ADAPTATION TO EXTREME ENVIRONMENTS: THE ANTARCTIC VOLUNTEER

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Introduction

This report, and a second report to follow, will review a series of studies concerned with psychological problems engendered by prolonged isolation at remote Antarctic scientific stations and with factors within the individual, the group, and the environment that are related to adaptation to this unusual setting. The research was supported by the U.S. Navy's Bureau of Medicine and Surgery which has responsibility for the psychiatric assessment of all applicants, military and civilian, for the United States Antarctic Research Program.

All through recorded history men have voluntarily exposed themselves to isolation, hardship, and danger for a variety of causes. Within this century scientific exploration of the most inaccessible parts of the earth and, now, of the undersea environment and interplanetary space, have provided the supreme challenge to man's courage and ingenuity. The conquest of the Antarctic -- largely within the past decade -- is a notable example of the successful application of imagination and technical resources to the pursuit of scientific aims under difficult and hazardous conditions. Since 1956 more than 1,500 participants in the United States research program have endured the rigors of Antarctic winters. A review of research on psychological problems of adaptation to the environment of the isolated Antarctic station would appear timely and worthwhile.

Subjects for the studies to be described were scientists, technicians, and Navy men who volunteered for Antarctic service. Many of these individuals spent approximately one year in the restricted environment of an Antarctic station. Investigations were concerned with a wide range of individual, group, and environmental characteristics which will be described in detail within the contexts of specific studies.

Observations and interview data gathered by psychologist-psychiatrist debriefing teams during the period of the International Geophysical Year (1957-58) provided valuable descriptive information concerning the reactions of participants to group isolation in the Antarctic and posed a number of useful hypotheses for further investigation (Mullin and Connery, 1959; Rohrer, 1961). Questionnaire and performance rating data gathered during the same period, although incomplete, also aided in the development of a systematic research program. The goals and success of the psychiatric assessment program during the IGY period were previously discussed at length by Nardini, Herrmann, and Rasmussen (1962).

The Antarctic Research Program

The International Geophysical Year (IGY) of 1957-58 represented a world-wife scientific effort in which scientists of more than 60 nations participated, 12 of them in the Antarctic. The research programs conducted by the scientists from the 12 nations active in the Antarctic area were considered very successful, and the sponsoring governments agreed to continue these cooperative studies of man's physical environment. Since 1959, the direction of the United States Antarctic science program has been in the hands of the National Science Foundation.

The U.S. Naval Support Force, Antarctica, was activated Fabruary 1, 1955, with the primary mission to support the United States Antarctic Research Program. Included in this mission are the construction and maintenance of the stations; the transportation of men, equipment and supplies to the Antarctic and their distribution within the area; the support of field parties; the provision of communication, meteorological, and medical services; and ensuring the health and safety of military and civilian personnel alike. The Navy, at times, has been assisted by the other branches of the Armed Forces and the Public Health Service in providing support to the scientific programs.

Antarctica, surface and subsurface, remains the least known of continents. Descriptive programs in the earth sciences and biology, particularly in geology and ecology, will be continued for some time to provide the framework for the basic research which has recently begun in earnest in Antarctica. During the months of winter darkness, such disciplines as biology, geology, and glaciology which require field work, cannot be profitably pursued; therefore, discriplines such as meteorology and upper atmospheric physics are emphasized in the wintering parties. Scientists from Government agencies, such as the Weather Bureau and the Bureau of Standards, are prominent on the winter roster. The atmospheric sciences claim the largest single portion of the scientific budget for the Antarctic followed by the earth sciences -- geology, oceanography, glaciology -- while the life sciences are assigned a relatively small share.

In 1959, a conference was convened of the 12 nations that had active programs in the Antarctic during the IGY to draft an Antarctic Treaty. Under the terms of the Treaty, the entire continent was set aside for peaceful purposes with freedom of scientific inquiry established throughout the area. Cooperative scientific efforts have been worked out among the signatory parties to the Treaty including exchanges of scientists from station to station and support of programs at other nations' stations. For example, Hallett Station, constructed in 1957, was operated jointly for several years by the United States and New Zealand.

Research programs are initiated by means of proposals submitted by educational and research institutes on behalf of one or more investigators. The participants in the field are scientists (often graduate students in science) from private educational institutions and scientists or technicians from private research organizations, private corporations, and bureaus or governmental agencies with Antarctic scientific interests and orientations.

The U.S. stations are constructed and maintained by Navy volunteers from a variety of occupational specialties required for station operation.

The Antarctic Environment

During the International Geophysical Year, seven scientific stations were established and maintained, two on the Polar plateau where men had not previously passed the winter. To one of these, Byrd Station at 80°S latitude, building materials, supplies, and equipment were initially transported over 600 miles by tractor-train. The other, at the geographic South Pole, was supplied by airdrop from Air Force Globemasters. When the United States Government decided to continue the Antarctic scientific program for an indefinite period, the number of stations manned year-round was reduced to four -- McMurdo, Byrd, Hallett, and Amundsen-Scott South Pole -- and what had been temporary camps were converted to permanent stations. A fifth station, Eights, was activated for year-round occupation in 1963.

Two important recent developments were the building of a new Byrd Station and the introduction of a nuclear power plant at McMurdo Sound. The new Byrd Station employed the underground snow technique first developed by the U.S. Army at Camp Century, Greenland. Tunnels were dug beneath the surface, then arched over, and the buildings placed under snow. The new Byrd Station was commissioned in February, 1962.

The greatest need in the Antarctic is for heat and power, both of which require large quantities of fuel that entail heavy cost for transportation. The situation appeared ideal for a nuclear power plant and one has been installed at McMurdo Station, the principal logistics station in the area, where there have been as many as 1,000 individuals during the summer season. A desalinization plant, using excess heat from the reactor, is now in operation to ensure, for the first time, an adequate water supply. The Antarctic continent is actually a frozen desert and production of water is a critical problem at all stations. At inland stations all water must be obtained by melting snow and ice.

The most revolutionary development in logistic supply was the acquisition of the Hercules LC-130 aircraft. The introduction of the Hercules in 1960 has made possible much more rapid, economical, and certain the delivery of supplies throughout the Antarctic continent in subsequent years.

The Antarctic station sites are in the most inhospitable environments inhabited by man. The Amundsen-Scott Station at the geographical South Pole is located at an elevation of approximately 9,500 feet above sea-level on an ice cap more than 8,000 feet thick. The mean annual temperature at the South Pole is -57°F and during the winter months the extremely low temperature of -110°F has been recorded. At the South Pole, there is but one day and one night each year. The station is completely isolated and inaccessible from the outside world from February until November, except for intermittent radio communications. Conditions at other stations are less extreme, but all groups are completely isolated and confined to close quarters for several months.

Important features of the four small Antarctic stations which were studied most intensively will be described in the next section of the report. The largest station, McMurdo, is staffed by approximately 260 winter personnel (almost all U.S. Navy). This base, except for extreme climatic conditions, is much like any military establishment with experienced line officers in charge and with a medical officer, supply officer, construction engineering officer, and chaplain carrying out the tasks normally associated with their professions. There is an in-patient dispensary, a large mess hall, several separate barracks buildings for officers and enlisted men, an enlisted men's club, and an officers' club. The winter station population at McMurdo has been utilized as a control group for certain comparisons with small station personnel.

During the three summer months, that is, mid-November to mid-February, personnel at all stations are heavily burdened with construction, repairs, and storage of supplies for the long winter ahead. These tasks demand hard work, entailing long hours, little sleep, very cold temperatures, and, at some locations, high altitude. During the six to eight months of severe weather and darkness, personnel are forced indoors for most of their limited activity. Undoubtedly, the most critical aspect of Antarctic life at any small station is the fact that after the onset of winter there is no possibility of evacuation or of obtaining outside help. Contact with the outside world is restricted to radio communication, and at times even radio communication is not possible. The men are confined to the physical boundaries of their camp and the social boundaries defined by their particular associates at the station. Another important facet of the situation is that there is little possibility of withdrawing from the small intimate world of the station, even temporarily, since opportunities for privacy are infrequent and brief.

Antarctic Small Stations

The major studies to be reviewed in this and a later report are concerned with 17 small groups (11 to 36 men) that wintered-over at four Antarctic stations: Amundsen-Scott South Pole,

Byrd, Eights, and Hallett. Essential characteristics of these stations are indicated in Table 1.

Table 1

Characteristics of Small Antarctic Stations

	OLD BYRD	NEW BYRD	EIGHTS	HALLETT	SOUTH POLE
Number of Groups	2	3	2	5	5
Average No. of Personnel					
Military	11	20	6	11	12
Civilian	10	15	5	7[a]	10
Number of Buildings	8	15	11	10	11
Established	1957	1962	1962	1957	1957
Feet Above Sea-level	4,971	4,971	1,500	16	9,184
Method of Supply	Air	Air	Air	Air/Sea	Air
Terrain	Inland Ice	Inland Ice	Inland Ice	Glacial Moraine	Inland Ice
Latitude	79°59'S	79°59'S	78°18'S	72°18'S	90°S
Air Distance from McMurdo	885 miles	885 miles	1,525 miles	380 miles	820 miles
Mean Annual Temp. (°F)	-18.6	-18.6	-12.6	+4.2	-56.7

[a]Includes New Zealanders; Hallett Station is jointly operated by the United States and New Zealand.

Two additional stations were established during the past two seasons, Palmer Station located on the Antarctic peninsula near South America in 1965 and Polar Plateau Station located between between the South Pole and Queen Maud Land in 1966.

The small stations are strikingly different from the main base at McMurdo Sound in a number of respects. The buildings at Byrd and South Pole are completely under the ice. Station members live and work in close proximity, and the status differentiations and highly structured organization characteristic of large military groups are much less likely to be present at these stations. Medical officers served as Officers in Charge at old Byrd, South Pole, and Hallett station while a chief hospital corpsman served in this capacity at Eights Station. At new Byrd, the senior of the two assigned officers, a medical officer and an engineering officer, served as Officer in Charge.

Abandoned at the end of the 1961 season when the station was threatened with collapse, old Byrd Station had very limited space and facilities.

The new Byrd Station consists of prefabricated buildings placed in long tunnels 40 feet

deep, roofed over with steel arches overlaid with packed snow. The station is designed to give individual scientific laboratories freedom from interferences, such as radio or electrical noises generated within the station itself. Laboratory facilities are maintained for seismological, meteorological, ionospheric, auroral, and radio noise research. The station is resupplied by air during the summer months and is maintained by about 20 to 25 Navy personnel. The wintering scientific party consists of 10 or 12 men.

Eights Station, located at the base of the Palmer Peninsula and occupied by six Naval Support Force personnel and five scientists, was a temporary station which ended year-round operations at the close of 1965. The major emphasis of the scientific program at Eights was on upper ionospheric physics. The station consisted of portable buildings flown in by large aircraft from McMurdo Station.

Hallett Station, operated jointly with New Zealand, is located on the west coast of the Ross Sea and is accessible by both air and sea. The science programs include upper ionospheric physics, meteorology, geomagnetism, and seismology as well as marine and terrestrial biology. Since 1964, Hallett Station has been occupied only during the summer period.

The Amundsen-Scott South Pole Station site has been described in a previous section. Scientific programs at South Pole include aurora and airglow, ionospheric studies, meteorology, and seismology.

Composition of Antarctic Groups

The typical composition of the groups at the four small outlying stations is shown in Table 2. Even the smallest station must have at least one man in each of the following occupational specialties: Medicine, radio communications, electronics or electrical repair, heavy equipment operation and repair, and cooking. Additional technicians and "Seabees" (Construction Battalion personnel) are utilized at the various stations, depending upon particular projects, equipment to be operated or maintained, and living space.

Except for radiomen and meteorologists, only one specialist from each occupation is typically present. Each man has a particular task which makes a unique contribution to the group's mission. In addition, individuals may be required to assume duties outside their occupational specialties, and each must take on his share of the general housekeeping chores. Detailed descriptions of the work roles and special problems of the Navy enlisted occupations typically represented at small stations are given in Appendix A.

As a consequence of the diversity in occupational specialties, cultural, social, and educational backgrounds of group members vary considerably. There is a wide range in age and

Table 2

Composition of Station Groups by Occupational Specialties[a]

Occupational Specialty	South Pole	Old Byrd	New Byrd	Eights	Hallett
Medical Officer	1	1	1	-	1
Hospitalman (HM)	1	-	1	1	1
Radioman (RM)	2	2	2	1	2
Cook (CS)	1	1	1	1	1
Electronics Technician (ET)	1	1	1	1	1
Electrician (CE/EM)	1	1	3	1	1
Mechanic (CM/EN)	2	1	2	1	1
Carpenter (BU)	1	1	3	-	-
Plumber (UT/SF)	1	1	2	-	1
Equipment Operator (EO)	1	1	2	-	-
Meteorology	4	4	4	1	3[b]
Civilian Technician	1	1	1	-	-
Aurora	1	1	3	1	1
Ionospheric Physics	2	1	2	1	-
Radio Science/Cosmic Rays	1	-	2	1	1
Seismology/Geomagnetics	1	1	1	1	-
Approximate Total	22	18	31	11	14

[a]Assignments shown represent average or typical complements and do not include exchange scientists from other countries.

[b]Navy Aerographers or New Zealand meteorologists; station is jointly operated by the United States and New Zealand.

work experience as well. Age and amount of experience vary with occupational specialty to some extent. All cooks at small stations in three expeditions, for example, were age 30 or older while the majority of radiomen and electronics technicians were less than 24 years old. It will be shown in a later section of this report that background variables form consistent patterns which have definite implications for work and social adjustment in small Antarctic groups. Detailed studies of cultural and psychological differences among Navy and civilian occupational specialties have been conducted; these studies will be reviewed in the next section of this report. Some of the background differences investigated appear to be related to group compati-

bility and work effectiveness. In long-term closed groups, it is necessary to consider the personality and social background characteristics which are related to group harmony, persistent task motivation, and emotional stability. While heterogeneity in personality traits and cultural interests is not necessarily detrimental to group effectiveness and, indeed, under some conditions may be desirable, there is a need to know what kinds of diversity might be consistently harmful to group compatibility and effectiveness.

Characteristics of Antarctic Volunteers

The United States depends upon volunteers to man vital national programs, such as nuclear submarines, space, and undersea exploration, which involve exposure to hazardous or unusual environments. Similarly, the Antarctic research program relies entirely upon volunteers to obtain qualified personnel. Recruitment for special assignments raises important questions concerning the technical qualifications, personal characteristics, and motivations of volunteers. Therefore, analyses were undertaken of the personal and social backgrounds and the demographic and occupational characteristics of Navy and civilian volunteers for Antarctic service.

As indicated in previous sections, groups of Navy and scientific personnel live and work together in close association and interdependence at several stations for approximately one year. Men are selected for Antarctic assignments primarily on the basis of competence in an occupational specialty, and because each station must be a self-sustaining community, a variety of scientific, technical, and military occupations are represented. Information concerning the Antarctic Research Program, including procedures for volunteering, is widely disseminated throughout the scientific community and the Navy. Volunteering procedures are basically similar: civilians send applications with accompanying references from superiors or knowledgeable instructors to the National Science Foundation; Navy personnel apply to their commanding officers, who forward pertinent information with a personal recommendation to the Bureau of Naval Personnel. All persons, military and civilian, who meet the technical requirements for their rate or occupation are given thorough medical and psychiatric examinations at Navy screening centers.

As a part of the psychiatric screening program for several years, each applicant filled out a biographical questionnaire, the Standard Psychodiagnostic Record Booklet (Personal History). The Booklet contains questions pertaining to developmental history, religion and worship, parental and family background, educational achievement and school adjustment, sports and social interests, medical history and symptoms, and occupational and military experience. Responses to multiple choice and factual items were coded for punching onto IBM cards, and response distributions were obtained by machine tabulation.

In recent years a similar but shorter Personal History Booklet has been used to gather biographical information. These data, too, were machine tabulated and distributions were compared for Navy and civilian volunteers.

Age and occupational experience differences between Navy and civilian volunteers for two time periods are shown in Table 3. During the IGY period, Navy personnel were much younger on the average than civilian volunteers. In the second time period (1960-1965), Navy men were again younger on the average, but the age difference between groups had diminished considerably (Gunderson, 1964a).

Table 3

Age Distributions for Antarctic Volunteers by Time Period

	IGY Period (1957-1958)		Post-IGY Period (1960-1965)	
	Navy %	Civilian %	Navy %	Civilian %
Age				
Less than 24 years	45.5	16.5	39.0	28.8
24 - 27 years	20.1	22.8	23.0	31.9
More than 27 years	34.4	60.7	37.9	39.3
Occupational Experience				
Less than 6 years	55.2	68.4	44.5	78.7
6 - 10 years	23.4	15.2	28.9	14.1
11 - 15 years	15.5	6.3	17.2	3.4
More than 15 years	6.1	10.1	9.4	3.7

At the same time, Navy personnel were more experienced in their occupational fields than were civilians. Many participating civilian scientists had not completed their graduate training or had recently received graduate degrees. The difference in occupational experience was more pronounced for the second time period. The fact that Navy volunteers were older and more experienced in the later expeditions had practical importance because presumably such changes would be paralleled by increases in maturity and competence.

A number of additional demographic and biographic characteristics of Navy volunteers, civilian volunteers, and U.S. males generally are compared in Table 4. Because the biographical questionnaires differed in the response categories utilized for certain items, separate results are shown for those items in two samples of Antarctic volunteers representing two time periods, 1957-62 and 1963-1965.

Navy and civilian volunteers were single much more frequently than were U.S. males of the same age range, and civilian volunteers were single more often than were Navy personnel. Navy

Table 4

Demographic and Biographic Characteristics of Navy Volunteers, Civilian Volunteers, and U.S. Males

	U.S. Males[a]	1st Time Period		2nd Time Period	
		Navy	Civilian	Navy	Civilian
Marital Status (Ages 20-34):					
Single	27.4[b]	51.5	67.5	53.0	81.4
Married	70.9*	40.4	30.2	42.2	14.7
Divorced	1.7	6.3	1.2	4.0	1.3
Separated		1.8	1.2	0.8	2.6
*Includes separated.					
Religion:					
Protestant	64.7	75.0	62.5	72.1	65.4
Catholic	25.7	22.4	19.8	24.3	17.3
None or other	9.6	2.5	14.7	3.6	17.3
Region of Residence:					
New England	6.3*	10.6	12.9	8.4	7.2
Northeast	22.7	19.6	25.2	18.9	31.4
South Atlantic	15.4	12.2	5.9	15.1	3.2
North Central	27.7	21.3	26.9	23.2	28.2
South Central	10.1	15.0	9.1	9.8	2.4
Southwest	7.4	7.8	2.4	9.0	7.2
Rocky Mountains	2.4	3.9	5.2	4.2	10.5
Pacific Coast	7.9	9.5	12.2	11.4	9.7
*Categories were revised for all U.S. Males to correspond to questionnaire data.					
Urban-Rural Residence:					
Rural	24.3*	35.0	19.6	22.7	14.3
Urban	75.7	65.0	80.4	77.3	85.7
*The "Other Rural" category, Table 13, was utilized for this estimate.					
Parents' Marital Status					
Living together	(No data	50.4	58.8	54.7	63.9
Divorced/Separated	available)	23.3	12.6	18.5	7.5
Father dead		15.7	19.5	17.3	18.0
Mother dead		6.4	4.4	5.5	4.5
Both dead		4.2	4.7	4.0	6.0
Birth Order					
Only child		6.9	12.0	9.8	10.2
Oldest child		31.2	31.8	33.6	39.1
Youngest child		22.7	28.0	22.4	23.4
Middle child		39.1	28.3	37.1	27.3
Education					
No college		79.7	12.0	87.9	17.1
College		20.3	88.0	12.1	82.9

[a]Data for U.S. Males obtained from "Statistical Abstract of the United States, 1963," U.S. Government Printing Office.
[b]Indicates percent.

volunteers had a higher divorce rate than did U.S. males or civilian volunteers. Thus, Antarctic volunteers much less frequently had attempted to establish or maintain households than U.S. males generally.

Navy and civilian volunteers differed from each other and from U.S. males in distribution of religious preferences. Protestants were overrepresented among military volunteers, while Catholics were underrepresented among civilians. Civilian volunteers more frequently had no religious preference as compared with Navy volunteers or U.S. males generally. Although the percentage differences were small, significantly more civilians expressed a preference for the Jewish religion in both time periods compared with Navy volunteers (data not shown in Table 4).

A larger proportion of Antarctic volunteers, both military and civilian, were reared in New England and in the Western United States (Rocky Mountain and Pacific areas) compared with all U.S. males. The Northeast and North Central regions were underrepresented among Navy volunteers. The southern areas of the United States (South Atlantic and South Central) were grossly underrepresented among civilian volunteers. More civilians than Navy personnel were born outside the United States (data not shown in Table 4).

Navy volunteers came from rural backgrounds much more frequently than did civilians and, in the first time period, exceeded the proportion living on farms of U.S. males generally.

Navy volunteers had had college experience much less frequently than civilians. More than 85% of the civilian scientists and technicians had had some college training and 58% were college graduates. This difference between Navy and civilian volunteers in education is a reflection of the higher academic requirements for most of the technical and professional specialties required for research in the Antarctic which is represented in these groups. The difference persists over the second time period.

Differences in age, birth place, citizenship, and educational and occupational levels for the parents of Navy and civilian volunteers paralleled those for the subjects in the two groups. Parents of Navy volunteers married at an earlier age than did those of civilians, were divorced or separated more often, and reared larger families. Civilian volunteers more frequently reported being influenced in their development by persons outside the immediate family, such as teachers or ministers. Wives of civilian volunteers more often had gone to college and worked in professional positions before marriage than had wives of Navy volunteers.

Navy Volunteers and the Selection Problem

A large number of Navy men volunteer for duty with the United States Antarctic Research

Program (Operation Deep Freeze) each year; for example, about 1,500 men applied for the 1965 expedition. The Bureau of Naval Personnel every year issues a notice to all naval ships and stations which gives information concerning Operation Deep Freeze and solicits volunteers from approximately 30 Navy occupational specialties to participate in the program. To be eligible for consideration, the volunteers much have 24 months of obligated service remaining (or agree to extend their enlistments), must have no history of domestic problems or indebtedness, must have positive recommendations from their commanding officers, and must have the capacity to meet rigorous physical standards. From among the many who meet these minimum requirements, the Bureau of Naval Personnel and the Bureau of Medicine and Surgery must select those best suited for the Antarctic wintering-over parties.

Navy Antarctic volunteers and Navy enlisted men generally were compared on a number of demographic and biographic characteristics to ascertain differences in pre-enlistment history and military status characteristics. The Antarctic volunteer sample consisted of 972 men psychiatrically screened in four expeditions (two IGY and two post-IGY), and the All Navy sample consisted of 11,009 Navy recruits studied by Plag (1962).

Results may be summarized as follows. A larger percentage of Navy volunteers than Navy men generally were born in New England. The middle-western United States (Illinois, Indiana, Michigan, Missouri, Ohio, Wisconsin) was underrepresented among Navy Antarctic volunteers. Catholics were underrepresented among Navy volunteers while Protestants were overrepresented. Antarctic volunteers reported more parents divorced or separated than the All Navy population, although this result might have been due to age differences between the two groups. Navy men generally were suspended from school much more frequently than were Antarctic volunteers. Only 4% of the Navy recruits had had any academic work beyond high school prior to enlistment as compared with 11% for the Antarctic enlisted volunteers. Finally, a sample of 483 Navy enlisted volunteers for whom GCT (Navy Basic Test Battery) scores were available had a mean score of 55, one-half standard deviation above the overall Navy mean of 50. These results indicated that Navy volunteers for Antarctic duty were superior in intellectual ability, school adjustment (number of suspensions), and academic attainment (college experience) than were Navy personnel generally (Gunderson, 1964a).

In a second study concerned with distinctive characteristics of Navy Antarctic volunteers, performance evaluations (Enlisted Performance Evaluation Marks) of applicants for Operation Deep Freeze were compared with those of other naval personnel. Performance marks are ratings by superiors on scales from 1.0 to 4.0 in five trait areas, Professional Performance, Military

Behavior, Leadership and Supervisory Ability, Military Appearance, and Adaptability. Performance evaluations after two years in service were obtained for 418 volunteers during one year. Performance data after two years in service for a large sample representative of Navy men in general were obtained from another source (Plag, 1962) and compared with marks for Deep Freeze volunteers (Gunderson, 1964b).

Table 5

Enlisted Performance Evaluation Distributions (Percentages) for Deep Freeze Volunteers and Other Naval Personnel

	Professional Performance		Military Behavior		Military Appearance		Adaptability	
Mark	Deep Freeze[a]	Other Navy[b]	Deep Freeze	Other Navy	Deep Freeze	Other Navy	Deep Freeze	Other Navy
> 3.6	22	12	27	13	29	13	31	14
3.6	32	20	37	27	36	25	28	30
3.4	24	21	22	26	23	26	20	25
3.2	16	25	8	15	11	20	8	16
< 3.2	5	20	6	20	2	16	3	14
Average	3.50	3.34	3.55	3.37	3.62	3.39	3.62	3.42
N	412	1503	418	1513	416	1510	417	1507

[a] Percentages for the 3rd marking period for Deep Freeze volunteers.

[b] Percentages based upon most recent marks received by a total sample of 1,903 Navy men after approximately two years in service.

Table 5 represents distributions of performance ratings for Deep Freeze volunteers and for a representative sample of Navy personnel. Men in both samples had completed approximately two years of naval service. The Table shows that a much larger proportion of the evaluations of Deep Freeze personnel fall toward the upper end of the rating scales than do those for Navy personnel in general. All chi-square tests between groups were highly significant ($p < .001$). It seems clear that the performance records of Deep Freeze volunteers are superior to those of the Navy at large. Further support for this conclusion was found in the fact that distributions for the normative Navy sample used here and those for a random sample of the entire Navy (Bureau of Naval Personnel, 1960) were hardly distinguishable except for slightly higher percentages in the categories above 3.6 for the All Navy random sample. Distributions for the Leadership and Supervisory Ability trait were omitted from Table 5 because marks on this trait were seldom given to inexperienced men.

In the same study, performance marks were grouped according to periods in the man's career when they were received, and percentage distributions of marks for 19 time periods were computed

for Deep Freeze volunteers. This provided a set of norms or standards against which performance records of either experienced or inexperienced Deep Freeze applicants could be evaluated. For example, a mark of 3.4 would be "above-average" for Navy men generally after two years of service, but the same mark would be "low" for Deep Freeze applicants of similar experience.

A further refinement in efforts to establish objective standards for evaluation of military performance records of Deep Freeze applicants was accomplished by the conversion of average marks (that is, marks averaged over five traits and six marking periods) into standard or T-scores within pay grades. T-scores have a mean of 50 and a standard deviation of 10. Deep Freeze candidates at a given pay grade can now be rank ordered in terms of their relative standing on performance marks for that pay grade, making it possible to select the best qualified applicants in terms of past performance, such as the top one-half or one-third, depending upon the total numbers of candidates available.

Past performance marks have been found to be positively correlated with performance criteria in two Antarctic expeditions, and research is continuing on the predictive value of past performance evaluations, particularly their value in selection of senior petty officers for Operation Deep Freeze.

In another study, Deep Freeze volunteers were shown to have received promotions more rapidly than other naval personnel (Arthur and Gunderson, 1965). Thus, all evidence indicates that the overall quality of Navy volunteers for Antarctic service is high. The process of selecting from among qualified volunteers is shown in some detail in the following tables. The data are for those Navy enlisted occupations typically assigned to wintering-over parties at small Antarctic stations. In Table 6 total numbers of petty officers in the Navy for each occupation at approximately the time volunteers were solicited are shown as well as total numbers of men applying for Antarctic service from each occupation. A "Volunteer Index" was constructed to show the relative proportion of petty officers from each occupation in the entire Navy applying for Deep Freeze multiplied by 1,000.

Data for Deep Freeze 1964 were drawn from Bureau of Naval Personnel listings of applicants and available screening records while data for 1965 and 1966 were tabulated from duplicate application forms (BuPers Form No. 1339) received by the Neuropsychiatric Research Unit and from screening records. The estimates of petty officer strength in the various occupations were obtained from Navy and Marine Corps Military Personnel Statistics (NavPers 15658).

From Table 6 it is clear that the "Seabee" rates (BU, UT, and EO) are very disproportionately represented among volunteers in relation to their numbers. The Construction Electrician (CE) and

Table 6

Proportions of Petty Officers in Various Navy Occupations Volunteering for Deep Freeze

Occupation	Total in U.S. Navy			Number Applied for Deep Freeze			Volunteer Index[a]		
	1964	1965	1966	1964	1965	1966	1964	1965	1966
Electronics Tech (ET)	10,214	10,909	13,150	32	30	16	3.13	2.75	1.22
Radioman (RM)	14,009	14,849	15,505	45	76	55	3.21	5.12	3.55
Hospitalman (HM)	14,858	14,265	13,536	--	60	42	--	4.21	3.10
Carpenter (BU)	1,536	1,424	1,498	36	26	19	23.44	18.26	12.68
Plumber (UT)	790	776	844	25	28	9	31.64	36.08	10.66
Electrician (CE/EM)	13,165	13,451	14,458	53	51	40	4.02	3.79	2.77
Mechanic (CM/EN)	12,925	12,221	12,362	50	55	27	3.87	4.50	2.18
Equipment Operator (EO)	1,665	1,531	1,570	35	46	36	21.02	29.10	22.93
Cooks (CS)	10,790	10,318	9,936	37	48	20	3.43	4.65	2.01

[a]Proportion volunteering x 1,000.

Construction Mechanic (CM) rates are similarly overrepresented, but this fact is obscured in the Table because Electricians Mates (EM) and Enginemen (EN), respectively, have been merged with the CE and CM volunteer groups. (These pairs of jobs are comparable and interchangeable in the Antarctic.) Radiomen (RM) and cooks (CS) volunteered in greater numbers proportionately than did Electronics Technicians (ET), particularly for Deep Freeze 1965.

Table 6 reflects some variability in the Volunteer Index from year to year and in particular shows sharp declines in relative numbers of volunteers in all occupational groups for Deep Freeze 1966 compared with Deep Freeze 1965.

A more complete picture of the selection problem and process is afforded by the data presented in Table 7. For Deep Freeze 1965 the numbers of petty officer applicants and the numbers of applicants psychiatrically screened in relation to the number of assignments to be filled are shown for each occupation. An index called the "Applicant Ratio" was computed to indicate the numbers of applicants available for each assignment. This index, which is the inverse or reciprocal of the familiar "selection ratio" employed frequently in personnel research, was computed both for small stations only and for all stations (McMurdo included).

The ratio of all initial applicants to small station assignments was a very favorable one for all occupations in Deep Freeze 1965, varying from about 15 men per assignment for Equipment Operators (EO) and Hospital Corpsmen (HM) to 7 per assignment for Utilitiesmen (UT). When the ratio of applicants to all personnel required (including McMurdo) is considered, however, the numbers available for each assignment (Total Applicant Ratio) diminish greatly; furthermore, when only those who have been psychiatrically screened are counted as possible candidates for

wintering-over assignments, ratios are quite low indeed, becoming 1.00 for Builders (BU).

Table 7

Applicant Ratios for Petty Officers Volunteering for Deep Freeze 1965

Occupation	Applied for D.F. 65	Psychiatrically Screened[a]	Assigned Small Station	Total Assigned[b]	Small Sta. Applicant Ratio	Total Applicant Ratio	Screened Applicant Ratio
Electronics Tech (ET)	30	15	3	12	10.00	2.50	1.25
Radioman (RM)	76	37	6	29	12.67	2.62	1.28
Hospitalman (HM)	60	18	4	8	15.00	7.50	2.25
Carpenter (BU)	26	9	3	9	8.67	2.89	1.00
Plumber (UT)	28	16	4	12	7.00	2.33	1.33
Electrician (CE/EM)	51	21	5	13	10.20	3.92	1.62
Mechanic (CM/EN)	55	20	6	19	13.75	2.89	1.05
Equipment Operator (EO)	46	20	3	16	15.33	2.88	1.25
Cook (CS)	48	15	4	9	12.00	5.33	1.67

[a]All petty officers psychiatrically screened.

[b]Includes McMurdo Station.

Table 8 compares the applicant ratios for Deep Freeze 1965 and 1966 and shows that the screening situation is appreciably less favorable for Deep Freeze 1966. The implications of Tables 7 and 8 would appear to be that initial numbers of applicants appear very adequate in all occupations for filling small station assignments, and an opportunity is provided for selecting a few outstanding men from among many applicants. When all personnel needs are counted and only psychiatrically screened men are considered, however, the range of choice becomes quite narrow, even to the point of not having enough men to fill the jobs in most occupations for Deep Freeze 1966. (In this event, of course, the Bureau of Naval Personnel takes appropriate steps to recruit more volunteers for specific jobs.)

Table 8

Comparison of Applicant Ratios for Deep Freeze 1965 and 1966

	Total Applicant Ratio[a]		Screened Applicant Ratio	
Occupation	1965	1966	1965	1966
Electronics Tech (ET)	2.50	1.23	1.25	.92
Radioman (RM)	2.62	1.82	1.28	1.00
Hospitalman (HM)	7.50	5.25	2.25	1.25
Carpenter (BU)	2.89	2.11	1.00	1.00
Plumber (UT)	2.33	.82	1.33	.64
Electrician (CE/EM)	3.92	2.86	1.62	1.36
Mechanic (CM/EN)	2.89	1.35	1.05	.45
Equipment Operator (EO)	2.88	2.12	1.25	.94
Cook (CS)	5.33	2.00	1.67	.80

[a]Included small stations and McMurdo Station.

The most important and meaningful selection task would appear to be the rank ordering of applicants in the various occupations in terms of their aptitudes and abilities to work and live effectively under the social and environmental restrictions of the Antarctic small stations. regardless of the numbers of candidates available. At the same time, of course. the number of applicants available is highly related to the probability that only well-qualified men will be selected.

Cultural and Psychological Differences Among Antarctic Occupational Groups

An earlier section compared Navy and civilian volunteers on a number of demographic and biographic attributes and compared both groups with U.S. males generally. Navy and civilian volunteers as groups differed significantly on many personal and social characteristics. of which education. age, and occupational experience were among the most pronounced. In this section a more detailed analysis of cultural and psychological differences among Antarctic occupational groups will be undertaken.

In the first part of the study, 1,405 Navy and civilian volunteers were grouped into nine occupational categories and were compared on a number of cultural background characteristics. In the second phase, a new sample of 717 Antarctic volunteers was grouped into the same occupational categories, and differences among groups were evaluated for 47 test scales and personality ratings.

In the first sample, each applicant filled out the biographical questionnaire described in a previous section. Subjects in the second sample filled out a number of personality inventories. including the FIRO-B Inventory. Survey of Interpersonal Values, the Allport-Vernon-Lindzey Study of Values. and two special inventories constructed by the author, called the Opinion Survey and the Friend Description Inventory.

Navy enlisted occupations were grouped into the following six categories:

Administrative: Storekeeper, Yeoman, Personnelman, Disbursing Clerk, Aviation Storekeeper. Hospitalman, and Dental Technician.

Technical: Radioman, Electronics Technician, Aerographer, Sonarman, Radarman, and Surveyor.

Mechanical: Machinists Mate, Engineman, Aviation Machinists Mate, Construction Mechanic. and Equipment Operator.

Construction: Builder, Utilitiesman, Steelworker, Shipfitter.

Electrical: Electricians Mate, Aviation Electrician, Construction Electrician.

Cooks: Commissaryman.

Three additional occupational groups were formed, one consisting of all naval officer volunteers. another of scientists, the third of meteorologists and civilian technicians.

Variations in a number of cultural characteristics over the nine occupational groups are shown in Table 9. Father's occupation was highly related to the man's own occupation. Scientists most often had fathers who were in "white collar" occupations (professional, technical, and managerial) and cooks least often -- 59% and 11%, respectively. Officers' fathers also were frequently in "white collar" jobs (56%). Meteorologists' fathers were more frequently "white collar" than those of men in Navy enlisted occupations, and fathers of men in Navy administrative and technical jobs were more frequently "white collar" than those of men in Navy "blue collar" trades (Mechanical, Construction, and Electrical groups). Fathers of scientists, civilian technicians, and officers less frequently were in skilled trades than were fathers of men in Navy enlisted occupations. Men in Navy construction jobs (carpentry and plumbing) had a relatively high proportion (62%) of fathers in skilled trades. The results clearly indicate that father's occupation had an influence on choice of or selection for an occupation far beyond chance.

Parents' education varied considerably among the nine occupational groups. Parents of the scientist and officer groups had completed high school much more frequently than had other groups. Parents of civilian technicians had completed high school more frequently than parents of men in Navy administrative and technical occupations. The pattern for parents' education closely parallels that for father's occupation.

Moderate differences among groups in urban-rural residence were present. Scientists and officers more often came from large cities and less often from rural areas than did other groups. Occupational groups varied by region of residence, but these differences were not large. Navy enlisted occupations, with the exception of construction jobs, tended to have resided in the southern states more frequently and in the northeastern United States less frequently than other occupational groups.

Virtually all of the scientists and a large proportion of the officers had attended college. Relatively few of the Navy enlisted men had attended college; those in administrative and technical jobs more often had had some college experience than those in other Navy occupations.

Expressed interest in hobbies varied considerably by occupation. Scientists, civilian technicians, and officers frequently reported two or more hobbies while the Navy enlisted groups much less frequently did so. Men in the Administrative and Technical groups more often had two or more hobbies than did other Navy enlisted occupations, although these differences tended to be small.

Distinctive patterns of cultural characteristics emerged for the major occupational

categories. Extreme differences were frequently found between the scientists and officers on the one hand and Navy enlisted "blue collar" occupations and cooks on the other. Differences among the Navy enlisted occupations tended to be moderate to slight, but differences present consistently favored the Technical and Administrative groups.

Table 9

Differences Among Occupations in Cultural Characteristics

	Civilian		Navy						
Variable	Scien.	Tech.	Off.	Admin.	Tech.	Mech.	Constr.	Elec.	Cook
Father's Occupation:									
% White collar	59	37	56	26	28	20	13	21	11
% Skilled	22	29	23	42	41	39	62	18	44
% Farm, Forest	8	16	10	15	12	23	14	44	22
Father's Education									
% No high school	23	34	24	45	40	56	48	48	65
% H.S. graduate	62	47	58	26	38	25	23	31	22
Mother's Education:									
% No high school	18	24	19	31	25	37	37	34	40
% H.S. graduate	68	56	67	46	49	37	32	35	40
Urban-Rural Residence:									
% Rural	17	23	22	31	32	46	33	36	33
% Large City	43	30	42	30	34	26	37	28	34
Region of Residence:									
% Northeast	32	38	43	32	29	26	38	30	24
% South	16	15	21	25	21	33	24	36	38
Education:									
% College	99	65	89	20	16	7	7	14	5
Hobbies:									
% More than one	67	56	56	30	38	27	19	25	13
N	170	135	157	120	272	273	123	100	55

The Scientist and Officer groups did not differ significantly from each other on any of the cultural attributes studied. Both of these groups differed moderately but consistently from the civilian technicians on fathers' occupation, parents' education, urban-rural residence, and number of magazines read; only on the college attendance item was the difference between the civilian technicians and the Scientist and Officer groups relatively large.

Results for the psychological data are presented in Tables 10 and 11. The F-ratios indicated

Table 10

Value Differences Among Occupational Groups

Scale	F-ratio[a]	df	Scientists Mean	Scientists S.D.	Officers Mean	Officers S.D.	Technical Mean	Technical S.D.	Mechanical Mean	Mechanical S.D.	Cooks Mean	Cooks S.D.
Study of Values:												
Theoretical	13.3	8/654	51.9	6.0	45.3	6.4	46.6	6.3	44.2	6.0	41.9	4.7
Economic	6.1	8/654	38.0	8.5	41.0	8.2	42.5	6.2	44.8	6.8	43.4	6.4
Aesthetic	10.3	8/654	39.7	9.5	33.5	8.6	31.9	7.2	30.6	5.4	33.0	7.2
Social	3.9	8/654	32.9	6.0	34.6	7.6	36.4	6.2	37.2	6.4	38.0	4.7
Political	4.5	8/654	40.4	6.4	44.4	6.8	42.1	5.8	42.9	5.7	44.1	4.7
Religious	2.7	8/654	37.3	10.8	41.3	9.4	40.5	7.6	40.3	7.6	39.7	5.3
Survey of Interpersonal Values:												
Conformit	10.4	8/527	13.3	6.8	18.6	6.5	20.1	6.2	20.8	5.9	23.4	3.8
Independence	4.5	8/527	18.1	7.5	13.4	6.1	12.9	7.0	13.2	6.4	11.5	4.4
Leadersh'p	4.3	8/527	18.4	6.8	18.7	7.0	15.1	6.1	14.0	6.6	12.0	6.4
FIRO-B:												
Ie	2.4	8/691	4.7	1.9	5.9	2.2	5.3	2.0	4.5	2.1	4.7	2.0
Ce	9.3	8/691	2.8	2.2	5.6	2.2	2.3	2.0	2.5	2.4	1.9	1.7
Ae	2.2	8/691	3.3	1.8	4.3	2.7	3.3	2.0	2.9	1.7	2.9	2.1
Aw	2.7	8/691	3.8	2.1	4.5	2.9	3.8	2.3	3.3	2.2	4.2	2.1

[a] F-ratios are for differences among means for nine occupational groups. Means and standard deviations for civilian technicians, administrative, construction, and electrical groups are not shown in this Table.

are for differences among the means for all nine occupational groups. For simplicity of exposition, test results are given for only five groups in Tables 10 and 11. Results for the Meteorologist-Technician group for the most part paralleled those for scientists, although means were consistently less extreme; results for the Administrative group differed little from those for the Technical group, and results for the Construction and Electrical groups as a rule differed negligibly from those for the Mechanical group. The range and nature of the psychological differences present, therefore, are well-represented by the five groups included in the Tables.

Differences among groups were significant beyond the .01 probability level for all of the Study of Values scales. Differences on the Theoretical scale were very large, mean scores ranging from 51.9 for scientists to 41.9 for cooks, a difference of almost two standard deviations. The Navy enlisted personnel in technical occupations scored next highest (46.6). These results appear highly consistent with occupational requirements.

Navy mechanics scored highest on the Economic scale, which represents practical as opposed to theoretical interests: scientists scored low on this variable. On the Aesthetic scale, scientists again scored very high in relation to other groups while the Navy Mechanical group

scored low. Cooks scored highest on the Social scale, approximately one standard deviation above scientists. Officers scored highest on the Political scale while cooks scored next highest and scientists scored relatively low. Officers scored highest of all groups on the Religious scale and scientists were at the low end of this scale.

Differences among occupational groups were significant on three of the six Survey of Interpersonal Values scales. A very large difference was present on the Conformity scale, with cooks at the high extreme and scientists at the other extreme. Conversely, on the Independence scale. scientists were much higher than other groups while cooks were at the low end of the scale. On the Leadership scale, officers scored highest and cooks scored approximately one standard deviation lower than officers. Scientists also scored relatively high on Leadership.

Differences among groups were significant for four of the six FIRO-B scales. Officers scored highest on Expressed Inclusion and the Navy mechanics scored lowest on this scale. On the Expressed Control scale, officers scored much higher than any other group, and cooks were at the low end of the scale, almost two standard deviations below the officers. Officers again scored highest on Expressed Affection; differences among other groups were quite small. Officers scored highest on Wanted Affection, cooks scored next highest, and the Mechanical group scored lowest.

Because the remaining scales are experimental and norms have not been published, results for the additional personality scales are presented in terms of deviations of groups from the grand mean. The numerical values shown in Table 11 are standard deviation units for each of the five groups. For example, cooks differed most extremely from other groups on the first scale, Achievement Need, their mean falling .78 standard deviations below the grand mean for all groups. On the same scale, officers scored relatively high -- .36 standard units above the grand mean -- while mechanics scored slightly below the grand mean and the Technical group slightly above the grand mean. On the Autonomy scale, officers and scientists tended to score high while cooks scored at the other extreme, on the average .60 below the grand mean.

All of the five attitude scales were found to discriminate significantly among the nine occupational groups. The large differences among the five groups compared in Table 11 for the Usefulness scale show a range in deviations from the group mean of a .70 deviation for scientists to -.29 for the Mechanical group. Officers scored relatively high on feelings of importance of job, .57 standard deviations above the grand mean for all groups. Conversely, results on the Boredom scale indicated that the Mechanical group felt most bored with their past duty assignments while scientists and officers were least bored.

The Technical group was most confident that the expedition would be well-organized while the

Table 11

Personality Differences Among Occupational Groups
(Standard Deviation Units)

Scale	df	F-ratio	Scien.	Off.	Tech.	Mech.	Cook
Need:							
Achievement	8/708	3.5	.02	.36	.14	-.12	-.78
Autonomy	8/708	2.6	.20	.27	-.08	-.10	-.60
Attitude:							
Usefulness	8/708	13.7	.70	.57	.04	-.29	-.20
Boredom	8/708	4.7	-.55	-.43	.06	.23	-.13
Confidence I	8/708	3.5	-.23	-.15	.29	-.06	.11
Confidence II	8/708	4.5	-.35	-.49	.12	.21	.23
Motivation	8/708	3.7	.13	-.32	.25	.03	.06
Self:							
Decisive	8/665	2.5	.02	.31	.03	-.10	-.16
Excitable	8/663	2.2	-.33	-.07	.02	.06	-.12
Friend:							
Efficiency	8/665	2.6	-.47	.26	.01	-.09	-.33
Sympathy	8/666	2.2	-.17	.33	-.20	.01	.12
Conservatism	8/666	12.9	-.96	-.58	-.06	.32	.41
Optimism	8/664	9.1	.60	.49	.01	-.[illegible]	-.40
Clinical Evaluations:							
Friction	8/705	2.0	.04	.10	-.06	-.03	-.38
Flexible	8/705	2.2	.14	.06	.08	-.09	.22
Acts Out	8/705	2.0	-.13	-.03	-.12	.10	-.12
Modest	8/705	2.4	.13	.17	.10	-.03	-.03
Conforming	8/705	2.3	.[illegible]5	-.12	.07	-.11	-.13
Alert	8/705	11.0	.58	.31	.19	-.36	-.53
Persevering	8/705	6.6	.52	.15	.18	-.24	-.60
Assertive	8/705	3.3	.38	.24	-.03	-.18	-.50
Tactful	8/705	6.1	.30	.17	.12	-.22	-.07
Orderly	8/705	10.3	.65	.39	.12	-.41	-.24
Paranoid	8/705	2.9	.05	.56	-.05	.00	-.36

scientists were least confident of organizational efficiency. Cooks had most confidence in the medical care to be available and officers were least confident of the medical care. Scientists also had relatively low confidence in medical care to be available on the expedition. The Technical group expressed highest motivation for the Antarctic assignment while officers expressed lowest motivation for the assignment.

Two of the four self-description scales significantly discriminated among the nine groups. Of the five groups shown in Table 11, officers described themselves as most decisive and cooks described themselves as least decisive. The Mechanical group tended to describe themselves as slightly more excitable than other Navy groups while the scientists considered themselves as not

excitable.

Significant differences were found among the nine occupational groups on four of the seven Friend Description scales. The first scale, called Efficiency, was composed of the following items: Efficient, Industrious, Punctual, Ambitious, and Tidy. Officers were relatively high in preferring traits of efficiency in friends; scientists were low on this scale, approximately one-half standard deviation below the grand mean for all nine groups. Cooks were also relatively low in valuing efficiency in friends.

Officers were relatively high in preferring sympathetic traits in friends. The Sympathy scale included: Sympathetic, Praising, Sentimental, Confiding, and Warm. The Navy Technical group was relatively low on this scale as were scientists. Differences were not large on this variable.

Variations among groups were extreme on the next variable, Conservatism. This scale consisted of the following items: Conservative, Thrifty, Commonplace, Apologetic, Cautious, and Formal. The cooks scored highest on this scale, indicating most preference for conservatism and caution in friends, and the Mechanical group too scored relatively high. Scientists scored extremely low on this scale, and officers scored much lower than the Navy enlisted groups.

On the Optimism scale, which was composed of the items Optimistic, Uninhibited, Curious, Frank, and Studious, a wide range of differences was obtained. Cooks scored relatively low on this scale and scientists scored at the other extreme, one standard deviation above cooks. Officers also scored high on this scale while the Mechanical group scored below the grand mean for all groups.

The nine occupational groups differed significantly on 11 of the 19 Clinical Evaluation Ratings. Cooks were rated lowest on Interpersonal Aggressiveness (Friction), Alert, Persevering, Assertive, and Paranoid. Cooks were rated highest on Flexibility. The Mechanical group was rated lowest on Flexible, Tactful, and Orderly. The Mechanical group was rated highest of the five groups shown in Table 11 on "Acts Out."

The foregoing studies of cultural and psychological differences among Antarctic groups have amply demonstrated that specific occupational roles are associated with particular personal backgrounds, value systems, needs, and motivations. The large differences present for a number of cultural characteristics and values indicate that the validities of these variables for prediction of individual performance may be profoundly affected. Cultural and value differences also may have practical importance in forecasting group compatibility at Antarctic small stations where persons in very dissimilar occupational roles must interact to achieve common goals. If differ-

ences are too great, reductions in group harmony and effectiveness might be expected. Some evidence for this hypothesis has been adduced from studies of friendship choices within small work groups (Nelson, 1964). Differences in cultural background characteristics and personality needs tended to be related to incompatibility among work associates during the latter part of the Antarctic winter period under conditions of maximum confinement and isolation from the outside world.

Summary

This report has described the Antarctic Research Program, the Antarctic environment, characteristics of small stations, and the composition of wintering-over parties. Demographic and biographic characteristics of Antarctic volunteers, Navy and civilian, were analyzed, and preenlistment histories and military performance records of Navy Antarctic volunteers were compared with those of Navy men generally. The selection process was portrayed for Navy occupations represented at small stations, and ratios of applicants to assignments for three expeditions were presented. A detailed analysis was conducted of cultural and psychological differences among Antarctic occupational groups.

The data reviewed in this survey -- the first of two parts -- were intended to present a rather complete picture of the Antarctic setting and the characteristics of Antarctic volunteers. In the second report, a series of studies concerned with sources and effects of stress, measurement of individual and group performance, patterns of emotional and motivational change in wintering-over groups, and methods for prediction of performance will be summarized.

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Appendix A. Job Descriptions for Navy Enlisted Occupations at Small Antarctic Stations[a]

Radioman (RM). Two radiomen are normally assigned to Byrd and South Pole stations, while the smallest stations are assigned only one. The senior man, usually a first class petty officer with considerable experience and training, schedules the monitoring and work assignments for his junior and himself. The duties, problems, and work schedules vary from station to station. but a standard schedule during summer, when air traffic is heaviest and constant communication between air and ground is required, is 12 hours on and 12 hours off. In winter when flying is no longer possible, the lighter work load permits a schedule of 24 hours on and 24 hours off.

Deep freeze radiomen are responsible for transmitting and for filing all official incoming and outgoing messages which may be sent via Code Wave (CW), radio teletype, Radio Audio Transmitter (RAT), or other voice and code circuits. They are responsible for communication between ground and air as well as for relaying messages between other stations and/or field parties. Included among their duties is the dissemination of weather data. Under ordinary conditions, radiomen are required to repair and maintain their own equipment, especially teletype equipment. Occasionally, without appropriate training, they are called upon to install radio equipment. Because of their experience, they are often called upon to operate the amateur radio gear which transmits the telephone conversations of station personnel via New Zealand to ham stations around the world. Time permitting, they help other station personnel in performing their duties as well as participating in mess cooking and tending the snow melter. Eight to 13 hours can be considered an actual, average work day for radiomen; the length of the work day, however, may vary depending upon the specific schedule of transmission between stations, weather conditions. and air traffic.

Storms which cause transmission blackouts, scientific equipment which interferes with transmitting, power failures, and disharmony between senior and junior radiomen are only a few of the problems faced by wintering-over personnel.

Hospitalman (HM). At most of the small Antarctic stations, the Officer in Charge is a physician. who is responsible for both medical and command administration. The hospitalman, in most instances an experienced first or second class petty officer, works with and for the doctor. Since rigid physical qualifications must be met prior to deployment to the Antarctic health problems are rare and accidents usually minor, the corpsman's problems are seldom medical but most often are those of a storekeeper, mailman, and/or general handyman. The summer work load is greatest since supplies are replenished during the long daylight hours. As a member of the crash crew, he is required to be on the runway for landings and takeoffs and, as medical storekeeper, he is responsible for sorting, labeling, maintaining a functioning pharmacy, and dispensary. Some typical year-round duties are: assisting the medical officer with patients, treating minor injuries, operating the laboratory and X-ray equipment, assisting in surgery when necessary. and acting as clerical assistant in administrative matters.

Because his medical duties diminish to "about 20 minutes per day" with few medical problems during the winter, the hospitalman becomes a jack-of-all trades. He performs such tasks as hauling snow for the snow melter, driving heavy equipment, dumping trash, running the movie projectors, cooking, building, helping to supply fuel for the station, and just plain "working like a mule." Extra time may be consumed by reading, operating the amateur radio station. making leather goods, photographing and developing pictures. The work day in the winter is approximately 6 hours long and returning hospitalmen have suggested that the corpsman billet could be eliminated without endangering the missions of the stations where a medical officer is present.

Electronics Technicians (ET). Although the specific duties of the Navy Electronics Technician differ from station to station, his overall task is to maintain and repair electronics and communication equipment. As the only military ET at a station, he is responsible for the continued operation of his equipment, the storage, cataloging, and reordering of electronics parts. During the first eight weeks of summer, when new supplies are being distributed and communications between ground and aircraft personnel are vital, these various activities require a work schedule

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[a]These composite descriptions are based upon the responses of several wintering-over personnel from each occupation to a job description questionnaire administered during the 1962, 1964, and 1965 expeditions.

of from 12 to 16 hours per day. As station life becomes more routine and the operation of electrical gear stabilizes, the ET spends less time at his electronics work and begins to help other station personnel with the general housekeeping chores. After the onset of winter, while continuing to maintain the electronics equipment during the three or four hours of evening, some may work outdoors as heavy equipment operators.

Important problems faced by electronics technicians in the Antarctic are: the lack of current reference books and proper test equipment; unsuitable work spaces; inadequate storage facilities for electronics spare parts; incorrectly ordered and/or supplied component parts; and the long delay between submission of an order for a much needed part, its procurement, and its arrival.

Mechanic (CM/EN). There are two mechanic ratings in the Navy which are commonly deployed to the Antarctic: Construction Mechanic (CM) whose duties most often involve maintenance and repair of heavy construction equipment, such as tractors, graders, and earthmoving equipment; and Engineman whose training has been in the maintenance and operation of diesel and gas engines and electrical generators. Each is qualified to serve as a general equipment mechanic and, depending upon the needs of the station and its complement, may serve interchangeably. Construction Mechanics, however, are more apt to be assigned to stations planning construction projects.

At a small station, the mechanic's duties may require that he repair the heavy equipment and rotate generator watches with the electrician (EM). At a station such as Byrd or South Pole, where various types of generators supply the station with heat, electricity, and water, and men are available to maintain the heavy equipment, the Engineman can most often be found working in and around the powerplant.

Because the Construction Mechanic is usually most concerned with the condition of heavy equipment, his job calls for more hours outside in the weather. During the summer when supplies are being distributed, the heavy equipment must be in top condition. Thus, as soon as winter darkness sets in, preventive maintenance and repairs must be made to the equipment to ready it for the arrival of the first plane with the station's much anticipated supplies.

At the small stations, where the complement is limited to the few most necessary rates, the mechanic may assume the duties of the builder, utilitiesman, and equipment operator. These duties, including the maintenance of the equipment, consist of ordering and inventorying spare parts, building caches for supplies, unloading planes, shoveling snow, repairing plumbing and stoves, and assisting in the general housekeeping chores of the station.

Commissaryman (CS). Each station must have one qualified cook for good food is one of the few pleasures left to Antarctic station members. This man is responsible for the entire commissary operation -- the planning, the preparation, and the clean-up as well as the storage of incoming supplies. At the larger stations, an assistant mess cook may be assigned during the summer when scientific visitors converge upon Antarctica. Aside from this temporary increase in the number of mouths to feed, the cook's duties revolve around the refrigerator, stove, and sink. Unlike most continental U.S. shore station cooks, the cook in Antarctica must also be a qualified baker, butcher, and innovator. The hours are usually long and a six-day week is considered normal.

The problems are those of traying to please a variety of tastes with a limited larder. The Antarctic messhall is the focal point for social life. Because of this the cook seems to have the least privacy and the most social contact of any member of the station.

Equipment Operator (EO). Occasionally, Byrd Station, because of its size and under-snow living conditions, is assigned two equipment operators but one is considered to be the normal complement for that station. The smaller stations, especially those situated in rough terrain, at extreme altitude, or where weather conditions prohibit extensive equipment operation, are not usually assigned an EO.

The duties of the equipment operator involve the actual operation of Sno-Cats, diesel tractors, earthmoving equipment, etc., and, when a mechanic is not available, general maintenance checks and repairs. The EO's heavy equipment is needed to level mounds of drifted snow, unload cargo planes with their tons of equipment, clear and maintain the airstrip, propel cargo-laden sleds, clear under-snow tunnels between buildings and, upon occasion, assist in actual construction operations. The equipment operator's duties change only slightly from summer to winter. Storms, which curtail the operation of equipment when they occur, usually leave in their wake more work. During the winter when flying is abandoned, the airstrip falls into disrepair and in the spring must be prepared for the arrival of the first plane.

The primary problems confronting the equipment operator are: intense cold which turns diesel fuel into jelly, frequent equipment breakdowns, and either no spare parts or a supply of spare parts which do not fit the equipment.

Electrician (CE/EM). Two Navy rates qualify for assignment to Antarctic stations as electricians: Construction Electrician (CE) and Electricians Mate (EM). Usually only one electrician is assigned to a Deep Freeze station but Byrd Station has consistently operated with three. A Construction Electrician is usually assigned at the initial opening of a station since his duties are more apt to involve wiring new buildings, installing new generators, and new sound telephones. The Electricians Mate usually is responsible for standing generator watches in the powerhouse and for maintaining electrical systems throughout the station.

The summer season is the busiest for the electrician as station maintenance and generator repairs are most frequently done at this time. During the winter, cold weather proves to be an additional problem as cables become stiff, break, and are difficult to handle. Essentially, the electrician's job is one of general electrical work under extremely rough conditions.

Utilitiesman (UT). The Utilitiesman is responsible for all station utilities systems, except the electrical system. It is his duty to repair and maintain the water, fuel, plumbing, heating and refrigeration systems of the station. The work demands change little from station to station, summer to winter. Most of the stations are assigned only one Utilitiesman but on previous occasions Byrd Station has had three and Eights Station has had none. Probably the most important single duty of the UT is the converting, by means of a snow-melting machine or, as at Hallett, distillation units, snow into water. About 1,500 gallons of water are normally required each week. The typical duties of the Utilitiesman are: repair and maintenance of storage tanks, fuel tank lines, distillation units, pumps, compressors, water heaters, washing machines, sewage lines, and stove stacks and stoves. The Utilitiesman may also be responsible for the station fire control. His collateral duties often include: hauling trash, disposing of honey buckets and urinal barrels, and general station clean-up.

The most common recurrent problems encountered by Utilitiesmen are a shortage of proper tools, insufficient stocks of proper replacement parts, and inadequate work facilities.

Carpenter (BU). The assignment of carpenters to an Antarctic station is usually contingent upon the amount of construction planned for that station during the coming year. Two, three, or even four carpenters may be sent to one station, while none is sent to another. The mechanic or equipment operator usually is assigned the tasks of the carpenter at a station where the complement does not include this rate.

During the summer months, the carpenter is busiest. He usually works a six-and-a-half day week, from 0730 to 1800. His duties may include the building of sidewalks and foundations, repairing wooden structures, operating heavy equipment, making runway drags and markers, and erecting buildings. During the winter when temperatures drop so low that outside work is limited to 10 or 15 minutes at a time, the carpenter moves inside where he constructs shelves and cabinets, paints walls, tiles floors, and repairs or remodels the living quarters as necessary. Probably more than any other station individual, the carpenter functions within his occupational classification.

Lack of proper materials and tools and the weather pose about the only serious problems likely to face a carpenter in the Antarctic.

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13. ABSTRACT

This report described the Antarctic Research Program, the Antarctic environment, characteristics of small stations, and the composition of wintering-over parties. Demographic and biographic characteristics of Antarctic volunteers, Navy and civilian, were analyzed, and preenlistment histories and military performance records of Navy Antarctic volunteers were compared with those of Navy men generally. The selection process was portrayed for Navy occupations represented at small stations, and ratios of applicants to assignments for three expeditions were presented. A detailed analysis was conducted of cultural and psychological differences among Antarctic occupational groups.

The data reviewed in this survey -- the first of two parts -- were intended to present a rather complete picture of the Antarctic setting and the characteristics of Antarctic volunteers. In the second report, a series of studies concerned with sources and effects of stress, measurement of individual and group performance, patterns of emotional and motivational change in wintering-over groups, and methods for prediction of performance will be summarized.

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