Parallels in Isolation: Managing Space Problems in Antarctica

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As more time is spent in the exploration and inhabitation of space, periods of isolation will grow longer, accompanied by unique forms of stress for individuals functioning in an artificial environment. In this article, Mr. Harding, once an expedition leader in Antarctica, discusses the similarities found in the stresses imposed on individuals working in Antarctica and space and the methods for managing problems encountered in isolation.

Human presence in Antarctica, as in outer space, is basically a twentieth century phenomenon. It was not until 1899, when the ship *Belgica* was beset in the ice of the Antarctic, that man spent his first winter on the seventh continent, a semi-mythical land that for centuries had been called, "*Terra Australis Incognita*."[1]

Accounts of the *Belgica* adventure inspired explorers to take up the challenge of earth's remote frozen regions. In 1909, the Pearey-Henson expedition reached the North Pole. Attention then turned toward the South Pole as earth's unconquered "final frontier." In January 1912, Robert Falcon Scott reached 90° south, only to discover that the Norwegian party of Roald Amundsen had beaten him there by over a month. Scott recorded his feelings in his diary: "The Pole . . . Great God! This is an awful place and terrible enough for us to have laboured to it without reward of priority. . . . Now for the run home and a desperate struggle. I wonder if we can do it."[2]

Tragically, as Scott's diary records, they did not make it. Disheartened and low on food, they perished in a storm that blew up when they were only eleven miles from their supply depot.

Scott's expedition was undertaken in part to test various hypotheses about what man would find at the end of the world. One such hypothesis was

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1. The Antarctic Continent appeared on maps such as that of Orontius (1531) centuries before it was actually sighted.
2. Scott's diary, quoted in: William Herbert Hobbs, *Explorers of the Antarctic* (New York: House of Field, 1941), p. 76.

Symme's theory of "concentric spheres,"[3] the essence of which predicted a "hole" at the bottom of the earth. Symme's romantic scientific theory and those of many others were proved wrong. Scott's disappointment with finding *nothing* at the ends of the earth must have been as sublimely ineffable as astronaut Armstrong's exhilaration at seeing *everything* from the surface of the moon.

Parallels between the exploration of Antarctica and outer space go far beyond the strong physical and psychological stresses both environments place on human inhabitants. Historically, the first major scientific expedition to Antarctica took place in 1957, the International Geophysical Year. In the same year, the Russians opened the Space Age with the launching of Sputnik I. The main participants in Antarctica are the primary explorers of space: the U.S.S.R. and the U.S.A

Russian interest in the Antarctic dates back to at least the early nineteenth century. In 1820, Admiral Fabian von Bellinghausen, commander of an exploratory cruise commissioned by the Imperial Russian government, met and congratulated Nathaniel Palmer, a Yankee sealer, and the first man to sight the continent of Antarctica.[4] The name of Bellinghausen's ship, *VOSTOK,* or "East" was later given to the Soviet's most important base in the Antarctic. Perhaps "East" has a greater meaning to the Russians — one that connotes frontier (in the way F.J. Turner thought of the "West"), as they have named their principal Siberian city Vladivostok. Their first manned spacecraft, which carried Yuri Gagarin into orbit on April 12, 1961, was christened *VOSTOK I.*

As this article is being written, NASA is evaluating the results of its most fruitful effort to date; the successful launch and landing of the Space Shuttle Columbia, which will pave the way for human colonization of outer space. Soviet astronauts have recently set the record for extended stay in space, and that record is likely to be broken many times in the future. As the Soviet Union and the United States take enormous strides toward the realization of man's dream of establishing permanent colonies in space, the potential for the spread of superpower conflict and a whole host of problems with space seems unavoidable. To anticipate and solve these problems, the U.S.S.R. and the U.S. will have to draw on a wide range of resources. But there is one resource both nations have in common which is likely to be more instructive than any

3. John C. Symmes believed the earth was hollow and habitable within. He claimed that an entrance to this inner world was located near the South Pole. In the 1820s there was some popularity for Symmes' theory even to the point of planned expedition under the Adams Administration — subsequently scrapped when Andrew Jackson won the election of 1828. William H. Kearns and Beverly Britton, *The Silent Continent* (London: Victor Gallancz Ltd. 1955), pp. 27-31.
4. This honor is in dispute. The British gave it to an explorer of their own, Edward Bransfield.

other: Antarctica. The road to be travelled in space has already been scouted in Antarctica.

These problems will cover a spectrum ranging from the effects of isolation on individuals to tensions between superpowers mentioned above. The editors of a book on the difficulties likely to be encountered in space describe one end of the spectrum:

> The missions of the early space age — when a relatively few, very highly trained, physically fit male pilot/astronauts operated for short times — will be supplemented in the future by missions where large numbers of non-pilot/astronaut men and women will work in orbit for long periods of time on research and industry-related tasks. The lengthening and changing complexity of space operations requires that the psychosocial, habitat design, food systems, and economic aspects of humans working in space be reviewed carefully.[5]

Another writer, concerned with Antarctica, looks at the importance of the seventh continent as an example for approaches to problems at the other end of the spectrum:

> The problem in Antarctica is the presence of human beings or, more precisely, the potential for ecological disturbance or destruction and conflict between states. Conversely, current human activities in Antarctica are among the most successful efforts at international cooperation and revolve around the accumulation of knowledge which will assist in the conservation and protection of the large global environment.[6]

Perhaps the development of space will follow an equally productive and peaceful path.

Many problems of jurisdiction and cooperation are shared by both Antarctica and space. The Antarctic Treaty of 1959 — which temporarily shelved sovereignty claims, banned nuclear and other weapons, and encouraged cooperation — served as a model for the Space Treaty of 1967. The exploration of these areas also gives rise to questions that pertain to the sovereignty and use of the oceans — another vast frontier where human habitation (as opposed to transit) is just beginning to increase.

Many science programs in Antarctica and outer space are interrelated.

5. Stephen T. Cheston and David L. Winter, *Human Factors in Outer Space Production* (Boulder: Westview Press, 1980).
6. Shirley Oake Butler, "Owning Antarctica: Cooperation and Jurisdiction at the South Pole," *Journal of International Affairs*, vol. 31, no. 1, (Spring 1977), p. 35.

Meteorology is studied by orbiting satellites and *in situ* on the Antarctic, dubbed "the weather factory of the world" because its large, cold mass acts as a gigantic heat sink. State of the art experiments in upper atmosphere physics are being conducted in both environments to help scientists learn more about the sun's effects on the outer layers of the earth. One third of all meteorites found in recent years were found in the Antarctic because they can be spotted easily in ice.[7]

At the present time, there are probably very few social or political scientists who would be willing to accept the idea that Antarctic or space stations can serve as laboratories for studying social and political interactions. The almost exclusively male scientific technician and support crews who go there in no way constitute an ideal or even representative sample of the larger social world. Nevertheless, some political analysts might be curious to discover whether a small group reflects its national values and if it retains planned organization as time goes by in isolation. Lawyers might be intrigued by a place that literally has no laws.[8] A diplomat might wonder how stations of different nationalities interact and if a "polar diplomacy" or "spatial diplomacy" exists.

To date, only a handful of scientists have drawn comparisons between the psychological effects of life in Antarctica and long duration space flight. One writer elaborated on some of the similarities.

> Both environments are novel and unique, and involve potential danger from both individual accidents and the failure of life support systems. Once established, the daily routine in both may become monotonous. However, due to the nature of these environments individuals may be required to suddenly shift from a state of boredom into their highest level of physical and mental activity to cope with an emergency. A certain type of individual is required to successfully meet these requirements to remain alert to potential hazards over an extended period of time and to maintain psychological adaptability under the influence of environmental stresses. Life in a high-risk environment requires an individual with psychological strength, an ability to learn quickly under unexpected conditions, tolerance for loneliness and anxiety, and an excellent functioning central nervous system.[9]

7. W. A. Cassidy, "Antarctic Search for Meteorites," *Antarctic Journal of the U.S., 1980 Review,* vol. 15, no. 5, p. 49.
8. Bill H.R. 10548 introduced by Mr. Rodino to the 94th Congress in 1975 would have amended Title 18 of the United States Code to bring civilians in Antarctica under U.S. jurisdiction in cases of criminal conduct. It did not pass.
9. Kirmach Natani, *Future Directions for Selecting Personnel,* eds. T. S. Cheston and David L. Winter, Ch. 2: *Human Factors in Outer Space Production* (Boulder: Westview Press, 1980), p. 25.

The writer goes on to discuss selection of suitable persons for work in the Antarctic and finds that, "given time and opportunity for personal contact, a good coach, flight instructor, or expedition leader can identify individuals who do not possess characteristics of psychological adaptability and competence. Unfortunately, psychologists and psychiatrists, when limited to a single interview, do not appear to match the selection performance of these seasoned veterans."[10]

It is with approbation that this writer offers some observations and perspectives on life in Antarctica. This knowledge is the result of duty as a station manager during the nine-month long Antarctic winter. The station manager (expedition leader) is charged with the welfare of the station's crew. The job description states that, "Pre-requisites for Station Manager are exceptional leadership and administrative capabilities, good judgment, an interest in science, an understanding of people, a strong moral code, exemplary character, physical stamina, willingness to follow orders, an ability to work under pressure even when fatigued (whether the job is menial, a dire emergency or challenging), a mechanical know-how, ability to maintain positive personal morale over a lengthy period of isolation, and a talent for innovativeness."[11]

Job descriptions can be notoriously inaccurate. U.S. Navy psychiatrists present a less rigid view: "Successful leadership techniques vary, of course, and experience proves how little we actually know about how the style and personality of the leader influence group performance. Nelson (1965) has observed however, that the smaller the station, the more successful seems to be the democratic style of leadership. The rigid and authoritarian methods of a large military command are usually unsuccessful at small stations."[12] Nelson's observation may be true because under isolated and confined conditions the only effective way to counteract contempt bred by familarity is through a working example and open dialogue.

Two well known Antarctic expedition leaders disagree: "One of Admiral Byrd's chief tennets regarding leadership in the Antarctic was that a leader had to remain aloof to keep group morale high. This, he felt, gave a sense of security to the men. . . . In addition, where a leader had to make arbitrary decisions, it was important that he not get too close to the men under his command."[13]

Captain Finn Ronne took a similar view and explained it by saying, "my experience is that in general the members of expeditions do not get along well

10. Ibid., p. 39.
11. T. A. Sinclitico, *"Position Description,"* (Unpublished report) 15 June 1976, Holmes & Narver, Inc., Orange, California.
12. R.E. Strange and S.A. Youngman, "Emotional Aspects of Wintering Over," *Antarctic Journal of the United States* (December 1971), p. 257.
13. Paul A. Siple, *90° South* (New York: G.P. Putnams Sons, 1959), p. 306.

with each other, though when they get home and write up their experiences, they feel ashamed of having acted childish and tend to gloss over their quarrels."[14] In other words, children have to be disciplined.

Whatever the expedition leader's style, his job is such that he must ensure the performance, confort and morale of the group in order to get the job done. And during the Antarctic winter, a large part of that job is simply staying alive.

The following account is from this writer's experience as the Station Manager/Facilities Engineer in charge of the management responsibility at Siple Station during the Austral year 1977 and at Palmer Station during 1978. The written material consulted for this section consists primarily of 130 weekly situation reports (SITREPS) sent from the station to the National Science Foundation as well as references to my personal diary.

SIPLE STATION, ANTARCTICA

Siple Station was established in 1969 and became a permanent U.S. "winterover" facility in 1973. Amundsen-Scott base, located at the geographic South Pole, and the Soviet base Vostok, located at the geomagnetic South Pole, are the only other year round stations located inland on the continent. All other U.S. and foreign bases are situated along the coastal periphery of Antarctica. Siple Station was named after the famous American explorer and geographer, Paul Allman Siple (1908-1968) who first visited Antarctica as an Eagle Scout of one of Admiral Byrd's expeditions in the late 1920s. Dr. Siple was Station Science Leader at Amundsen-Scott base at the South Pole during its first year of occupation.

Siple Station (76°S 84°W) sits on a featureless plain of snow one mile thick at the base of the Antarctic peninsula, in a region known as Ellsworthland. The station is supplied entirely by air. Special ski and JATO[15] equipped LC-130 Hercules aircraft fly 1,250 nautical miles from McMurdo Station three months out of the year. There are no aircraft operations on the continent during the Austral winter because of cold, darkness, and logistical problems. Therefore, residents of inland stations can expect no outside assistance for nine months of the Austral winter, even in the most dire of emergencies.

Siple Station's population usually ranges from 20 to 30 members in the summer months and four or five during the winter. It was the first all-civilian U.S. Antarctic station and has the distinction of having the smallest, most isolated group to winter in the Antarctic since Admiral Byrd's lone four month stay at

14. Finn Ronne. *Antarctic Command* (New York: G.P. Putnams Sons, 1961), p. 251.
15. Jet Assisted Takeoff: eight solid fuel rockets are strapped to the airplane for added thrust needed to overcome the friction between the skis and snow.

Advance Base south of Little America II in 1934.[16] Despite its stark surroundings, the geographical location of the station is rich in scientific importance. As the geomagnetic conjugate point of Roberval, Quebec (Canada's thunderstorm region), "Siple offers a unique window with which to study the earth's upper atmosphere." Very low frequency transmissions from Siple to Roberval, via magnetospheric ducts, are used to study how electrically charged particles and waves interact in space and how the distribution of charged particles is affected by solar activity."[17]

The most prominent piece of scientific apparatus at the station is a 100 thousand watt radio transmitter (a modified Omega Submarine communication system) which powers a 21 kilometer long dipole antenna. Other scientific instruments include receivers and recorders that monitor the effects of magnetic storms, auroras, whistlers, cosmic rays and other atmospheric phenomena found in abundance at Siple's location.

I arrived at Siple Station with a crew of five at 10 p.m. on Friday, November 13, 1976. It was spring in the Southern Hemisphere. The sun was shining brightly and the sky was an electric blue that can only be seen in those latitudes. The stillness and quiet of the day was so complete that one could hear the blood pumping to one's head. The station was unoccupied. It had been abandoned the previous year for two reasons: three of the six LC-130 Hercules transports had crashed during take-off as a result of JATO rockets breaking loose from their mountings, and the Station crew had suffered an outbreak of hepatitis. The diminished air support and concern over the staff's medical problem led to the decision to evacuate all personnel, with plans to begin operations at the beginning of the next Austral summer.

The airplane that had brought us stayed on the "ground" for only a few minutes, waiting until we could set up a field radio and establish contact with one of the other bases. The big "Herc" had to taxi for several miles in order to gain enough speed for take-off. Siple has no prepared runway, and the surface snow can be soft and fluffy.

Antennae and bamboo poles with trail flags marked the location of the main station and the satellite camp. Nothing else was visible on the snow's surface. All structures and living quarters had been completely buried by the falling and drifting snow. The remnants of a Union Jack hung from one of the antennae, testimony to a British Otter pilot's (light aircraft) visit ten months earlier.

The new station crew was composed of seasoned Antarctic veterans who between them had spent nearly 20 years on the white continent. Immediately after arrival, they insisted that we begin work, warning that spring weather was

16. W.J. Trabucco, "Siple Station: The First Winter," *Antarctic Journal of the United States*, (June 1974), p. 88.
17. Ibid., p. 88.

notoriously fickle and that the grey and purple band on the flat eastern horizon might mean that a "herbie," or blizzard, was approaching. They were right. We erected a 60 foot Jamesway tent just in time. The weather turned foul as the last blanket was being tied down. We busied ourselves by tidying up and settled down to a meal.

After dinner, the conversation centered around the group that was to follow us once the storm abated. Thus far, I had been very impressed with the diligence and efficiency of my experienced associates and recalled that at the Antarctic conference at Scottsdale, Arizona, one prominent speaker had attested that the United States Antarctic Research Program (USARP) "placed its faith in men and not machines." As Facilities Engineer, I was particularly concerned with how well certain pieces of equipment withstood these low temperatures, and posed such a question to Rob Flint, a three time winterover who had even stayed for a year with the Russians at Vostok. "In the Antarctic, by the large, the machines hold up better than the men," he said. His statement made me wonder about the effects this strange place would have on not only the machines, but the men as well. After several days, we decided to explore the main station. We followed a line of red trail flags to a hatch and climbed down into 50 feet of cold darkness. The galvanized, quonset-like steel arch, which protects the equipment and living quarters, showed signs of deformation as a result of the tons of snow and ice that weighed upon it. The "Wonder Arch," as it was called, measured 210 feet in length, 40 feet in width and (except where it was crushed) 24 feet in height. When a colleague explained that the station actually moved 30 feet a year towards the Bellinghausen Sea, it became evident that whoever was to live here would, in fact, be residing inside a glacier.

One third of the "Wonder Arch" area was used to store fuel. Two 25 thousand gallon bladders, looking like large pillows, rested on the snow floor. They contained special diesel fuel, Arctic (DFA), which was supposed to freeze only at around -70°F and had a high flash point. The price of this fuel, after shipping costs to McMurdo and air transport to Siple, was about $12.00 per gallon. In this section, smoking was not permitted.

The living quarters, which occupied the central portion of the "Wonder Arch," could best be described as a hodgepodge of insulated trailer vans tacked on to a one-story prefabricated house. (The corner of one van touched the arch because the snow floor tended to rise from snow pressure and the arch tended to descend.) In a few days, we would cut part of the roof from our living quarters to relieve the pressure — a process that was to be repeated again as the year progressed, and our "world" grew smaller.

Eventually the season began, as more people came out to Siple to participate in the hectic preparations for winter. The five "winterovers" moved into the station after lighting and heating were re-established. The rest of the scientists and construction workers lived "topside" at the summer camp.

The total area of our heated living space in the main station was roughly the same as that of a modest two-bedroom house. Like the interior of a submarine, the inside was crowded with equipment, supplies and machines. Very little space was wasted, and anything that could stand the cold was stored outside in the subzero temperatures beneath the arch. A huge fan sucked air from a gauze plenum buried in the snow to provide ventilation and to keep the snow from melting, thereby slowing the deformation of the arch.

The organization of the station was quite simple. At one end, a laboratory known as the "active lab" housed a variety of sophisticated electronic equipment, including the "ZEUS" VLF transmitter. Although small, this laboratory contained the most important reason for the station's existence. Its decor was reminiscent of Dr. Frankenstein's basement.

The transmitter operated eight to ten hours a day as the computer "keyed" the transmitter into certain responses. Hundreds of lights would blink and sparks (bleeding static from the 13 mile long antenna) would shower as the large transformers emitted a peculiar high pitched whine. The ZEUS normally operated in the region of 20,000 Hz which is at the limit of the human hearing spectrum.

At times, two of our diesel electric generators had to be run in tandem, or "parallel," as the transmitter often required more electricity than the rest of the station did at a normal load. Admist the roar of the turbo-charged generators, the "zee-zee" sound from the transmitter pervaded the station. Harmonics from this "symphony" would resonate off different metallic objects and creep into the speakers of our stereo system and movie projector. Occasionally we would amuse ourselves by holding a neon bulb in our hands near the transmitter and watch it light up. More often, we would brace ourselves against the incessant noise, which was impossible to escape within the confines of our station.

The second laboratory was known as the "passive lab." This laboratory contained most of the receivers, chart recorders, clocks, and other gathering devices. The two scientists were constantly at work trying to keep most of these sensitive instruments running while making observations, building new components and so forth.

The generator room or "power house" was located adjacent to the active lab and housed three old, but powerful, caterpillar diesel electric generators capable of producing a total of 275 KW, along with a variety of pumps, switches, fans and other machinery. These dynamos were placed only inches apart and could be considered the hearts that pumped the life blood of the station. No energy from these machines was wasted. Electricity ran our lights and the engines' cooling medium was used to heat our living space. The varying load imposed by the transmitter meant that the lights would dim and flicker and that temperature would change throughout the station as the engines' thermostat tried to compensate.

The powerhouse contained a metal box that was heated by the diesels' exhaust. Snow was shoveled by hand from the surface into the hatch of this "snowmelter" and later the melted water was pumped into a holding tank for station use. Snow was invariably shoveled from near the station and, as a consequence, the water often contained fire-proof wood chips, DFA asbestos insulation and the like which had been discarded on the surface.

Despite the fact that the diesel generators were vital to our existence, it was impossible to monitor them at all times. They were old and had previously been in use at Byrd Station during the 1960s. Their year of "cold soaking," when Siple Station had been closed, did not enhance their reliability. Occasionally, there occured a power failure resulting in total silence, pitch darkness and a mad scramble to reactivate the generators and reverse the thermometers' plunge before the pipes froze.

There existed an ever present danger of failure in the engines' governor, resulting in a condition known as "overspeed." If not arrested in time, the generator will produce a higher and higher voltage as the engine winds faster and faster. The engine or dynamo may fly apart violently if not adjusted properly.

Adjacent to the power house was the galley. The number three generator was only inches away, behind the wall of the stove. When the generator was running, an intense vibration prevented the cook, who also doubled as the radio operator, from baking either bread or cakes.

Despite its small size, the galley contained all the conveniences of a modern kitchen. Some very interesting meals originated here, determined in part by the age of the ingredients. Most of the food which was stored in the "ice caves" had been packed in the late 1960s or early 1970s. More than once we prepared World War II vintage corned beef with the date 1944 stamped on the can. No one suffered any ill effects from this and the taste was quite acceptable.

The small bathroom was inconveniently situated, so that it opened into the eight-foot by fifteen-foot dining room. The single commode was in almost constant use as the latrine on the surface was a drafty wooden affair without any heat. Showers were rare for everyone, and water was always scarce in the summer, because the snowmelter could only produce water at a limited rate.

Also included in the living space was a dispensary, which was the only medical facility within a radius of 650 miles. Among the bandages and medicines, the medic had five body bags and one straightjacket. Among the five winterovers at Siple, one was designated as a full time paramedic, although time was spent on other chores.

Finally, five single eight by eight-foot bedrooms made up the individual private quarters. The adjacent lounge was a natural magnet for all social activity because it was the largest and quietest room in the station. It also served as a berthing area for guests in the summer, a carpentry shop, and a weightlifting room.

This, then, comprised the living space and home for the five people who were to remain there for over a year. Its closeness and smallness gave everyone a claustrophobic feeling at one time or another. There were no windows, of course, since the station was buried. Eventually one of the scientists devised a periscope so that weather observations were possible without climbing the ladder to the surface.

These noisy, confined and restricted living quarters contrasted sharply with the vast expanse outside. The horizon at this locale was completely unbroken for 360° and the vista was similar to that seen from a boat in the middle of the ocean. Except for the snow waves, or sastrugi, there were no natural features on the surface. On windless days the sound-deadening effect of the snow created an unnatural silence.

It is characteristic of people who spend time in an environment like Siple Station to focus their eyes on the sky or horizon as opposed to the ground or nearly straight ahead, as is usually the case in more varied and hospitable climes.

The sky, which changes with the season and with the weather, represents variety, life and freedom in an otherwise featureless spot where no vegetation or habitation occurs naturally. Charles Darwin once defined the Antarctic circle as "the point where the living and non-living cease to compete." In the period November 1976 to December 1977, one lovely and obviously lost Suka gull was the only creature observed to visit the locale.

One intriguing phenomenon, in which interest is undiminished by frequent occurrence, is a weather condition known as a "whiteout." Unlike a blizzard, which reduces visibility as the result of falling and blowing snow, the true white out occurs on calm and overcast days, when the sunlight diffuses through descended cloud cover. The horizon is completely obscured, and it becomes impossible to differentiate earth from sky. All surface definition is lost so that one can experience feelings of vertigo and disorientation accompanied by a lack of depth perception. A Navy man once aptly described a whiteout "as the view a fly has in a bowl of milk."

A whiteout also may occur during the winter when moonlight diffuses through the icy fog, and much like a blizzard it can greatly hamper navigation. Since battery cells last only a few minutes in the winter cold and a compass is useless in a region so near the South Magnetic Pole, travel from the station must be undertaken by rope or with string.

Some Effects of Improved Communications

We installed a new Motorola satellite link transmitter/receiver during the Austral winter at Siple Station. Earlier we had relied on the traditional Collins

KWM-2A UHF radio/teletype system to communicate with the outside world. All official traffic had to be relayed in teletype "hard copy" through the Naval Communications Center at McMurdo Station some 1,250 miles away. All outgoing messages required the approval of the Station Manager or the Station Science leader. Most messages for resupply requests, clarification of instructions, and logistical matters, were directed to corporate headquarters, and other messages which pertained to the experiments were directed to the Radio Science Laboratory at Stanford University.

All personal messages to friends and family were transmitted by voice through the informal and generous efforts of private ham radio operators in the United States. Use of the ham radio network required some good will. One had to search the airwaves to find a willing ham operator who had the necessary equipment to ensure a "phone patch" — that is, a link between the radio and a telephone system.

Many ham radio operators were eager to make "contact" with Antarctica and would even "break in" on a conversation so they could receive a station "call card" proving that they had established communications with Siple Station. The radio waves from Antarctica to the United States pass over the continent of South America where radio procedures and competition for use of cer tain bandwidths are not controlled by the Federal Communications Commission (FCC). As a result, the airwaves occasionally became a forum for airing transnational dialogues.

Occasionally, someone might use foul language on the air and find himself being reprimanded simultaneously from such far-flung places as Zaire, New Guinea, and Mandan, North Dakota.

It was often difficult to remember in that isolated setting that there is no privacy in the conversations passing between a station and the outside world. Theoretically, anyone with a proper receiver could monitor and even record both sides of the dialogue.

Once I was inadvertently eavesdropping on a conversation from another Antarctic station, waiting to break in with the ham operator, when it became clear that the person at the other Station was having marital trouble. His wife was explaining that she was leaving him for someone else, taking the children and the checks he had sent thus far. She had, she said, already sold the house. That personal tragedy can result from absence is not the point: this person's problems were immediately made apparent to a bunch of news-starved speculators around the continent and elsewhere. Distance and interference can distort voice intonations, often leading to misunderstandings and making the situation even more difficult. There was no possibility for this person to hide his feelings, to try to clarify the situation or even stop his checks from being sent to his wife's bank without considerable difficulty.

By current standards, the Ultra High Frequency (UHF) radio system is inefficient and inconvenient. The equipment is complex and requires a skilled operator to use it and a trained technician to maintain it. We were obliged to adhere to the strict procedures laid down by the Navy, which passed on all our official messages. The Navy procedures required use of approved abbreviations and standard format codes to indicate the importance and priorities of the messages, and certain routing indicators to ensure that the proper parties would be notified.

Perhaps the biggest technical drawback to the use of this UHF system in Antarctica was that radio wave propagation can be severely and adversely affected by aurora, magnetic storm and sunspot activity. The awesome beauty of the southern lights, Aurora Australis, was often accompanied by loud static or complete radio blackout. Siple Station is located in an area that is particularly rich in magnetospheric phenomena, which is one of the scientists' prime objects of study, but also results in poor communications. The ionispheric layer sometimes "disappeared" for days, preventing radio waves from bouncing back and forth to their destination and hampering radio communications.

The installation of the satellite ground station eliminated most problems. The corkscrew-shaped antenna bounced a directed signal off the ATS-3 communication satellite and relayed voice traffic static-free to its destination. ATS-3 had lost some of its commercial value as it had begun to wander in its orbit. NASA generously donated satellite time several hours a week to the station with the provision that it was to be used exclusively for scientific purposes. And so it was.

The clarity and reliability proved to be a boon to the Very Low Frequency scientific experiments which could then correlate scientific transmissions from Siple to receivers at Roberval receiving station.

PALMER STATION

Almost exactly a year later, I found myself again wintering over at a different station — Palmer — under similar, but not identical circumstances. Palmer is located in a much balmier zone at the tip of the Antarctic peninsula. The station was still obliged to relay all official traffic through McMurdo, some 2,500 miles away. This added distance caused extra problems. A message would have to be relayed through Siple or South Pole Station to McMurdo, then to Christchurch, New Zealand on to Stockton, California and then to its final destination. Each stop could mean that a message had to be retyped and recut, always subject to interpretation or mistakes.

As a result of this extended line of communications, a decision was made to install a satellite ground station at corporate headquarters to speed up and improve communications. Palmer Station already had satellite systems that had been installed for scientific purposes, so everyone saw the new change as an unqualified step toward progress.

Unfortunately, the immediate effect on that isolated winterover group was quite different from what had been anticipated. Our boss required that we set up a schedule to talk one hour a day, seven days a week. From our standpoint, this was entirely too much. The satellite system was as clear and convenient as a telephone system. We knew that the office had a small speaker attached to the satellite receiver so that several people could gather around to listen to our conversations. After the many months of isolation, we had become self-conscious of the way our speech had been affected. We knew that some people would be getting a kick out of listening to a bunch of "drifty" winterovers if they had nothing else to do.

Theoretically, only the Station manager was required to be present for these conversations, which were supposed to pertain to business matters.

As it turned out, however, the satellite hour became the daily high-point for a group of people who lived a generally monotonous existence. Everyone would gather in the meteorology laboratory (to the dismay of the meteorologist), except for two scientists who had piped speakers into their laboratories, so that they could listen to the latest scuttlebutt without having to leave their posts. As a result, everyone was present for each and every schedule.

Most of the time there was not much to say except that things were going well. After all, we were in complete isolation, and there was nothing materially anyone in the outside world could do for us. Why bother to tell them that the saltwater pump broke and there was no spare, or that we ran out of beer, or the Station Science Leader has two ingrown toenails? Whatever happened, we would have to fix it or live with it until the station opened in December. If we wanted advice, we could ask for it.

For these reasons, we tried to keep conversations short, but invariably one of the station members would get on the air under the pretext of discussing some area of business or resupply and wind up gossiping, asking about a certain secretary at the office and so forth. Most of the time the office would be receptive to these queries and opinions, thinking that outside conversation was good for these isolated souls. I am certain that some of these conversations led to a great deal of speculation at both ends.

We tried to adhere to a daily routine based on Eastern Standard Time, but the effect of the polar night and the consistently long hours that some tasks required caused some of us to deviate from our normal schedule. Some people suffered from "big eye" — a form of insomnia that is fairly common in the polar regions. Others, because they had no need to stay on a fixed work pattern, used to end up "going around the clock" — going to bed and waking up an hour later each day or so.

Being off schedule posed some problems with respect to our satellite hour. For example, the Facilities Engineer might have to be awakened at three in the afternoon to answer some questions — even if he had just gone to bed with a frozen ear and several stiff brandies. Predicting or controlling what he might say on the satellite might prove difficult. People react differently to isolation, but all seem to sound strange and a bit eccentric after they have been removed from society for a while.

Our Communications Officer took a jaundiced view of the satellite rig; in a sense it rendered his job obsolete and made his work seem redundant. When someone feels useful, he usually feels contented; conversely, if his function is removed, he may become resentful. It was hard for our Communications Officer to justify spending hours cutting message tapes, maintaining equipment and waiting for atmospheric conditions to be right when the same result could be produced in a matter of minutes with a small blue box and a corkscrew antenna. The satellite system irritated the Navy as well, for no longer were they able to monitor all messages from the United States stations. As Manager, I was also disturbed by the disruption that the new avenue of communication created. Problems did not go through a chain-of-command system, but were referred to the office directly. We could not put forth an official position without time; and this system and its "nine-to-five" proponents demanded instant response. We began to feel as if "Big Brother" had moved into our living room.

Eventually, we were able to make our views known and some relief on the basis of "Don't call us, we'll call you" was finally worked out. I cite the following excerpt from my end-of-tour report as Station Manager dated December 1978:

> This Comsat system is new and when properly used, is an efficient means of communications. Under normal circumstances, a weekly schedule seems adequate and especially helpful on clarification of resupply.
>
> The satellite rig provided the strongest and most immediate link with the outside world. I believe that its use should be restricted to business matters only and that discussions be used at all times to avoid confusion or misunderstanding at either end. During the winter of 1978, almost all the station members were present for each and every schedule.

We learned that Palmer Station was not the only base to suffer the consequences of improved communication.

Unfortunately, things were not going well back at Siple Station. It was the last year that the original facilities were to be used because the crushing weight of the snow had severely deformed the buried "Wonder Arch." This inevitable fate removed any incentive for the five-man crew to improve the existing facilities since operations were scheduled to shift to a newly completed station the following year. Sadly, this left them with much time on their hands, which, coupled with the isolation, was to have disastrous results.

We became aware of the difficulties at Siple on that unique Antarctic holiday known as "Midwinter's Day." This festive date, June 21, marks the exact middle of the southern hemisphere's winter. Each successive day becomes progressively brighter, until at last the sun returns. All United States and foreign stations send greetings and congratulations to each other on this day.

The message from Siple read:

> 19 June 1978
> From: Siple Station
> To: All Antarctic Stations
>
> Announcing the first all-continent midwinter celebration at the Antarctic's favorite vacation spot — Siple Station! The Station's door will be open at 0012 June 21 for 24 hours of unlimited fun. Come as you are. All beverages and activities are absolutely free. Here is just a hint of what you can expect:
>
> — Olympic size swimming pool.
> — Air conditioning!
> — 24 hour go-cart track!
> — Polo
> — Patti McGuire [Playmate of the year 1977]!
> — Open Bar!
> — Continuous movies!
> — Champagne Baths!
> — And, of course, free parking!
>
> Everybody is invited. A 24-hour nursery will be provided for the scientists. If you can't make it, have a very happy mid-winter's day anyway.
>
> The Sipleites

The second paragraph stating that a nursery would be provided for the scientists was a catalyst for a telling and sad chain of events.

The administration back in the United States asked Palmer whether a feud had developed between Siple and Palmer, a notion that certainly had not occurred to us. One Palmer scientist agreed that the statement about the nursery was a bit provocative — but certainly written in jest. Unfortunately, officials did not hear the message — which was intended for Antarctic ears only — as a joke. Those at Siple lost their sense of humor, too, since unbeknownst to us or authorities in the U.S., the "Sipleites" had been eavesdropping on our satellite discussions of their problem.

Apparently group distinctions, always a threat in the Antarctic environment, had sparked divisions at Siple. Possibilities always exist for clashes between military and civilians, drinkers and non-drinkers, winterovers and summer crews. At Siple, personal problems between scientists and support personnel had percolated to the surface. During the next few days we heard from Siple, voices requesting an aircraft rescue. One crew member signalled the frightening: "They want to kill me, bury me in the snow and say that I walked off in a whiteout!"

That was in June. The airplane finally came, but not until October. All five crew members left the station forever.

DISCUSSION AND DEFINITIONS

The human factor in isolated realms such as long-duration space flight, Antarctic service and submarine duty has received steadily increasing attention as more men and women venture into these new areas. But problems remain. The usual candidate who enlists for this kind of mission knows very little in advance about what is likely to be experienced psychologically during the long period of isolation. The same can apply when returning home to a world that has grown and changed. Problems, too, are encountered because isolation duty analysis is focused on the individual's competence, and is not geared towards examining the group as a whole.

Prospective Antarctic and submarine candidates are usually screened by psychiatrists and psychologists with very little feedback. Applicants may get a quick lecture before they are shipped out by doctors and veteran winterovers — known as OAEs, or old Antarctic explorers — or by old submariners. In the case of prospective winterover candidates, they may refer to the historical or anecdotal literature, or personal and professional contacts before they go. The U.S. government manual on *Survival in Antarctica*, for example prepares South Pole aspirants as follows:

Wintering Over

> Medical personnel know that human adaptation to the Antarctic environment affects physical and emotional health. Although there may be problems during the summer, they may be more serious for those who live in Antarctica for an entire year.
>
> During the six months of summer daylight, many activities are carried on outdoors. Even the relatively mild summer climate makes difficult the heavy work entailed in construction projects and the receiving and storing of supplies. Once winter sets in, activity at most stations generally is confined to the indoors for nearly six months. Life at inland stations especially is physically and socially restricted in winter. You will find that your companions have diverse backgrounds and different purposes for being in Antarctica. The unique combinations of people will necessitate individual

> adaptation to the close living environment as well as the physical environment. Survival should be a collective concern. Group discussion of the procedures and techniques of survival are appropriate topics of discussion during your long stay.
>
> The close living conditions obviously make it mandatory that individuals be able to get along with one another. You must be tolerant of the idiosyncracies of others while, at the same time, not being overly sensitive about yourself. Your emotional composure at work and play socially affects the whole station team.
>
> Your ability to accept leadership will be a measure of your maturity. Your capability to work and live day-to-day with stable disposition is the key factor in your contribution to the winter's success. Once the novelty of being in a strange environment wears off the problems facing you will be similar to those with which you must cope elsewhere: your work and those around you. It may be difficult to work in such a setting. Remember that many people before you have accomplished their jobs admirably. Your ingenuity in providing that which seems to be missing is important for successful adaptation, high morale and productivity.
>
> It should be obvious that the successful surmounting of the demands of Antarctic survival depends on the physical condition of the individual and the preparation he or she has made. The condition of all personnel is assumed to be of a high level, but an endurance check is not part of the physical examination. It is endurance that is most often called upon in emergencies. Reviews of past polar survival ordeals reveal avoidable hardships caused by overestimating personal capabilities. In too many instances deaths may be attributed to a lack of appreciation for the physical demands of actual conditions. Like flying, survival can be unforgiving of excessive optimism, carelessness, and neglect; these three are the trinity of trouble.[18]

The term isolation, it seems, has meanings as varied as its effects. One common denominator stands out: Isolation separates the individual or group from important parts of its normal environment, a lesson which must be learned by those planning or anticipating extended ventures in Antarctica or space.

The four main components of isolation are:

- *Confinement,* usually produced by threat, physical enclosure or encapsulation.

18. National Science Foundation, *Survival in Antarctica* (Washington, D.C.: Government Printing Office, 1974), pp. 69-70.

— *Aloneness,* or separation from familiar surroundings, with feelings that one is miles from nowhere in a vast exposure, often accompanied by feelings of relief and exhilaration in some, but fear and depression in others.
— *Sensory deprivation,* which occurs during an absence of sensory stimulation. And
— *Stress,* encompassing the overall effects of time, pain, danger and annoyance, perceived both personally and professionally, either imagined or real.[19]

Coupled with its effects must be at least brief mention of the reasons one might enter into isolation. Three reasons come immediately to mind. One might be a captive, as in the case of American prisoners of war in Vietnam or the embassy staff in Iran. One might be the victim of a disaster, as in the case of the Uruguayan football team downed in an airplane crash in the Andes or refugees shipwrecked on desolate, tropical atolls. Compared to these involuntary groups, the third enters isolation voluntarily, for the challenge, escape, prestige, money, adventure, curiosity or other less obvious personal purposes.

Time as well is an important factor in the consequences of isolation. There exists the kind of voluntary isolation in remote work sites in the desert, jungle or oil drilling platforms from which escape to a larger society is always possible. A second possibility is when the time commitment to a period of isolation is known and definite, but from which escape is impossible. Examples of this would be the winterover period in the Antarctic and submarine cruises under the polar ice cap. The third type of isolation occurs when the length of stay is unknown and where no escape is possible. This happens in many kidnapping cases and is probably the most difficult because of a tendency toward hopelessness.

It is harder to gauge the psychological adversity of the first and second categories. In some ways, it seemed easier to resign oneself to the inescapable period of isolation at Siple Station (despite harsher conditions) and to "make the best of it" than it was at Palmer Station, where in the event of an emergency, the possibility of leaving existed. This was because the personnel at Palmer knew they could leave and each day, therefore, had to reconvince themselves of their purposes for being there.

Human beings are remarkably adaptive creatures and often make the best of any situation. One well-qualified observer was Sir Ernest Shackelton who, after his ship *Endurance* had been crushed by the Antarctic pack ice and his men had been forced to live under severe conditions for many months, wrote: "They

19. S.B. Sells and Charles A. Berry, *Human Factors in Jet and Space Travel* (New York: Ronald Press, 1961), pp. 180-182.

had adjusted with surprisingly little trouble to their new life and most of them were quite sincerely happy. The adaptability of the human creature is such that they actually had to remind themselves on occasion of their desperate circumstances."[20]

CONCLUSION

This article has attempted to focus attention on some inherent problems of isolated, artificial and high-technology community environments. The anecdotal section on Siple Station was included to portray, rather than interpret, some of these problems. Unlike the other three permanent bases in Antarctica, almost nothing has been written about the human experiences at Siple; from a historical standpoint, then, it seemed appropriate to leave at least a small written testimony to some of the blood, sweat, tears — and money — that will disappear when the science program is finished and the station becomes buried beneath the Antarctic mass.

Future changes in technology will alter the effects of isolation, both at the poles and in space. As aircraft technology improves, it is likely that Antarctic crews will not remain isolated for such long periods of time. Perhaps by then, however, space will be occupied by human beings on a full-time basis and we will still have to place our faith in men and women locked in extended isolation. At the present time and into the foreseeable future, the period of voluntary isolation will remain longest in Antarctic duty where the period of total physical separation ranges from six to ten months.

Recent strides in space technology, though, already foreshadow a challenge to this earthly record. The Soviets recently completed the longest manned space flight in history when cosmonauts Leonid Popov and Valery Ryumin remained orbiting in the Salyut 6 space station for six and one-half months. The U.S. record was set at 84 days in Skylab when the manned space program was actively operational five years ago.

One writer analyzing space politics, places Antarctica "midway between the history of overseas exploration and the future of space exploration, [but that conditions there] have caused physiological, psychological and even philosophical stress" to those who go there.[21]

It is this "philosophical stress" which is perhaps the most difficult to circumscribe. As the months go by, monotony couples with the absence of the usual satisfactions — social, sexual, recreational, academic and others — producing a particular kind of introspection.

20. E.H. Shackelton, *South* (London: Macmillan, 1920), p. 380.
21. Alan K. Henrikson, "Space Politics in Historical and Future Perspective," *The Fletcher Forum*, vol. 5, no. 1 (Winter 1981), p. 112.

The individual may feel that his sense of what is really important in life — something previously taken for granted — is made somehow more clear. A walk around the candy-cane-like south pole marker ("walking around the world") may make him more aware that the earth is, after all, just a ball. He also may feel that he has gotten to know his colleagues better than his own family, in fact better than he *should* get to know anyone.

The small group finds that in a closed system it can organize itself and experiment anywhere along the political spectrum — just as the expedition leader must make a choice between managing by directive or managing by objective. The keen awareness that there is no "they" to provide help or entertainment is enhanced by the fact that no one in a survival group can strike or get fired. Arbitration of disputes by long distance appeal is just not possible. In a successful wintering scenario it appears that a type of "creative anarchy" emerges and occasionally evolves into a brand of functionalism similar to the Bauhaus paradigm, where "form follows function."

The late Arnold J. Toynbee argues in his book, *A Study of History,* that so close is the correlation between technological advancement and moral decline that the appearance of the former may be used to forecast the latter. Antarctica and space may be exceptions to Mr. Toynbee's rule. On January 7, 1978, the first child was born in Antarctica. Emilio Palma took his first breath on a continent that has never recorded war or a major crime.

One could say that the concepts of pioneering and isolation are inseparable, because the one who goes before into the unknown, the untried, prepares the way for others. Be he scientist or settler, he will be set apart from others and placed alone.

If we are to look ahead to our place among the stars, first we have to look at ourselves and search, if need be, to the ends of the earth.