 7 | 15 | 28 (23.7%) |
| Do you know of a community shelter where you could take cover? | 14 | 11 | 9 | 17 | 51 (43.2%) |
| Do you have emergency supplies of food and water in your home? | 6 | 5 | 12 | 11 | 34 (28.8%) |
| Do you have emergency supplies of medicine and first aid equipment in your home? | 9 | 7 | 15 | 13 | 44 (37.3%) |

Table 8

Selection Frequencies of Anticipated Shelter Discomforts

| Factor | Frequency of Selection | | | | |
|---|---|---|---|---|---|
| | Study I (N=30) | Study II (N=30) | Study III (N=30) | Study IV (N=28) | Total Frequency (Total N=118) |
| Sleeping conditions | 15 | 20 | 15 | 10 | 60 |
| Lack of bathing facilities | 14 | 15 | 15 | 8 | 52 |
| Odors | 7 | 12 | 12 | 10 | 41 |
| Lack of fresh air | 8 | 7 | 10 | 15 | 40 |
| Lack of exercise | 8 | 14 | 9 | 9 | 40 |
| Food | 11 | 11 | 11 | 5 | 38 |
| Lack of space | 10 | 9 | 10 | 8 | 37 |
| Uncomfortable temperature | 11 | 7 | 10 | 7 | 35 |
| Boredom | 9 | 12 | 9 | 5 | 35 |
| Lack of interesting activities | 5 | 10 | 3 | 5 | 23 |
| Chemical toilet | 6 | 8 | 6 | 3 | 23 |
| Other people in the shelter | 4 | 4 | 5 | 7 | 20 |
| Drinking water | 4 | 5 | 5 | 5 | 19 |
| Noise | 2 | 1 | 5 | 6 | 14 |
| Lighting | 3 | 2 | 3 | 3 | 11 |
| Being observed | 4 | 3 | 4 | X* | 11 |
| Testing before entering shelter | 5 | 5 | X* | X* | 10 |

*Item not included in discomfort scale

of a community shelter.

3. The most fruitful recruitment source for participants proved to be presentation of the research mission to public school students.

4. Shelterees approached the studies with similar expectations, focusing particularly on sleeping conditions.

5. Anticipated and experienced discomforts reported by the shelterees were similar, though the subjects were more liberal in citing their experienced discomforts.

## II. Shelter Diaries

To assess the shelterees' personal experiences during shelter confinement, confidential diary forms were administered twice daily, in the morning and in the evening. The primary value of these diaries was immediate feedback on the in-shelter program and environmental variables under investigation. They also served to crystallize shelteree thinking from day to day, such that valuable information was retained and later expressed on the Post-Shelter Questionnaire. It was also possible through the diaries to predict likely defections, as well as emergent leadership and group morale.

Diary complaints outnumbered any pleasant aspects of shelter life, as expected; however, the number of daily complaints diminished toward the end of a study. Possible reasons are adaptations to discomfort, as well as shelterees' considering repetition of a complaint unnecessary, once stated. The morning diaries contained more complaints than evening reports. Possible explanations are that the greatest felt discomfort factors occurred at night and would therefore be reported in the morning diaries. Shelterees also reported depression in the morning reports, which diminished toward the end of the day. It was also noted that in

both two-week studies the occupants reached the lowest stage of depression at the midpoint of the experiment, that is, at the end of the first week. Thereafter, morale improved.

It was difficult, however, to evaluate diary content on an objective basis, since much of the material was written in general terms. Therefore, interpretation of shelter experience and reaction was based on the Post-Shelter Questionnaire data.

## III. Medical Complaints During Occupancy

A simple medical complaint record was maintained by the in-shelter medic during each occupancy. The purpose was to evaluate type and frequency of complaints made to the individual designated as caretaker of shelteree health. The shelterees were informed in each case that their discomforts were to be reported irrespective of their degree of severity. It was necessary for shelterees to report to the nurse or medic prior to receiving any medication, even aspirin. No routine sick calls were held since such formal activities were considered unnecessary and also more apt to sponsor suggested discomforts.

### A. Specific In-Shelter Medical Complaints

Table 9 defines the major complaints made during the three longest shelter occupancies. Headache was the most frequent complaint in each study, as well as nearly three times as frequent as the next most frequent complaint, colds and sore throats, particularly in Experimental Study III. Nausea was the third chief complaint. Other complaints were infrequent and minor except perhaps that of homesickness in Experimental Study IV.

Aspirin was the most used and most effective item in the medical kit. Two aspirin tablets relieved nearly all headaches reported. Nearly all of the infrequently reported complaints were of a very minor nature and only reported because of the request to report <u>all</u> discomforts.

Frequency of complaints decreased as the time of occupancy continued. This decrease was noted in each study and is presented in Table 10. Several reasons for this decline in complaints may be noted: (1) complaining shelterees often left the shelter during the first two or three days, (2) the remaining shelterees adapted to shelter conditions and suffered fewer discomforts, (3) the nature of the complaints shifted to other sources. The latter explanation refers to complaints of constipation, cut fingers, toothaches, and leg cramps which were representative of infrequent complaints during the last days of occupancy. The greater number of complaints in ES III compared to ES II

Table 9

Frequency of Medical Complaints During the Three Longest Shelter Occupancies

| Complaint | Study | | | Total[3] |
|---|---|---|---|---|
| | ES II[1] | ES III[1] | ES IV[2] | |
| Headache | 22 | 65 | 10 | 97 |
| Cold or Sore Throat | 8 | 26 | 1 | 35 |
| Nausea | 7 | 22 | 2 | 31 |
| Homesickness | 1 | 0 | 6 | 7 |
| Stomach-ache | 0 | 1 | 5 | 6 |
| Constipation | 0 | 5 | 0 | 5 |
| Toothache | 1 | 1 | 2 | 4 |
| Rash | 0 | 4 | 0 | 4 |
| Infection | 0 | 0 | 3 | 3 |
| Pain in Chest | 0 | 0 | 3 | 3 |
| Fatigue | 0 | 0 | 2 | 2 |
| Minor Cut | 0 | 1 | 1 | 2 |
| Leg Cramps | 0 | 2 | 0 | 2 |
| Nervousness | 0 | 0 | 1 | 1 |
| Wart | 1 | 0 | 0 | 1 |
| Total | 40 | 127 | 36 | 203 |

[1]Two-week confinement

[2]One-week confinement

[3]Number of shelterees complaining

Table 10

Number of She'terees with Medical Complaints
During Successive Days of Shelter Occupancy

| Day | Study | | | Total |
|---|---|---|---|---|
| | ES II | ES III | ES IV | |
| 1 | 11 | 13 | 5 | 29 |
| 2 | 3 | 6 | 3 | 12 |
| 3 | 9 | 10 | 5 | 24 |
| 4 | 6 | 9 | 6 | 21 |
| 5 | 6 | 8 | 2 | 16 |
| 6 | 1 | 6 | 2 | 9 |
| 7 | 5 | 4 | | 9 |
| 8 | 0 | 8 | | 8 |
| 9 | 1 | 6 | | 7 |
| 10 | 1 | 8 | | 9 |
| 11 | 0 | 5 | | 5 |
| 12 | 1 | 4 | | 5 |

(both were two-wee occupancies) may be due to the greater number of defections occurring in ES II (eight), and consequently less people to complain. Only two defections occurred in ES III. However, since there was a greater reluctance to leave during ES III, it could be that increased complaints were made by those who elected to stay despite their discomforts.

B. Conclusions

It may be concluded that:

1. Shelteree medical complaints were primarily due to headaches, colds, sore throats, and nausea.

2. The number of shelterees making complaints decreased as the occupancy continued.

3. Nearly all complaints were easily handled by the shelter medic, primarily by means of aspirin.

## IV. Post-Shelter Questionnaire

On the day before shelter exit, all subjects in each experimental study were asked to complete a mimeographed questionnaire designed to survey their reactions to the experiences of fallout-shelter living. The orientation of the questionnaire was the same for each study, though the format and method of eliciting information varied. As in the Shelter Entrance Questionnaire, a modified select-and-rank procedure was employed. As part of his training, the shelter manager was briefed concerning the questionnaire, so as to see that the forms were completed correctly and thoughtfully. Careful attention appeared to be given the questionnaires by each shelteree. When the task was finished, the forms were passed out from the shelter.

### A. Post-Shelter Questionnaire Data

The Post-Shelter Questionnaire analysis presented here includes information given by all subjects who remained in the shelter for the duration of their particular study. One early-exit shelteree in Experimental Study III completed the form upon exit, and his responses are included in analysis of that study. The shelter manager's and nurse's comments are excluded from analysis of Experimental Study IV records, since the major focus of that study was on the reactions of elementary school children.

Evaluations of self and others' tolerance for confinement under minimal conditions were elicited by means of questions presented in Table 11. Ss of Study I manifest less tolerance than

Table 11

Shelteree Evaluations of Tolerance of Actual Confinement

| Question | Percentage of Affirmative Responses | | | | |
|---|---|---|---|---|---|
| | Study I (N=22) | Study II (N=25) | Study III (N=29) | Study IV (N=17) | Total (N=93) |
| Would you have volunteered to stay in the shelter if you had known what it would really be like? | 63.6% (14) | 88.0% (22) | 86.2% (25) | 100% (17) | 83.9% (78) |
| Do you think you would volunteer to stay in this shelter again sometime? | 31.8% (7) | 60.0% (15) | 79.3% (23) | 88.2% (15) | 64.5% (60) |
| Does it seem to you that many of the adults find living in the shelter a hard thing to do? | 72.7% (16) | 24.0% (6) | 62.1% (18) | 29.4% (5) | 48.4% (45) |
| Does it seem to you that many of the young people find living in the shelter a hard thing to do? | 68.2% (15) | 60.0% (15) | 17.2% (5) | 58.8% (10) | 48.4% (45) |
| Is living in the shelter a hard thing for you? | 77.3% (17) | 28.0% (7) | 44.8% (13) | 29.4% (5) | 45.2% (42) |

Ss in any other study. A possible explanation for this may be that some of the conditions of this study were more arduous than those established for subsequent groups. On the whole, more than 80% of the Ss did not regret having participated, more than 60% would agree to be confined a second time, both adults and young people were perceived as relatively similar in ability to adjust to shelter conditions, and less than one-half the Ss felt the experience to be a personal hardship. Other percentage contrasts in Table 11 might reflect, in addition to experimental variables, sampling differences among the shelteree groups tested.

Further insight into tolerance for shelter confinement is evident from the Shelterees' estimates of how much longer than their particular study they felt they could endure under the same living conditions. These estimates are presented in Table 12. The Ss in the four-day (ES I) and one-week (ES IV) studies estimated a lower tolerance for longer confinement than did the Ss in the two-week studies (ES II and ES III); respective mean estimates for the former two studies were 1.9 and 3.4 as compared with 11.4 and 20.9 additional days for the latter studies. An adjustment factor may be operative - the longer that shelterees endure confinement, the more tolerant they became in ability to accept and adapt to the circumstances. The more crucial period of confinement appears to be during the first several days. Or, it may be that a selective factor was operative in those who agreed to endure confinement - those who participated in shorter studies were generally less motivated to stay an extended length of time than those who agreed on longer confinement. Shelter leadership is another important variable in influencing shelteree adaptation to and acceptance of shelter confinement.

A discomfort scale, containing aspects of shelter conditions which might have proved uncomfortable or bothersome to the Ss, received the frequency of comments tabulated in Table 13. Seven factors emerged on the discomfort scale as discomforts for at least one-half of the shelterees who endured confinement the full period of their study. These factors, in order of their frequency of mention, were: sleeping conditions, lack of bathing facilities, odors, the chemical toilet, uncomfortable temperature, lack of space, and food.

Further examination of primary discomforts was accomplished by asking the Ss to state what created the discomfort incurred by various conditions. Dominant explanations were as follows:

1. Sleeping conditions. Major complaints focused on the hardness of the floor, even when corregated fiberboard pallets were utilized, and the soreness incurred by these conditions. Also contributing to discomfort with this aspect of shelter living were the closeness of other people (a space factor),

Table 12

Shelteree Estimates of Toler nce for Extended Confinement[1]

| | Study I (4 days) | Study II (2 weeks) | Study III (2 weeks) | Study IV (1 week) |
|---|---|---|---|---|
| Men | N=11 | N=10 | N=12 | N=1 |
| Mean | 2.7 | 19.9 | 32.6 | 0 |
| Median | 3.0 | 12.5 | 7.0 | 0 |
| Women | N=11 | N=9 | N=9 | N=1 |
| Mean | 1.1 | 4.9 | 9.7 | 1.0 |
| Median | 0 | 3.0 | 5.0 | 1.0 |
| Children | N=0 | N=4 | N=8 | N=17 |
| Mean | - | 5.0 | 16.0 | 3.5 |
| Median | - | 5.0 | 6.0 | 2.0 |
| TOTAL | N=22 | N=23 | N=29 | N=19 |
| Mean | 1.9 | 11.4 | 20.9 | 3.4 |
| Median | 1.5 | 7.0 | 5.0 | 2.0 |

[1]Expressed as number of days beyond duration of the study.

Table 13

Selection Frequency of Experienced Shelter Discomforts

| Factor | Frequency of Selection Study I (N=22) | Study II (N=25) | Study III (N=29) | Study IV (N=17) | Total Frequency (N=93) |
|---|---|---|---|---|---|
| Selected by 50% or More of Total Number of Shelterees | | | | | |
| Sleeping conditions | 22 | 18 | 16 | 9 | 65 |
| Lack of bathing facilities | 15 | 21 | 18 | 6 | 60 |
| Chemical toilet | 13 | 18 | 14 | 10 | 55 |
| Odors | 12 | 20 | 15 | 8 | 55 |
| Uncomfortable temperature | 16 | 18 | 14 | 6 | 54 |
| Lack of space | 19 | 16 | 11 | 7 | 53 |
| Food | 13 | 10 | 12 | 11 | 46 |
| Selected by Less Than 50% of Total Number of Shelterees | | | | | |
| Drinking water | 13 | 3 | 7 | 6 | 29 |
| Lack of fresh air | 8 | 8 | 4 | 0 | 20 |
| Boredom | 5 | 6 | 1 | 6 | 18 |
| Lack of means of telling time | X* | X* | 4 | 9 | 13 |
| Testing before entering shelter | 6 | 6 | X* | X* | 12 |
| Lack of interesting activities | 7 | 2 | 2 | 1 | 12 |
| Lack of exercise | 4 | 5 | 2 | 1 | 12 |
| Other people in the shelter | 1 | 3 | 1 | 6 | 11 |
| Noise | 1 | 2 | 2 | 5 | 10 |
| Being observed | 4 | 2 | 0 | X* | 6 |
| Lighting | 1 | 0 | 1 | 0 | 2 |

*Item not included in discomfort scale for this study

the absence of pillows and blankets, and in some instances a cool temperature.

Suggestions from the Ss as to means of improving on this factor were primarily that blankets be included as part of the stocked shelter supplies. This addition would care for virtually all of these sleeping discomforts by simple adaptations of the blankets to individual needs for softness, warmth, or head support.

2. Lack of bathing facilities. Water was not available for any use other than drinking. In addition to this, the Ss were made uncomfortable by wearing the same clothing for the duration of the study. The possibility of body odors in such close quarters very likely was a contributing source of concern in this regard, too. Also evident was the thought that some means of washing the face and hands would alleviate the discomfort of feeling unclean. Apparently, the use of the hand cleaner did not prove psychologically beneficial, since the provision did not remove the appearance of dirt and left a "greasy" covering on the hands.

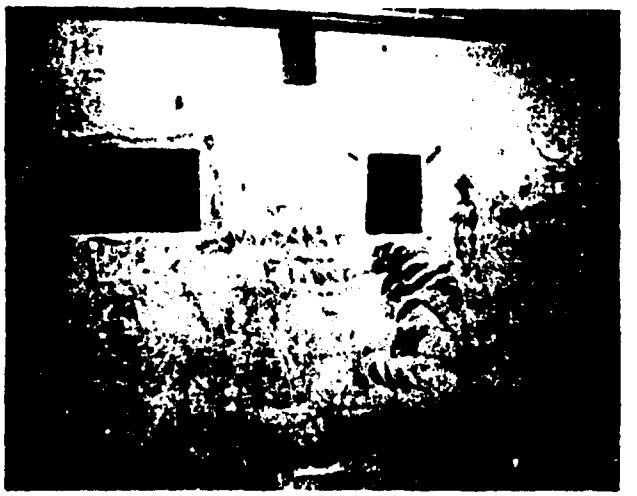
A possible solution to this problem, when the water supply is severely limited to rationed drinking needs, is the provision of body deodorants and "towelettes" or some similar product which is packaged for preservation over a long period of time.

3. Odors. Unpleasant smells were reported by the Ss to have been produced first by the chemical toilet facility, by one's own body, and then by others' bodies. The odors from the toilet were dominant in all studies and were due in large part to the ineffectiveness of neutralizing agents (see Chp. 1). Concern was felt by most Ss over the offensiveness of their own body odor to other Ss. This appears to have been due to a combination of realistic awareness and culturally-induced self-consciousness.

Possible deterrents to this factor's being a problem are further investigations for maximum effectiveness in chemical toilet neutralizers and the aforementioned stocking of some type of body deodorant. An alternative may be the stocking of a general atmospheric deodorant.

4. Chemical toilet. Primarily associated with this facility proving to be a discomfort was the unpleasant odor which became more and more intense as duration of confinement progressed. Consequent to odor was the general attitude that the toilet was unclean, which was also fostered by males not removing the seat when urinating, the sight of effluvium, and a

tendency for toilet contents to spray. In the case of the children and some adults (especially females) the toilet proved too high for comfortable use. The general repugnance toward this facility should be dealt with through shelter management's fostering of positive attitudes and careful attention to all possible hygienic precautions.



5. Uncomfortable temperature. While more than one-half the shelterees in the four experimental studies cited discomfort with the temperature, the nature of this factor cannot be easily examined. This appears to be a random, individual phenomenon contingent upon a variety of idiosyncratic factors. There is a tendency for females to be more prone to feel too cool and for males to feel too warm. The weight of an individual also enters in, with larger persons becoming too warm at lower temperature levels than do those who weigh less. Too, temperature comfort is different during inactive than during active periods - what is acceptable for daytime activity is too cool for the inactivity of night, and acceptable night temperatures are too warm for daytime activity. These individual and diurnal variations make it virtually impossible to effect maximal, universal temperature comfort.

A partial solution to the problem of acceptable temperature levels would be the stocking of blankets in the shelter for those who are too cool and a recognition of the problem by shelter management so that attempts may be made to position people in shelter locations more atmospherically suitable to their likes.

6. Lack of space. This discomfort was particularly pertinent during sleeping or resting periods when all Ss were lying on the floor, although the space allotment per person was sufficient for all shelterees to lie at the same time. Having no

means whereby they could psychologically or physically "escape" from the incessant presence of other persons also contributed to this as a discomfort.

Under emergency conditions, when the greatest number of persons must be sheltered in relatively little protected space, the psychological effect of lack of space for retreat from others or for moving around unhindered is an inevitable problem. Perhaps the most corrective measures to this as a discomfort would be for shelter inhabitants to respect the automatically "staked-out claims" of others for particular portions of the shelter area, not to insist that everyone always be participant in shelter conversation or activity, to create sleeping arrangements which would maximize use of available space, and to designate special "quiet areas" of the shelter for rest or sleep. Space limitations are not physical problems so much as the precipitate psychological reactions; thus the most effective means of minimizing the discomfort would be to establish practical means whereby the issue does not create undue psychological stress.

7. Food. Under the experimental conditions of each study, food types varied. However, the amount and kind of food stocked in every study was far different from anything the subjects had subsisted on prior to confinement. This change was a major reason for complaint. Relatively little was said about the supplies failing to satisfy appetites; rather, negative comments focused on lack of variety and dryness of the crackers, biscuits or wafers.

The carbohydrate supplement in Experimental Study IV tended to diminish complaint about food supplies, which leads to the conclusion that possibly the inclusion of even minor variety in the diet would be a satisfactory solution. Children particularly were reluctant to eat the stocked food because of the newness of it and its relatively bland taste; this factor may be overcome through proper handling of the situation by inviting (not forcing) them to eat. However, food does not appear to be a discomfort of great dimension, and the diet conditions in the present confinement studies appear quite tolerable for emergency circumstances.

Shelteree comments on desired additional supplies for the shelter generally followed the factors discussed above, viz., improvement of sleeping conditions, more variety in food, inclusion of recreational materials (games and books), and better toilet facilities. Factors or conditions of customary daily life which the shelterees most often cited as missing also tended to follow primary discomfort dimensions: customary variety and kinds of food, family and friends, usual sleeping conveniences, bathing facilities, and freedom of movement. Tobacco merited comment when the supply first diminished, but ceased as a

complaint as confinement continues. The lack of coffee was also commented upon.

B. Conclusions

The following conclusions are based on Post-Shelter Questionnaire responses:

1. More than 80% of the shelterees reported satisfaction with having volunteered for confinement, with more than 60% stating agreement to be confined under the same conditions a second time and less than 50% of them reporting that confinement was a personal hardship.

2. Subjects in the shorter studies gave lower mean and median estimates of tolerance for extended confinement than did subjects participating in the longer studies; and the estimates of women and children in all studies were lower than those of males.

3. Citations of shelter factors found to be uncomfortable emphasized sleeping conditions, lack of bathing facilities, odors, the chemical toilet, uncomfortable temperature, lack of space, and food.

4. A primary, comprehensive solution to discomfort with sleeping conditions would be provision of blankets for softness, head support and/or warmth.

5. Body deodorant and packaged "towelettes" should ease discomfort incurred by severely-rationed water supplies.

6. A more effective neutralizing agent for the chemical toilet and an atmospheric deodorant or freshener should suffice to control unpleasant odors in the shelter.

7. Food does not appear as a great discomfort, and any complaints should be modified by minor variety in the diet.

8. Shelterees felt that their confinement could have been made more tolerable via improvement of the sleeping conditions and sanitation facilities, some variety in food, and the stocking of recreational materials. However, these additions were not absolute in necessity as evidenced by the satisfactory outcome of the studies apart from the innovations.

## V. Sociometric Analysis

### A. Procedure

As part of the Post-Shelter Questionnaire, shelterees were asked to cite fellow shelterees whom they thought were most appropriately described by various statements concerning shelter leadership and adaptability. The sociometric statements were either positive or negative in orientation, providing opportunity to evaluate the attitudes and group relationships. Ss in Experimental Studies I through III made the nominations only at the conclusion of the study, whereas Experimental Study IV children completed the nominations twice during confinement as well as a part of their Post-Shelter Questionnaire.

The sociometric choices of the respective group were expressed in terms of constituent members who appeared "accepted," "rejected," or "isolated." As a rule, Ss who were generally other-directed and able to channel their energies to the betterment of other's well-being were those who emerged as sociometric "stars" for the groups. Withdrawn, quiet persons were not rejected by their fellow shelterees, nor were they actively accepted. Rejected subjects tended to be those who were actively hostile, loud, uncooperative and complaining.

Shelterees who had some specified role to play tended to use this opportunity as an outlet and became sociometric leaders in one way or another. As would be expected, the shelter manager and nurse or medic were focal points of leadership and tended to receive a number of sociometric nominations. Among the informal roles, females tended to assume responsibility for the group more than males and were more creative. Males were more reticent to bring to the fore any abilities for encouraging group cohesiveness and were more content to be spectators. Sociometric rejections most often occurred at age extremes of the comparatively very old or the younger members of the group.

### B. Conclusions

The sociometric analysis indicates the following conclusions:

1. The older adults provided a stabilizing influence in the shelter.

2. The encouragement of individual talent and initiative appeared imperative in the formation of a satisfactorily interested and active shelter group.

3. Abilities not usually emphasized outside of confinement were welcomed under the shelter conditions, and contributed greatly to group morale.

4. Leadership appeared to come most readily from older teenagers and young adults.

Details of the sociometric analyses may be found in the Appendices.

# Chapter 4 - Behavioral Measures

Measures of behavior presented in this chapter include activity, noise and lighting levels, behavioral patterns, and time perception during occupancy.

## I. Activity and Noise Variations

During all experimental studies continuous recordings were made of relative changes in locomotor activity and noise level, to determine the stability of patterns of these two variables as a function of confinement.

### A. Activity Data

Figure 4 presents activity measures for each hour of confinement for each experimental group. The periodicity of these measures is readily seen in each curve and was supported by direct observations. Also, there is a high degree of similarity between the curves for each group. These measurements are compatible with expected activity variations relative to "normal" waking and sleeping patterns of the "average" individual. However, the method employed to obtain these measurements provides a quantitative index of activity patterns free of observer bias. While there were no significant changes of activity patterns which may affect the success of group adjustment to shelter living, these measurements do reflect the amount of daily activity within the shelter. The amount of locomotor activity permissible within a crowded shelter would be an important consideration.

### B. Activity and Noise Compared

The relative noise level changes each hour paralled the activity patterns and are not presented here. The high positive relationship between these two variables was expected, i.e., when the Ss were moving about, they were making noise. Figure 5 illustrates the high degree of correlation between noise and activity of Experimental Studies II and III. The curves represent the composite or average activity and noise patterns over a 24-hour day. Pearson product-moment correlations greater than .90 among the four curves clearly demonstrate the high relationships. When the high between-study correlations are considered relative to time orientation, they are somewhat surprising. Experimental Group III had no means of telling time and made errors in their estimations of the hour of the day; yet their activity and noise patterns correlated .90 and .94, respectively, with Group II, which did have means of telling time.

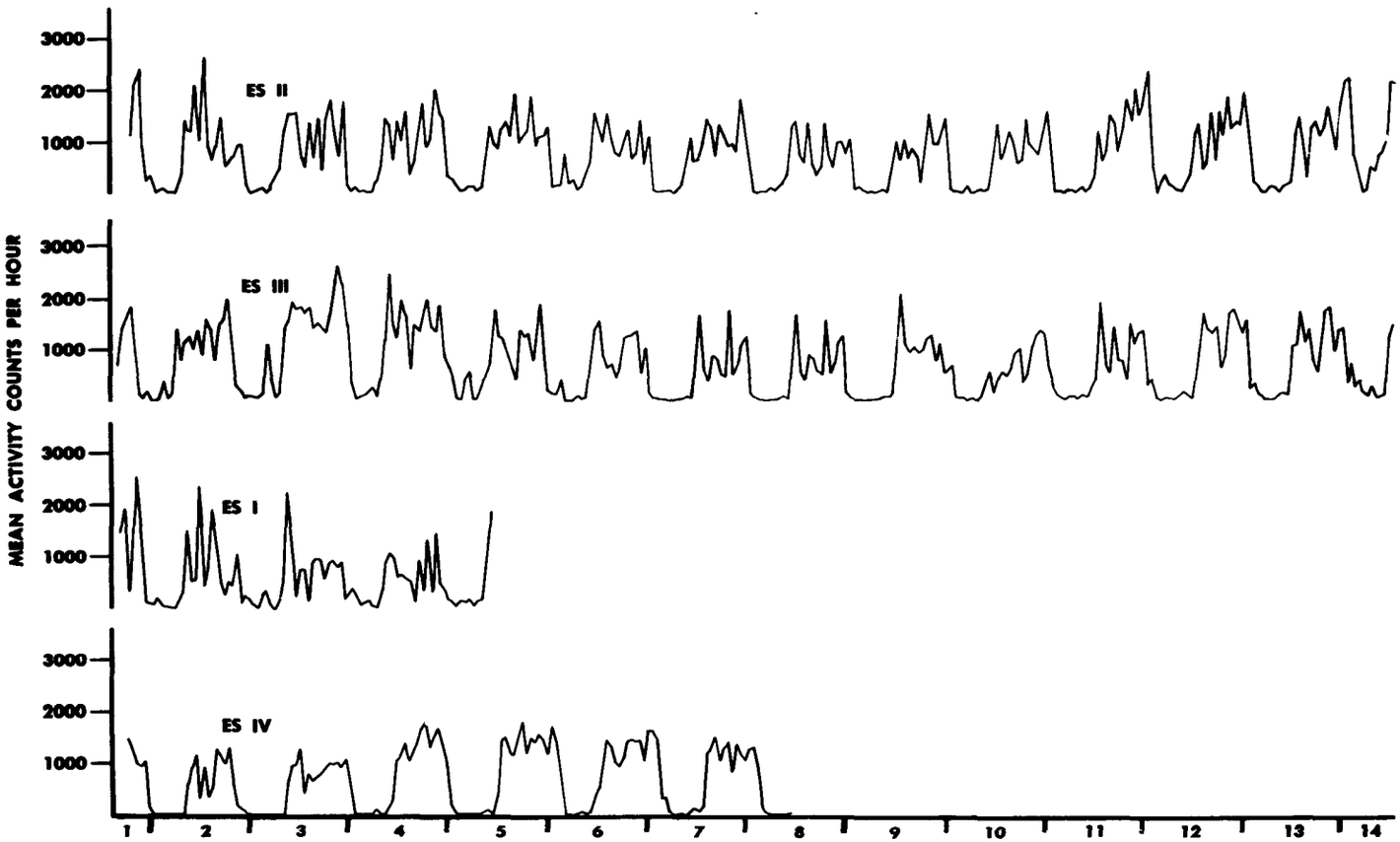



FIGURE 4 DAILY ACTIVITY LEVELS FOR ALL EXPERIMENTAL STUDIES

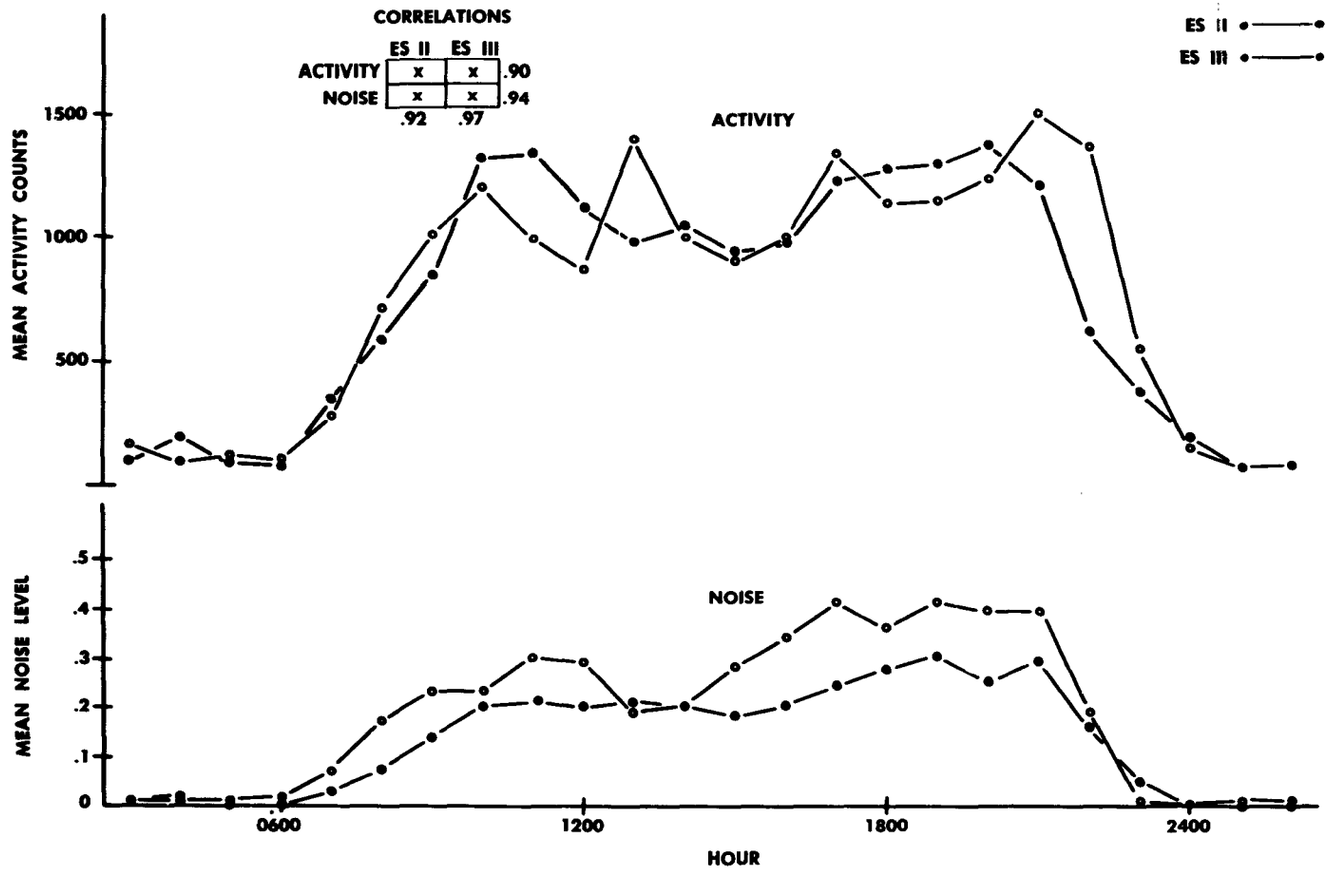
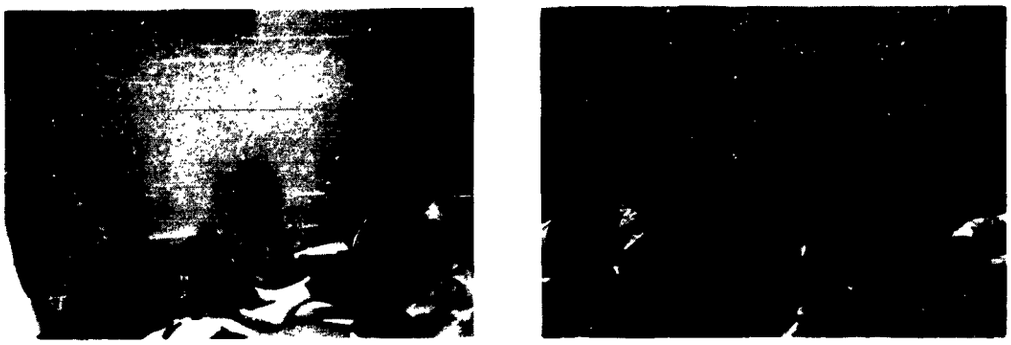



FIGURE 5 HOURLY ACTIVITY AND NOISE LEVELS FOR ES II AND ES III



The between-days changes in relative amounts of activity and noise in ES II and III are seen in Figure 6. Activity and noise increased to the third or fourth day for both experimental groups and were followed by a general decline to the ninth day of confinement. For the last four days, activity increased while noise levels continued to decrease. Apparently the adjustment to the novel shelter environment produced the initial increases in these variables, while the general decrease following the fourth day may be attributed to adaptation and resignation to shelter living. The elevated activity over the last days of confinement may reflect anticipation of the successful completion of the studies. The continued decrease in noise levels was noted by the observers as the Ss moved about and talked less. Possibly, effects of fatigue in combination with the lack of new conversational material resulted in small group discussions that were less animated. The low points in the activity curves correlated positively with the evaluation of group morale from observations and diary forms.

The absolute differences between the curves for each study reflect differences in the initial sensitivity setting of the activity and noise level devices, and do not indicate group differences in absolute levels of these variables.

C. Conclusions

Analysis of activity and noise data indicates the following conclusions:

1. Activity declines from a relatively high level upon shelter entry to a low point between the 7th and 9th day of confinement, then increases to the time of release. This trend parallels variations in group morale as judged by observers and evaluation of written shelteree diaries.

2. Daily relative noise levels parallel the changes in group activity until the 9th day of confinement, but continue a general decline until the time of release. The frequency

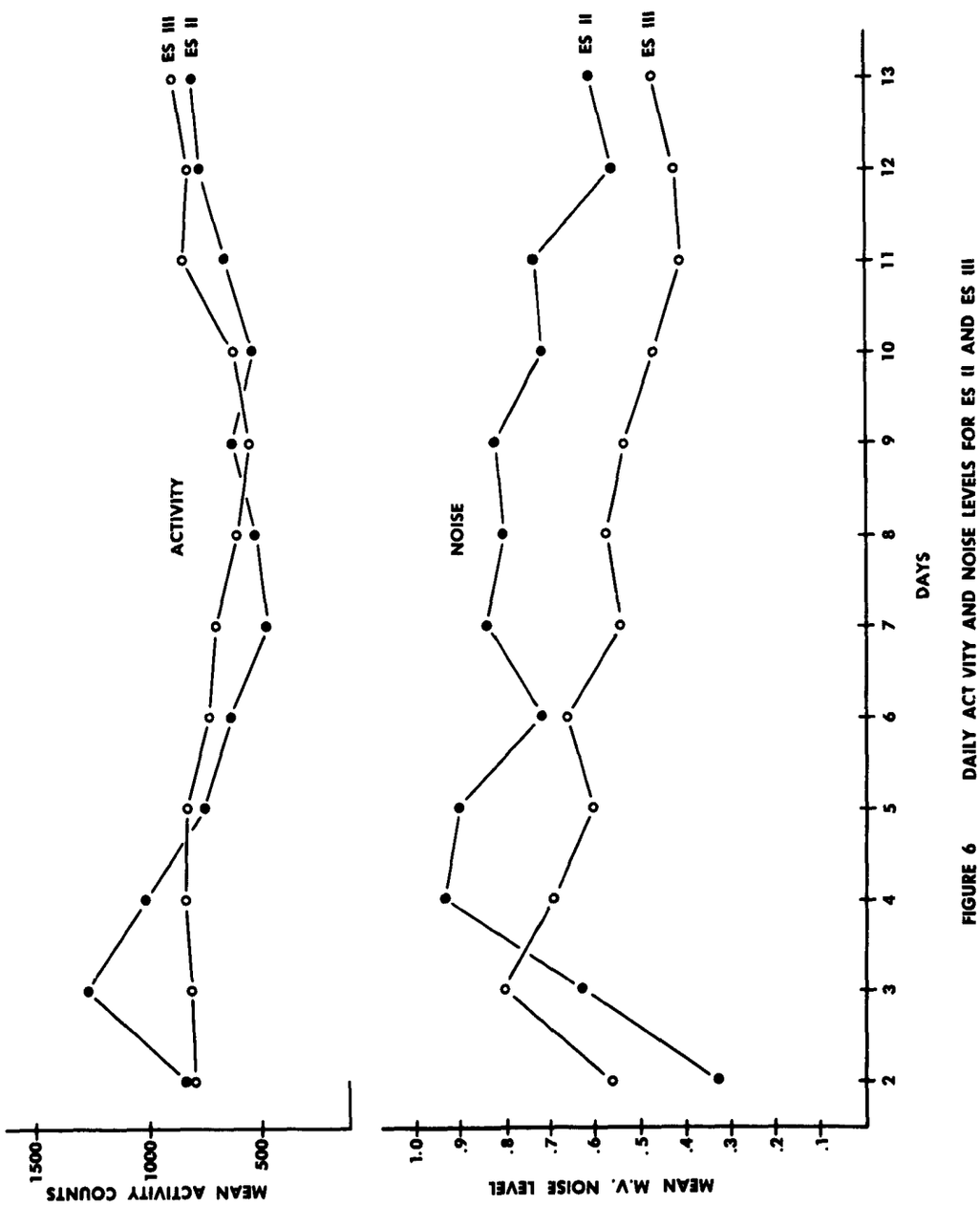



FIGURE 6 DAILY ACT VITY AND NOISE LEVELS FOR ES II AND ES III

of group conversations was not observed to change as a function of confinement. However, the Ss were observed to talk with reduced vigor and animation compared to the laughing and yelling following shelter entry. These changes in daily noise levels may be attributable to the adaptation of individuals to the novel shelter environment.

3. The average daily patterns of activity and noise are highly correlated between confined groups with and without a standard means of time reference.

## II. Selection of Lighting Levels

The level of illumination selected by the Ss was measured in all experimental groups. Illumination level for all groups positively correlated with noise and activity levels and revealed the expected patterns compatible with the Ss' shelter behavior. Generally the Ss selected the maximum level of lighting available during waking and active hours, while reducing the illumination to near minimum during periods of rest or sleep. The amount of available lighting varied between 600 w. and 200 w., dependent upon the position of the movable wall. Figure 7 illustrates the lighting levels selected in Experimental Study I during the four days of confinement where the maximum available lighting was 300 w. Since seven of the Ss defected within the first twenty-eight hours, with the movable wall being adjusted to maintain constant floor space, the maximum lighting available was 200 w. The elevations in the curves above this maximum reflect changes in the unoccupied section of the shelter by the E during removal of Ss and for adjustment of the wall. Again, the patterns of lighting change as well as the levels selected were generally the same for all experimental groups, i.e., they reflected the activities of the shelter groups. On no occasion was it found that there was insufficient available lighting for any shelter activity. The level of illumination required within the shelter was a function of the specific activity at any particular time.

## III. Behavioral Patterns

One observer at each watch during all experimental occupancies was assigned to tally the number of shelterees assuming various bodily positions and engaging in various activities. Counts were made every fifteen minutes throughout each study of body positions (standing, sitting, and lying), and activities (sleeping, exercise, eating, recreation, training, conversation, and quiet). All Ss were assumed to fall in one of the body positions of "Lying" - prone, horizontal; "Sitting" - shoulders off the floor, legs and/or buttocks on the floor; or "Standing" - erect, vertical. All Ss were assumed to fall in one or more of the activities of "Sleeping"

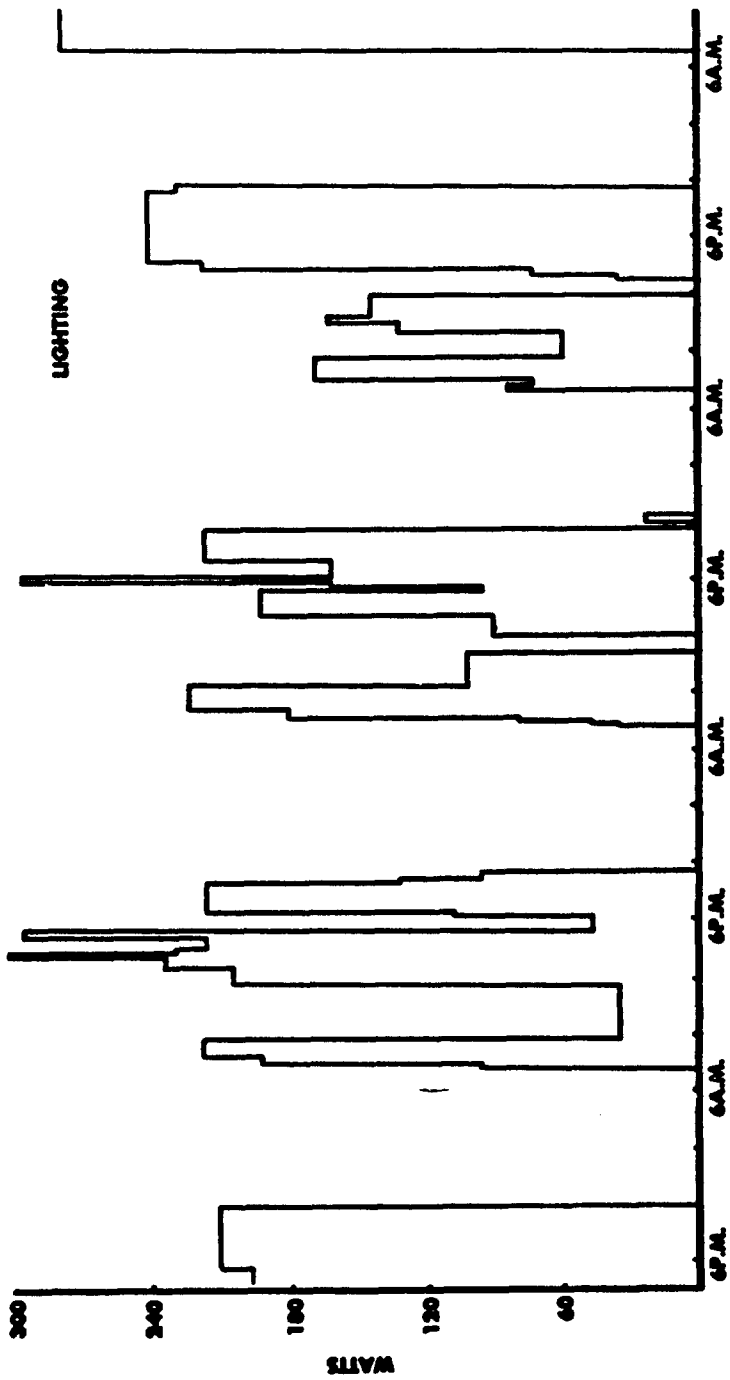



FIGURE 7 DAILY ILLUMINATION LEVELS FOR ES 1

- determined by judgment of observer, no movement; "Exercise" - individual or group performance; "Eating" - alone or with others, preparation as well as actual eating; "Recreation" - alone or with others, exclusive of conversation, generally some game or participation in group activity such as a talent show; "Training" - usually group session led by shelter manager involving some aspect of protection from radiation, first aid or post-attack preparation; "Conversation" - between individuals or in groups of three or more individuals, active participation; and "Quiet" - no interaction with other shelterees, not sleeping, general withdrawal from shelter situation.

The purposes of frequency counts were (1) to establish a means of detecting the onset of fatigue, depression, and withdrawal symptoms of the group as a whole, (2) to provide an overall picture of position and activities of the group throughout the occupancy, and (3) to determine relative amounts of time devoted to various activities by the occupancy group.

The tally sheets were totaled for each hour, and hourly means for each category were obtained by dividing each total by four (since there were four observations/hour). Each hourly mean was then converted to a percentage of the number of shelterees in the shelter at this hour. Percentages were required to offset the effect of exiting shelterees and to yield an index not disturbed by these exits.

A. Body Position and Activity Patterns

Table 14 presents the grand percentage means for body position for Studies II, II, and IV. Study I, the four-day occupancy, is not included since the final procedure was established after this study was completed. The high degree of uniformity between occupancy studies II, III, and IV is perhaps the most

Table 14

Grand Percentage Means for Body Positions During Three Occupancy Studies

| Position | Study | | |
|---|---|---|---|
| | ES II | ES III | ES IV |
| Lying | 52 | 51 | 49 |
| Sitting | 35 | 36 | 35 |
| Standing | 11 | 12 | 14 |
| Total | 98 | 99 | 98 |

striking result. Secondly, the order of magnitude of the lying position indicates that the shelterees spent half their time lying on the floor. Slightly over one-third of the time was spent in the sitting position and about one-sixth of the time in the standing position.

Table 15 indicates that the major time consuming activities were sleep, quiet reflection or withdrawal, and conversation. Approximately nine percent of shelter time was involved with recreational activity. Eating, training, and exercise each involved percentages ranging from one to eight percent of occupancy time during the three studies.

Figures 8, 9A, and 9B present consecutive daily means over the interval of confinement. Figure 8 indicates a slight increasing trend in the lying category, a slight decreasing trend in the standing category and no trend in the sitting category for each of the two longer studies. The greater variability in the trends for the one-week study is perhaps related to the difference in shelter population characteristics, since the one-week occupancy involved children in the 7-13 year age range. Figure 9A indicates that slightly more time was relatively given to sleep on later days of occupancy for occupancy studies II and III. No trends are observable for quiet, conversation or recreation. Figure 9B indicates an increase in training time for ES III but not for ES II or IV. No consistent trends are discernible for recreation, exercise, or eating.

B. Conclusions

Analysis of shelteree behavior patterns indicates the following conclusions:

1. Approximately one-half of shelter time was spent in the lying position, about one-third in the sitting position, and one-sixth in the standing position.

2. The most time-consuming activities in order of magnitude were sleep, quiet reflection, conversation, and recreation.

3. Training time varied from two to eight percent and eating time varied from three to six percent. Only one to two percent of shelter time was devoted to exercise.

4. Slight longitudinal trends in bodily position were noted with an increase in the use of the lying position and decrease in the use of the standing position.

5. The lack of marked trends in the use of various bodily positions indicates a fairly consistent physiological state throughout confinement.

Table 15

Grand Percentage Means for Activities
During Three Occupancy Studies

| Activity | Study | | |
|---|---|---|---|
| | ES II | ES III | ES IV |
| Sleeping | 37 | 40 | 38 |
| Exercise | 2 | 2 | 1 |
| Eating | 3 | 4 | 6 |
| Recreation | 8 | 9 | 10 |
| Training | 2 | 8 | 2 |
| Conversation | 20 | 17 | 21 |
| Quiet | 28 | 20 | 21 |
| Total | 100 | 100 | 99 |

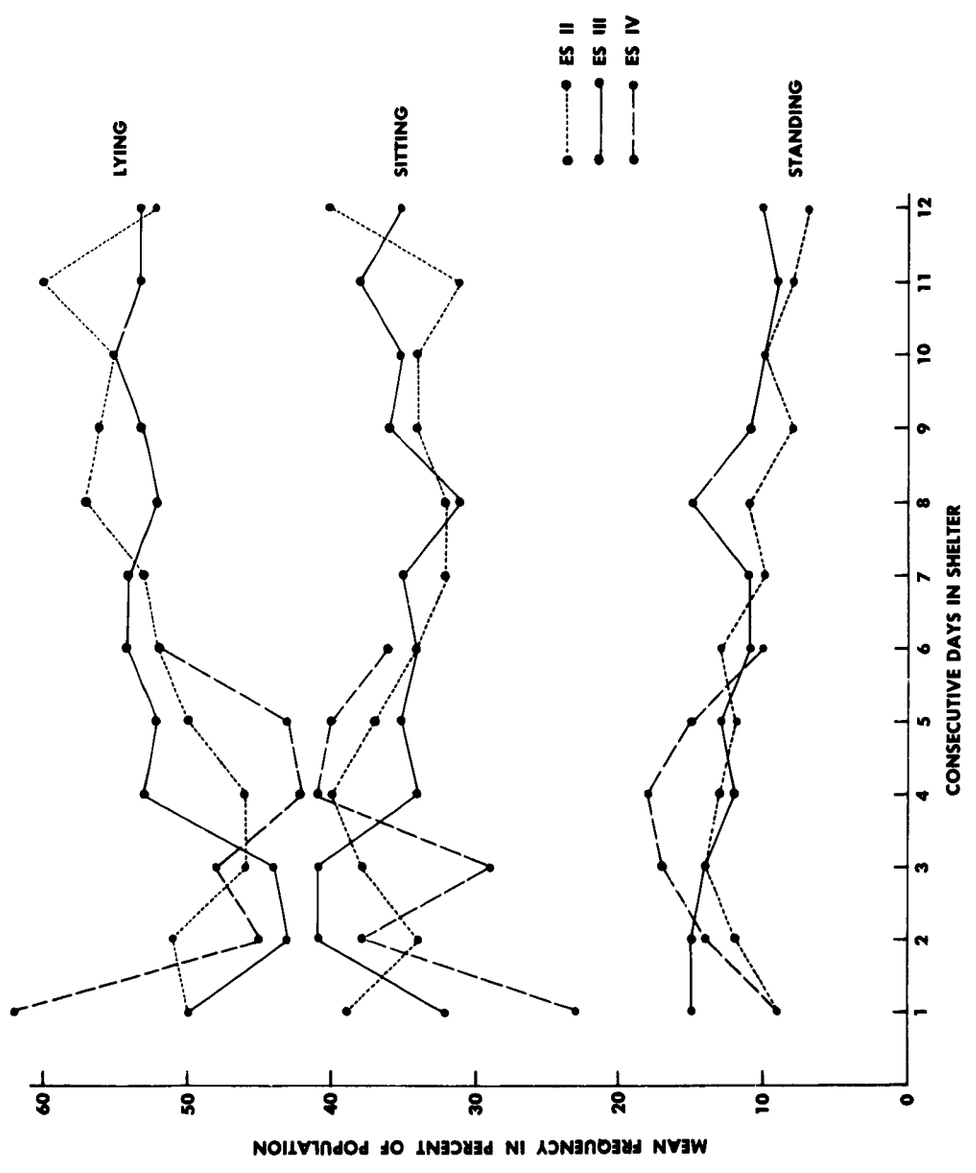



FIGURE 8 DAILY USE OF BODY POSITIONS IN ES II, III, AND IV

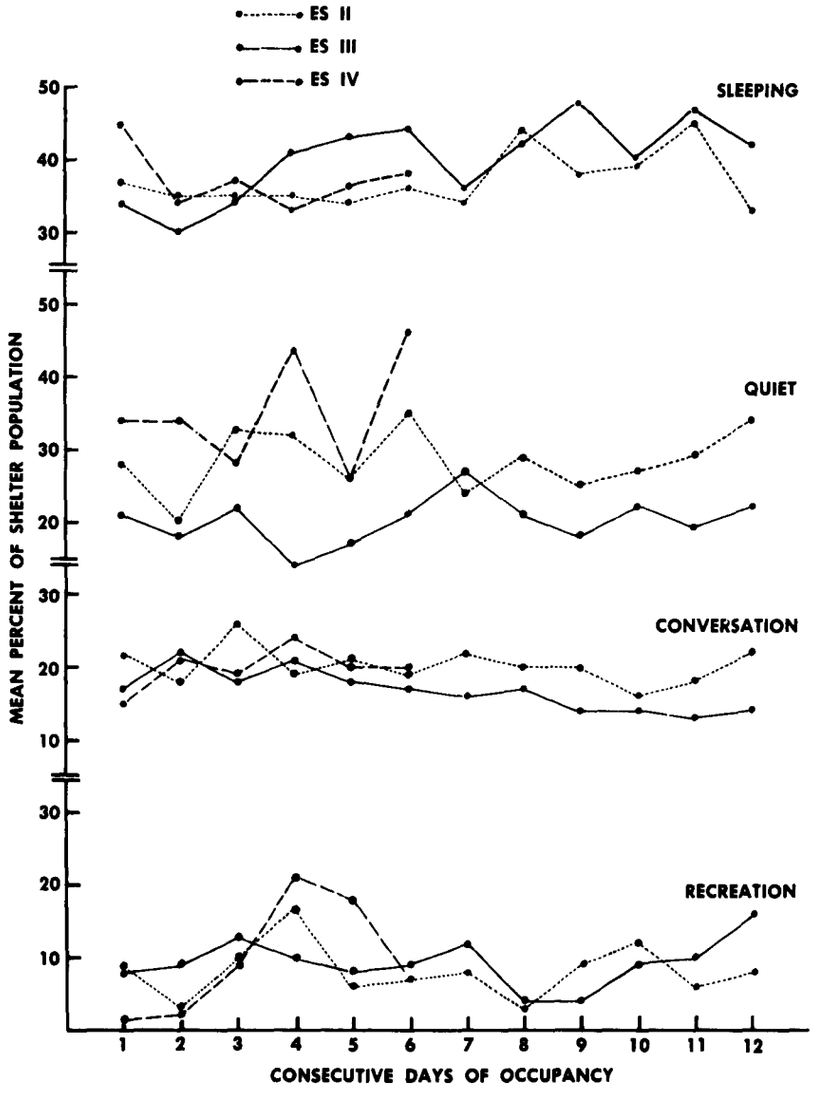



FIGURE 9 A ACTIVITY PATTERNS IN ES II, III, AND IV

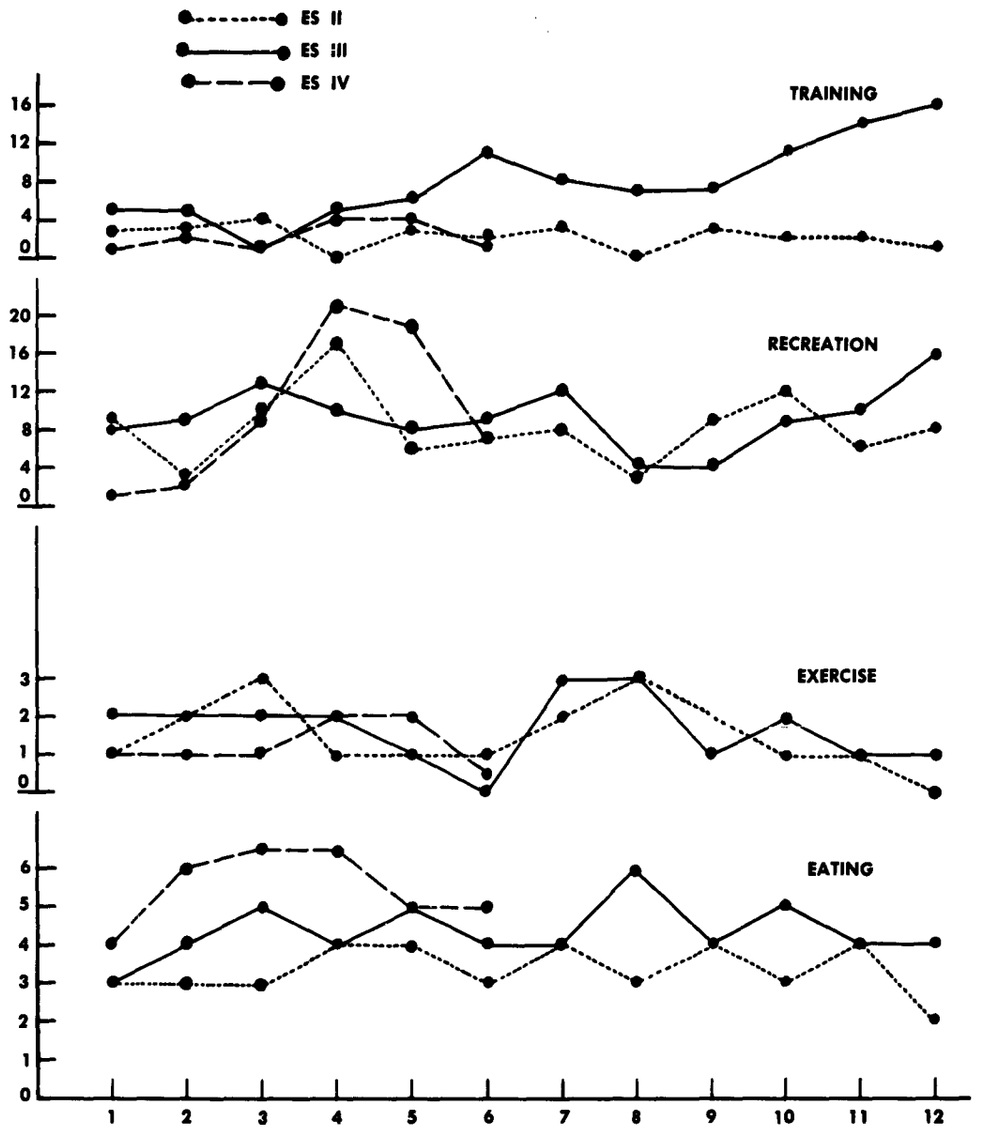



FIGURE 9 B ACTIVITY PATTERNS IN ES II, III, AND IV

6. No general longitudinal trends were noted in any of the activity patterns.

IV. The Perception of Time by Shelterees

Shelteree perception of time was investigated in Experimental Studies III and IV. All watches were collected just prior to entrance, and there were no mechanical means for determining the passage of time in the shelter. Normal cues such as light, temperature, and noise changes were non-existent or unknown due to the nature of the simulated shelter construction.

The purpose of these tests involved the measurement of the accuracy of time judgment over an extended interval. It was also of interest to note the influence of the lack of knowledge of time upon shelteree behavior.

The procedure in Experimental Study III (a two-week occupancy) was to have all shelterees indicate their estimate of the correct time of day on their morning and evening diary sheets. The diaries were completed at approximately 9:00 AM and at approximately 9:00 PM, these times judged by the shelter manager. The shelter manager made his judgments on the basis of time of arising and time for retiring. Time for morning arising was based upon the awakening of half of the shelter population.

The time judgments were made simultaneously by all shelterees, as the outside observers recorded actual clock time.

The data were tabulated and converted to deviations from true time. Two-day mean deviations in minutes are presented in Figure 10. The mean deviations are for shelterees classified by age, sex, and IQ over two-day periods.

Figure 10 may be interpreted as to relative influence of a number of variables upon the perception of long intervals of time. There are two outstanding influences, viz., the time of day at which the estimates were made and the overall shape of the trends which appear nearly identical irrespective of age, sex, or IQ grouping, or time of day at which estimates were made. The age groups differed significantly ($P<.05$) on the morning estimates.

Experimental Study IV (a one-week occupancy) was composed of elementary school children, age 7-13 years, an adult shelter manager, and a nurse. Only the children took part as subjects in the time study, which consisted of the same time of day measures taken in Experimental Study III; in addition, time judgments were made of short intervals on the order of four to twenty seconds. The short interval estimations were of visual and auditory stimuli

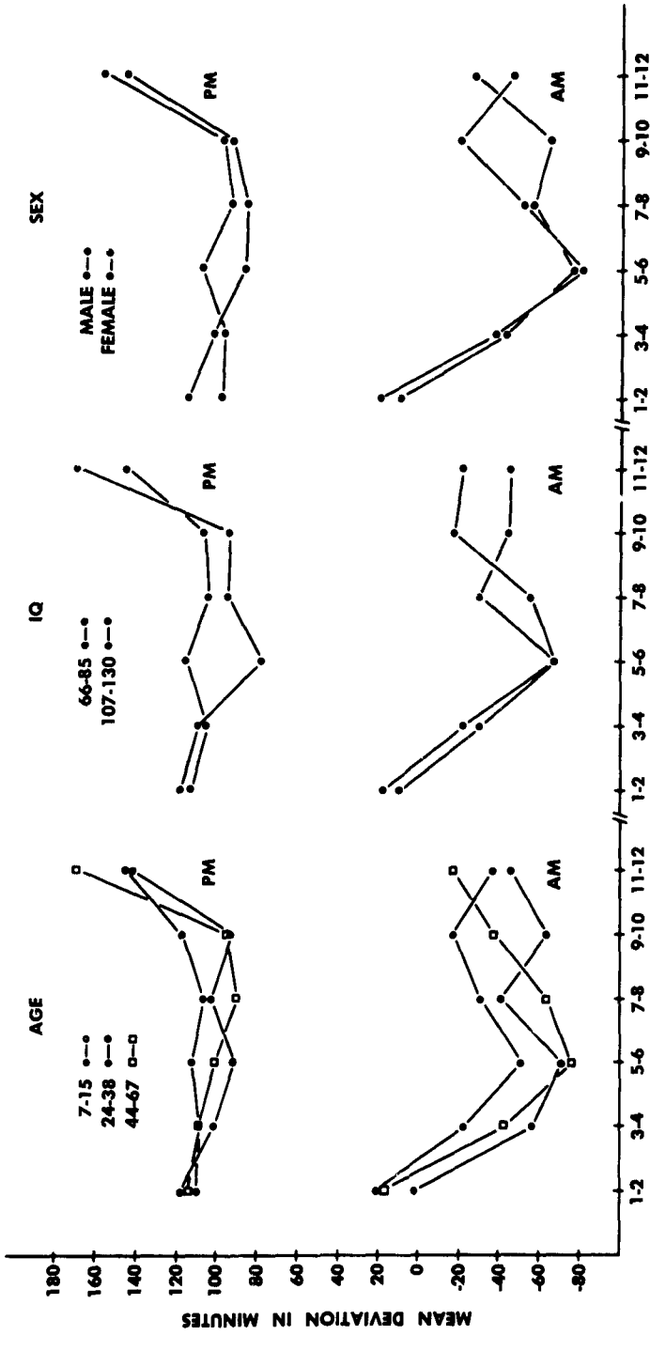



FIGURE 10 DAILY DEVIATIONS IN TIME ESTIMATES IN ES III

presented by means of a buzzer and a small light bulb. After estimates of the time of day were made, the shelter manager activated a circuit which automatically presented the light and sound intervals for short interval estimates.

Interval order and series order of visual and auditory durations were randomized. Each subject made duration estimates on three occasions daily. Each session was completed in approximately five minutes.

The results revealed no significant differences between duration estimates of visual and auditory stimuli. There was a significant ($P < .001$) days of confinement effect upon the visual interval estimates, but the confinement effect was not significant for the auditory visual estimates (see Figure 11).

The influence of time of day became less disparate toward the fourth and fifth day of confinement as the group mean estimate deviation reached three hours. In both sets of curves of Figure 12, the day to day trend toward underestimation is evident from Day Two to Day Five. On the last full day of occupancy, there was a decrease in mean estimate deviations from morning to night.

A significant IQ effect ($P < .05$) was found between absolute mean deviations from true time of two IQ groups (see Figure 13). The low IQ group made greater mean absolute errors estimating time of day on all but the fourth day. Age and sex groups did not differ significantly in time of day estimations.

On post-shelter interviews, only four shelterees of ES III indicated that lack of watches was a personal stress factor. Nine of the remaining seventeen children in ES IV indicated that lack of watches was a stress variable, and four of these nine referred to lack of accurate knowledge of time as a potential reason for early exit.

With no cues as to time orientation, shelterees would very likely maintain their normal day-night routine for extended periods. Under great emotional stress, however, such periodicity might not be likely. The rapid passage of time appears linked to the excitement of the first few days after entry and to the anticipation of exit on the last days. During middle occupancy, time passed more slowly. The rate of passage of time is related to age, but other variables such as time of day appear to exert a more pronounced influence.

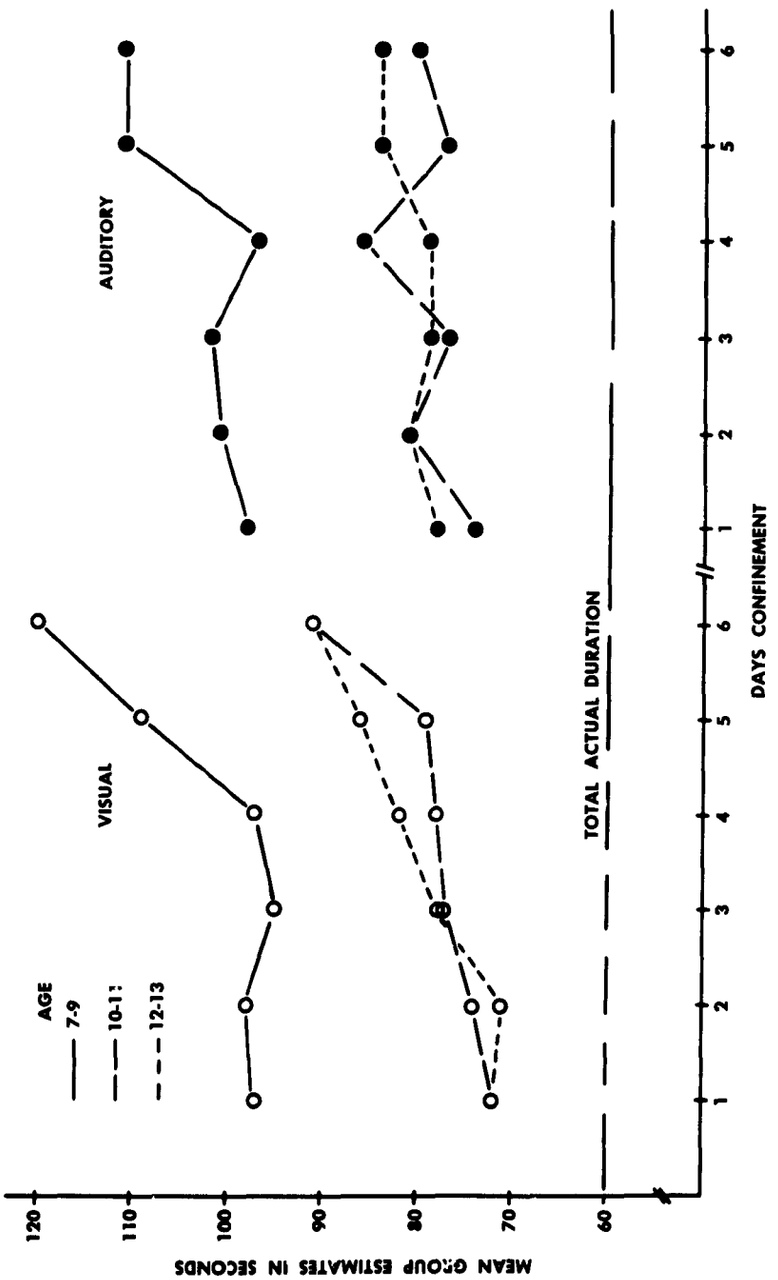



FIGURE 11 DAILY ESTIMATES OF DURATION OF VISUAL AND AUDITORY STIMULI IN ES IV

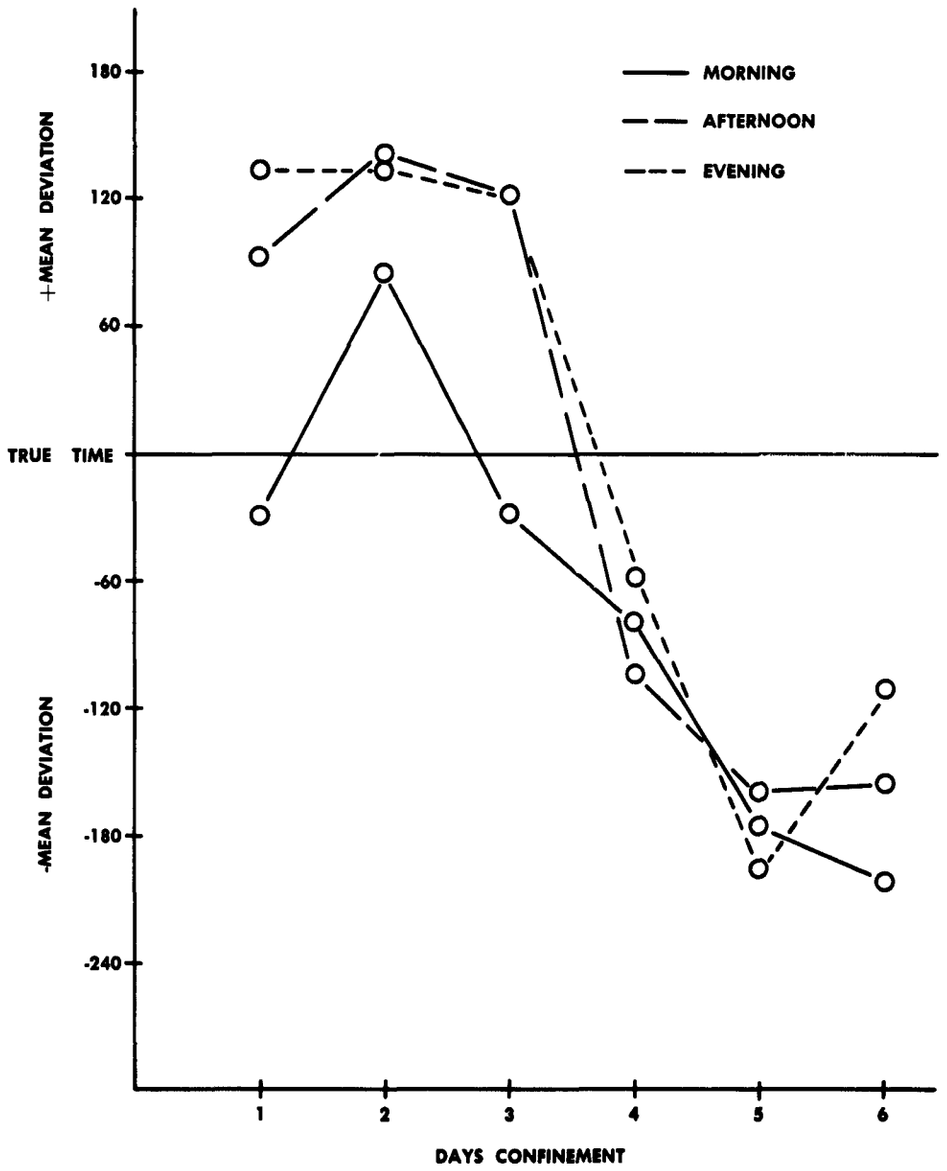



FIGURE 12 DAILY DEVIATIONS IN TIME ESTIMATES IN ES IV

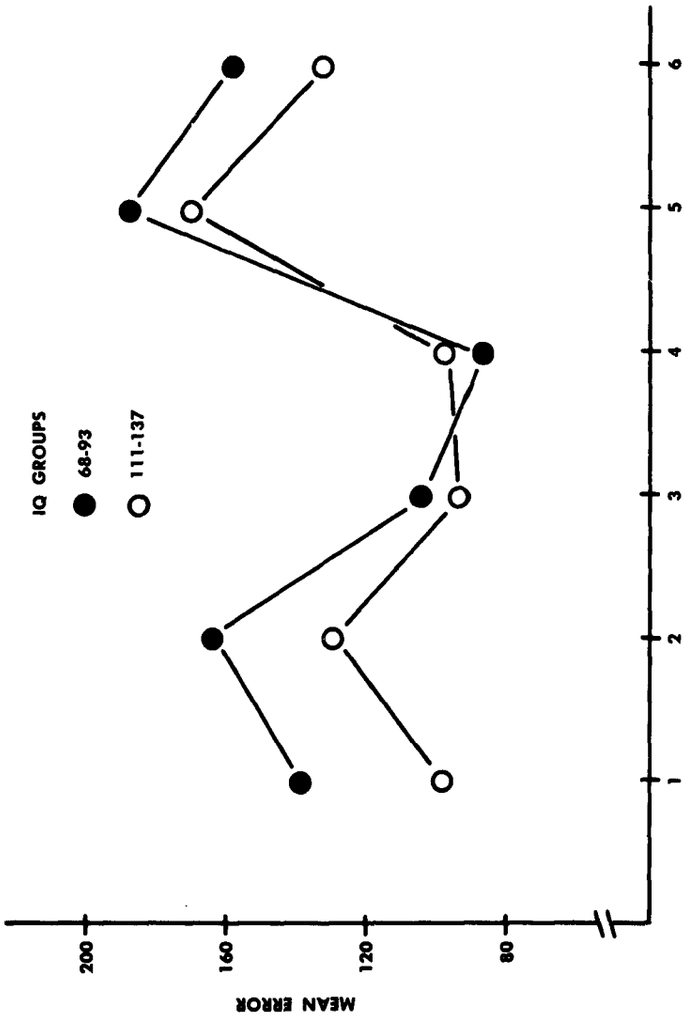



FIGURE 13 DAILY MEAN ABSOLUTE ERROR IN TIME ESTIMATES FOR TWO IQ GROUPS IN ES IV

# Chapter 5 - Environmental Measures

Throughout the series of experimental studies certain environmental variables were controlled and monitored while others were measured as dependent variables. Appendix G includes detailed evaluation of these variables for each study.

## I. Effective Temperature

Experimental Studies I-IV were conducted under "optimal" temperature conditions. Though control of refrigerated air was effected by the experimenters, changes were initiated at the requests of the shelterees. These requests were met by changing the temperature of the air supplied to the shelter, and/or changing the rate of air flow.

Table 16 presents the mean ET values and ranges for each experimental group over the total confinement period. Here it is seen that Study I requested a somewhat higher temperature (78°) than did the other groups (74-77°).

Figure 14 is a graphic presentation of the daily mean effective temperature values for all experimental groups. Here again, it is seen that Study I required higher temperatures. This difference is probably accounted for by the absence of the cardboard used as bedding in the other groups. Ss in Study I had no material to insulate them from the cement floor, a condition which permitted greater heat dissipation. Also to be noted is the increase in preferred temperatures for Studies II and III during the last week of shelter confinement. This may have been the result of the prolonged stress of sleeping on the hard floor and low caloric diet.

Since the relative humidity varied with the activity of the Ss, it was necessary to increase the dry bulb temperature at night in order to maintain comfortable effective temperature levels. Figure 15 presents a composite curve of the typical effective temperature changes for ES III. This curve approximated the changes for all groups. The changes were always initiated following the retirement or arising of the Ss in order to avoid unnecessary external cues as to the time of day.

Eighteen additional thermistors were employed for measurement of temperatures at various locations within the shelter and associated air ducts. Eight of these thermistors were programmed to provide 15-minute samples each hour of shelter temperatures. Table 17 summarizes the mean values of these measurements for each experimental study. From this table it is noteworthy that a 2° differential was recorded between floor and ceiling locations within

Table 16

Means and Ranges of Effective Temperature Values*

| Study | Mean E.T. | Range E.T. |
|---|---|---|
| ES I | 78° | 74-81° |
| ES II | 77° | 69-83° |
| ES III | 74° | 70-79° |
| ES IV | 75° | 73-76° |

*Fahrenheit

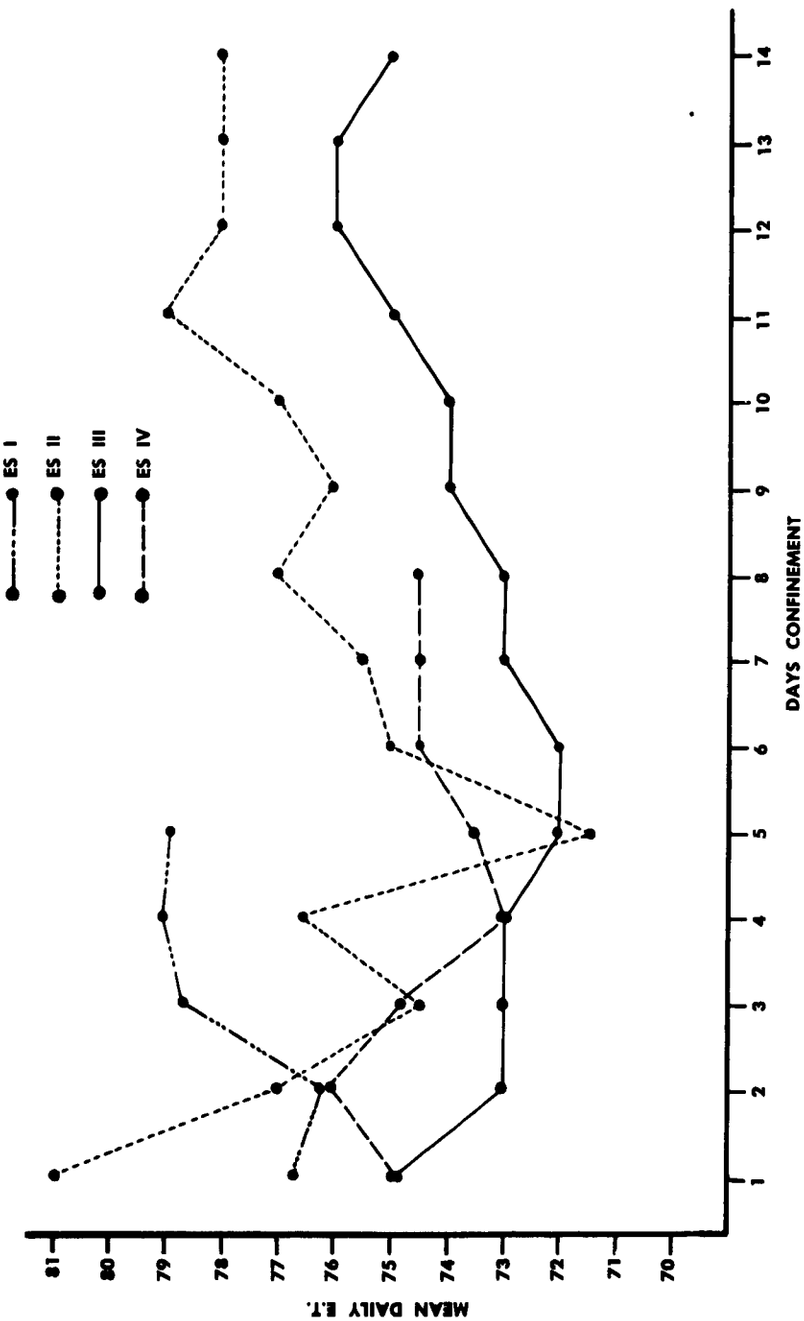



FIGURE 14 MEAN DAILY EFFECTIVE TEMPERATURE VALUES FOR RESPECTIVE STUDIES

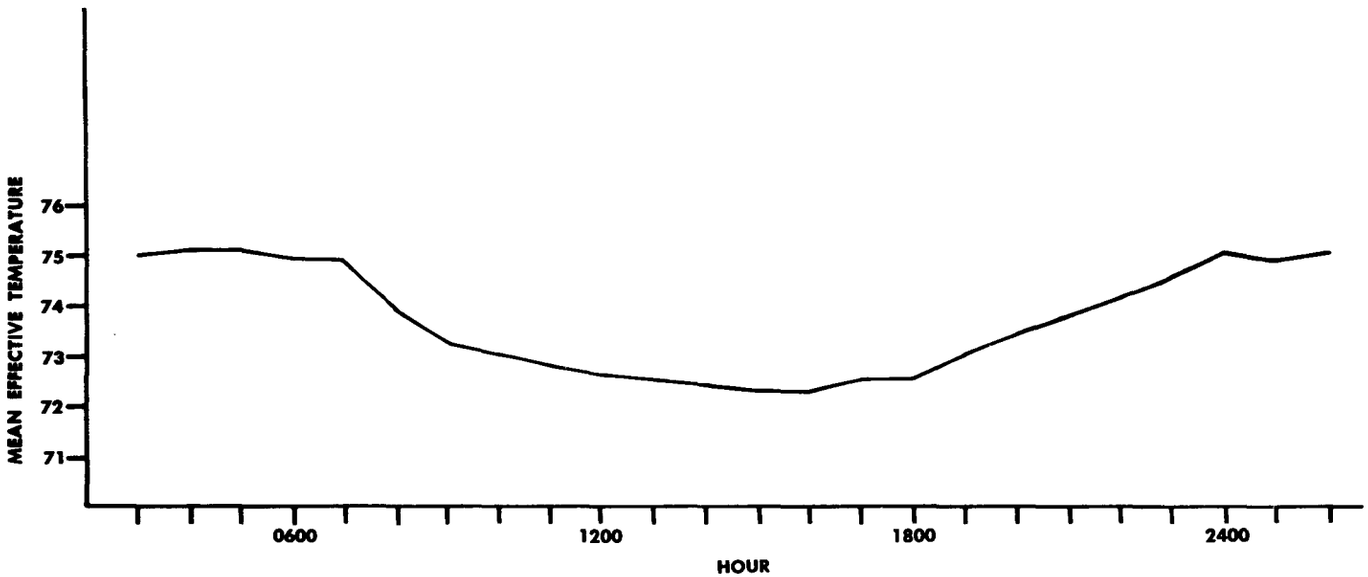



FIGURE 15 HOURLY MEAN VALUES OF EFFECTIVE TEMPERATURE FOR THE AVERAGE DAY, ALL GROUPS COMBINED

Table 17

Mean Dry Bulb Temperatures at the Eight Thermistor Locations

| Study | Thermistors 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| ES I | 76 | 79 | 78 | 81 | 75 | 79 | 78 | 80 |
| ES II | 78 | 80 | 84 | 83 | 79 | 79 | 81 | 83 |
| ES III | 77 | 80 | 78 | 80 | 75 | 77 | 77 | 80 |
| ES IV | 76 | 79 | 78 | 81 | 75 | 79 | 78 | 80 |
| | | | 2° | | | 2° | | |
| Mean | 77 | 79 | 79 | 81 | 76 | 78 | 78 | 81 |

| Thermistor | Location |
|---|---|
| 1 | Within concrete floor |
| 2 | 6" above floor |
| 3 | 36" above floor |
| 4 | 6" below ceiling |
| 5 | 6" above floor ] |
| 6 | 36" above floor ] Behind Movable Wall |
| 7 | 6" below ceiling ] |
| 8 | 6" below ceiling |

*Degrees Fahrenheit

the occupied shelter space as well as the unoccupied section behind the movable wall.

All effective temperature calculations were made by use of the ASHRAE* comfort chart for still air.

## II. Ventilation Rates

Two ventilation rates were used in all studies but ES I, wherein the low supply rate of 15 cfm/person was found to be adequate. The ratio of fresh to recirculated air was 1:4 for all groups at both supply rates.

In Experimental Studies II-IV the 15 cfm rate was sufficient for maintenance of acceptable temperatures only during sleeping hours and periods of low activity. A higher (40 cfm/person) rate was employed during waking hours. The higher ventilation rate was necessary to control temperature, and was not required for oxygen or carbon dioxide control. During ES I the oxygen and carbon dioxide levels were well within acceptable limits at 15 cfm/person.

## III. Conclusions and Recommendations

Investigations of the habitability of fallout shelters should consider the environmental variables at levels common to the average shelter space. Applicability of results obtained under optimal environmental conditions should not be extrapolated to non-optimal situations. Conclusions based on environmental data obtained from the present studies follow:

1. Prototypes of prospective ventilation equipment to be stocked in shelters should be employed as a variable in assessing the habitability of fallout shelters.

2. Assessment of shelter habitability relative to temperature levels should be accomplished using proposed bedding (cardboard, blankets, etc.) under a variety of temperature conditions.

*Heating, Ventilation, Air Conditioning Guide. American Society of Heating and Ventilating Engineers, New York, 1955.

## Chapter 6 - Pre- and Post-Shelter Testing

This chapter presents data obtained from medical, psychological, and physical fitness testing administered before and after shelter occupancy.

### I. Medical Examination

Prior to every study each prospective shelteree was examined by his personal physician and recommended for participation in the experiment. On the day of shelter entry a team of consulting physicians again examined each subject's heart, lungs, temperature, pulse rate, blood pressure and respiratory tract. Blood and urine samples were also taken (see Chp. 7). The post-shelter examination was essentially the same as the pre-test.

All subjects who completed the experiments left the shelter in good health. Temperature, pulse rate, and blood pressure readings usually were slightly lower following confinement. However, these variables were within the normal range.


On the basis of the results of research involving three pilot studies and four experimental groups (150 Ss), it may be safely concluded that normal healthy children and adults representing a cross-section of the civilian population suffered no ill effects from a two-week shelter confinement. That is not to say that the restricted diet, limited water, and overcrowded conditions did not create some transitory physical stress or temporary inconvenience. However, in almost every instance the subjects left the shelter in good mental spirits and sound physical health, although they were dirty, sleepy, and hungry. After a warm bath, a balanced meal, and a good night's rest, all shelterees quickly returned to normal daily routines.

## II. Physical Fitness and Psychomotor Testing

Physical fitness and psychomotor tests were given by experienced examiners before and after shelter confinement immediately following the medical examinations. The measures of fitness* included the Rogers Strength Test, either in whole or in part, and the Harvard Step Test. Psychomotor testing consisted of measures of visual-motor coordination, depth perception, and dynamic balance (see Table 18).

Loss of weight from pre- to post-testing was significant for both males and females in every study. The mean loss for participants in the two-week groups was 5.04% for males and 4.96% for females. In most cases return to normal weight was complete within two weeks after completion of the study.

Marked depreciation of the shelterees' overall level of physical fitness was not apparent from the test results nor from direct observation of the Ss' behavior. However, there was a tendency for males to show a decrease in leg strength from pre- to post-examination. This loss was greater for the boys in ES IV than for male subjects in other experiments.

Visual motor coordination, depth perception, and dynamic balance were not adversely affected by shelter confinement. In some cases psychomotor performance showed improvement on the post-test. This improvement may be due to practice effect, or the result of a group competitive spirit built up during the confinement experience.

In summary, then, except for loss of weight and a slight decrease in leg strength for males, the shelterees completed the experiments in good physical condition. It may be concluded that normal healthy children and adults do not suffer serious loss of physical strength or muscular coordination from two weeks shelter confinement.

## III. Psychological Testing

As outlined in Table 19 the psychological battery was designed to measure general mental ability and a number of social and emotional factors. This procedure was followed to establish the representativeness of the sample and in order to establish a baseline from which post-confinement changes might be evaluated. Table 19 describes the measuring instruments used.

---

*Matthews, D. K. Measurement in Physical Education. Philadelphia: W. B. Saunders Co., 1958.

Table 18

Variables Evaluated Before and After Shelter Confinement

| Experimental Study | Variables | | | |
|---|---|---|---|---|
| | Medical | Physical Fitness | Psychomotor | Psychological |
| ES I | Cardio-Respiratory Functioning<br>Temperature<br>Pulse Rate<br>Blood Pressure | Weight<br>Grip Strength<br>Lung Capacity<br>Cardio-Vascular Cond. | Visual Motor Coordination | Verbal Reasoning<br>Numerical Ability<br>Learning<br>Memory<br>Personal and Social Adjustment |
| ES II | Cardio-Respiratory Functioning<br>Temperature<br>Pulse Rate<br>Blood Pressure<br>Blood Analysis<br>Urine Analysis | Weight<br>Grip Strength<br>Lung Capacity<br>Leg Strength<br>Back Strength<br>Arm Strength | Visual Motor Coordination | Verbal Reasoning<br>Numerical Reasoning<br>Spatial Perception<br>Personal and Social Adjustment |
| ES III | Same as Experimental Study II | Weight<br>Leg Strength<br>Endurance | Visual Motor Coordination<br>Depth Perception<br>Dynamic Balance | Verbal Concepts<br>Numerical Reasoning<br>Logical Reasoning<br>Spatial Relationships<br>Personal and Social Adjustment |
| ES IV | Same as Experimental Study II | Weight<br>Leg Strength<br>Endurance<br>Grip Strength | Visual Motor Coordination<br>Dymanic Balance | Verbal Concepts<br>Numerical Reasoning<br>Logical Reasoning<br>Spatial Relationships<br>Personal and Social |

Table 19

Test Instruments Used Before and After Shelter Confinement

| Experimental Study | Medical | Physical Fitness | Psychomotor Proficiency | Mental Ability and Psychological Adjustment |
|---|---|---|---|---|
| ES I | Cardio-Respiratory<br>Temperature<br>Pulse Rate<br>Blood Pressure | Weight<br>Lung Capacity<br>Grip Strength<br>Harvard Step | Selected Performance Tests of the Wechsler Intelligence Scales | Differential Aptitude Test (VR & NA)<br>Digit Symbol<br>Minnesota Multiphasic Personality Inventory<br>S-O Rorschach Test<br>Digit Span |
| ES II | Cardio-Respiratory<br>Temperature<br>Pulse Rate<br>Blood Pressure<br>Blood Analysis<br>Urine Analysis | Weight<br>Rogers Strength Test:<br>Lung Capacity<br>Leg Strength<br>Back Strength<br>Grip Strength<br>Arm Strength | Pursuit Rotor<br>Flanagan Aptitude:<br>Coordination | School and College Ability Test<br>General Aptitude Test Battery (S,V,A)<br>Minnesota Multiphasic Personality Inventory<br>S-O Rorschach Test |
| ES III | Same as Experimental Study II | Weight<br>Modified Step Test<br>Leg Strength | Pursuit Rotor<br>Stasiometer<br>Keystone Telebinocular<br>Beam Balance | California S-F Mental Maturity<br>Minnesota Multiphasic Personality Inventory |
| ES IV | Same as Experimental Study II | Weight<br>Modified Step Test<br>Leg Strength<br>Grip Strength | Pursuit Rotor<br>Stasiometer<br>Beam Balance<br>Mirror Tracing | California S-F Mental Maturity<br>California Test of Personality<br>Bell Adjustment Inventory |

On the basis of speculation and previous reports it had been hypothesized that subjects confined in Civil Defense survival shelters as presently stocked and equipped would suffer impaired concentration, reduced attention span, and a general loss of mental acuity. This hypothesis was not supported by the experimental evidence in the present studies. In spite of prolonged shelter confinement, restricted diet, and loss of sleep, shelterees showed no measurable signs of reduced mental efficiency.

It was also predicted that the stresses of shelter confinement would produce measurable personality changes in the experimental Ss. The austere conditions were expected to cause mild signs of dysphoria, increased anxiety, overconcern with bodily functions, and other problems of personal and social adjustment. Any changes in the personality measures, however, were not statistically significant.

The results of the three pilot studies and the four experimental studies indicate that healthy adults and children can be expected to sustain two weeks of shelter confinement without adverse effects upon either mental acuity or personal-social adjustment.

# Chapter 7 - Nutritional Analyses*

## I. Introduction

In ES II a nutritional analysis was made of the bulgur wheat wafer in terms of blood and urine studies. Analyses conducted by Van Reen, Consolazio, and Matoush in the Bureau of Yards and Docks (BYD) protective shelter** were the pattern for the nutritional analyses in the Georgia study. However, the BYD study was conducted with healthy, young, male Naval personnel subsisting on a diet which included adjuncts and a higher daily caloric intake. Other contrasting aspects will be discussed throughout this chapter.

The University of Georgia Civil Defense Research Staff is indebted to the U. S. Army Medical Research and Nutrition Laboratory (AMRNL), Fitzsimons General Hospital, Denver, Colorado, and the School of Veterinary Medicine at the University of Georgia (SVMUG) for the biochemical analyses conducted. The procedures used at the SVMUG are described in the Manual for Nutritional Surveys, published by the Interdepartmental Committee on Nutrition for National Defense (ICNND), unless otherwise indicated.

## II. The Bulgur Ration

The in-shelter ration consisted solely of survival-ration bulgur wafers and water. The composition of the wafer is shown in Tables 20 and 21. Each wafer was considered to have an average weight of 20.61 gm., and to contain 88.64 calories. Twelve wafers, weighing 228 gm. and containing 1063.68 calories was the maximum allowable ration per person per day along with 2000 ml. of water.

A comparison of recommended minimal allowances of water and food for fallout shelter survival, with the BYD and Georgia rations, is presented in Table 22.

Shelter management practices permitted participants to save or share both wafers and water as long as accurate records were kept. However, mean daily consumption for the entire period was only 8.9 wafers (182.9 gm., 787 calories) and 1271 ml. water per person per day. This is considerably less than the caloric intakes recorded in the BYD study. It was significant to note (see

---

*Interpretations of nutritional analyses were composed by Dr. H. C. Morgan, Assistant Professor of Veterinary Medicine, University of Georgia.

**U. S. Naval Research Laboratory: Studies of the Bureau of Yards and Docks Protective Shelter - Winter Trials (31 December, 1962).

Table 20

Composition of the Survival Ration (Bulgur wafer)*

| Compound | Amount (%) |
|---|---|
| Protein (N x 6.25) | 8.30 |
| Fat | 9.90 |
| CHO (By Differences) | 75.88# |
| Moisture | 3.68 |
| Ash | 2.24 |
| Caloric Value | 4.30 Cal./gm** |
| Crude Fiber | 2.68 |
| Sodium | 0.37 |
| Potassium | 0.36 |
| Nitrogen | 1.32 |

*Data furnished by Lt. Col. Marion E. McDowell, Fitzsimons General Hospital

#71.00% By direct CHO analysis - Dr. Friediman, U. of Colorado

**Manufacturer recommended 4 cal./gm.

Table 21

Vitamin Analysis of the Bulgur Wafer
(Partial List)*

| Compound | Amt/100 gm. |
|---|---|
| Thiamine ($B_1$) | 0.205 |
| Riboflavin ($B_2$) | 0.10 |
| Niacin | 4.67 |
| Pyridoxine ($B_6$) | 0.175 |
| Folic Acid | 0.047 |
| Pantothenic Acid | 0.635 |

*Average of tests on two samples of puffed (heat expanded) bulgur - Data furnished by Dr. J. W. Pence, Chief, Cereals Laboratory, USDA, Agricultural Research Service, Albany, California

Table 22

Comparison of Recommended Minimal Survival Rations With BYD Rations and Georgia Rations[1]

| Factor | Recommended Ration[2] | BYD Ration | Georgia Ration (bulgur) |
|---|---|---|---|
| Calories | 1500 per day | 1480-1850 per day | 787 per day |
| Protein | 5-10% of calories from common cereal grains | 6.5-7.0% of calories (mostly from cereal grains) | 7.12% of calories |
| Fat | Less than 50% of calories | About 25% of calories | 19.14% of calories |
| Vitamins | Addition not recommended | Crackers provided 0.57-0.76 mg vitamin $B_1$/day | See Table 21 |
| Minerals | No fortification except to provide 2/g NaCl/ 1000 Calories | Crackers provided 2.6-3.4 g NaCl/day | See Table 20 |
| Water | 1.9 liters/day | Mean intake 1.4 liters/day | Mean intake 1.3 liters/day |

[1]Table is adapted from the BYD Winter Studies Report
[2]Food and Nutrition Board, National Research Council, National Academy of Sciences

Table 35) that the mean consumption for females was considerably less than for males. This factor greatly affected the vitamin and protein intakes of the former group.

III. Procurement of Samples

Since the primary purpose of the shelter confinement was to study the psychological response due exclusively to the austere mode of life, every effort was made to minimize adverse reactions to blood withdrawals and urine procurements. This was of special concern when the 25-30 ml. blood withdrawals were made from young children.

To insure fasting samples, the initial blood samples were taken before breakfast following the first night in the shelter (approximately fourteen hours after entering). The shelterees were taken in a group to a small ante-room, bled in an adjoining room, and then returned to the shelter. The shelterees did not anticipate the withdrawal, and thus did not have time to become too emotionally reactive. From information gained in shelteree reports, it was learned that the blood withdrawals did have a traumatic emotional effect on some shelterees, especially the children.

Herapin was used as the anti-coagulant in collection of blood samples. Ten ml. samples were shipped by air express to the AMRNL and the remainder of the 25-30 ml. sample was retained for use by the SVMUG. In one instance bad weather caused a delay en route (Chicago), causing some samples to hemolyze and producing fibrin clots in others. Such weather exigencies indicate the future use of a different anti-coagulant.

Urine collections were made for four 24-hour periods, beginning at noon on Days 1, 5, 9, and 12, respectively. Disposable urine collection bottles were provided, and the medic inside the shelter handled urine collection, pH adjustment, and transfer to the outside. Careful records were kept by the medic to insure accurate 24-hour samples but indications are that at least one, and possibly more, of the shelterees were hostile to the collection procedure and did not completely void into the container. Data of the known "hostile" have not been included in these results. Collected samples were refrigerated until the completion of the 24-hour period, at which time volume measurements were made and 100 ml. samples frozen for later shipment to AMRNL.

The respective biochemical studies conducted by AMRNL and SVMUG are presented in Table 23.

All changes occurring in the nutritional measures were statistically evaluated to determine the reliability of such changes,

Table 23

Nutritional Analyses
(Experimental Study II)

| | USA Med. Res. & Nutrit. Lab Fitzsimons Gen. Hosp. Denver, Col. | School of Veterinary Medicine University of Georgia |
|---|---|---|
| Blood Studies: | Erythrocyte Transketolase<br>Erythrocyte Riboflavin (Vit. $B_2$) | Vitamin A<br>Carotenoid<br>Vitamin C<br>Hematocrit<br>Hemoglobin<br>MCHC<br>Plasma Protein<br>Blood Non-Protein Nitrogen |
| Urine Studies: | Urinary Creatinine<br>Urinary Riboflavin (Vit. $B_2$)<br>N'Methylnicotinamide<br>Urinary Niacin (Vit. B. Complex)<br>Urinary Thiamine (Vit. $B_1$)<br>Urinary Pyridoxine (Vit. $B_6$) | Urine specific gravity<br>Urinary Non-Protein Nitrogen |

using a Lindquist Type I analysis of variance design*. The probability levels expressed in Tables 24 and 36 indicate the possibility of obtaining the nutritional changes on the basis of chance. If the probabilities are low, then the possibility of chance accounting for the obtained changes becomes correspondingly less. Thus, a P-level of .05 means that the obtained values would be expected on the basis of chance only 5 times in 100, or 5%. When chance plays such a minor probability role, the obtained values are said to be statistically significant and reliable, i.e., due to some factor other than chance. Such changes were the only ones considered in the interpretation of nutritional data.

## IV. Blood Studies

Statistically significant changes in the blood tests are given in Table 24.

### A. Vitamin A and Carotenoids

For plasma Vit. A and carotenoid values see Table 25 and Fig. 16. Although changes in Vit. A were statistically non-significant, the carotenoid changes were found to be reliable. It has been established that plasma levels are slow in reflecting a change in the dietary intake, even though the individual may be on a deprivation study. This fact is the result of the liver's tremendous storage ability. According to Pearson**, in referring to work of the British Medical Research Council, it is possible to maintain adults on a Vitamin A free diet for periods up to two years with only minor evidence of Vitamin A deficiency. Pearson further states that serum Vitamin A levels can remain relatively constant for several months, and a case in point is one individual who did not show significant decrease after an interval of nearly two years. Distribution of plasma Vitamin A and carotenoid values among the shelterees are shown in Tables 26 and 27.

### B. Vitamin C

Vit. C values are shown in Table 28 and Fig. 17. Results differ from those on the BYD study because analyses were made on whole blood instead of plasma. This fact made a significant

---

*Lindquist, E. F. Design and Analysis of Experiments in Psychology and Education. New York: Houghton Mifflin Co., 1953.

**Pearson, W. N. Biochemical Appraisal of Nutritional States in Man. Am. J. Clin. Nutrition, 1962, 11, 462-476.

Table 24

Statistically Significant Changes in Blood Tests

| Blood Test | Variable | P |
|---|---|---|
| Vitamin A | --- | (no sig. change) |
| Carotenoid | Pre-Post | .02 > P |
| Vitamin C | Pre-Post | .001 > P |
| | Pre-Post x Sex | .001 > P |
| Hematocrit | Sex | .02 > P |
| Hemoglobin | Sex | .05 > P |
| | Pre-Post | .005 > P |
| | Pre-Post x Sex | .05 > P |
| MCHC | Pre-Post x Sex | .06 |
| Plasma Protein | Pre-Post | .001 > P |
| | Pre-Post x Sex | .05 > P |
| Erythrocyte Riboflavin | Pre-Post | .01 > P |
| Blood Non-Protein Nitrogen | Pre-Post | .005 > P |
| | Pre-Post x Sex | .06 |

Table 25

Vitamin A and Carotenoid Levels*

| | Concentration mcg/100 ml. | | |
|---|---|---|---|
| | Males | Females | All |
| Vitamin A | | | |
| Beginning | 62.8 | 54.4 | 59.15 |
| End | 53.6 | 47.0 | 50.71 |
| Carotenoids | | | |
| Beginning | 65.6 | 69.2 | 67.17 |
| End | 47.5 | 54.1 | 50.38 |

*SVMUG

Table 26

Plasma Vitamin A Distribution

| Rating* | mcg/100 ml | Number Subjects Beginning | End |
|---|---|---|---|
| Deficient | < 10 | 0 | 0 |
| Low | 10-19 | 0 | 0 |
| Acceptable | 20-50 | 13 | 14 |
| High | > 50 | 10 | 9 |

*ICNND

Table 27

Plasma Carotenoid Distribution

| Rating* | mcg/100 ml | Number Subjects | |
|---|---|---|---|
| | | Beginning | End |
| Deficient | < 20 | 0 | 0 |
| Low | 20-39 | 3 | 8 |
| Acceptable | 40-100 | 15 | 15 |
| High | > 100 | 5 | 1 |

*ICNND

Table 28

Whole Blood Vitamin C*#

| | Concentration, mg/100 ml** | | |
|---|---|---|---|
| | Male | Female | All |
| Vitamin C | | | |
| Beginning | 1.08 | 1.27 | 1.18 |
| End | 1.82 | 1.88 | 1.84 |

*Method of Roe and Keuther
**Normal Values, 1.2-2.3 mg/100 ml
#SVMUG

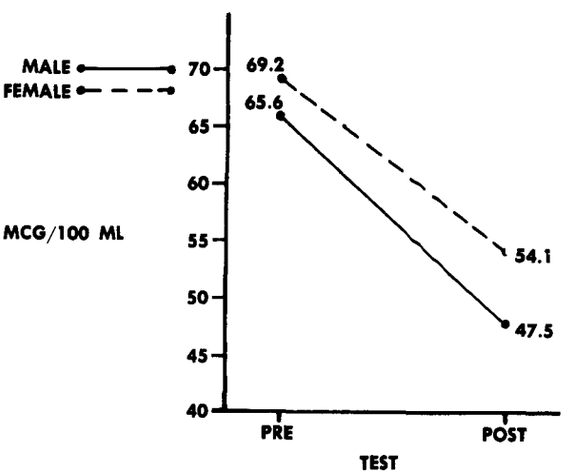



FIGURE 16 PLASMA CAROTENOID (ES II)

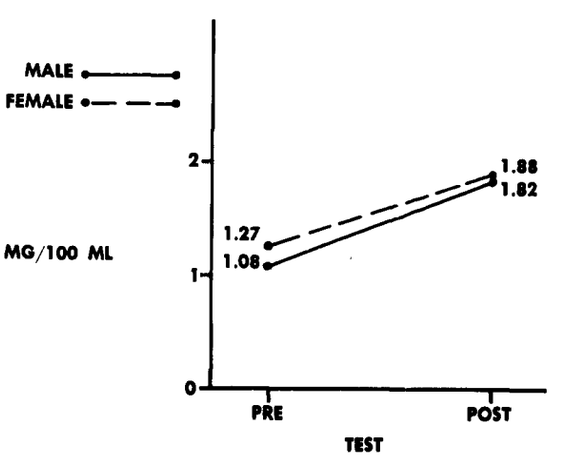



FIGURE 17 PLASMA VITAMIN C (ES II)

difference in interpretation standards, since plasma levels are depleted faster than blood levels on reduced dietary intake. Blood values are much higher and remain high longer because considerable Vitamin C is contained in the formed elements. Depletion must occur in these formed elements before clinical signs of deficiency will appear. Therefore, whole blood determinations can be considered a more reliable index of the Vitamin C status of the individual than plasma evaluations.

All mean values fall within normal limits described by Boutwell*, (e.g., 1.2-2.3 mg./100 ml.), with females having higher values than males. A point of concern, however, is the rise in mean values obtained at the end of the experiment. This result would not be predicted to occur on plasma determinations. The only apparent explanation available is the co-existent relative increase in cellular volume due to dehydration. Since different determination methods and standards were used, it is difficult to compare the Georgia findings more closely with those of the BYD study.

C. Hematocrit, Hemoglobin, Mean Corpuscular Hemoglobin Concentration

In considering the entire group of shelterees, it can be said that increases were noted in mean values for hematocrit, hemoglobin, and MCHC (see Table 29 and Figures 18, 19, and 20).

The differences obtained between males and females were due to the higher normal values for red blood cells and hemoglobin in males. Unexplainable is the fact that there was a slight decrease in the mean values for MCHC of the females.

D. Plasma Protein

Plasma protein values increased during the confinement from a mean value of 7.01 to 7.88 mg./100 ml. for all shelterees. This compared favorably with the BYD study but when differentiated by sex it was found that the increase was greater in females than males (Table 30 and Fig. 21). The latter finding may be due to the fact that the females progressively consumed less water than the males and were showing stronger signs of dehydration (see Fig. 24).

At one time plasma protein determinations were used in an attempt to detect protein deficiencies but actually decreases are not even expected in cases of severe deficiency because of mobilization of body stores.

---

*Boutwell, J. H. Clinical Chemistry, Laboratory Manual and Methods. Philadelphia: Lea & Febriger, 1961.

Table 29

Hematocrit, Hemoglobin, MCHC

| Measurement | Interval | Mean Values | | |
|---|---|---|---|---|
| | | Male | Female | All |
| Hematocrit (%) | Beginning | 46.1 | 40.7 | 43.7 |
| | End | 46.1 | 41.2 | 43.9 |
| Hemoglobin (gm./100 ml) | Beginning | 15.3 | 13.6 | 14.5 |
| | End | 16.2 | 13.7 | 15.0 |
| MCHC (ug/100 ml) | Beginning | 33.2 | 33.2 | 33.2 |
| | End | 35.2 | 33.1 | 33.8 |

Table 30

Plasma Protein*

| | mg/100 ml | | |
|---|---|---|---|
| | Male | Female | All |
| Beginning | 7.2 | 6.8 | 7.01 |
| End | 7.8 | 7.9 | 7.81 |

*SVMUG

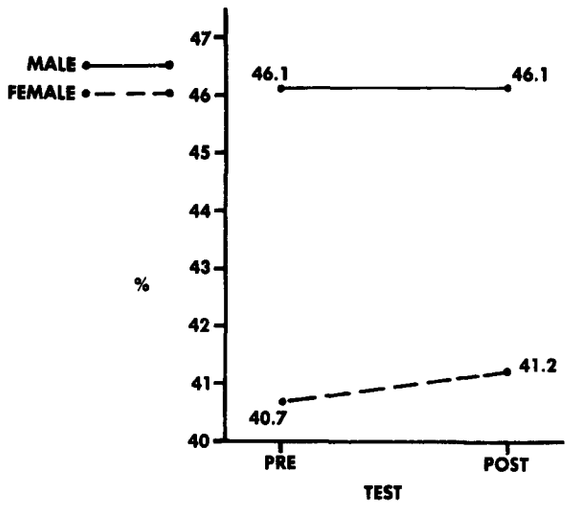



FIGURE 18 HEMATOCRIT (ES II)

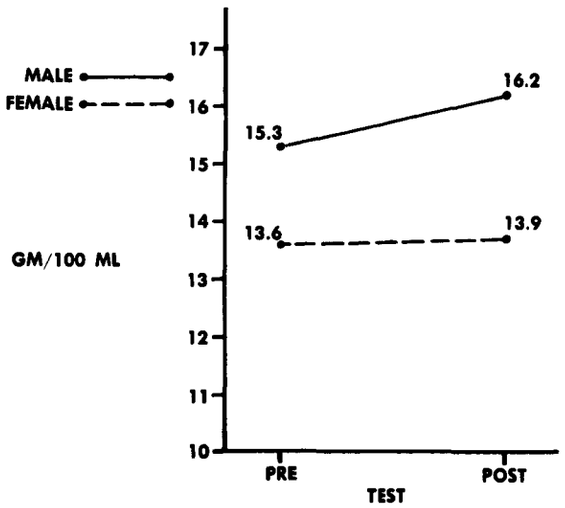



FIGURE 19 HEMOGLOBIN (ES II)

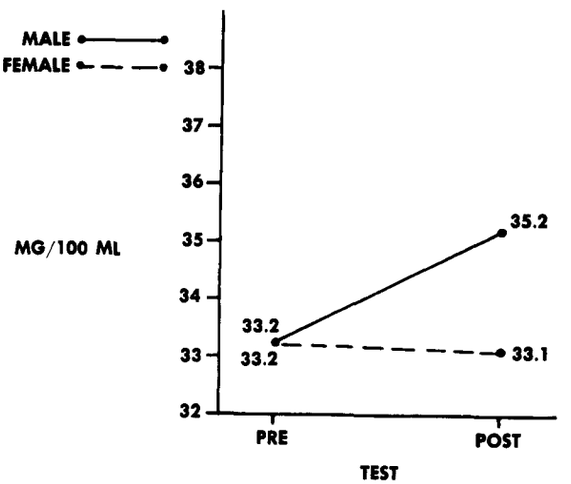



FIGURE 20 MCHC (ES II)

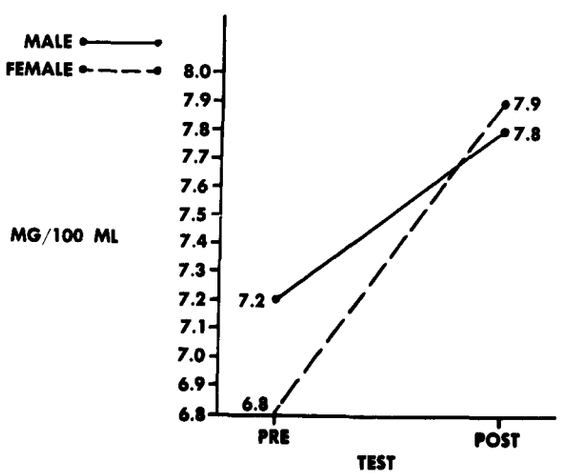



FIGURE 21 PLASMA PROTEIN (ES II)

E. Erythrocyte Transketolase

Evaluations for erythrocyte transketolase were made in measuring thiamine nutrition*. The principle of testing is that inadequate dietary thiamine causes inadequate utilization of an enzyme. Consequently, the amount of erythrocyte transketolase that is present for stimulation by an exogenous source of thiamine (thiamine pyrophosphate) is an index of thiamine nutrition. Table 31 shows the rating system used in the BYD study applied to data obtained in the Georgia study. Slight changes are noted, with movement toward the deficiency range. A significant contrast to the BYD study was the fact that two subjects began the confinement in a state of deficient thiamine nutrition. The analysis of erythrocyte transketolase indicates a diet deficient in thiamine. Data on the calculation of thiamine intake (Table 21) and urine thiamine excretion findings (Table 41) support this observation.

F. Riboflavin (Vitamin $B_2$)

The level of riboflavin in the erythrocyte was used to determine the availability of this vitamin in the ration. Results shown in Tables 32, 33, and Figure 22 were in agreement with the BYD study and show increases at the end of the study.

G. Blood Non-Protein Nitrogen (NPN)

Nitrogen of the blood in forms other than protein include that found in urea, uric acid, creatinine and free amino acids. Urea is the most common constituent and is the major waste product of protein metabolism. Under normal conditions urea is cleared from the blood at a fairly constant rate and is not allowed to become elevated except through reduced kidney filtration. Table 34 and Figure 23 present results of NPN data. While increases were noted on the second test, the mean findings were within a normal range of 25-35 mg./100 ml. One explanation for the elevation could be a depressed kidney function as evidenced by the reduced urine volume and increased specific gravities (see Fig. 24). It is of interest to note that the males had more evidence of elevation than did the females.

*Brin, M., Tai, M., Ostashever, A. S. and Kalinsky, H. The Effect of Thiamine Deficiency on the Activity of Erythrocyte Hemolysate Transketolase. J. Nutrition, 1960, 71, 273.

Table 31

Erythrocyte Transketolase-
Activity Increase With the Addition of TPP

| Rating | Increase (%) | Number of Subjects | |
|---|---|---|---|
| | | Beginning | End |
| Deficient | > 20 | 2 | 4 |
| Low | 16-20 | 0 | 2 |
| Acceptable | 10-15 | 1 | 0 |
| High | < 10 | 19 | 16 |
| Average % increase | | 5.70% | 8.98% |

Table 32

Erythrocyte Riboflavin Rating*

| Rating* | mcg/100 ml RBC | Subjects | |
|---|---|---|---|
| | | Beginning | End |
| Deficient | < 10 | 0 | 0 |
| Low | 10.0-14.9 | 8 | 2 |
| Acceptable | 15.0-19.9 | 14 | 19 |
| High | > 20 | 1 | 2 |

*ICNND

Table 33

Erythrocyte Riboflavin Means

| | mcg/100 ml RBC | | |
|---|---|---|---|
| | Male | Female | All |
| Beginning | 15.1 | 15.7 | 15.3 |
| End | 16.8 | 17.4 | 17.1 |

Table 34

Blood Non-Protein Nitrogen*
(mg/100 ml)

| | Male | Female | All |
|---|---|---|---|
| Beginning | 24.0 | 25.8 | 24.5 |
| End | 35.7 | 28.8 | 32.8 |

*SVMUG

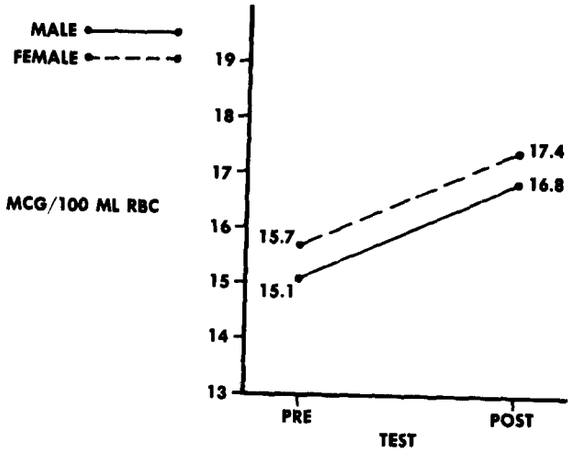



FIGURE 22 ERYTHROCYTE RIBOFLAVIN (ES II)

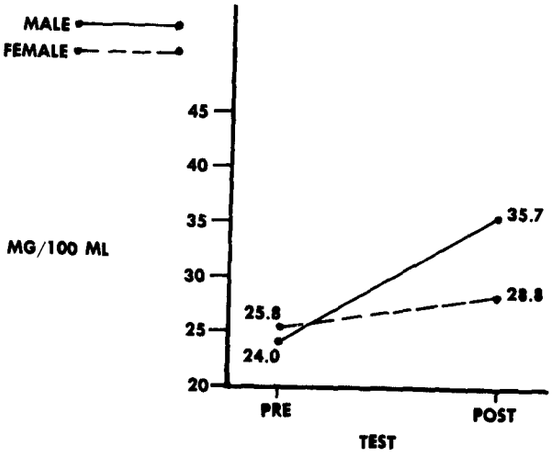



FIGURE 23 BLOOD NON-PROTEIN NITROGEN (ES II)

## V. Urine Excretion Studies

### A. Introduction

Daily measurements were made on water and food consumption (Table 35). Although no attempt was made to obtain daily urine volume measurements, four days were selected for 24-hour specimens (Days 1, 5, 9, 12). The relationships between water consumption, urine excretion and urine specific gravities are shown graphically in Figure 24. The mean water consumption for the entire period was 1271 ml./person/day with the highest mean daily intake per person being 1440 ml. The urine excretion was unusually low, especially when compared to the BYD study, with a mean urine volume of 339 ml./person for the four 24-hour collection periods. Several factors could have influenced the urine volumes, and it is realized that, due to the psychological stress imposed, some shelterees could have, through hostility, purposely discarded part of their urine. Volumes on one individual who was known not to have cooperated were omitted from the analysis.

Because of the question of accuracy of the 24-hour urine volumes, most analyses were based on excretion/gm. of creatinine rather than on actual volumes.

It was concluded that the measured urine volumes were within a reasonable range, even though considerably below volumes of the BYD study. It should be remembered that subjects in the Georgia study were of both sexes, with a range in age from 7-67 years, whereas the BYD subjects were all young healthy adult males having an average age of nineteen years. Six of the Georgia subjects completing the test were less than 16 years of age. The age and size of the individual would naturally have a definite bearing on the urine output. Adults on an average diet need approximately 500 ml. of urine to adequately excrete waste products; however, in the Georgia study not all shelterees were adults. Other factors were reduced food intake, reduced fluid intake, and excessive moisture loss from the skin. A rise in blood NPN has been noted (Table 34), possibly due to depressed kidney function. Favorable comparisons were observed between measured urine volumes and volumes calculated on the basis of creatinine. (See Table 37 and Figure 26.)

Considerable reduction in urine occurred concurrently with the reduced fluid intake and this is graphically shown in Figure 24. By observation and shelteree testimony, it was learned that each shelteree was conserving water, and because of its taste and temperature also, he drank only what he thought absolutely necessary. The peak water consumption on the second day could indicate that some shelterees set their water ration too low on the first day and felt partially dehydrated. It is of interest

Table 35

Food and Water Consumption
(Experimental Study II)

| Day* | Water Consumed (ml/person) Male | Female | Both | Food Consumed (gms/person) Male | Female | Both |
|---|---|---|---|---|---|---|
| 1 | 1368 | 1098 | 1224 | 138.2 | 94.9 | 115.53 |
| 2 | 1566 | 1350 | 1440 | 146.5 | 90.8 | 113.47 |
| 3 | 1440 | 1422 | 1440 | 264.1 | 181.5 | 222.80 |
| 4 | 1350 | 1314 | 1332 | 233.1 | 140.3 | 187.73 |
| 5 | 1332 | 1278 | 1296 | 257.9 | 152.7 | 206.30 |
| 6 | 1350 | 1296 | 1314 | 235.2 | 140.3 | 187.73 |
| 7 | 1314 | 1188 | 1260 | 249.6 | 123.8 | 193.92 |
| 8 | 1386 | 1224 | 1296 | 249.6 | 146.5 | 208.36 |
| 9 | 1242 | 1134 | 1188 | 247.6 | 136.2 | 193.92 |
| 10 | 1260 | 1008 | 1134 | 255.8 | 127.9 | 193.92 |
| 11 | 1206 | 1098 | 1152 | 241.4 | 117.6 | 181.54 |
| 12 | 1278 | 1044 | 1170 | 249.6 | 125.8 | 189.80 |
| Mean | 1341 ml | 1205 ml | 1271 ml | 230.7 gm | 131.5 gm | 182.91 gm |
| | 1.4 qts | 1.3 qts | 1.4 qts | 992.1 cal# | 565.6 cal | 786.51 cal |

*The first and last experimental days consisted primarily of testing and only partially of shel er occupancy. Consumption data for these days are omitted.

#To convert grams to calories multiply no. of grams x 4.3

to note that the males always consumed more water than did the females, that both sexes drank less with the progression of time, and that the females decreased their daily consumption at a faster rate. This correlates very well with the urine specific gravities (Figure 24) which show an increase in the specific gravity of the females at the same time as their lowest water consumption and urine excretion. It is also interesting to note the similarities for each sex between the water and food consumptions, shown in Figures 24 and 25, respectively.

There was little difference in the specific gravities of the male and female group, except that males were always slightly higher. This latter fact could be due to higher daily food intake on the part of the males. The mean value for the entire shelteree group rose from the first collection period value of 1.029 to the last collection value of 1.040. The latter value is understandable in view of the restricted fluid intake, decreases in urine volume, and excessive skin losses. This finding is clinically significant in that normal subjects rarely exceed 1.040.

Statistically reliable changes in the overall urinalysis data are presented in Table 36.

B. Urinary Excretion Studies

Due to low urine volumes, it was decided that excretion values should be calculated in terms of excretion/gm. creatinine. Creatinine is formed in quite constant amounts, and since daily excretions are only slightly influenced by changes in diet and urine volumes, it is used in balance studies to check on the accuracy of 24-hour urine collections. Mean values of creatinine excretion, estimated urine volumes and measured urine volumes are compared in Table 37 and Figure 26. The estimated urine volumes compared favorably with the measured collections although the former was in most instances slightly higher.

The creatinine excretions show the males to have had a higher rate of excretion than the females throughout the test period. Both groups demonstrated the same pattern of change, a fact which reflected not only the constancy of creatinine excretion, but also a correlation with the decrease in urine excretion.

C. Urinary Riboflavin (Vitamin $B_2$)

A meaningful comparison between Georgia and BYD data on urinary riboflavin excretion must take into consideration the age differences between the two groups. In the Georgia test there was a considerable decrease in the amount of riboflavin

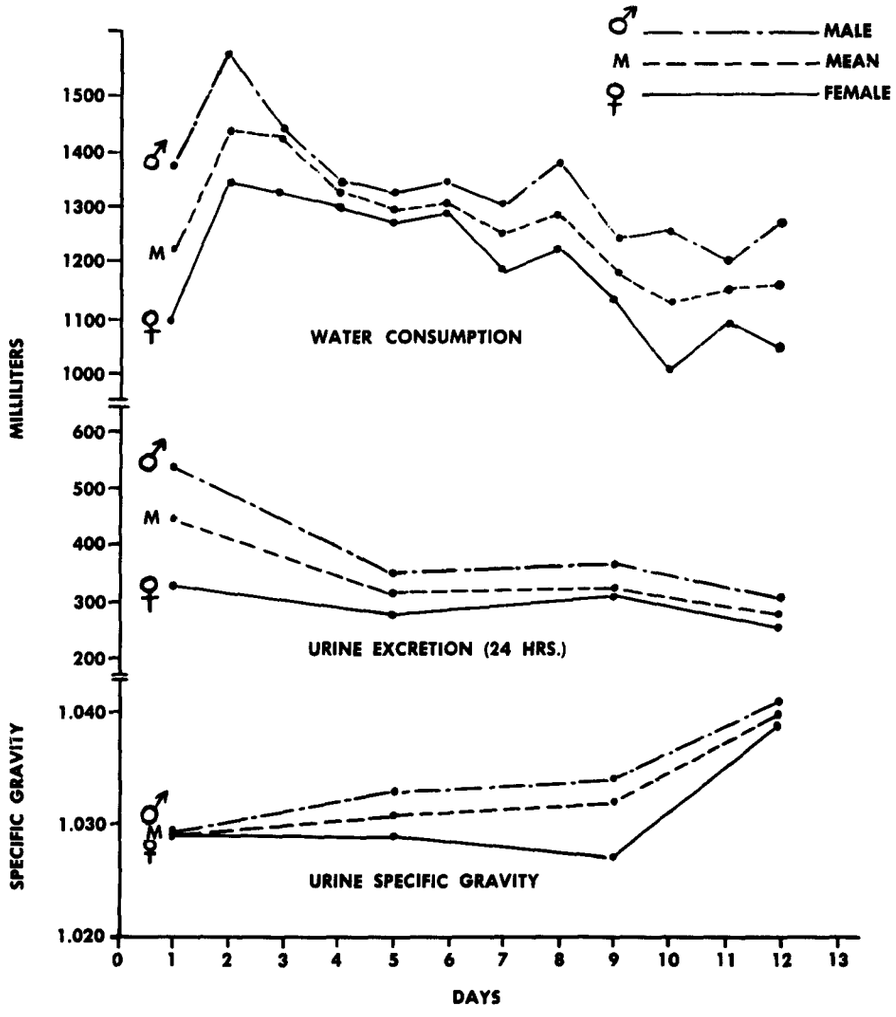



**FIGURE 24 COMPARISON OF WATER CONSUMPTION, URINE EXCRETION, AND URINE SPECIFIC GRAVITIES (ES II)**

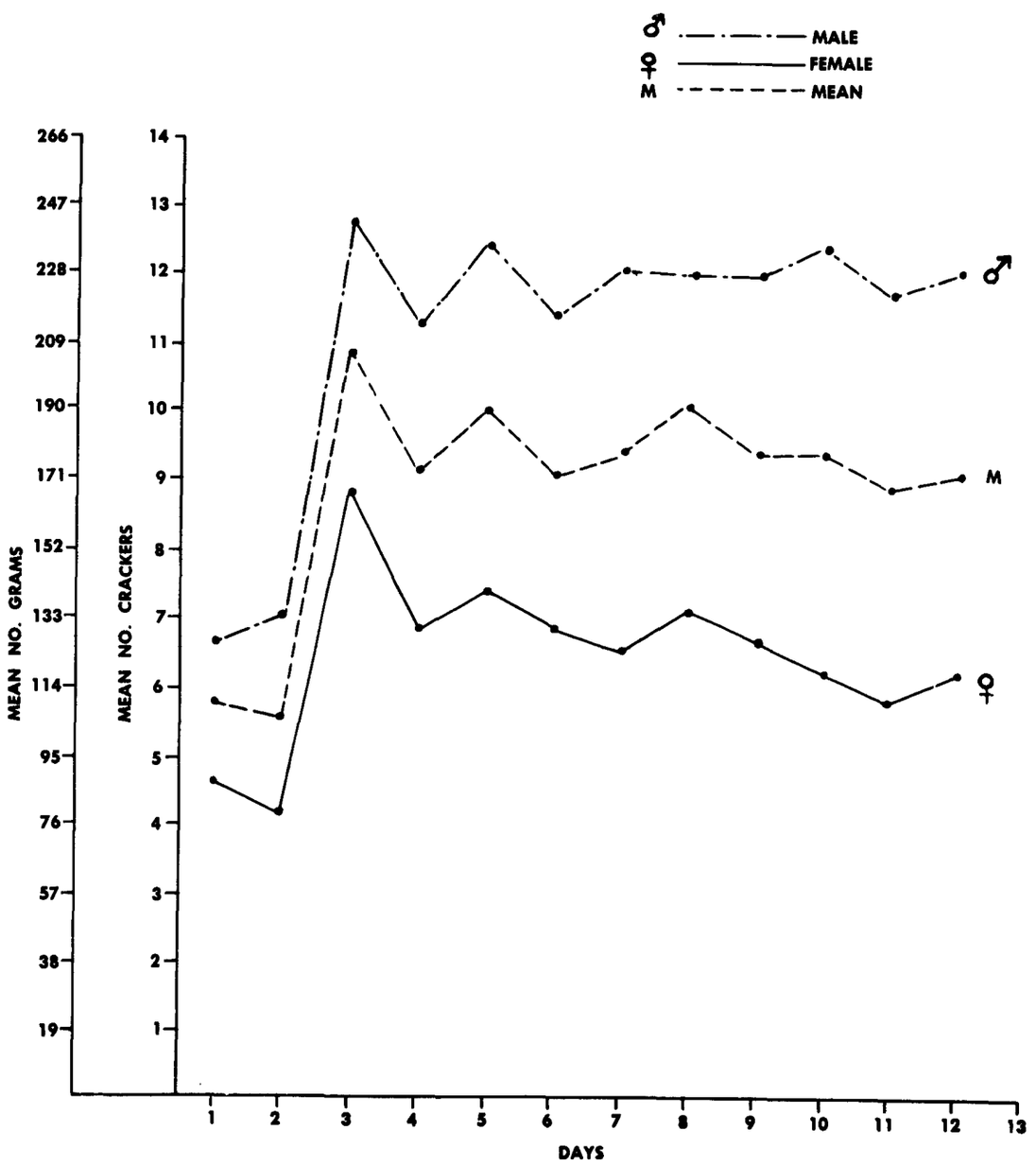



**FIGURE 25 FOOD CONSUMPTION (ES II)**

Table 36

Statistically Significant Changes
in Urine Analyses

| Urine Analysis | Variable | P |
|---|---|---|
| Urine Excretion | Sex | .005 > P |
| | Pre-Post* | .001 > P |
| Urinary Creatinine | Sex | .10 > P > .05 |
| | Pre-Post | .01 > P |
| Urine Specific Gravity | Pre-Post | .001 > P |
| Urinary Riboflavin (Vit. $B_2$) | Pre-Post | .01 > P |
| N'Methylnicotinamide | Sex | .06 |
| | Pre-Post | .01 > P |
| Urinary Niacin (Vit. B Complex) | --- | (no significant change) |
| Urinary Thiamine (Vit. $B_1$) | Pre-Post | .05 > P |

*Changes over the four days' collections

Table 37

Measured Urine Volumes Compared With
Creatinine Estimated Volumes*

| Collection Day | Determinations | Male | Female | Both |
|---|---|---|---|---|
| 1st | Creatinine, gm/100ml | .286 | .199 | .241 |
| | Estimated** Vol.(ml) | 456 | 510 | 477 |
| | Measured vol. (ml) | 538 | 329 | 442 |
| 2nd | Creatinine, gm/100ml | .315 | .253 | .284 |
| | Estimated Vol. (ml) | 413 | 395 | 412 |
| | Measured vol. (ml) | 356 | 271 | 316 |
| 3rd | Creatinine, gm/100ml | .331 | .248 | .258 |
| | Estimated Vol. (ml) | 393 | 405 | 410 |
| | Measured vol. (ml) | 366 | 312 | 320 |
| 4th | Creatinine, gm/100ml | .423 | .321 | .371 |
| | Estimated Vol. (ml) | 307 | 315 | 310 |
| | Measured vol. (ml) | 304 | 248 | 278 |

*Analyses by AMRNL

**Estimated volumes based on creatinine excretion factor of 1.3 gm/day for males, 1.0 gm/day for females and 1.15 gm/day for both sexes

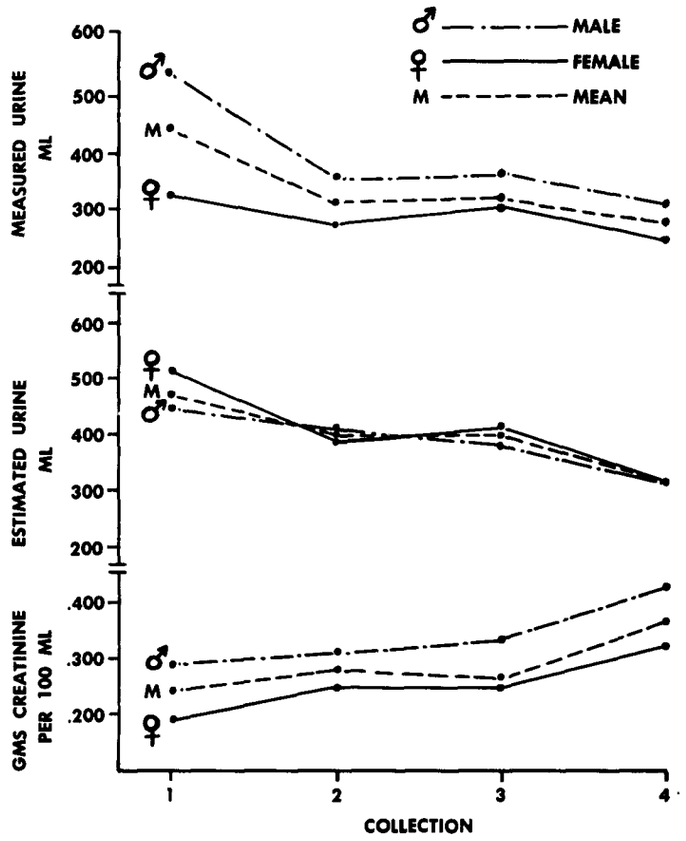



**FIGURE 26** COMPARISON OF MEASURED URINE VOLUMES WITH CREATININE EXCRETION AND ESTIMATED URINE VOLUMES

eliminated throughout confinement. Although the trend was toward deficiency, there were enough subjects remaining in the "High" and "Acceptable" ranges to conclude that the diet was adequate to sustain an individual for a two-week period (Table 38 and Fig. 27).

D. N'Methylnicotinamide (N'MN)

The excreted amount of N'MN, a urinary niacin metabolite, was determined in an attempt to evaluate the dietary status of niacin (Table 39 and Fig. 28).

Males were found to show more N'MN excretion throughout the confinement period than did females, and there was a significant increase in the amount of N'MN being excreted by both sex groups. This fact was sufficient to cause an increase of 14 to 18 in the number of shelterees in the high range. Of further interest is the fact that on the third collection period twenty-one shelterees were found to be in the high range.

These findings appear contrary to those of the BYD study. It is possible, however, that the niacin and tryptophan quantity of the Georgia survival ration was actually higher than the native diet of many of the shelterees; whereas, the BYD study may have used men subsisting on previously nutritionally sound rations. The ICNND manual indicated that unusually large excretions may be observed during prolonged fasting and in subjects in negative nitrogen balance. The Georgia group was in negative nitrogen balance for the entire period of study.

E. Urinary Niacin (Vitamin B Complex)

Niacin excretion was determined and compared to values quoted in the BYD study. A normal range was considered to be 0.14-1.40 mg. niacin excretion per day. The Georgia data (Table 40 and Fig. 29) are within normal range. The decrease in the amount excreted by both sexes was not statistically significant. The decrease noted in the BYD study, although thought to be interesting, was not considered an indication of a problem in niacin nutrition.

F. Urinary Thiamin (Vitamin $B_1$)

A strong contrast to the BYD study, and a fact supporting the possibility of the Georgia shelterees as having a poorer nutritional background, was the great number of subjects in the thiamine deficiency range (Table 41, Fig. 30). Previous work, as discussed by Pearson, indicates that a definite correlation exists between the urinary excretion of thiamine/gm. creatinine and thiamine intake. Pearson noted differences in the expected excretions when sex and age are considered, and proposed a guide

Table 38

Urinary Riboflavin (Vit. $B_2$) Excretion#
(Micrograms/gm Creatinine)

| Collection | Male | Female | *Ages | Def** | Low** | Accept** | High** |
|---|---|---|---|---|---|---|---|
| | | | 7-9 | <85 | 85-269 | 270-500 | >500 |
| | | | 10-15 | <70 | 70-199 | 200-400 | >400 |
| | | | *Adults | <27 | 27-29 | 80-270 | >270 |
| 1 | 543 | 665 | | 0 | 0 | 3 | 21 |
| 2 | 389 | 404 | | 0 | 0 | 4 | 20 |
| 3 | 345 | 355 | | 0 | 0 | 7 | 17 |
| 4 | 324 | 352 | | 0 | 0 | 12 | 12 |

*Pearson
**ICNND
#Analyses by AMRNL

Table 39

Urinary N'Methylnicotinamide (N'MN)#
(Milligrams/gm Creatinine)

| Collection | Male | Female | Def* | Low* | Accept* | High* |
|---|---|---|---|---|---|---|
| | | | <0.5 | 0.5-1.59 | 1.6-4.3 | >4.3 |
| 1 | 3.2 | 6.1 | 0 | 2 | 8 | 14 |
| 2 | 5.5 | 8.3 | 0 | 0 | 6 | 18 |
| 3 | 8.2 | 11.2 | 0 | 0 | 3 | 21 |
| 4 | 7.1 | 8.8 | 0 | 0 | 6 | 18 |

*ICNND
#Analyses by AMRNL

Table 40

Urinary Niacin (Vit. B Complex) Excretion#

| | Male | | Female | |
|---|---|---|---|---|
| | mcg/100 ml.urine | mg/day* | mcg/100 ml.urine | mg/day* |
| 1 | 128 | .584 | 116 | .592 |
| 2 | 124 | .530 | 147 | .558 |
| 3 | 118 | .464 | 117 | .475 |
| 4 | 152 | .464 | 137 | .432 |

*Based on estimated urine volumes
#Analyses by AMRNL

Table 41

Urinary Thiamine (Vit. $B_1$) Excretion#
(mcg/gm creatinine)

| Collection Period | Male | Female | No. of Shelterees | | | |
|---|---|---|---|---|---|---|
| | | | Def* <27 | Low* 27-65 | Accept* 66-130 | High* >130 |
| 1 | 46.4 | 101.2 | 11 | 8 | 3 | 2 |
| 2 | 13.4 | 28.2 | 22 | 2 | 0 | 1 |
| 3 | 10.3 | 13.9 | 24 | 0 | 1 | 0 |
| 4 | 8.7 | 10.7 | 22 | 2 | 0 | 0 |

#Analyses by AMRNL
*ICNND standards

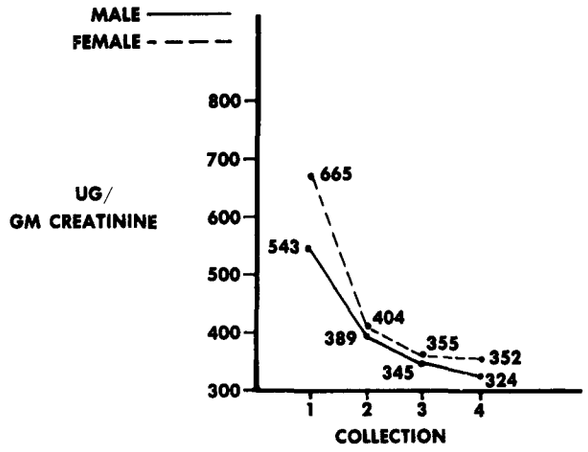



FIGURE 27 URINARY RIBOFLAVIN (VIT. $B_2$) (ES II)

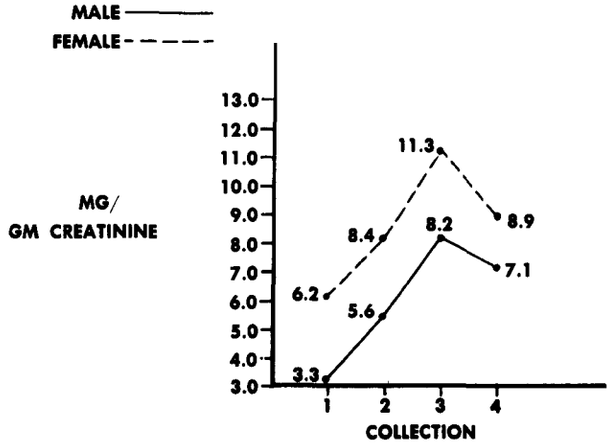



FIGURE 28 N'METHYLNICOTINAMIDE (ES II)

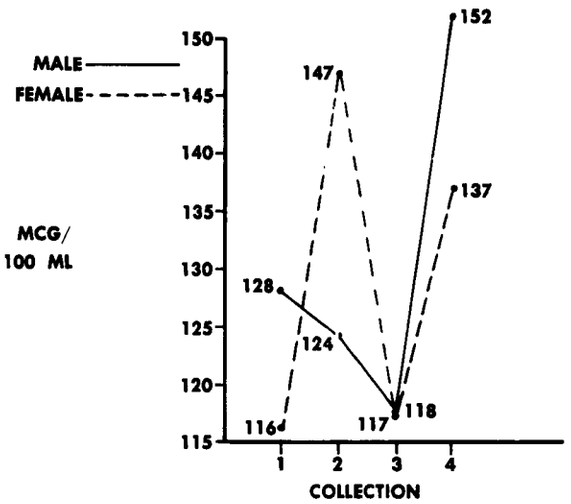



FIGURE 29 URINARY NIACIN (VIT. B COMPLEX) (ES II)

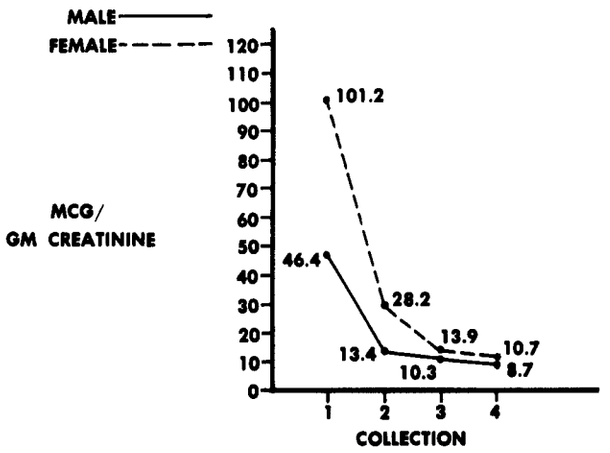



FIGURE 30 URINARY THIAMINE (VIT. $B_1$) (ES II)

for use on mixed population studies (Table 42). When results from the Georgia study are related to Pearson's guide, there is even greater evidence of dietary deficiencies reflected in the Georgia sample (Table 43). Seventy-five percent of the shelterees were in the deficient range at the beginning and all were deficient on the final collection. One individual, a 41-year old female, decreased her excretion from 859.8 to 189.0, 70.2 and 28.3 mcg/gm. creatinine, on subsequent collections.

Comparison of results of thiamine excretion with erythrocyte transketolase stimulation (ETS) should reflect similar trends. The ETS did suggest that dietary thiamine was inadequate, and thiamine excretion analysis indicates a definite deficiency. When the mean intake of thiamine was considered, it was found that the shelterees consumed only .35 mg. thiamine/day (males, 0.44; females, 0.25) which is less than the 0.6-1.0 mg/day suggested by ICNND and considerably less than the average daily intake of those on the BYD study. (BYD averaged 1.62 mg./day for days 1-8 and 2.14 mg./day for days 9-14). Thus, it is clear why the Georgia group could decrease in thiamine excretion, for if each shelteree consumed 12 wafers/day, his maximum intake would be .47 mg. and below the ICNND standards. McHenry*, in discussing factors affecting thiamine requirements, based his requirements on mg of thiamine/1,000 calories and recommended minimum requirements of 0.5 to 0.6 mg./1,000 calories/day. McHenry also stated that if the caloric intake became less than 2,000 calories the total thiamine intake per day should not drop below 1 mg. In the present study the mean caloric intake was 787 calories person/day.

These findings do not mean that the short period on deficit diet was detrimental to the shelterees' health. McHenry, in discussing several research efforts, points out that adults have been maintained for periods up to three years on diets containing 0.18 mg./1,000 calories with only slight manifestation of deficiency.

G. Urinary Pyridoxine (Vitamin $B_6$)

Values obtained in this test (Table 44) did not show the marked decrease obtained in the BYD study. A reason for this could be the fact that the initial samples were approximately half of the value given for the BYD controls. The mean values fluctuated in a narrow range, and can be considered "acceptable." Since a precise guide for evaluating 24-hour collections is not available, no attempt was made to classify individual shelterees.

*McHenry, E. W. Basic Nutrition (Rev. Ed.) Philadelphia: Lippencott, 1963.

Table 42+

Tentative Guide For the
Interpretation of Thiamine
Excretion (ug/gm. Creatinine) By Children

| Age Group | Def | Low | Accept. | High |
|---|---|---|---|---|
| 1-3 | <120 | 120-175 | 176-600 | 600 |
| 4-6 | < 85 | 85-120 | 121-400 | 400 |
| 7-9 | < 70 | 70-180 | 181-350 | 350 |
| 10-12 | < 60 | 60-180 | 181-300 | 300 |
| 13-15 | < 50 | 50-150 | 151-250 | 250 |
| Adult Male* | <38 | 38-115 | 116-195 | 195 |
| Adult Female** | <33 | 33-96 | 97-165 | 165 |
| ICNND Adult | <27 | 27-65 | 66-130 | 130 |

+From Pearson, W. N. Am. J. Nutrition, 1962, 11, 462-476.
*Creatinine Coefficient = 24.0; caloric intake = 3,200
**Creatinine Coefficient = 24.0; caloric intake = 2,300

Table 43

Thiamine Excretion
(mcg/gm. Creatinine)
(Results compared with Pearson's Guide)

| | Def | Low | Acceptable | High |
|---|---|---|---|---|
| 1 | 18 | 4 | 1 | 1 |
| 2 | 23 | 0 | 0 | 1 |
| 3 | 23 | 1 | 0 | 0 |
| 4 | 24 | 0 | 0 | 0 |

Table 44

Urinary Pyridoxine (Vit. $B_6$) Excretion*#

| Period | Male | | Female | |
|---|---|---|---|---|
| | mcg/100 ml | mcg/24 hrs | mcg/100 ml | mcg/24 hrs |
| 1 | 5.6 | 25.5 | 5.9 | 30.0 |
| 2 | 6.6 | 27.4 | 6.9 | 27.2 |
| 3 | 5.7 | 22.4 | 5.8 | 23.5 |
| 4 | 9.7 | 29.8 | 9.9 | 31.2 |

*Based on estimated urine volumes
#Analyses by AMRNL

Another possible reason for the BYD subjects to deplete pyridoxine faster than the Georgia group would be the fact that the protein intake of the former was considerably higher. An increased amount of amino acid metabolism would subsequently use more pyridoxine.

H. Non-Protein Nitrogen

Non-protein nitrogen (NPN) studies were conducted on urine to demonstrate nitrogen balance deficit.

Since NPN is composed chiefly of end-products of protein metabolism, the amount excreted is greatly influenced by dietary changes and abnormal metabolism. Nitrogen balance is attained when the intake of protein nitrogen exactly matches nitrogen excretion from the body. Since elimination occurs at a reasonably constant rate from feces and other extrarenal channels, the urine nitrogen excretion is considered the reflection of protein metabolism. Thus, an individual is considered to be in negative nitrogen balance if his protein nitrogen intake is less than the total NPN that he is excreting. Since a person on a starvation diet will continue to degrade body protein into amino acids, he must receive approximately 25-50 grams of protein daily to maintain nitrogen balance. The average protein consumption per day in the Georgia study was only 13.4 gm. (for the two-week period) and the highest single daily intake was 16.2 gm. Therefore, it is understandable that the group, as a whole, would be in negative nitrogen balance. This fact is shown in Table 45. The mean values for the entire group did not show significant fluctuation and do not correlate with protein intake. The negative nitrogen balance is consistent with the average shelteree weight loss of 7.4 lbs. per person (males, 8.0 pounds; females, 7.3 pounds).

Table 45

Non-Protein Nitrogen Excretions
Compared With Protein Intake

| Study Day** | Average of 24 Shelterees Intake Protein gm/day** | Protein** N G/Day | Urine Excretion Urine NPN* gm/Day |
|---|---|---|---|
| 1 | 8.25 | 1.32 | 10.49 |
| 5 | 13.65 | 2.18 | 5.40 |
| 9 | 14.10 | 2.26 | 7.05 |
| 12 | 13.80 | 2.21 | 7.88 |
| AV | 12.45** | 1.99** | 7.70 |

*SVMUG
**Values and means for collection days only

## Chapter 8 - Research Film

Part of the project mission was to film the research results. Consequently, in-shelter activities of Experimental Study II, a two-week study, and Experimental Study IV, the one-week children's study, were visually recorded.

A breakdown of the resultant twenty-nine minute, 16 mm, black and white sound motion picture follows:

| | | |
|---|---|---|
| :20 | TITLE Survival in the Community Shelter | 00:20 |
| :20 | OPENING STATEMENT (purpose of study - its implications) | 00:40 |
| 1:20 | THE SHELTEREES<br>Where they came from<br>Testing and Examinations | 02:00 |
| 1:50 | DR. HAMMES' WELCOMING STATEMENT | 03:50 |
| 2:45 | DESCRIPTION OF SHELTER<br>Over-all dimensions<br>Staff and Control operations<br>Shelter rules | 06:35 |
| 4:30 | THE FIRST FEW HOURS<br>Entry<br>Civil Defense Survival Provisions<br>The first meal<br>The first night | 11:05 |
| 1:50 | SUNDAY IN THE SHELTER<br>Normal daily activities<br>Sunday service | 12:55 |
| 1:15 | GRAPHIC (Averages of time spent in three positions: Lying, Sitting, Standing) | 14:10 |
| 1:00 | SHELTER LIVING<br>Training lectures<br>Making games from materials at hand<br>Children at schoolwork | 15:10 |
| 1:50 | GRAPHIC (Averages of time spent at Conversation, Recreation, Quiet, and Sleeping) | 17:00 |
| :40 | A SHELTER CHRISTMAS PARTY | 17:50 |

| | | |
|---|---|---|
| 1:35 | GRAPHIC (Noise-Activity relationship) | 19:20 |
| 2:00 | SECRETARY OF DEFENSE PITTMAN VISITS THE SHELTER<br>Reaction of Shelterees<br>Reaction of the Assistant Secretary | 21:20 |
| 1:00 | BOREDOM IN THE SHELTER | 22:20 |
| :40 | GRAPHIC (Mood fluctuations over the study) | 23:00 |
| 1:30 | LEAVING THE SHELTER<br>The confinement ends<br>Post-Shelter examinations<br>Conclusions | 24:30 |
| 3:30 | THE CHILDREN'S STUDY (IV)<br>Similarities and differences<br>Nurse's role<br>The Shelter Manager Defection<br>Conclusions | 28:00 |
| 1:00 | CLOSING CREDITS | 29:00 |

# SUMMARY AND CONCLUSIONS

During 1962 and 1963 the University of Georgia Psychological Laboratories conducted for the Office of Civil Defense a series of simulated fallout shelter occupancy studies. Men, women, and children, age 7-70 years, participated in studies which varied from four days to two weeks in the length of isolated confinement. These studies have surpassed in austerity all previous shelter research using civilians. Occupants were allotted 8 sq. ft./person of space, slept on a concrete floor covered only with thin cardboard, and subsisted on severe rations of 1 qt./person/day of water and less than 850 cal./person/day of survival food without adjuncts.

Specific Conclusions

The following statements are in reference to the conditions under which the occupancy tests were conducted. Caution should be exerted in extrapolating these findings to realistic conditions of actual nuclear war.

A. Experimental Variables

1. Space - Eight square feet per person, exclusive of storage, although uncomfortable, would appear to be adequate for the community fallout shelter, six square feet per person for children in the elementary school fallout shelter. These conclusions are restricted to optimal temperature and adequate ventilation conditions.

2. Water - Under optimal temperature conditions, an average of 1 qt./person/day of water is adequate for a two-week occupancy period.

3. Food - Under optimal temperature conditions, an average of 814 cal./person/day of OCD survival rations without adjuncts is adequate in maintaining good physiological condition for a two-week occupancy period.

4. Sleeping Conditions - Corrugated fiberboard pallets provide an uncomfortable but adequate sleeping surface, although blankets would be a valuable addition to shelter supplies. Bunks are unnecessary unless vertical utilization of space is desired.

5. Sanitation - The commode chemical provided for use in the chemical toilet is inadequate in removing toilet odor as a primary complaint, but is satisfactory in combination with sodium nitrate. The hand cleaner, though functional, does not remove the appearance of dirt, and leaves a "greasy" film.

B. Defections

1. Shelterees exiting prior to study completion (26 of 120 participants) did so primarily for reasons of psychological instability, and inability or unwillingness to adjust.

2. Headaches, body aches, and nausea were secondary reasons for early exit.

C. Shelteree Reactions

1. Pre-Shelter Questionnaire

The following conclusions are based on statements of shelterees on a questionnaire given prior to entry:

a. Primary motivation for study participation was interest in nuclear survival.

b. The majority of shelterees were inadequately prepared for survival.

c. The public school system proved the most fruitful means of shelter participant recruitment.

d. Shelterees anticipated sleeping conditions as the source of greatest shelter discomfort.

2. Shelter Diaries

a. In the two-week studies the occupants reached their lowest morale level at the midpoint of the occupancy period, i.e., at the end of the first week.

b. When depression does occur, it is highest in the morning hours, and diminishes toward the end of the day.

3. Medical Complaints

a. Headache was the most frequent in-shelter medical complaint, followed by colds, sore throats, nausea, and homesickness (in the children's study).

b. Frequency of complaints decreased as occupancy continued.

c. Nearly all medical complaints were resolved by the use of aspirin.

4. Post-Shelter Questionnaire

The following conclusions were indicated in the responses received on a questionnaire given upon completion of the occupancy period:

a. More than 80% of the shelterees expressed satisfaction with having volunteered for confinement; more than 60% were willing to volunteer again; and less than 50% reported confinement to be a personal hardship.

b. Shelterees participating in the longer confinement studies gave longer estimates of endurance for extended stay than those shelterees participating in studies of shorter duration. Estimates given by men exceeded those of the women and children.

c. Primary discomfort factors were sleeping conditions, lack of bathing facilities, odors, the chemical toilet, uncomfortable temperature, lack of space, and food.

5. Sociometric Analysis

Evaluation by the shelterees of each other indicated the following conclusions:

a. The older adults provided a stabilizing influence in the shelter.

b. The encouragement of individual talent and initiative appeared imperative in the formation of a satisfactorily interested and active shelter group.

c. Abilities not usually emphasized outside of confinement were welcomed under the shelter conditions, and contributed greatly to group morale.

d. Leadership appeared to come most readily from older teenagers and young adults.

D. Behavioral Measures

1. Activity -- Activity declined from a relatively high level upon shelter entry to a low point about midway in a study.

2. Noise - The noise level paralleled the activity level to the midpoint of a study, then continued a gradual decline.

3. Knowledge of Time - Activity and noise levels of groups provided with knowledge of time of day correlated highly with those of groups deprived of such information.

4. Bodily Positions - Approximately one-half of shelter time was spent in the lying position, one-third in the sitting position, and one-sixth in the standing position.

5. Activity Patterns - The most time-consuming activities were sleep, quiet reflection, conversation, and recreation.

6. Trends in Behavior - No marked trends were noted in bodily positions and activity patterns, indicating a fairly consistent physiological state throughout confinement.

7. Perception of Time - Time passed rapidly during the first few days of confinement, and more slowly during the latter part of occupancy.

E. Environmental Measures

1. Shelterees requested higher preferred temperatures as the occupancy period continued, indicating an increasingly greater sensitivity to lower temperatures.

2. Higher temperatures were preferred during the night than during the day.

3. Thermal characteristics of the simulated shelter required increased ventilation during daytime hours to keep temperature and humidity optimal, a specified experimental condition.

F. Pre- and Post-Shelter Testing

1. Medical Examination - Other than a weight loss, recovered within two weeks, shelterees emerged in good physical condition on completion of confinement.

2. Physical Fitness - No deleterious effects were observed in physical fitness, psychomotor performance, visual motor coordination, depth perception, and dynamic balance.

3. Psychological Testing - No attenuation of mental abilities, attention span, concentration, or mental efficiency was indicated in test results. Neither were there any adverse effects on personal-social adjustment scores as a result of shelter confinement.

General Conclusions

A. Healthy men, women, and children can endure two weeks' isolated shelter confinement under conditions of severe austerity without suffering deleterious physiological or psychological effects.

B. OCD supplies as presently stocked in public fallout shelters appear to be sufficient for healthy men, women, and children for a two-week survival period.

## Implications for Further Research

The occupancy studies conducted to date at the University of Georgia have indicated the adequacy of presently stocked OCD supplies for the maintenance of good physiological state of healthy men, women, and children. It was also found that no deleterious psychological or social effects occur from two-week periods of group confinement under austere conditions.

By the spring of 1963, it was apparent to the Georgia researchers that certain aspects of occupancy research had emerged as pivotal points for future research. These aspects were at that time presented to the Office of Civil Defense as follows: (1) the development of an in-shelter activity program that would (a) help occupants to adjust rapidly to shelter life, and (b) prepare them for immediate adjustment to the post-attack world upon emergence; (2) the development of an abbreviated yet realistic shelter manager training course to be implemented on a nationwide basis in event of a sudden nuclear emergency; (3) the development of an in-shelter handbook for use by groups without a trained shelter manager; (4) continual assessment of changes in the OCD stocking policy. It was further recommended that these four areas be evaluated experimentally.

A. In-Shelter Program

The need for a good in-shelter program is obvious. However, there can be various emphases placed on the orientation of such a program. The Georgia researchers believe that training involving shelter adjustment can be effected within a few days; the program should then be oriented toward adjustment to the post-attack world. This training involves both the empirical knowledge of physical adjustment, e.g., decontamination techniques, sources of stored food supplies, etc., and also psychological preparation, i.e., strengthening of morale and motivation, so that upon emergence the civilian population will "turn to" and exert maximal effort toward national stabilization.

B. Shelter Manager Training

The historical record of the U. S. indicates a reluctance in preparing for war. The public attitude toward Civil Defense seems to indicate a slowness in implementing a civilian training program. There is a real possibility, therefore, that this nation will suddenly encounter a nuclear emergency without sufficient civilian preparation for fallout shelter living. Consequently, and realistically, it would appear advisable to have ready a practical short

course, crash program type of shelter manager training, amenable to instant nationwide implementation. This program might conceivably be reduced to a one-day indoctrination in the essentials of survival.

C. Shelter Handbook

The severest assumption, of course, is that the civilian population will be totally unprepared and suddenly thrust into the community fallout shelter situation. This possibility should be realistically met. A solution would be a handbook to be placed in all fallout shelters as part of standard stocking procedures. The handbook would be constructed in such a way that it could be implemented by the naive shelter leader with average intelligence. Followed faithfully, the content of the manual would insure in-shelter training and adjustment, as well as adequate planning for post-shelter emergence.

All of the above aspects of Civil Defense research should be investigated <u>experimentally</u>. To survey the literature and write manuals are only preliminary steps. Experimental validation is the best means of assessing the value of Civil Defense preparedness. Obviously, the true attack situation can never be experimentally created; nevertheless, many aspects can be successfully simulated. Those aspects of Civil Defense which <u>can</u> be experimentally evaluated <u>should</u> be. In accordance with this policy, the Civil Defense Research Staff at the University of Georgia is planning for a 300-person occupancy study, in anticipation of a subsequent 1,000-person occupancy study.

APPENDIX A

## Shelter Manager Reports

Upon completion of each occupancy the shelter manager (SM) was requested to submit a written report of his experience. Recommendations, criticisms, and commendations upon both training and occupancy were solicited. The report was to be a condensation of post-shelter reflections during the week or two following exit. No particular outline or form was suggested since it was assumed that the report would necessarily contain the aspects of the leadership experience deemed of personal importance to the SM. Each of the five SMs (two in ES IV) submitted a post-shelter report within six weeks following exit. The reports were edited to exclude such things as introductory statements, references to personal background, and repetition.

The SM reports may be evaluated in several dimensions. One of the outstanding differences was the degree to which each manager identified with the overall purpose of the occupancy tests. The younger, more intellectual leaders currently or recently engaged in academic pursuits apparently grasped the research nature of the endeavor. To this end they adopted a problem solving attitude with emphasis upon the adaptability of the group to the situation. The SMs who apparently failed to adopt this research attitude were more self-concerned with their individual problems and frustrations.

The reports also differed in organization. The most general and far-ranging reports were written by the SMs of ES I and II. The report by SM for ES III interpreted his task as that of identifying important aspects of his brief training experience. The SMs for ES IV interpreted their roles as administrators, similar to that which they held as principals of their schools. The latter reports reflect concerns over administrative details and lack the scope of the other reports. Apparently, the shelter managers reflected in their performance and their reports the roles and status of their present, everyday life.

The overall nature of the reports indicated concerns, problems, recommendations, and evaluations of relatively minor points insofar as survival is considered. All apparently agreed that the shelter conditions and situations were generally compatible if survival were the background theme. The chief value is perhaps the insight offered the reader in viewing the shelter experience through post-shelter reflection of five shelter leaders.

Shelter Manager Post-Shelter Report, Experimental Study I (4-day occupancy):

> The shelter itself appeared to be adequate with a minimum of essentials to sustain life during a required stay under actual conditions. However, I believe a few remarks should be made about a few of the more specific items.

The space provided for each shelteree during this study, though below the recommended space, appeared to be sufficient under most circumstances. During the hours of sleep, however, there was a lack of space which created a few problems, most of these being minor and accepted by the majority of the shelterees. One of the shelterees (#28) having an artificial leg probably presented the greatest problem. The shelteree, having no feeling in this limb, occasionally kicked several people very hard and added to their discomfort. Most of the shelterees appeared to accept this fact, however, and adjusted accordingly, trying to avoid this situation as much as possible. Only a few complaints were expressed about this situation during the stay.

Sleeping on the cement floor probably presented one of the greatest problems to the shelterees. The floor was very uncomfortable to everyone. Many of the shelterees were unable to obtain more than a few hours sleep at a time. After the first night everyone expressed different degrees of soreness from sleeping on the floor. This problem increased in severity as time passed, every place that touched the floor becoming very sore and thus preventing sleep. After two days there appeared to be a very few, if any, ways to lie in comfort. The fourth and last night in the shelter, more sleep was obtained by the shelterees as a whole than at any other time. It was my personal experience to be a little less sore, and I found it easier to adjust to the floor. The same opinion was expressed by several other shelterees. The lack of sleep on the previous nights may have accounted for the increase in hours of sleep obtained on this night. The knowledge that they would be released the next morning may have also facilitated sleep on this night.

The food, in the form of survival wafers, left much to be desired among many of the shelterees, myself included. They appeared to be adequate as far as curbing hunger pains, but they presented a problem to a few shelterees and myself because of the amount of water available. I found that they created an intense desire to drink water, becoming entirely unchewable on the fourth day due to a lack of saliva. This problem also confronted shelterees #14 and #18, but not to the extent that I was affected. The wafers appeared to provide enough energy during the four-day period and would be adequate nourishment with an ample water supply.

The water ration provided (1 quart a day) probably created the greatest problem over the four-day period, other than sleeping on the cement floor. If the study had been carried further, I believe this would have become a very grave problem for shelterees #14, #18, and myself. The ration of one quart was entirely inadequate for those mentioned. None of the women in the shelter appeared to suffer from this condition. Many of them

consumed less than their ration during the stay. Dehydration became very apparent in my case and also began to be a problem with #14 and #18. Shelteree #14 remedied his condition by comsuming fourteen cups of water on the last night in the shelter. I believe it would have been impossible for #14, #18, or myself to survive a two-week stay with the amount of water provided. This may have become quite a problem among some of the other shelterees if the study had been conducted for a longer period of time.

The cups provided for drinking pusposes presented a few problems. They appeared to be easily broken and were not very substantial. They were exposed to more damage than under ordinary circumstances due to the lack of an adequate storage place while they were not in use.

The supplies in the medical kit appeared to be sufficient in most cases. However, I think that a few things could be added which will be discussed later.

During the stay, a total of eight shelterees left the shelter for various reasons. These shelterees can be classified in two general groups, the first being those of lower education and from the lower class of people, and second, those that withdrew from the rest of the shelterees. Shelterees #3, #4, #6, and #30 fit into the first group. Several of them left because others were leaving. Shelterees #25 and #26 left together, having influenced each other in this regard. Shelteree #25 is an exception to the first group in regard to education. Shelterees #17 and #29 fit into the second group. These two shelterees withdrew from the entire group and showed varying signs of depression. First they stopped talking to anyone, then refused food and water and finally broke into tears and requested to be removed. I believe the shelterees fitting into the first group failed to grasp the purpose of the study and thought it created too many problems for them to endure for the entire period of the study.

Morale among the shelterees as a whole remained very good, with a few exceptions. The removal of some of the shelterees presented quite a problem to shelteree #22 who expressed a desire to be removed when he saw the others leaving the shelter. However, this shelteree was talked into staying a while longer and expressed no further desire to be removed. Morale among the entire group fell to a low ebb when the wall was moved in after the removal of the shelterees. This appeared to have quite a psychological effect on all the shelterees, many of them expressing their dislike at this action. All remaining shelterees appeared to go through periods of depression lasting anywhere from a few minutes to several hours, but all seemed to be able to handle the situation and to overcome it. Morale appeared to

improve as time passed and was probably at its best the last night in the shelter. This improvement can be explained by the fact that the shelterees had been informed of the time of release the next morning.

Upon entering the shelter, a number of the shelterees began to improvise methods of self entertainment and types of entertainment designed for groups of four to six people. Several decks of cards were made and card games were frequent among a majority of the shelterees for the first few hours after entering. This type of entertainment was utilized less and less and was not used at all the last two days in the shelter. Entertainment became more of the group type involving nearly all of the shelterees and consisted mostly of conversation and discussions which were usually started without any prior suggestions or comments to stimulate these discussions.

Cooperation among the shelterees was outstanding during the entire stay. Some of the training sessions, however, failed to stimulate too much interest and discussion. This was probably the fault of the instructor, however. Everyone cooperated very well with the sleeping and eating times. No complaints were voiced to me at any time. Even after the lights were turned out during the rest periods, quite a bit of conversation and laughing continued for some time. No one appeared to be particularly annoyed, nor did they voice any complaints. I was unable to detect any jealousy among the shelterees at any time over even the smallest items, and there appeared to be no malice shown by any of the shelterees toward any member of the group.

The following are a few recommendations I believe may be of help in future studies and may make the study more like the actual conditions.

A study may be conducted in which the actual time of release is not known. This could be conducted by establishing a maximum time of stay in the shelter, but not letting the shelterees know the actual time of release. This should present more psychological problems for the shelterees as well as other problems of rationing, sanitation, and some unforeseen conditions. The removal of watches from the shelterees which would not be true under actual conditions would create problems as to loss of time, ways of telling day from night and would probably present many other conditions which would have to be reckoned with.

I would not recommend less than ten square feet of space per person under these conditions, as this may lead to hostilities among the shelterees in longer stays. The addition of a floor covering such as a 1/4-inch of foam rubber or a rubber pad of some type would help in making the shelter more comfortable. This would help in relieving some of the soreness that

developed from sleeping on the cement floor and thus may relieve some tension or hostility that could develop from this lack of comfort and would greatly facilitate sleeping.

I believe another type of drinking cup should also be recommended. The ones used in this study were broken very easily and developed holes wherever they cracked, resulting in leakage. I believe a regular paper cup with a plastic cover would prove to be more satisfactory. These are easily crushed but could still be used and would last longer than the plastic cups provided.

The chemicals used in the chemical toilet may have been adequate for destroying bacteria, but the deodorizing agent proved to be of little value after the first couple of days. This could create quite a problem in longer stays in the shelter and possibly be remedied somewhat by increasing the amount available for use which could be provided by adding an extra bottle of the chemical to each of the kits.

The number of sanitary napkins provided in each kit were adequate for this study, but I believe they would be entirely inadequate under different circumstances. Possibly the number of these should also be increased. The cost of these is very nominal compared to some of the other supplies provided. These napkins could also be used as bandages in the cases of an emergency. Consequently I believe the supply should be increased.

More leg exercises should be used during these stays. I experienced a feeling of weakness in the legs upon leaving the shelter and believe that more exercise would have helped prevent this. Perhaps a set of special exercises should be designed for use in the shelter and instructions provided along with the C.D. information that is placed in each kit.

The preceding have been a few recommendations that I believe should be considered for future studies and to be provided in the shelters being stocked throughout the country.

Shelter Manager Post-Shelter Report, Experimental Study II (2-week occupancy):

Upon first entering the shelter, the group was noisy and boisterous. This behavior persisted throughout the first night and began to diminish during the next day or two. The first night, everything said was thought to be funny and laughed at.

My first night of sleep was the most difficult of the two-week stay. The heat, being in a strange place, the hard floor,

and the close proximity to strange people were some of the things which kept me from getting much sleep. Also, the constant whispering and talking of others during the night made sleep almost impossible.

For the remainder of the two weeks, I had at least four hours of good sleep every night, and most nights many more. Differences in sleeping habits caused minor irritations during the stay. Some persisted in talking until late in the night and wanted to arise late. Others wanted to arise early. These early risers usually woke the rest of the group, and there was bickering on both sides.

Much to my surprise upon having been in a shelter a few days, I found that the space allotted was completely adequate. During the day when there was much activity, there was sufficient space to move around. At night there was adequate space. To a person like myself who occupies a whole double bed at home, the sleeping in close proximity was repugnant at first. But after the first few nights it didn't bother me.

Although there was much complaint on this score (space), I don't think there was anything unbearable about it. It was all a matter of becoming accustomed to it. The arrangement of the people in an orderly fashion is the main problem.

The cardboard was, to my mind, entirely satisfactory. It lasted for the entire two weeks and softened the effect of sleeping on the concrete floor. It was also used for cover by some of the shelterees. The first use of cardboard in this manner was during the second night when an older male, #26, became cold, having loaned his shirt to a female child, #3. He took one of the unused boxes and slipped it over his head and shoulders. It apparently afforded him some degree of warmth. Thereafter, use of the cardboard by other shelterees for cover when the temperature dropped was a common occurrence. The cardboard was also used for brooms, checker boards, bingo cards, and to make a donkey for playing pin-the-tail-on-the-donkey.

The survival biscuits, although tasteless at first, tasted better and better as the time went on. At first, several people refused to eat them. Most of these were children who eventually left the shelter. To influence the children to eat, we began a contest to see which child would eat the most, the reward being a box of candy. This had remarkable effect, and I'm sorry it wasn't instituted earlier. It might have possibly kept some of the other children in the shelter.

I had no hunger pangs during the two weeks. In that I had been expecting them, I was pleasantly surprised. The biscuits seemed to fill me. I did notice more gas than usual on my stomach,

though. Some of the women never became accustomed to the biscuits and would eat only a few each day. All of the men were hearty eaters.

Meals at first were served five times a day because some shelterees could take only one biscuit a meal. I felt that if it took more meals to make them eat more, then we could afford to do this. After the children began to eat heartily, this was cut to four a day.

Regular schedules were not adhered to at first. The second week, dinner was served at 12:30 P.M. and the afternoon meal at 4:45 P.M. The morning and just before bedtime snack were left flexible and food was served when enough people became hungry or when they awakened in the morning. This arrangement, I believe, was suitable to most. The only complaints were from hungry people who objected to the rigid schedule of 12:30 P.M. and 4:45 and wanted to eat sooner. The majority seemed satisfied with the schedule.

The one big complaint was the odor from the chemical toilet. Although it was noticeable almost all of the time, I don't rate it as any great discomfort. Certainly if we had not had the air circulation facilities that were present, it might have become intolerable. But as it was, the odor was no worse than is present when outdoor privies are used and lime applied. I think that the odor would have had to be much stronger for anybody to have considered leaving the shelter because of it.

The plastic gloves were indispensable for the tending of the toilet facilities. No trouble was encountered in the sealing off of the toilet. The odor was completely stopped when sealed. One thing I was sure to do when the sealing was done was to allow slack in the top of the plastic bags. I noticed that the chemical did not stop the contents from fermenting, and when the toilet became over half full these bubbles which were coming to the top and bursting created a kind of spray which was disturbing to anyone using the toilet. Medic _____ and I were worried that the gases created after the bag was sealed could conceivably burst it if sufficient slack were not allowed.

The number of sanitary napkins was found to be inadequate.* I would recommend that they be stocked in greater quantity. The waterless hand cleaner was more than sufficient. I imagine my failure to give a demonstration as to what "a little on the

*This problem did not arise in ES III, the other two-week occupancy study, in which greater emphasis was placed on conservation of supplies.

fingertips" meant was responsible for the large amount used. Also, some shelterees secretly used it as an underarm deodorant.

There were no complaints over the amount of water given for drinking purposes. There were complaints over the method used to dispense it. Some of the men suggested that the water cans could be fixed with nozzles at the bottom and would be better than siphoning. They seemed to think that plastic bags could be easily found with nozzles at the bottom. The method suggested for siphoning before entering the shelter, that the tube be allowed to fill up and one end closed with the closed end being pulled out of the barrel, seemed to be insufficient. The ordinary method of using the mouth was the easiest and quickest, especially since the water frequently stopped coming through the tube and the process had to be repeated. There was little complaint as to the taste of the iodine in the water. I didn't notice it after the first day.

The language used by the shelterees I think was acceptable. I announced that there would be no profanity in the shelter upon entering, and there was little if any. Some of the men had to be reminded during the poker game to watch their language, but that was the extent of it. Some of the talk did center around things that would not be normal in polite society (body odor, etc.). The presence of young children in the shelter was one of the stablizing factors in holding this down and may well have been the primary influence.

I had no serious challenge to my authority as shelter manager. I thought at first that one male shelteree, #36, was going to do so. But this did not turn out to be the case. Although he was at times loud and boisterous and wanted to do things in a certain way, once I made a decision as to what should be done he never challenged it. In fact, he was the most helpful person besides Medic _____ in the shelter.

The voluntary segregation of the sexes during sleeping hours seemed to have been the idea of the women, and the men acquiesced to the arrangement. This arrangement minimized the problem of romantic attachments. None seemed to arise and any inclinations toward such seemed to be unilateral. In that nothing definite even began in this field, I feel that it would be irrelevant and mere conjecture for me to speculate as to who might have been so inclined under different circumstances.

Cards were made from the heavy paper found in the children's notebooks, and immediately a poker game began. The women seemed to have no objections and, as it was for small stakes, I had none either. The poker game served as an outlet for the men and occupied their time. They played between two and three hours each day. Rook cards were also made in the same way, and the

children and women played this.

The shelterees showed a great deal of interest in the civil defense talks. Each of these lasted approximately 30 minutes. Medic _____ gave talks on first aid and radiation sickness. The group's interest was more than I had expected. They enjoyed discussing things, but often ended up in the irrelevant. If I were going into the shelter again as shelter manager, I would carry more Civil Defense literature with me and do a more detailed job of lecturing than I did. I just couldn't picture the group absorbing very much of the information, when in fact they were very attentive and really seemed to enjoy the discussions.

Generally, I can say that I will look back on my stay in the shelter as a very interesting and enjoyable incident in my life. During my stay in the shelter, I was never at any time tempted to leave. I had to fight lethargy a good bit of the time. The only time I really felt bad was the first night. I awakened about 3:00 A.M., and it seemed unreal that I was in the shelter. After the first night, I was all right. About the fourth day, I awakened groggy. This condition remained with me one day. Other than these two incidents, I felt fairly normal the entire period.

Of course, the lack of a bath for two weeks created a terrible odor. I didn't notice it on others as much as I did on myself. I found myself avoiding the women because of it, although I knew that it was something common to all the shelterees.

Shelter Manager Post-Shelter Report, Experimental Study III (2-week occupancy):

Knowledge of the implementation of and value received from properly administered discipline was of extreme importance to me in the management of affairs in the shelter. Strict military discipline is not good with a civilian group. However, if there is a choice to be made between strict discipline and little or no discipline, one should tend toward the administration of strict discipline. One can always slack off, but to tighten up on discipline once it has been lax is next to impossible.

Very little of my training as SM was of a formal nature. In fact, about the only phase that could be considered formal was my instruction in the use of the equipment in the shelter, methods for reporting information, filling out diaries, etc. However, I did spend about a total of eight hours in conversation with various members of the staff, and it was during these talks that I was able to pick up fragments of information, much of which proved to be invaluable to me as the SM. The following

is a listing of the various bits of information that were of real significance.

1. Space - Finding space for all to sleep will be a problem and in the past studies various sleeping arrangements had been tried. The best sleeping arrangement when individuals of both sexes are in the same room is to have the men sleep in one section and women in the other with the young people interspersed in the available space.

2. Variations in temperature - When sleeping, a temperature that is comfortable for one person will not necessarily be a comfortable temperature for another. During the stay in the shelter, this was a constant problem and one which I feel we were only partially successful in solving. However, knowing that this would be a problem, I was constantly aware that we must make every attempt to equate these variances in sensitivity. At the conclusion of the shelter stay it was the consensus of opinion that if blankets had been available, a good deal of this problem would have been solved. I also feel that whenever feasible, the Ss should wear as much heavy clothing as possible. It is very easy to shed clothing when it gets too warm, but it is impossible to wear more if you do not have any with you. Some of the women, I feel, were very much underdressed in that they did not have a sweater or some other similar article of heavy clothing.

3. Odors - After awhile one's own body odor will become quite apparent and some people will become overly concerned about this. Realizing that this situation would eventually occur, I was prepared to inform the group that this should cause no one any real concern.

4. Constipation - Since the Ss will be on a bland, low calorie diet, the need to defecate will be greatly reduced. The knowledge that this situation would occur and that there was no real cause for alarm if bowel habits were temporarily halted or reduced, helped me to allay the fears of many who were at first concerned.

5. Cardboard - In the past the Ss used these as floormats, drew checker boards on them, and some even had tried to use them as covers.

6. Drinking Water - The dispensing of water had proved to be a problem to the past groups; at least it was a problem if dispensed according to the prescribed methods. We, too, found that dispensing the water as prescribed

was a problem, but we were able to come up with a solution very quickly because I had thought about what I would do if our group also had trouble.

7. Lectures - For the most part the Ss were interested. The length of the lectures could be somewhat longer than under normal conditions. This fact I found to be true and I was therefore able to present almost all the material planned for the lectures to the group. The lectures also kept the Ss thinking about things other than themselves.

8. Critical Periods in Shelter Adjustment - The second, fourth, seventh and tenth days were the critical ones. Some of the things which would bother persons at one time would, as time progressed, bother them less, and a new irritant would take its place. I did not know exactly what to expect concerning this matter, but I was at least aware that I should be looking for various signs, which if not corrected might have a detrimental effect on group morale. What the SM does and says has great influence on the Ss. I was ever cognizant that I must be very careful not to make adverse comments on anything that might be an irritant factor, for by doing so would only tend to intensify the factor. As an example of this, the very first day I was having real difficulty in getting any of the Ss to drink the water. Many disliked the taste of the iodine; in fact, some refused to drink any, and many of those who drank felt nauseated. I felt at this time there were many who could not taste very much iodine in the water, but if some noticed it, they could not be the ones in the group to say that they did not notice anything. I decided that when we opened the second container of water that I, along with a couple of picked persons, was going to be the first to sample the new water. Although to me personally it did not taste any different, I made sure that all knew I considered this new water to taste far superior to that of the previous container, and I asked those whom I had picked if they did not also feel the same. As I expected, they too noticed a great difference in taste. It was not long thereafter that everyone wanted to sample the new water. It did taste good and from then on I had no real problem in getting the people to drink it.

9. Daily Routine - Some type of routine should be established. Although I did not formulate a definite plan for a daily routine before I entered the shelter, I was aware that a planned routine was necessary, and one

of the things that I took with me into the shelter was a sheet with a suggested timed routine. I found that using this routine as a guideline helped me to formulate a schedule which was for the most part flexible and responsive to the moods of the Ss.

10. Squatter's Rights - Prior to entry I was told that it would not take long before some of the Ss would establish themselves in a particular spot and beware to the person who violated his space. It was also pointed out that some persons, once they find their place, rarely move from that spot. Knowing that this was going to take place and that it was best to keep the people active, we were able to fabricate a plan that accomplished this without the individual knowing that he was being moved. Playing games and shifting furniture will accomplish this objective.

The Shelter Manager should be alert and responsive to the needs of the Ss and therefore should alter the schedule whenever it will serve the best interests of the entire group. The SM must be the boss with respect to changes in the daily routine; he will not be able to please everybody all the time. Keep the group active, make them move about, keep them thinking, but not about themselves. Plan some special events well in advance so that the group will have things to look forward to.

It might be well to note that during this shelter study no time pieces were used. In our present day society many of our actions seem to be geared to the clock, and when the clock fails or is not correct, we often experience difficulty in making the adjustment. When I first learned that we would not be taking any watches into the shelter I was somewhat worried. How could I schedule the various activities? Would the whole shelter program turn into chaos? Contrary to my initial beliefs, I feel that after spending two weeks in the shelter without the knowledge of the exact time, I was better off for having done so. By not knowing the exact time I tried to gauge how long we should spend on a specific activity by studying the group, and thus I feel I was more acutely cognizant of how they felt. I also found that the human biological system will set its own time signals, which for the most part have been geared to the pattern of living that the individual established prior to entering the shelter. I feel that many persons were better off for not knowing the time. When one does not watch the

clock, time usually passes much more rapidly--this is an important aspect in shelter living.

Shelter Manager Post-Shelter Report, Experimental Study IV (1-week occupancy)

First SM

Entered shelter about 5:00 PM Saturday. There were some discipline problems and it took two or three conferences with some of the boys to make them understand that the shelter manager was not just another shelteree. It was necessary to threaten some of the boys with punishment or expulsion from the shelter.

The time intervals scheduled for various activities were usually too long, e.g., one hour was too long for eating a few crackers and drinking a cup of water.

Saturday evening the children cooperated well with regard to toilet, records, etc. Much of the evening was devoted to explanations of the shelter and experimental nature of the occupancy test.

The depression that eventually drove me out of the shelter began immediately upon entering. If I had given in to my feelings, I would probably have left after the first hour or two.

Sunday went very well but I had trouble with my memory. I couldn't even remember the Psalm and Sunday School lesson which I had prepared. Depression increased and desire to leave grew. Lack of knowledge of time also began to disturb me.

Monday I thought I was doing very well until two of the children had to leave. At this time I communicated my desire to leave to the outside. After a short conference with the observers outside the shelter I was more relaxed but still doubt I could have stayed the entire week. My reasons for leaving are indeterminable; I can't pin point any particular thing.

Record keeping was simple and not a factor in leaving. This limited space and wall moving in to take up space when a S left made us feel that something was unjustly taken from us. Perhaps my biggest concern was not having my watch, and if I were to go into the shelter again I would probably stay if I could keep my watch.

The strange children caused some initial dissatisfaction. If they had been from my school they would not have been a problem.

External factors which may have also caused me to leave were concerns with professional problems at school and a personal financial matter. Also knowing that there was another shelter manager available may have encouraged my giving in to the desire to leave. If I had known that the test would have concluded because of my leaving I would perhaps have endured it even though it would have been very difficult.

Alternate SM

The night I entered the shelter I spent the first thirty minutes getting acquainted and explaining my role as shelter manager. This was accepted at the moment but a little later one or two shelterees indicated a desire to test me. I handled this with a combination of friendliness and firmness. I maintained the necessary mutual respect for the remainder of the week.

As our week progressed the noise was my greatest personal problem. When we were engaged in interesting games, etc., the noise did not bother, but several times during a short rest period two or three shelterees would be very loud and not show any respect for their fellow shelterees. This type problem was a disappointment to me. Not only the noise but I had tried to impress upon each person the need to respect the rights of every person in the shelter. This wasn't grossly abused but there were instances when a shelteree would bully other members.

The loudness, rudeness, etc., was usually a result of a shelteree attempting to establish himself. There was a constant and continuous effort on the part of a few boys to be first, the best, the strongest, the richest, the bravest or whatever was necessary to be in the limelight. This was carried to such extremes that other shelterees would show their open disgust.

The food, water, toilet, sleeping conditions, lack of a watch, etc., did not present any real problems for me. These things were the total concern of the shelterees but I was concerned with keeping the children occupied and on schedule as best I could.

The shelterees enjoyed drawing better than any other activity. When we were having a rest period or taking temperatures the shelterees would draw.

I will not attempt to suggest the different type materials to be used to keep the shelterees occupied. I will say the shelter manager needs all the games, etc., he can possibly collect. The one thing I would certainly do if I were returning to this type study would be to have more games at my command.

When a new game was introduced the entire group would participate. Later in the week the younger shelterees would want to play their favorite game, the older group wanted their favorite. In the limited space it was impossible to play more than one game at a time. When a decision was made about which game we would play first, the disappointed group would make noise and not obey the rules of the game and naturally this would bring the game to an early end. The second game would then be tried and the disappointed group in this case would cause this game to end. I had tried to save some of the games but found I had used them all before the week ended. To attempt anything with this group that was not popular with the great majority caused several problems.

The dirt presented a very depressing problem for me. Several times each day we would try to clean the floor but without a broom we could not do a good job. The crackers, water and candy caused the floor to be sticky and dirty. The children's feet and socks were really dirty by the end of the study.

After leaving the shelter it was much harder for me to adjust to the outside than was true in my adjustment to the shelter. I can't explain my feelings except to say I have never been as thoroughly drained mentally.

Now that a week has passed since the study I am beginning to remember only the pleasant things that happened.