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RAYMOND J. NOONAN, PH.D., CCIES WEBSITE EDITOR

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Updated, with More Countries

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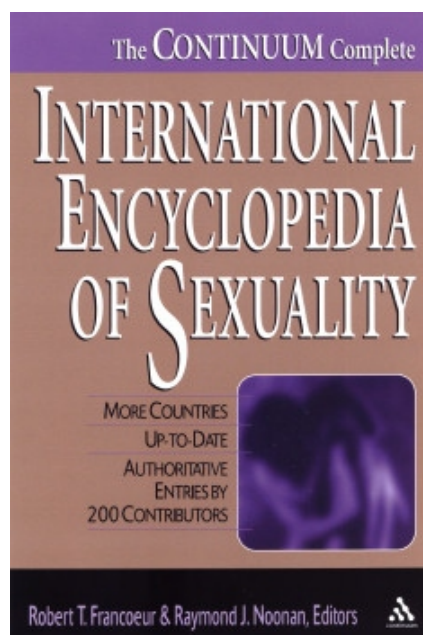
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Outer Space and Antarctica

Sexuality Factors in Extreme Environments

Raymond J. Noonan, Ph.D.*

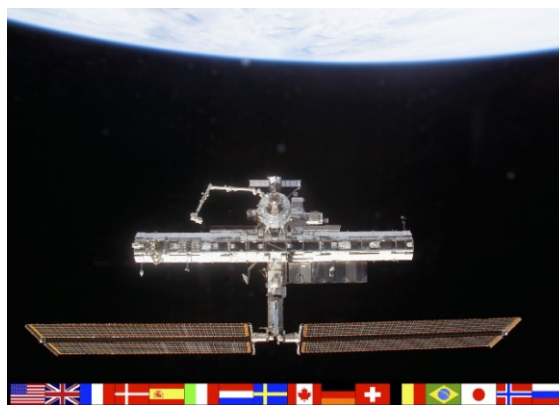
Updates and new material by R. J. Noonan

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An Introduction to Life in Extreme Environments

Antarctica and outer space are considered two of the most extreme environments with which human beings have to contend. Because of certain similarities, these two are well-suited to being addressed in one chapter because of their common elements, which allow one—Antarctica—to be a research environment studied to find solutions to potential problems in the other—space habitats. In fact, numerous authors continue to consider them together in the human factors realm (e.g., Harrison, Clearwater, & McKay 1991; Stuster 1996; Palinkas, Gunderson, Holland, Miller, & John-



International Space Station (NASA/JSC 2003)

son 2000; Dudley-Rowley, Whitney, Bishop, Caldwell, & Nolan 2001). Sexuality in extreme environments is often a second thought—or later, if it is even thought about at all—for good reason: These environments are such that they require meeting the most basic of human needs in terms of immediate survival. In Maslow's (1970) motivational hierarchy of needs, this would include the lowest levels of survival and safety. Sexuality is at a higher level on the scale, and entails needs that, of necessity, would come later once the others have been adequately met. For additional analysis of this thesis, see Noonan (1998a). In addition to this are the corporate or state-sponsored interests in these endeavors (because of the costs and the technologies involved), which typically ignore or discourage sex-related behaviors because they are conceptualized as potentially (or likely to be) disruptive.

Extreme environments are not limited to space and the polar regions of Earth. Studies—particularly those in the psychosocial realm—focus on those factors that push the envelope of human survival and performance, because of environmental-system extremes in the physical, psychological, and social spheres. They have high barriers and sharp boundaries that limit both life and effective performance under normal circumstances, many of which require technological advances and intensive training for adaptation success. In addition to Antarctica and the space environment, extreme environments include arctic and other isolated environments, undersea operations and deep-ocean submarining, high-performance and general aviation, the armed services and special forces, caving, mountaineering, and vulcanology, and mining and hazardous-substance work, as well as medical, emergency, police, and firefighting scenarios in natural and man-made disasters. Essentially, extreme environments are those in which humans, either individually or in groups, have to perform under highly stressed, complex, and challenging conditions. The difference between space and Antarctic environments, however, is much less than the difference between those two and most of the other earthly pursuits listed above, and will be detailed more fully later in this chapter. Of particular importance to the success or failure of a particular space mission or polar expedition that makes the consideration of sexuality factors necessary, is the fact that these environments entail day-to-day living and working, and thus increase the likelihood that sexuality factors could have a determinative impact.

Suffice it to say that the physical environment of space has several important characteristics that Antarctica does not have: microgravity, high electromagnetic and particle radiation levels, high vacuum conditions, lack of oxygen, and extremes in temperature and pressure. Although it has extended periods of extreme cold and lack of humidity, Antarctica is protected by the Earth's mass, which provides a magnetic

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In addition to updates, this chapter now includes a new section on life in extreme environments and a new section on Antarctica.

field, called the magnetosphere, that deflects most of the charged particles that are carried by the solar wind, which give rise to the Van Allen radiation belts surrounding the globe as well as the polar auroras. In both environments, it is necessary to construct ecologically more-or-less closed, self-sustaining habitats for protection, and it is difficult if not impossible to effect a quick rescue in the case of an emergency.

Psychosocial factors are the key items of interest, however, in terms of scientific research relating the two environments. These include: isolation, remoteness, hazardousness, and extremely confining quarters—and the resulting high levels of emotional and physical stress that accompany them, including decreased motor function, fatigue, and unpredictable and potentially life-threatening occurrences. It is here that sexuality factors could have an impact, potentially both positive and negative, that need to be considered.

The Society for Human Performance in Extreme Environments (<http://www.hpee.org/>) is the organization for professionals involved in these fields. The Society publishes *Human Performance in Extreme Environments*, a journal devoted to fostering knowledge of and improving the levels of human performance in these environments.

OUTER SPACE

Demographics and a Brief Historical Perspective

A. Demographics

At this point in history, only a few hundred men and women from more than 25 countries have traveled and lived for some period of time in space.* With the advent of the new millennium, and despite the catastrophic loss of the Space Shuttle Columbia on February 1, 2003, the permanent human presence in space has become firmly entrenched, with the sixth crew of three beginning its stay on the new International Space Station (ISS) in November 2002. The largest cooperative scientific program in history, the ISS was developed jointly by the United States, Russia, Canada, Japan, and Brazil, and the participating nations of the European Space Agency (ESA): Belgium, Denmark, France, Germany, Italy, Netherlands, Norway, Spain, Sweden, Switzerland, and the United Kingdom (NASA 2003). Because of this virtually unprecedented mixing of cultures in a peacetime endeavor, we must expect that participants' cultural backgrounds will have an impact on gender interactions and any sexual relationships that will inevitably develop in space environments. Certainly, our common biological nature will have a different set of challenges in the sexological realm that will have to be met as well. Evidence for this comes from recent studies by Italian researchers that found that levels of the sex hormone testosterone are temporarily decreased in male astronauts by exposure to space, along with a concurrent decrease in sexual drive or libido (Strollo et al. 1998).

The "territory" of outer space, the study of which broadly comprises the domain of cosmology and astronomy, is open to interpretation. As Fazio (1997) has noted, where space begins depends on the physical properties of the area in question, specifically the problems that need to be resolved to allow humans to travel and live there. For example, extreme cold occurs, and sufficient air to breathe is lost, at considerably lower altitudes rising from Earth than the oxygen

needed to power a jet engine. Thus, humans would require physical protection much sooner than they would need a rocket engine, which does not require atmospheric oxygen to fly. In addition, at various points in space, we would be faced with the potential effects of microgravity, several types of radiation, extremes in temperature and pressure, a near-complete vacuum, and the impact of meteorites. Therefore, for men and women to live and work effectively and safely in various space environments, engineers either have or will design vehicles and habitats, including spacesuits, with countermeasures to protect spacefarers from some of these extreme conditions. Others are pervasive, however, like radiation, which could have serious consequences outside of the protection of the Earth's magnetosphere, in which lie the Van Allen radiation belts, and microgravity, which will likely have an impact on sexuality factors.

Perhaps the most critical aspect of space with which we have to contend, however, is a psychosocial environment that is "characterized by isolation (a separation from the normal or daily physical and social environment), confinement (restriction within a highly limited and sharply demarcated physical and social environment), deprivation, and risk" (Connors, Harrison, & Akins 1985, 7). In fact, they said that in space, "... the physical environment, when not terrifying, is likely to be bland" (p. 9). Pesavento (2000), in a very recent study of the psychological and social effects of isolation in space and during space-simulation analog studies on Earth, said that these may be the ultimate barriers to extended human spaceflight. He noted those factors that have yet to be resolved, including: "depression-like symptoms on orbit [(which Russian space physicians have named "neuresthenia")]; less-than-encouraging social interactions with mixed-gender and mixed-foreign-national groupings; sensory deprivation; as well as the emotional and sexual affects of close confinement on crew members" (p. 1; see also Cabbage 2001).

Yet, many astronauts have also described the profound sense of spiritual and philosophical awareness they gained being in space and viewing the awe-inspiring panoramas, especially looking back at the Earth (White 1987). Some have noted the absence of geographical boundaries, other than land and sea, and the meaning they ascribe to it in terms of the absence of political boundaries and the unity of humanity. Almost certainly, our collective sense of the fragility of Earth's environment has come from some of the widely published photographs taken in space.

For the foreseeable future, however, the laboratory for this grand human experiment will be the International Space Station (ISS), the largest and most complex scientific endeavor ever attempted on an international scale, which began assembly in orbit in late 1998 and had its first sustained trio of inhabitants in November 2000. When finished, the ISS will have a mass of over 1 million pounds (454,000 kg), measuring about 360 feet (110 m) across and 290 feet (88.5 m) long, with almost an acre (4,000 m²) of solar panels for electrical power. Flying at an altitude of 250 statute miles (400 km) with an inclination of 51.6°, at which it can be reached by all of the international partners, the ISS will be able to observe 85% of the globe, covering 95% of the Earth's population. It will be the site of a wide range of scientific endeavors and research (NASA 1999).

B. A Brief Historical Perspective

The realization of the fantasy of space travel is a distinctly 20th-century phenomenon, having its antecedents in the age-old fantasy of human flight dating at least from the ancient Greek story of Daedalus and Icarus. Combining the human need for exploration and discovery with the political

*Citizens from the following countries have flown in space: Afghanistan, Austria, Belgium, Bulgaria, Canada, Cuba, Czechoslovakia, France, Germany, Great Britain, Hungary, India, Israel, Italy, Japan, Mexico, Mongolia, Netherlands, Poland, Romania, Russia, Saudi Arabia, Syria, Ukraine, USA, and Vietnam.

realities of striving for nationalistic prestige and military advantage, and now, with the possibility of vast economic returns, the spaceflight revolution began during World War II with the development of the first V-2 ballistic rockets used by Germany against Great Britain. One of the fascinating stories surrounding the end of the war involves the race, won by the Americans, with the then-Soviet military to capture these rockets after the fall of Nazi Germany, which, in 1946 and 1947, were used by the U.S. to carry its first biological payloads into space (Bushnell 1958). It was the V-2 rocket that made human spaceflight a theoretical possibility, and this, in turn, both stimulated an interest in suborbital test flights and spurred the development of space biology, as well as space medicine, which was first discussed by leaders at the U.S. Air Force School of Aviation Medicine in 1948 (Nicogossian, Pool, & Uri 1994). Thus began the pervasiveness of a military culture, with its similarities yet distinct dissimilarities with the wider culture of which it is a part, which once dominated but still persists in national space programs.

Test flights by the U.S. continued, including two primates in V-2 rockets prior to 1950, various animals in rockets until 1952 and high-altitude balloons from 1950 through 1954, and two men in balloons in the summer of 1957. Similar ballistic rocket flights by the Soviet Union from 1949 through 1957 used dogs as subjects. The Space Age proper is said to have begun with the launching by the Soviet Union in October 1957 of Sputnik-1, the first artificial satellite to orbit the Earth. This was followed a month later by Sputnik-2 carrying a dog named Laika, the first animal in orbit. The U.S. responded with the February 1958 launch of Explorer 1, which detected what would be named the Van Allen radiation belts. Subsequently, both the U.S. and the Soviet Union launched a number of animal flights, using mice, rats, monkeys, dogs, or other small animals, sometimes to test systems that would later contain humans. In April 1961, the Soviet cosmonaut Yuri Gagarin became the first man to orbit the Earth, with Gherman Titov being the second in August 1961. Following two manned suborbital flights by the U.S., John Glenn was the first American to reach orbital flight in Mercury's *Friendship 7* in February 1962. In June 1963, Soviet cosmonaut Valentina Tereshkova became the first woman in space.

It would be almost two decades later, August 1982, before the second woman, cosmonaut Svetlana Savitskaya, would fly; she would later be the first woman to conduct an EVA (extravehicular activity) in July 1984. Although it is widely accepted today that women will always be a part of the American space program, it was over 20 years, almost to the day from Tereshkova's historic flight, before the first American woman, Sally Ride, would fly on the space shuttle in June 1983, and October 1984 for the first EVA by an American woman, Kathryn Sullivan (Cassutt 1993; Nicogossian et al. 1994). Although it is interesting to note that Tereshkova's flight was considered by many at the time to be a Cold War public-relations ploy by the Soviet Union (Santy 1994), the United States had tested women as potential astronauts as early as 1960 (Atkinson & Shafritz 1985; McCullough 1973), although this fact is not widely recalled today. When news of it reached the press, it was treated with skepticism and flippancy. In fact, these women had been systematically barred from the space program, even though it was thought by some in the scientific community that women might be better suited, both physically and psychologically, for the severe requirements of those pioneering spaceflights (Levin 1989). These events illustrate an example of the collision of prejudice (sexism) with scientific knowledge that occurs all too often with sex-related issues (see Noonan 1998a).

Santy (1994) expressed her belief that a contributing factor to women's finally being selected as astronauts, although less obvious, was the fact that the first private toilet had recently been designed for use on the space shuttle:

The issue of privacy, linked as it was to sexuality and personal hygiene, had been a big factor in NASA's reluctance to include women as astronauts, and the development of the private toilet—probably more than any other reason—encouraged NASA to believe that females could finally (and without embarrassment to the agency) be integrated into Shuttle missions in a way impossible during the earlier missions. In *Gemini* and *Apollo* missions, the spacecraft required that crew members live side by side without even the most minimal capability of providing privacy for personal activities. (p. 51)

In 1978, the first group of astronauts to include women and male minorities was chosen. It was considered a watershed event, signaling a change in the way in which future astronauts would be recruited and selected (Atkinson & Shafritz 1985). In fact, it was probably our first experience with what would later be called the "development of space cultures" (cf. Harris 1996), given that racial and ethnic minorities have distinct cultural attitudes and behaviors, and many regard males and females as having different cultures as well (Francoeur 1997, 1998). Cultural factors later became important in the Space Shuttle Program, which first flew in April 1981, and in the Shuttle-Mir Program, including Shannon Lucid's current-American-record 188-day stay on *Mir*, which resulted in unprecedented cooperation and trust between the U.S. and Russian space programs. The Shuttle-Mir Program, in which several Americans flew on *Mir* between 1995 and 1998, was designed in part to elicit some of the possible psychological, psychosocial, and human performance aspects of multicultural crews in preparation for the International Space Station (Morphew & MacLaren 1997). All of these experiences led to the present ISS, first known as *Alpha*, with its historical antecedents in the early space stations of the U.S. (*Skylab*) and USSR (*Salyut*) in the 1970s.

At the present time, international treaties govern the use of space, including the Outer Space Treaty of 1967, the Liability Convention of 1973, the Moon Agreement of 1979 (which was never signed by the U.S. or Russia), and others, under the auspices of the United Nations Committee on the Peaceful Use of Outer Space. Also, other agreements have been entered into in the telecommunications realm (Harris 1996). In addition, in the United States, Congress and the President determine space policy. Federal agencies also affect space activities, including NASA (the National Aeronautics and Space Administration), the Federal Communications Commission, and the Departments of State, Defense, Transportation, Commerce, and Energy, as well as the military, as noted earlier. Similar national organizations function in other countries. The Space-World Bar Association (Smith 1997) is working further to develop a prototype Lunar Economic Development Authority that would coordinate the planning of more extensive uses of space resources, not the least of which are the mineral resources expected to be mined and the microgravity environment expected to make possible new manufacturing opportunities.

Space tourism, in fact, is expected to be a very important, although initially expensive venue in which ordinary citizens will be able to visit space habitats for their vacations. Just as air travel has become common today with its mass-market availability and the concurrent affordability resulting from it, a few entrepreneurs are already creating private companies to offer the service. One expected attraction is

what a former U.S. congressman called widespread public attention to: the honeymoon in space (Gingrich 1995). Such ideas, of course, echoed similar predictions by science fiction writers, such as the space visionary, Arthur C. Clarke (1986), but this was the first time that such an inherently sex-bound human activity was included in a political vision for future Americans (if not for the bulk of humanity).

1. Basic Sexological Premises

A/B. Character of Gender Roles, and Sociolegal Status of Males and Females

Early in the space programs of both the United States and Russia, men were virtually the only ones recruited for space missions. Although this has been attributed to the fact that the Eisenhower Administration in the U.S. directed that military test pilots be the first to attempt these early missions because of their skills in testing new aircraft designs, and the inherent danger they entailed, women had been considered as early as 1960 (see Section B, A Brief Historical Perspective, above). At present, women have been an integral part of the various space programs, including commanding the space shuttle, although there is still not a gender-balance in the ranks of astronauts. In addition, some authors have noted that sexist attitudes have been a part of the experience of some women, as well as attitudes that some women still have to prove themselves because they are women (Casper & Moore 1995; Connors et al. 1985). The issue with regard to the development of the toilet, noted above, serves as an example of the constraints surrounding the biological aspects of our differing anatomies, and psychological differences have been cited as well (see Noonan 1998a).

C. General Concepts of Sexuality and Love *Conjecture on the Influence of Spaceflight on Sexological Issues*

Levin (1989), a British consultant on reproductive and sexual physiology, has written the most extensive review of the possible effects of space travel on these human systems. In surveying the research literature, he wrote:

Despite th[e] large number of people who have been exposed to space flight with all its attendant hazards, our knowledge about the effects of space travel on the human reproductive system, and human sexuality, is sparse, bordering on the non-existent. Some of the most elementary questions seem not to have been investigated, indeed in some respects not even to have been asked. For example, it appears that no programme to evaluate the effect of space travel on human spermatozoa was ever initiated despite the obvious hazard of exposure of astronauts to radiation, stress and G forces. Even if asked, answers have not yet appeared in the open literature. (p. 378)

With regard to the lack of research on the behavioral aspects of human sexuality, Levin provided additional insight:

In some respects this near-complete avoidance of what is a sensitive area of human behaviour represents a significant failure to investigate fully the possible reasons for the known stresses of living in isolated, confined environments. It is remarkable that there is no study as to whether human sexual activity, *or its loss* [italics added], can influence the adverse effects of such environments e.g. boredom, listlessness, sleep disturbances, fatigue, impaired cognition, irritability, hostility, depression and deterioration of personality. (p. 382)

Despite these concerns expressed within the space science literature—and readily available in their headquarters

library in Washington, D.C.—little research has been done by NASA, whose typical response has been that sex is not yet an issue (Date 1992; Vaughan 1992). It is my contention that much of this official response to sexual expression and to sexual research by the U.S. space establishment has been guided by attitudes distorted by a conceptualization of human sexuality as a capacity to be feared, avoided, sensationalized, problematized, or trivialized unless considered within the traditional boundaries of American sexual propriety. Similar negative views of human sexuality have failed to alleviate many of the perceived problems of people on Earth—and, in fact, have created many more problems because of ignorance and irrational fear (see Francoeur & Perper 1997; Weis 1997). Americans, after all, whether educated scientists or the generally scientifically ignorant general public, are Americans first. As such, we have been profoundly influenced by cultural values publicly accepted and promulgated by those who define society's norms, even if those norms have often been privately ignored by significant numbers of people, including, often enough, the very leaders who promote them.

In 1998, the first comprehensive analysis of human sexuality factors in relation to extended spaceflight, *A Philosophical Inquiry into the Role of Sexology in Space Life Sciences Research and Human Factors Considerations for Extended Spaceflight* (Noonan 1998a), was published, in which the author explored the issues and constraints surrounding the study of sex in space and conjectured about the potential impact of our sexual nature on mission success or failure. It suggested new terminology, the *human sexuality complex*, as a useful construct in which to consider the various sexuality factors in which human beings interact in and with their various environments.

The complexity of human sexuality, human sexual relationships, and sexual responses suggests the advantages of adopting a complex systems approach, one that draws on chaos and complexity theories, in future research on sexual phenomena and the interactions of its various components conceived as systems (Noonan 1998ab). Research on human sexuality in space, it would seem, could definitely benefit from the systems perspective, much as it was essential in developing our space programs. It also seems worthwhile and reasonable to consider the space environment to be a culture in itself, a "microsociety in a miniworld," as Connors et al. (1985, 2) described it, although it is also influenced by the outside cultures that sponsor it, much as any organization or workplace develops an indigenous culture, and the cultures of birth and subsequent origin of the individual crewmembers. In time, of course, any group will develop its own culture and norms that may be independent and/or an intricate mix of the others.

[Update 2003: Stuster (1996, 180-181) discussed the reluctance of NASA to deal with sexual behavior mainly because of concerns about media reactions, and noted historical parallels with some earlier explorers (restricted to commanding officers and expedition leaders when it occurred) who took wives or mistresses with them on long voyages. He cited Kanas and Federson (1971), who "tongue in cheek" discussed "Tension Reduction" associated with a multiyear mission to Mars:

The question of direct sexual release on a long-duration space mission must be considered. Practical considerations (such as weight and expense) preclude men taking their wives on the first space flights. It is possible that a woman, qualified from a scientific viewpoint, might be persuaded to donate her time and energies for the sake of improving crew morale; however, such a situation might

create interpersonal tensions far more dynamic than the sexual tensions it would release. Other means of sexual release (masturbation, homosexuality) would be discouraged because of the confined quarters and the lack of privacy on such a mission. Thus, it appears that methods involving sublimation are more practical than these more direct alternatives. (p. 38)

[Stuster (1996) also noted how women contributed a stabilizing influence to the isolated Antarctic research stations when they were first introduced to the continent and became a regular part of expeditions. In contrast to the men's previous boisterous and disruptive behavior, he wrote:

Winter-over crews now tend to be less disruptive and more concerned about their behavior or, more accurately, how women in their groups perceive their behavior. More important, the groups are believed to be more productive now than they were in the male-only days of Antarctica. Several experienced Antarctic managers confirm this observation. (p. 178)

[Thus, it appears that this behavior is similar to ordinary American life. (*End of update by R. J. Noonan*)]

On the International Space Station or future space habitats, it is likely that conflicts will occur when the status of women and men are inherently unequal, or if there is a perception of sexual deprivation among some members of a crew when others are in a sexual relationship there, as has occurred in Antarctica analogs (see Noonan 1998a). An anecdotal story tells of a Muslim passenger on an international spaceflight who had to take directions from a woman. Whenever she addressed him, he ignored her, because his cultural heritage, influenced by his religious beliefs, prohibited such contact between men and women. As a result, directions needed to be given by the woman to a male colleague who then repeated them to the man who then carried them out.

2. Religious, Ethnic, and Gender Factors Affecting Sexuality

A/B. Source and Character of Religious Values, and Character of Ethnic Values

The experiences of U.S. astronauts on *Mir* are well-known examples of some of the problems encountered by international crews of different ethnicities. Pesavento (2000) and Harris (1996) highlight the potential impact that cultural differences have had or might have on future missions. Of particular importance with respect to cultural and religious factors would likely be the compatibility of crewmembers' worldviews, as Francoeur and Perper (1997) have elucidated. The example previously noted of the Muslim crewmember's inability to interact with women as a partial result of his religious beliefs about innate differences between the sexes would also be relevant here. Of equal or greater importance might be the organizational (i.e., NASA's) stance and corporate-cultural beliefs about sexual issues that are transmitted to crewmembers (probably reinforcing similar beliefs in the astronauts), although such beliefs may have the same questionable effectiveness long-term as similar ones do generally in the U.S. and in other societies today.

3. Knowledge and Education about Sexuality

A/B. Government Policies and Programs, and Informal Sources of Sexual Knowledge

The impact on extended spaceflight is likely to occur as a result of policies that resist the study of both the potential positive aspects inherent in the human sexuality complex

as well as the potential negative ones. There may also be problems in failing to communicate the findings—and their importance—to the space community, Congress, and the American public as a whole, once they have been studied. The sexual myths of individuals at all levels of the scientific, administrative, and other parts of space organizations and their contractors or subcontractors are also likely to have a negative impact, as the myths become the guiding principles that are incorporated in the organizational philosophy. Perhaps another benefit of the space program (the so-called spinoff effect) could be the furthering of sexual knowledge by combining sexuality education and space education. Young people are very interested in both, and each subject could be used to impart knowledge about the other, particularly in the realm of science.

4. Autoerotic Behaviors and Patterns

A/B. Children and Adolescents, and Adults

Today, masturbation is believed to be a generally healthy and normal part of the experiences of human beings throughout their lifecycle. Nevertheless, we are still influenced by some of the beliefs of the 19th century, that masturbation (and ejaculation in general) depletes certain personal mental and energy reserves, such as when coaches sometimes suggest that neither be engaged in prior to competing. Money (1985a) has shown that this now-discredited degeneracy theory of masturbation, which some people thought could be counteracted by proper fitness and nutrition, prompted prominent health proponents, such as John Harvey Kellogg and Sylvester Graham, to develop foods they believed would extinguish sexual appetite and masturbation. Today, two of these foods remain associated with their creators, Kellogg's corn flakes and graham crackers, respectively, although their original purpose is long forgotten. Nevertheless, some religious traditions continue to oppose masturbation as moral degeneracy. Both of these traditions—the medical and the religious—are likely to be important in the context of space, because they have and will prevent the study of masturbation as a sexual activity that will likely be practiced in space, in the unlikely event that it has not been already. Among other things, it can help to counteract boredom and stress, and the environment is amenable to it, in that sufficient privacy can be found in which to practice it. Pesavento's (2000) recent study noted that in the early 1970s, a physician suggested that masturbation would be an effective countermeasure to maintain prostate health and avoid urinary tract infections for astronauts on *Skylab*, the longest mission of which lasted 84 days. Children and adolescents will, of course, practice masturbation when they become a part of settlements in space in the distant future, just as they will have hetero- and homosexual experiences, as they do on Earth in various societies today.

5. Interpersonal Heterosexual Behaviors

A/B/C. Children, Adolescents, and Adults

Heterosexual behavior encompasses a wide variety of possibilities: in specific activities, such as kissing, oral and anal intercourse, and vaginal-penile intercourse, for example, and in the variety of ways in which they can be done. A device has been patented, the "Belt to Paradise," to enable sexual intercourse in microgravity (McCullough 1992). In addition, there are numerous fantasy behaviors that can be acted out with a partner or imagined alone. Any of these heterosexual activities are very likely to occur in space at some point in the future, if some have not occurred already. Pesavento (2000) has discussed some of the rumored pairings that have occurred, although everyone officially denies

that anything happened. However, it seems likely that sexual intercourse and oral sex have already occurred in space. It is likely because, in our culture, sex is pervasive, gender awareness is ubiquitous, and the astronauts are mostly young, healthy people. However, given the current political climate, it is not possible nor expedient to prove that sexual behavior has occurred because of the potential harm to the astronauts involved, as well as to the space program as a whole. Speculation at this time may be the best approach until the next sex-positive cultural phase, which, if Reiss (1990) is correct in his characterization of sexual revolutions as being cyclical, will probably occur early in this century, that allows and emphasizes healthy sexual experience as the predominant social norm (see also Noonan 1996, 1998b).

Given our experience on Earth, it is also very likely that at least a few astronauts have entertained the notion of being the first to "do it" in space—unknown to the world, but still a shared, cherished, intimate secret. In addition, there has long been evidence that higher levels of intelligence and overall education—characteristics selected for in astronauts—increase the likelihood that certain sexual behaviors will be experienced (Hunt 1974). At this point in the space program, the astronauts are a large-enough population so that individuals would likely be able to find appropriate partners. Privacy and space in which any sexual activity can occur, albeit scarce, can be made available with appropriate planning. Sexual intercourse can also be done rather quickly, if need be, with very satisfactory results.

Our experience on Earth with some of the heterosexual subcultures, such as multiple sexual partnerships, also would imply that, although they have been sometimes problematic when flaunted in an atmosphere of sexual deprivation for other crewmembers in the analogous Antarctic settings (see also Stuster 1996), in the more-normal conditions of typical urban, suburban, and sometimes rural settings, extramarital affairs, multiple relationships, and even group sex, have the potential to coexist with the more traditional expressed norms of heterosexual monogamous marriage (Libby & Whitehurst 1977). When these alternative relationship patterns are successful (i.e., functional), it is usually because the couple and the subcultural network in which it functions have adopted it, and group norms have evolved that define their expression, often in contrast to how they perceive the outside world's views of their subculture's behavior. In space, because there will be limited populations for the foreseeable future, both with and without a balanced gender mix, the various diverse alternative sexual lifestyle patterns might be an avenue of inquiry to minimize potential problems. Again, given the current political and social climate in the country, it may be necessary to keep it an internal group secret. Nevertheless, a television news magazine reported the possibility that group sex had occurred in space (Anderson 1992).

[*Update 2003*: The first wedding took place in space on August 10 between International Space Station commander, Yuri Malenchenko, a Russian cosmonaut, and Russian-born Ekaterina Dmitriev, an American citizen, in Texas. A quirk in Texas law allows a person to get a marriage license and to get married by proxy if one of the parties is not in the state. Malenchenko was present via a video downlink, with a lifesize cutout of him also used in the ceremony in a Johnson Space Center meeting room. Neither the Russian space agency nor NASA was enthusiastic about the marriage, however—Russia because, as a colonel in the air force, he needs prior clearance for changing his family status, and NASA because of the use of ISS resources. They will need to remarry when they return to Moscow, because the marriage is not recognized as valid by the Russians. (Boyle 2003; Stewart 2003). (*End of update by R. J. Noonan*)]

6. Homoerotic, Homosexual, and Bisexual Behaviors

A/B. Children and Adolescents, and Adults

Connors et al. (1985) considered the possibility of homosexual relationships in space, although they considered heterosexual relationships to be the more realistic problem. At this time, it appears that homosexual activities in their varied forms are significantly less likely to have occurred in space, even if there are gay astronauts, simply because the majority of their colleagues are likely to be heterosexual; in addition, the process of coming out (making their homosexuality known to others) would very likely be the end of their career. However, homosexual sex may have occurred, because individuals are often able to find each other by conscious and unconscious subcultural cues. Then, allowing for the accidents of time and scheduling, potential homosexual partners may have been assigned to the same flight, guaranteeing training together for the mission and allowing them to be together in space for sex to occur. Again, it would not be politically expedient to prove that homosexual activities have occurred for the same reasons noted above for heterosexuals, but in this instance, there would also be the potentially greater harm that might come to a gay astronaut if his (or her) sexual orientation were unintentionally made public (although losing one's career would likely hold true for heterosexuals as well, if the activity occurred outside the accepted bounds of marriage).

The number of women who are astronauts would make lesbians even less likely to be represented in the astronaut corps than gay men, and thus would make it less likely that lesbian sexual activity has occurred. Nevertheless, both lesbians and gay men are represented in other aspects of the space program. The likelihood of bisexuals who might be astronauts is more difficult to assess, because many bisexuals typically do not identify themselves as a distinct subculture, but tend to shift between heterosexual or homosexual affiliations. Bisexuals, female and male, who are attracted equally to females and males are less common than those who tend to focus on one sex or the other. With regard to multiple pairings, my comments with reference to heterosexual astronauts would also likely apply, although in the case of gay astronauts, more or less their whole sexual persona would need to be kept secret in the present social climate.

7. Gender Diversity and Transgender Issues

At present, this issue probably has no relevance in the space programs.

8. Significant Unconventional Sexual Behaviors

A. Coercive Sex

Sexual Harassment and Rape

Sexual harassment has been cited as a significant problem in the military, and, although it is often used now as a means of extortion or harassment itself, trivializing its actual victims as well as obscuring its real meanings and incidence in general, there is little information as to whether it has been a problem in the training or other professional or social settings involving the astronauts; it could be a problem in a space setting where significant levels of stress might precipitate that or other antisocial behavior. The same might be said for rape, although it is less common than sexual harassment. Clearly, we have not yet found the solutions to these problems in many of Earth's cultures.

Casper and Moore (1995), noting the instances of friction in the analog and space environments that have occurred as a result of the psychosocial stresses covered earlier, at one point highlighted the possible sexual violence that might occur because of these stresses. Apparently rejecting the evidence that shows that mixed-sex groups function more effectively in many ways than single-sex groups (Bishop 1996ab; Pierce 1991; Stuster 1996), they wrote:

These accounts raise compelling questions about the limits of the "complementary sexes" model proposed by NASA as leading to more harmonious and productive work. Psychological disturbances raise the specter of sexual violence, racial violence, and other serious interpersonal conflicts resulting from stress induced by long missions. It is somewhat disturbing to us that sexual behavior in space is assumed to be "total consenting adult free-choice sex." Given contemporary gendered power dynamics, this seems naively idealistic. Yet, an interesting research question is presented by the possible effects of weightlessness on expressions of sexual and other types of violence. For example, how would physical/bodily deterioration affect an individual's capability to overpower, force, and/or injure another astronaut? What does force look like in a 0-gravity context? Despite these concerns, issues of sexual violence are rarely raised with respect to long-term travel, and when we mentioned this possibility to informants they seemed vaguely puzzled. (p. 325)

Coercive sexual behaviors and blatant sexual harassment are not likely to be a problem in space, except in the event of a complete breakdown of the micro-society within the space culture. As Pierce (1991) noted, such microaggressions are usually more verbal and do not result in explosive violence. Rather, Casper and Moore frame outcomes of sexual expression as likely to be negative, reflecting the prevailing antisexualism of our culture, and is a clear example of the concerns noted by Money (1995b) regarding the effects of the pseudoscience of victimology today.

Nevertheless, Pesavento (2000) noted that an attempted sexual assault did occur in a more-than-six-month-long simulated *Mir* mission module at the Institute for Biomedical Problems in Moscow. Alcohol was involved, as it occurred during a New Year's celebration. Still, it is important to emphasize that possibility does not equal likelihood. [Update 2003: Dudley-Rowley and her colleagues (2001/2002) continue to look at crew and mission characteristics that might affect deviance, conflict, and dysfunction in extreme environments. (End of update by R. J. Noonan)]

B. Prostitution

Prostitution will likely find its way to space settlements once commercial exchange becomes established there, but it will not likely be an issue in any scenario until some time later in this century. It may well be a part of the expected sex-tourism industry that is expected to occur in the not-too-distant future.

C. Pornography and Erotica

It seems reasonable to expect that there would be a place for pornographic and erotic materials during a long flight. Bluth (1985) has noted that at some Antarctic research stations, "the men liked to watch pornographic films and it's best if a woman is not offended by pornography" (p. 143). This brings up questions of a sexological nature that may have relevance to extended spaceflight. If sexually oriented materials have the ability to relieve stress under extremely trying conditions, then they should be studied to determine if, in fact, they do. They also may serve as a morale booster.

In addition, they may have value in places where there is currently a disproportionate ratio of women to men. The issue of sexual harassment would also be a factor when women are also members of the crew, because many courts have adopted the standard that such material sexualizes a workplace because some women (and some men) are offended by it. Although it is unlikely that it in fact does typically sexualize an environment, this position fails to take into account the sexually oriented materials marketed to gay males or lesbians, nor the feminist-produced corpus of literature and films for women. As a result, the ban on such materials as an expression of sexual harassment is typically applied only to materials oriented to heterosexual males.

Recently, Pesavento (2000) revealed that pornographic films were available to cosmonauts on the space station *Mir*, which Russian space psychologists recommended viewing only in the later stages of an individual cosmonaut's flight. He also described the surprise that American astronaut Norman Thagard had when he found that these soft-core French and Italian erotic videos were there. Pesavento also described plans for a movie to be made on *Mir*, in which sexual activity would be filmed, for which the Russian Space Agency had already been paid millions of dollars for training the actors for their time in space. However, the filmmakers were not able to raise the additional millions needed to save the *Mir* from its planned deorbiting, which occurred at the end of March 2001.

D. Paraphilias

The paraphilias are those behaviors that are dependent on atypical or socially unacceptable things for sexual arousal, such as inanimate objects or parts of the body or events that are linked erotosexually to a person's childhood. They are thought to arise out of a traumatic or similar event that affects psychosexual development at critical periods during a child's life. Nevertheless, one may speculate that a generally sexually repressive environment would, at the same time, facilitate the expression of paraphilias. In relation to spaceflight, therefore, it would be incumbent upon space officials to create and maintain a sexually positive environment to avoid the problems associated with paraphilic behaviors.

9. Contraception, Abortion, and Population Planning

A/B. Contraception and Abortion

Effective contraception is essential for long-term space travel for heterosexual couples, and efforts need to be undertaken to develop safe and effective contraceptive techniques, both for use on Earth and in space. Pregnancy is currently a contraindication for spaceflight because we do not know what effect the space environment would have on a fetus conceived on Earth. Abortion would probably be required in the event of failed contraception while in space, because of mixed results found with the development of fertilized eggs of various animals, although the morning-after pill could be available as an alternative of first choice. Because abortion at the earliest stages is relatively simple to perform, the necessary equipment for a menstrual extraction or for a later suction curettage should be available in the medical station, as well as appropriate pregnancy-testing kits. Returning to Earth would simply not be an option, at least for the foreseeable future, given that we do not know whether human development *in utero* is possible, nor what would occur later in life if a birth did occur after conception in space.

In a series of articles dealing with the effects of space on humans posted at one time on NASA's website, Jenks (1996) noted that "NASA has not studied the subject of hu-

man reproduction in space.” It was the first sentence of an article mistitled “Sex in Space,” which went on to briefly discuss developmental biology and plant and animal reproduction. However, it did, perhaps, unintentionally serve to highlight the pronatalist bias that persists in many societies’ conception of the primary purpose of sexuality, that is, its procreational aspects. The more-common (and probably more important at the individual level) recreational and relational aspects of sexual behavior, on the other hand, were simply ignored, likely because of the erotic components that tend to fuel them (Noonan, 1998a).

C. Population Programs

Population planning will become an issue when settlements are needed to be designed for lunar, Martian, or other outposts, and in that case, it is likely to be at the level of engineering the social environment around the professional expertise needed for the various parts of the mission (Harris 1996).

10. Sexually Transmitted Diseases and HIV/AIDS

The typical Earth-bound STDs with which we have to contend may present additional problems in space. This is because there is evidence that the immune system is compromised by spaceflight, although Sherr and Sonnenfeld (1997) wrote that some results are difficult to interpret. However, if this is found to be true, they thought it could severely limit long-term human spaceflight. Certainly, additional studies are needed to clarify this possibility, as well as to continue to learn more about our immune systems to be able to meet these challenges. There might also be the possibility that other disease organisms could mutate and become new STDs. The same is true for HIV/AIDS as well. In addition, there is the possibility that studies that gain a better understanding of the human immune system in space may have direct application for dealing with HIV/AIDS. It is also possible, given that drugs are expected to be manufactured in space because crystals form more purely in microgravity, that space science could assist in eradicating AIDS, as well as the STDs and other diseases and conditions.

11. Sexual Dysfunctions, Counseling, and Therapies

Sexual response can be viewed physiologically as essentially a series of cardiovascular and muscular events resulting in a buildup of vasocongestion and myotonia to a psychophysiological peak and release known as climax or orgasm—coupled with a buildup and release of muscular tension. In the human sexual response cycle, as sexual stimulation progresses, blood engorges the vascular tissues of the clitoris, penis, and other parts of the body in the process called vasocongestion, while the buildup of muscle tension (myotonia) occurs. This is usually accompanied by an increase in respiration and metabolic activity. Orgasm releases and is typically considered the climax of this vasocongestion and myotonic buildup of sexual tension, in a paroxysmal, rhythmic, reflexive discharge of energy, typically resulting in a feeling of relaxation throughout much of the body.

Among the most visible physiological effects of spaceflight are the shifts in body fluids, most importantly the blood, which rises from the lower extremities to settle into the chest cavity and head. In time, the cardiovascular system acclimates itself to the new environment. At the same time, with less blood volume and no longer the need to pump blood against gravity, the heart muscles begin to relax

somewhat, and the process of deconditioning begins (unless exercise is used to compensate for the loss by forcing the heart to pump harder). A similar condition occurs with overall body muscle tone, especially the large, weight-bearing, anti-gravity muscles that allow us to walk erect and maintain an upright posture. Therefore, we can probably expect a change in our perception of the various physiological phases of the sexual response cycle.

Anecdotal stories confirm that erections can and do take place in space, although a characterization of the quality of these erections has not been done. Information about whether women have experienced clitoral erections and vaginal lubrication has not been forthcoming, although the homologous nature of this aspect of the sexual response cycle would support the conclusion that they have. NASA could be easily monitoring this while the astronauts slept. One may conjecture that both female and male astronauts, when they are not asleep, would perceive a difference in their genital responses from their normal preflight experiences. Using Masters and Johnson’s (1966) four-phase model of the human sexual response cycle, each phase might be affected in the following ways. During the excitement or arousal phase, penile erections in men may not feel as physically strong, particularly as the time in space gets longer and the body continues to adapt to weightlessness by deconditioning. The increase in respiration—the heavy breathing or hyperventilation, along with the increase in blood pressure and heart rate experienced during arousal through the plateau phase to orgasm—may also take more effort and feel more tiring as time progresses for the same reason. In women, clitoral erections and vaginal lubrication are likely to be similarly perceived.

Both vaginal lubrication in women and the erection of the clitoris and its homologue in men, the penis, are essentially vasocongestive in character. Vasocongestion forces the lubricating fluids through the pores of the walls of the vagina. This response varies with age, decreasing as women get older. This is likely to have an impact on astronauts who eventually travel to Mars, because older individuals are now thought to be among the prime candidates for such a trip because of the higher exposure risk to radiation in interplanetary flights. The main idea is that because the radiation effects are usually manifested many years later, it would be more likely that the astronauts would approach the natural end of their lives before the radiation effects would become evident. In addition, it is likely that the older astronauts would be well past the stage of starting families than younger ones would, given the impact of the possible and probable effects of radiation on gamete production.

The myotonia, the increase in muscle tension also characteristic of the sexual excitement and plateau phases, is likely to be experienced by the astronauts as being less intense during spaceflight than they normally experience on Earth, particularly in the voluntary muscle groups over which we have conscious control. This effect may increase as the time in space increases because of the progressive deconditioning of the muscles. Sexual activity, thus, might be an ideal part of an exercise program that people would very likely want to do regularly to maintain overall body and sexual fitness.

All of the effects on the human sexual response cycle just described provide possible mechanisms for a breakdown at some point in the cycle. Thus, there is the distinct possibility that any of the sexual dysfunctions experienced by men and women on Earth may increase or be aggravated in the space environment. But, just as Masters and Johnson (1966) indicated with respect to human sexual functioning on Earth, the range of normal functioning in space will need

to be clarified before mechanisms and ameliorative actions for sexual dysfunctions can be described. Counseling practices will also need to take into account the unique psychosocial environment and the total space experience to be effective. In addition, countermeasures found to treat space-related sexual dysfunction should have application to the same problems on Earth.

Recently published data support the speculation that there would likely be some effect on sexual functioning, although deconditioning was not the focus of the study. Strollo et al. (1998) measured hormone secretion in four male astronauts pre-, in-, and postflight to test their hypothesis that stress-induced hormone changes might impair gonadal function by reducing testicular androgen (especially testosterone) secretion. In addition to its many roles in the differentiation of the fetus and the development of the secondary sex characteristics at puberty in males, testosterone stimulates the sex drive (libido) in both sexes. Strollo et al. found that "[s]exual drive was reduced inflight and postflight as compared with preflight ($p < 0.05$)" (p. 135), which correlated with a decrease in testosterone levels in the men. In addition, they noted that there were no endocrine signs of acute stress, in that the levels of adrenocorticotropin (ACTH) and cortisol (CS), although high from the preflight anticipation that astronauts typically feel, did not change inflight, although interstitial-cell-stimulating (i.e., luteinizing) hormone (LH) levels unexpectedly increased. LH stimulates the secretion of testosterone in the testes. The researchers also found that testosterone levels recovered dramatically one day following the astronauts' reentry from space. Thus, they noted, "For the first time, space life sciences research has shown reversible primary hypoandrogenism in man during exposure to microgravity" (p. 136). Nevertheless, although testosterone levels recovered quickly (as measured in the saliva), they noted that 15 days after reentry, other measurements suggested that more than two weeks were required for complete recovery at the cellular level. The timeframe for libido recovery, however, was not revealed in the article, or even whether it did recover. The authors stated that further research was needed to clarify whether fluid shifts or altered androgen distribution in the body because of microgravity was responsible for the results.

12. Sex Research and Advanced Professional Education

In the space arena, the time will eventually come when sexological concerns are recognized as legitimate topics for research in support of extended spaceflight missions. Administrators at the top levels of management and those with influence within the space life sciences of national and international space agencies, such as NASA, the Russian Space Agency, and the European Space Agency, need to encourage and support relevant biomedical, psychosocial, and human factors professionals within their organizations to receive advanced sexological training. These professionals should be urged to make contact with colleagues in sexology to find out the advances and concerns within this discipline that might have relevance to their spaceflight responsibilities, as well as to offer their knowledge from the space program that might be relevant to the work of sexologists. The Society for the Scientific Study of Sexuality (SSSS), with its international membership, would be the professional organization of sexologists whose expertise in sex research, counseling and therapy, and education would provide the best interdisciplinary support that would benefit the work of space life scientists. In addition, training pro-

grams for space life scientists should incorporate sexological information into their curricula, and sexologists have the expertise necessary to provide knowledgeable input at all levels of the educational spectrum, including advanced medical training for physicians.

Conclusion

It should be clear that the integration of various human and mission components work synergistically to provide the context in which space missions will function and how they might be affected by the human sexuality complex. At the same time, it is not yet as clear that humans on Earth will soon come to terms with their own sexualities, as Perry (1990) has noted, and this should be a cause for concern. Despite this truism and the demonstrated evidence that various space life scientists and others have projected that sexuality factors are likely to have an impact on future long-term space missions, the intersection between the two scientific specialties whose domains encompass either the space life sciences or sexuality and gender has scarcely begun to be investigated. This should serve as a call to action to prepare adequately for meeting the challenges expressed here. One focus of intervention will need to be directed toward the managers and mission planners; the other focus will need to be on the individual crewmembers, as well as their families and intimate partners. My earlier work (Noonan 1998a) might well serve as a rationale and an outline for action for the managers and planners in the space endeavor. Certainly, wherever humanity goes, our sexuality will surely follow.

To me, possibly the most important conclusion to come out of my study was embodied in the new terminology I coined, the human sexuality complex, that conceptualized the various factors of human sexuality to be components of a unified system, one that has characteristics ascribed to chaotic, complex systems. Such a conceptualization, I believe, will allow scientists in both the sexual and space life sciences, as well as policymakers in the public domain, to better understand and address both the potential problems of sex and the role that healthy sexual expression has in society and in space. Once we are effectively able to do that, the consideration of the human sexuality complex in the closed ecological environments of space will appear more justified, and so a space sexology might well be established.

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ANTARCTICA

Demographics and a Brief Historical Perspective

The continent of Antarctica at the southern pole of the globe encompasses 10% of the world's landmass, about the size of the United States and Mexico combined. Covering 5.4 million square miles (14 million km²), it is the fifth-largest continent, with only 108,000 square miles (280,000 km²) ice-free. It is the coldest place on Earth with temperatures ranging from about -25° C to -80° C (-13° F to -112° F), with the lowest recorded temperature of -89° C (-129° F). It holds 90% of the world's ice and 70% of its fresh water. It is a landmass with an average ice thickness of 1.24 miles (2 km) and can be as thick as 2.97 miles (4.776 km). For about six months of the year, there is no sunlight at the pole. Most activity there occurs during the brief Antarctic summer from November to early February, although summer storms with temperatures as low as -60° C (-76° F) and blizzard conditions can occur. Chile, Argentina, Australia, and South Africa are the countries closest to the continent, which is surrounded by the Southern Ocean, which meets the South Atlantic, the South Pacific, and the Indian Oceans (Cornelius 1991; Taylor 1991; John Splettstoesser, polar consultant, personal communication, April 25, 2003).

In July 2002, Antarctica had an estimated winter population of 964, about one quarter of the summer population of 3,687. No other demographic data are available, other than the number of individuals representing each country that is a party to the Antarctic Treaty; these data are available in *The World Factbook 2002* (CIA 2002).

B. A Brief Psychohistorical Perspective

There is no indigenous human presence. However, both men and a few women have been part of the pioneering exploratory efforts over the years since interest in Antarctica began in 1892. Since the 1957 International Geophysical Year (IGY), there has been a continuous human presence on the continent, which no country owns and which has been set aside for scientific and peaceful uses by treaty. As such, approximately 27 nations* have research programs in Antarctica, either in the summer or year-round, of which those of the United States, Chile, Argentina, Russia, and Australia



(CIA 2002)

lia were the largest in terms of number of people in 2002 (according to the CIA data). Although a novelty in the beginning, women are now an integral part of life there.

Once the arduous task of reaching the continent was accomplished for the first time, scientific discovery became the major focus. Often-introspective accounts written in diaries by the early explorers provide valuable knowledge about their psychological experiences and social interactions. These introspective reports gave way after World War II to formal behavioral studies. During the winter season between February and November, the stations are closed to outside travel. Cornelius (1991) described the isolation, which can vary, depending on the station and its distance from the pole, from about seven to nine months:

The isolation is almost complete: no mail, no visitors, no leaving, and no fresh supplies. Outside contact is primarily by the high-frequency radio and sometimes by a satellite link. The first-ever midwinter airdrop at [Amundsen-Scott] South Pole [Station] was accomplished with a C-141B (refuelable version) in June of 1981 and has been done almost every year since. (p. 10)

The airdrop brings mail, fresh fruit and vegetables, movies, and other items. Cornelius expressed his view that this somewhat diminished the totalness of the isolation. He also noted that the radios and other transmissions were sometimes unavailable because of solar storms. Today, the Internet and email provide better communications capabilities than ever existed before, although they too can be sporadic. In 1999, the first midwinter rescue from the United States' Amundsen-Scott South Pole Station was attempted that succeeded in the emergency evacuation of Dr. Jerri Nielsen (2001), who diagnosed and treated her own breast cancer before being airlifted out, which made headlines around the world.

Antarctica is often described as an extreme environment, and human performance in extreme environments is just one major focus of research being explored there today. Pierce (1991) wrote that Antarctica was an environment (like space) in which people would experience the stressful effects of prolonged isolation, confinement, uncertainty, and hazard. In addition, he described other sources of stress and the potential results:

*The nations with research teams in Antarctica at various times include: Argentina, Australia, Belgium, Brazil, Bulgaria, Chile, China, Finland, France, Germany, India, Italy, Japan, Netherlands, New Zealand, Norway, Peru, Poland, Russia, South Africa, South Korea, Spain, Sweden, Ukraine, United Kingdom, USA, and Uruguay.

Inhabitants in both places are subject to important psychosocial stresses that affect the success of the expedition. These include lack of privacy, boredom, inability to escape, forced socialization, anxiety, and nostalgia. While operating under these burdens, each individual must comply with a welter of regulations, formal and informal. Some of these are imposed by outside authorities, some by the person's culture, and others by developing traditions within the group. Sensitivity to obligations and regulations is compounded in stressful environments because of the heightened importance of vigilance and leader-follower relations. Constantly, the individual must assess and evaluate each crewmember's entitlements.

Under these conditions, orders from the outside world, differences in lifestyle, differing preferences for such things as music, and conflicts over the use of an exercise facility can develop compliance frictions. This psychosocial travail can yield offending slights, or microaggressions, rather than full-blown explosions or social turbulence. (p. 126)

Pierce (1991) also listed a number of other possible physiological and psychosocial disturbances that could result in some people at some point during their stay. These included: sleep disturbances, anxiety, increased territoriality, decreased performance, reduced motivation, impaired mental efficiency, withdrawal, and occasionally, augmented suggestibility and biological dysrhythmia. However, he noted, unlike the space environment in which space motion sickness has been a recurring problem, no polar-peculiar illnesses or derangements have yet been found. The reader is referred to Harrison, Clearwater, and McKay (1991abc) for a comprehensive review of other Antarctica research that is being applied to space habitability issues (see also the Outer Space section of this chapter).

In terms of possible ramifications for the human sexuality complex (Noonan 1998ab) in extreme environments, it is interesting to compare the occurrence of these microaggressions with similar minor problems that many couples living in more-normal situations experience after living together or being primarily focused on each other over extended periods of time. These microaggressions are usually expressed as verbal, often subtle comments, which can be perceived as insults that sometimes build up to what often appear to be major arguments over minor issues. The apparently almost-universal occurrence of this friction on some level in almost every group in the close quarters of the Antarctic stations (in the apparent absence, at least presumably in most cases, of any sexual interaction) might provide us with some insight into the phenomenon, both on Earth as it so commonly occurs with intimate couples and small workgroups, and its potential occurrence in space. In addition, it might be worth looking to the results of research that seeks to discern the mechanisms for its occurrence and the efforts that are being sought to prevent it, and apply them to everyday life on Earth. In those groups that had both men and women, certain frictions surrounding the actual or presumed heterosexual activity of others have been highlighted by a few reports, which I will review shortly.

Nevertheless, as with any frontier, national prestige factors entered into some of the very early attempts to be the first to reach the "white continent," similar in many respects to that which motivated the explorations that found the New World centuries earlier. Pierce (1991) noted that commerce, science, defense, and politics are the factors that are of strategic importance today for both Antarctica and space exploration, of which Antarctica is considered an analog for scientific research purposes, because both environments are

characterized by isolation, confinement, deprivation, and risk, as noted earlier. In addition to space-based experience (Boeing Aerospace Company/National Behavior Systems 1983a; Bluth & Helppie 1986/1987), space scientists rely on information learned about human behavior in so-called analog environments found here on Earth. Analog environments are those that scientists believe closely approximate some of the key conditions found in space, such as the research stations in Antarctica, which are also remote and hazardous. Studies include those in Antarctica (Bluth 1985; Harrison, Clearwater, & McKay 1991a) and underwater habitats such as long-range nuclear submarines (Boeing Aerospace Company/National Behavior Systems 1983b). The descriptions of Antarctica by Cornelius (1991) and Taylor (1991) highlight why it is considered the best Earth analog for studies of the psychosocial processes that will occur during long-term space missions. Based on such analog studies, extended space missions, like Antarctic expeditions, are expected to follow what might seem to be a quite-obvious pattern, i.e., they have a beginning, a middle, and an end, each with varying durations. Yet, each has specific characteristics with distinct psychological ramifications for the participants, regardless of the full length of the entire mission. Of primary importance are the coping mechanisms that the individuals use to deal with the stresses at hand (Palinkas 1989, 1991, 1992; Palinkas & Browner 1995).

1. Basic Sexological Premises

A. Character of Gender Roles

For most of the 20th century, the primary organization that supported exploratory and scientific expeditions to Antarctica for the United States was the U.S. Navy, although civilians conducted virtually all of the exploration and science after the 1957 IGY (John Spletstoeser, polar consultant, personal communication, April 25, 2003). As such, the old military's attitudes toward women were decidedly exclusionary—and all-male cultures were the norm. As women began to intrude in this all-male world, attitudes slowly changed, although then-current biases were tenacious. Today, private contractors conduct most of the American research in Antarctica, under the auspices of the National Science Foundation (NSF), and women are a regular part of the programs. Kanas (1992) has noted that during long-term Antarctic expeditions, status leveling occurs, in which leadership diverges into domains of expertise, such as emotional support functions, out of which conflicts may arise (of which some may be gender-based).

Similarly, other nations' expeditions originally consisted exclusively of men. Conditions were considered so severe that only men were thought to be able to withstand the rigors of Antarctic life. Finally, after a number of women—always vastly outnumbered by men—joined expeditions over many years, in 1984, an expedition consisting solely of women was sponsored by Germany. Since then, women have begun to approach, but have not yet fully achieved, parity with men in terms of their number and job functions. Today, it appears that women make up about 25% to 40% of most expeditions, with a higher percentage of women in the summer than who winter over, although some still consist of all men.

Robin Burns (2001) provides important insights into this history through the lives of women, mostly Australian, who have lived and worked in Antarctica, providing at the same time important insights into various aspects of the character of gender roles there. A summer expeditioner herself, she interviewed 130 women who spent some time there. Although the timeframes of the expeditions of most of the women were the 1980s and 1990s, some traveled there in the 1960s and

1970s, with a few going there even in 1959. Thus, Burns gives us a sense of the changes that have occurred as reported by these women, as she highlights the history of women on the continent. She also provides a look at the hardships faced by women and the impact of the extended separation from their families, which probably apply to others as well. She writes:

Even with modern communications between Antarctica and Australia, twelve to fifteen months is a long time for couples to be separated. New relationships can form that are difficult to explain, and each may find it hard to understand the experiences of the other; for example, the intensity of life in Antarctica, or the new-found independence of the partner left at home. (p. 18)

She also discussed the difficulties in keeping up with younger children's development, although the use of the Internet now enables closer contact and the exchange of photos.

Burns's subjects tend to say that, although things have changed for women, in many ways the traditional roles of men and women are still in effect, with some men still viewing Antarctica as the "last frontier . . . where men go to prove they're men" (p. 25). Yet Burns also sees Antarctica as beneficial in breaking down some women's stereotypes of men. In some ways, there seems to be some hope of moving toward an interdependence between men and women.

2. Religious, Ethnic, and Gender Factors Affecting Sexuality

Although Antarctica has a multinational appearance, it is really largely a collection of national "neighborhoods," each station being staffed and run by its sponsoring country. As such, religious, ethnic, and other cultural factors tend to reflect, in varying degrees, the composition of the respective countries. One could anticipate, then, that these cultural factors operate in a similar manner to the way they do on their native soil, and, thus, their impact on sexuality factors might be assumed to operate in large measure the same way. Research has yet to be carried out to determine whether the physical and psychosocial environments peculiar to Antarctica mitigate their impact on people's sexuality in any significant way. As noted earlier in the Outer Space section of this chapter, idiosyncratic local cultures at the various stations are likely to develop as well, which will likely have an important impact as well. A good example follows:

Cornelius (1991) described the use of a ritualized nudity activity that was conducted every year at one Antarctic station, usually just past the midpoint of winter. The 300 Degree Club is a South Pole Station custom, whose name came from the fact that the temperature in midwinter (in September) drops below -100°F (-73°C) and there is a sauna that is set to 200°F (93°C) for the event. The crew would sit in the sauna wearing nothing but footwear and build up a profuse sweat. They would then dash out into the cold to the marked site of the geographic South Pole (about 325 feet, or 100 meters), pose for a quick picture, then dash back. The trick is not to fall, as the ice would burn like dry ice; the quick freezing of the sweat actually protects the body. Cornelius did not detail whether or how this was done when women were part of the crew. However, a 1996 Discovery Channel documentary reported a similar custom at another Antarctic station in which the members, male and female, after leaving the sauna took a quick dip in the water in a hole that was cut in the ice, before running back inside. This was described as a rite of passage that signified a major turning point of the expedition. This is also relevant to this discussion because of the common idea that many people have of

confusing nudity with inviting sexual activity. However, in both of these cases, there is apparently no overtly sexual significance involved.

Given the realities of sexuality today and the widespread perception that being associated with it somehow compromises one's professional standing and credibility, it is necessary to look at ways in which researchers can release the results of any sex-related research that might be done. Gender-related research does not carry the additional burden that specifically sex-related research does, and is thus being released and results presented at conferences often today (e.g., *Gender on Ice: Proceedings of a Conference on Women in Antarctica*, Edwards & Graham 1994; "Gender-Based Differences in the Cardiovascular Response to Standing," Gotshall, Tsai, & Frey 1991). This may be partly because gender has become neutered, in effect allowing it to be "uncontaminated" by sex, (i.e., the "clean" part above the belt vs. the "dirty" part below), as hypothesized by John Money (1995). In fact, today, it is common to use *sex* and *gender* as if they were synonymous, when sex is actually the biological (genetic, hormonal, and morphological) basis of gender, and gender is the cultural manifestation of sex.

With respect to gender factors, it is clear that, generally, women tend to change the environment in positive ways, because men appear to behave differently than they do in all-male groups (Bishop 1996; Stuster 1996). Nevertheless, Pesavento (2000) has noted that less-than-encouraging social interactions can occur in mixed-gender groupings. (See Section 5, Interpersonal Heterosexual Behaviors, below.)

3. Knowledge and Education about Sexuality

Antarctica is by and large an all-adult world, and children and adolescents are not part of most expeditions. Thus, sex education is not and probably will not be relevant in American or most other stations in Antarctica for the foreseeable future. Chile and Argentina, however, do have families, including children, living there year-round, with schools and other small-town facilities (John Spletstoesser, polar consultant, personal communication, April 25, 2003). The children are taught by teachers who come from their respective countries, although it is not known what kind of sex education might be taught. It is thought that the settlements were established to support territorial claims by these two countries should the Antarctic Treaty be dissolved, although none of the claims of the seven countries who make such claims are currently recognized by any others.

4. Autoerotic Behaviors and Patterns

No studies have been found that discuss masturbatory behavior in Antarctica. It can be presumed, however, that it is and has been practiced there, not only because of our human nature, but because, in the past, it would have been expected if no (heterosexual) partners were available in all-male crews (although it is normal behavior in individuals in couples in ordinary environments as well). It can also be expected in high-risk environments, in which it can function as a stress-reducer.

There is some anecdotal evidence, however: In all-male groups, masturbation was often the subject of a lot of jokes. At some Australian stations, stories were told of Wednesday nights being "wank night," although they may have been made in jest (Desmond Lugg, former head of polar medicine, Australian Antarctic Division, personal communication May 9, 2003). Dr. Lugg also related the story of how, when he gave the same preparatory lecture to new expeditioners prior to going to Antarctica (after having

been admonished by some women that they get the same information as the men), one woman said, "We wank too."

5. Interpersonal Heterosexual Behaviors

Intimate relationships do develop, some quite open and some quite secret. I might expect that the open or secret nature might parallel the experience of people in ordinary workplaces or small towns, where group norms establish its acceptability and the positive, negative, or neutral impact on the individuals involved in and around them. There are no data available on the incidence or prevalence.

In an American Antarctic analog study commissioned by NASA for the Space Station Program (Bluth 1985), several aspects of heterosexual interaction were noted under a subheading called "Sex Roles." Among the issues discussed were the benefits and drawbacks of having married couples in the crew and the effects of fraternization, as well as of men's attitudes toward women. Some findings were that fraternization did occur at stations and that it "did not seem to be a problem as much when a woman remained with one person and did not flaunt or change relationships" (p. 141). The comments of one man indicated that those men who did not have a partner felt upset and resented those crewmembers who were indiscreet about sexual relations. Many of the women who wintered-over said they became the victims of gossip. The men also had a variety of other attitudes toward the women, some positive and some negative. One finding recommended that women need to be able to deal with male sexual attention.

Stuster (1996) echoed these observations and provided additional information about mixed-sex pairings:

Promiscuity has had a rare but occasionally disruptive effect at Antarctic stations. Winter-over personnel have reported that if a woman chooses to have a relationship during her stay in Antarctica, it is usually with one man. Senior personnel are typically selected over junior staff, and clean-cut Navy men tend to be favored over the civilian construction workers, which can contribute to friction between military and civilian members of a remote-duty crew. In most cases, the other men tend to respect the decision once a woman makes a choice or makes clear her unavailability. Persistent, unwanted attention has occurred, however, with negative consequences to individual adjustment and group solidarity. Particularly disruptive problems develop when a woman and the station leader are involved in a relationship. In these circumstances, others in the group tend to claim that the leader has an unfair advantage. (pp. 178-179)

Stuster went on to suggest that leaders of space missions should avoid such involvements, but added that "it might be unwise for mission managers to dictate how crew personnel conduct this aspect of their personal lives" (p. 179).

Bluth (1985) also identified the "Antarctic Queen Syndrome," in which "every woman is beautiful," which "[s]ome women take advantage of . . . and play man against man" (p. 142). The Antarctic Queen "flirts with all the males, . . . always asks for favors [and] attention, . . . [and], "[i]f they need help . . . honey up to one of the guys, [which] causes problems between people and groups" (p. 142). Clearly, many of the situations noted can occur in non-isolated environments as well; however, in the latter situations, there are alternatives outside the group that can mitigate the frustration and problems that can occur.

Nevertheless, the benefits of both men and women working together appear to outweigh the disadvantages, as noted by Bishop (1996) and Stuster (1996). Bishop noted that in

Earth-based studies, mixed-sex groups appeared to perform workgroup tasks better than all-male groups. She also reported that in military mixed-sex interactions, aggressive behavior appeared to be lessened, disciplinary cases were fewer, and the problems with sexual liaisons and pregnancies anticipated by critics failed to materialize. She also said that the addition of women tended to normalize group functioning, in that the presence of women seemed to enable or encourage the men to engage in a greater range of expression and cooperative behavior than in all-male crews. Women and men on extended spaceflights are likely to experience similar pressures and benefits, even though the crew sizes for the foreseeable future will remain smaller than on most Antarctic stations today. Law (1994) anticipated that many of the problems would not be solved until a more even balance of women and men is achieved. Lugg noted that women's entry into Antarctica after the transition from all-male to mixed-sex expeditions caused disruptions at times, but that it depended on the leadership and other factors (personal communication May 9, 2003). All this suggests that sexuality factors will still likely be stresses that will need to be addressed in both Antarctic and space environments.

Careful planning of living quarters with the assumption that sex is likely to take place is just one aspect that needs to be considered. In describing the differing characteristics of the Palmer Station, which is located near the coastline and so enjoys slightly less harsh conditions than the South Pole Station, which is located deeper in the interior on the high ice plateau, Cornelius (1991) noted in passing that the design of that station was poorer than that of the South Pole Station. In describing the crew's private quarters at Palmer, he wrote that, as a result of the station's poor design, which caused additional problems and stress, the acoustic privacy left much to be desired: "One can hear the crewmember in the next room breathing, making love, or listening to *his* music" (p. 14). In a follow-up article by ABCNews.com (2001) discussing Dr. Jerri Neilsen's outcome of her breast cancer and her planned return to Antarctica to work as a doctor on a cruise ship, she was quoted as saying that there were little of either sex or romance for similar reasons. Thus, some acceptance that sexual activity will take place, and a little foresight and planning, can help to alleviate some future problems with respect to sexuality factors.

Nevertheless, Burns (2001) has written that sexual relationships do happen in Antarctica. She noted that one third of the women she interviewed had been in Antarctica at the same time as their current partner, although fewer than half of these had started the relationship there. She noted that women entered sexual relationships for two reasons: One was to share the special experience of being in Antarctica with an intimate partner; the other reason was to handle the various pressures that had to be addressed.

In addition, Burns (2001) described the psychosocial aspects of relationships, such as dealing with male competition and the sexual activities of women who are known to be married, and the impact these can have on the men who might resent the fact that women have a choice of partners, whereas they do not. With respect to the married woman, it may arouse fears about what their wives at home may be doing. It appears that many of these dynamics, which are not uncommon outside of Antarctica, may be heightened in the extreme environment there. These dynamics might be useful for space mission planners in their Mars mission planning, for example, as the trip is expected to take maybe three years with far fewer people, which could exacerbate these effects further. It will be important to ascertain the differences between the two environments, however, as well as the psychosocial relationship variables that are different to more accu-

rately gauge what can be done to minimize any potentially negative impact and to maximize the positive potential.

6. Homoerotic, Homosexual, and Bisexual Behaviors

A. Adults

It is unlikely that there have been no gay Antarctic participants, and Burns (2001) has noted that "differences in ethnicity, class and sexual preference, as well as gender, are all reasons for not belonging" for women "to the male hierarchy" (p. 87). Thus, we might assume that this might apply to gay men as well. In my early research on this topic (Noonan 1998a), I came across Lugg (1991), who, writing of Australian expeditions, wrote that descriptions of "groups who lisped or used 'quaint' language" (p. 32) are part of the folklore of the Australian experience. I took this as a possible reference to the use of stereotypical American gay-male behaviors, which are often used for either ridicule or self-parody, although they are not typically used in everyday life by gay men. In a subsequent conversation, Dr. Lugg noted that it really was not related to gay caricatures, but rather that the language in the group mimicked the lisping of jokes that circulated one year at one Australian station, as well as the quaint language (i.e., old British-style accents and such) of old movies, which they would watch without the sound and the men would provide the dialogue imitating the actors. Thus, this is a good example of how different cultural behaviors and their meanings can lead to misunderstandings. He noted further, with respect to the lisping, that the language of the men had changed—they had developed their own language (inflections, meanings, and vocabulary) because of the isolation and their response to the environment. For the same reason, dogs at the station would sometimes be personified and become quiet partners in conversations. A parallel can be seen in less-isolated workgroups, and especially in intimate couples, where private languages often develop because of their insular nature.

Law (1994), a leader of 28 all-male Antarctic expeditions for Australia from 1947 to 1966 that established that country's three Antarctic stations, speaking at an Australian international conference on women in Antarctica, said:

So far as I know there was no overt homosexuality at our stations. We of course, went to some pains to avoid homosexuals in the selection process. I heard that one man, a bisexual ex-naval rating, did some soliciting early on, but there were no takers, so that sort of fizzled out. Whether there was any covert homosexuality I would not know, but it would have been very difficult at a station to have kept secret such a liaison, and I was never informed by any of our men that anyone knew of anything of that sort happening. (p. 72)

Despite these comments, he appeared not to be necessarily opposed to homosexual behavior, however, as he qualified his statement:

In that regard, however, I must point out that if we are to advance arguments justifying heterosexual behaviour at ANARE [Australian National Antarctic Research Expeditions] Stations now that women are admitted as expeditioners, then for the same reasons we shall have to accept possible homosexual behaviour and modify our selection processes accordingly. (p. 72)

He added, "It is important to stress the need for discretion in both heterosexual and homosexual behaviour at stations. Overt behaviour is objectionable for a number of reasons." He went on to say that the role of the leader in the event of

sexual behavior was important and could have a "considerable effect in moderating undesirable behaviour" (p. 72). Puskeppeleit (1994), the leader of the first-ever all-female expedition to Antarctica that was sent by the German Polar Institute, also speaking at the women-in-Antarctica conference, did not address the possibility that homosexual behavior was an issue at all for the women. She did note, however, that all of the women "would have preferred a mixed overwintering team" (p. 80), which the Institute would not allow.

Even today, potential problems could emerge with crewmembers who discovered that one of their team was homosexual or bisexual—just as they have when certain behaviors have been perceived as inappropriately heterosexual.

7. Gender Diversity and Transgender Issues

Although intersexual issues may become an issue in Antarctica in the future, it appears not to be so now, although it is known that men, as in some other all-male analog environments, sometimes dress up and act as women for parody and entertainment. The explanation seems to be that it occurred when there were no women who were part of the expeditions, and the men missed the company of women and sought to "normalize" the social environment. Burns (2001, 83-84, 91) noted, however, that "cross-dressing, 'girlie' posters and magazines, regular blue movie nights and 'page three girls' in the daily station news bulletins have been part of the tradition" at Australian stations, "and all have become contentious in recent years."

8. Significant Unconventional Sexual Behaviors

A. Sexual Harassment, Rape, and Prostitution

Personal accounts of those who were in Antarctica when women first arrived suggest that mild forms of what has come to be known as sexual harassment, i.e., constant attention and cajoling for dates and such, appear to have taken place. As noted by Stuster (1996) in Section 5, *Interpersonal Heterosexual Behaviors*, apparently more-recent persistent, unwanted sexual attention has occurred, with negative consequences to individual adjustment and group solidarity. No reports of real (quid-pro-quo) sexual harassment, as opposed to the current social construction of "sexual harassment," or rape were found. Prostitution does not seem to occur.

B. Pornography and Erotica

Cornelius (1991) noted that the ways in which the crew decorated common areas, such as with a large mural of a forest, probably helped to relieve stress during the period of isolation. This is likely to be true for the individual crewmember's small private quarters as well, in which he noted the "[m]any nature scenes and posters of the opposite sex" (p. 13). Law (1994) further noted that the Australians were always astonished at the number of nude photos on the walls of the American stations. The role of the use of sexually oriented materials in the leisure activities of the crew is, however, an issue that was not addressed in any of the analog studies, except that of Bluth (1985), who noted that at some of the stations, "the men liked to watch pornographic films and it's best if a woman is not offended by pornography" (p. 143).

Also, stories are told of how, along with Russian fur hats, American *Playboy* magazines, when they were banned in many countries, would become a valuable local currency in trade. In fact, *Playboy* centerfolds became part of the history of one station in the 1950s, where they were used to cover a ceiling, nicknamed the "Sistine Ceiling."

Anecdotal reports say that when women first became part of the expeditions, they tended to ignore the pornographic pictures or pinups (typically less sexually explicit), although they were eventually taken down from common areas. Private areas were considered private, and so these images usually stayed. In the late 1980s and early 1990s, when anti-pornography feminists came in and sexual harassment laws became common, they caused much acrimony and angst at the stations, as pinups and other materials had to be removed. For example, an uproar in the Australian press occurred over one explosive episode when a female leader banned the private posting of this type of material in one's personal area.

9. Contraception, Abortion, and Population Planning

A. Contraception and Abortion

In a report prepared by George Washington University and Analytic Services Inc. (GWU/ANSER 1994a) on potentially difficult and sensitive events, including pregnancy, that might occur in space prepared for the National Aeronautics and Space Administration (NASA), the GWU/ANSER (1994b) team reviewed the Australian and U.S. Antarctic analog environments, and found the following related information. Both countries' stations have reported that pregnancies have occurred during expeditions. The policy they followed was that the woman be evacuated at the earliest possible time. "It is interesting to note," according to these authors, "that the father is not also sent home. The implication of this policy is not that sexual relations resulting in pregnancy are condemned but that the pregnant woman represents a medical liability unsuited for an extreme, isolated environment" (p. 30). They noted that an incubator was available at the Australian station in case the baby was born before evacuation was possible, and that abortions will not be performed there because of legal liability concerns, even though abortion is legal in Australia. However, they noted, pregnancies do not often occur in Antarctica, "[p]erhaps because birth control is readily available at all of the stations studied" (p. 30). The possibility that heterosexual relationships did not occur was discounted with the statement: "As one [Australian] female crew member reported, 'Just about every woman ends up in a relationship'" (p. 40).

CNN.com (2001) reported that New Zealand's Scott Base, located on the Ross Ice Shelf, installed their first two condom machines in anticipation of the influx of visitors in August 2001 in preparation for the warmer spring season in October. The supplier was quoted as saying, "It's pretty much a little village down there where everyone knows everyone, so if they can walk into a loo and buy a condom, it's a lot easier than going to the local shop and buying them, when everyone knows what's going on." It was expected to serve about 400 people, as well as about 1,200 Americans at their nearby McMurdo Base.

10. Sexually Transmitted Diseases and HIV/AIDS

It appears that most if not all countries do some screening for various diseases and conditions, and, if one is found with a condition, he or she is not allowed to go to Antarctica, so many diseases apparently do not appear there. Nevertheless, as noted above, condoms are now being sold in vending machines at New Zealand's Scott Base, which are also expected to serve the needs of the U.S.'s McMurdo Base nearby. UNAIDS.org (2002) does not list Antarctica among its list of countries for which it offers an epidemiological assessment, so HIV/AIDS does not appear to have reached that continent.

Various epidemiological data on STDs in Antarctica also suggest that STDs may not be an issue, although STDs have been taken to Antarctica in a number of national expeditions, but were not passed on to others within the group (Desmond Lugg, personal communication May 9, 2003). This suggests that those who had them got them earlier, perhaps in one of the South American entry points or their homelands. Screening specifically for STDs is not done. HIV screening is done through walk-in blood banks, and is provided as an ancillary finding. Because of the possibility of an HIV-infected person converting to full-blown AIDS, that person would probably not be allowed to go to Antarctica, because of the lack of medical support to treat it. It is unknown what would happen with someone who got an HIV-positive test result once there.

Some studies suggest, further, that the polar environment does depress the human immune response in otherwise healthy individuals, although specific environmental factors have not been identified that contribute. I would conjecture that stress is a likely candidate, and it would be interesting to compare the results of any studies on stress-hormone levels with Strollo, et al.'s (1998) study of male astronauts, which showed decreases in libido and testosterone levels while in space, which returned to normal postflight. No similar effects—or reports of sexual dysfunction specific to the polar region—have been reported in Antarctic settings.

Dr. Nancy Chin, a medical anthropologist from the University of Rochester School of Medicine who is studying social interactions in Antarctica, has noted that many summer participants clearly have an away-from-home attitude about being in Antarctica, and being there for sexual exploration is part of the Antarctic experience. However, she noted that sexual diseases are not screened out at the U.S. stations prior to arrival, and so, contrary to some myths, Antarctica is not the safest place in the world to have sex. For the most part, the same risks they faced at home were possible in Antarctica as well (personal communication August 12, 2003).

11. Sexual Dysfunctions, Counseling, and Therapies

Cornelius (1991) highlighted some of the major psychosocial factors that contribute to stress in Antarctica:

For example, absent are windows, privacy, living green things and animals, the sun, thick moist air to breathe, freedom to travel, or freedom to leave a rumor-infested, isolated human outpost. The "rumor mill" can be quite potent. Cliques can develop and be quite cruel and stressful to an individual with a different background than the rest of the crew. Cliques can also be quite insensitive to their own kind. Lack of acoustic privacy in the small "private" rooms can also lead to stress. Privacy becomes a cherished commodity. Time away from the group alone is very important for "charging one's batteries." Lack of a partner of the opposite sex can also lead to stress. Married couples who have wintered tend to handle the isolation much better. Constant low light levels can cause stress, too. It was observed that much higher light levels inside the dome at South Pole Station during the isolation period seemed to increase the morale of the crew. The higher light levels tend to decrease stress. (p. 10)

Thus, we can see that the level of stress, which is a major factor in disrupting interpersonal couple relationships and small-group interactions, can be quite high. In addition, stress is a major factor in many sexual dysfunctions. Therefore, we can expect that although stress can affect overall sexual performance and relationships, at the same time some undelineated aspect of the marital relationship (perhaps sex)

tends to mitigate against the effects of stress for some married couples. It has been noted that most of the American work being done in Antarctica is being conducted by private contractors, who often send married couples to Antarctica.

In Antarctica, the value of off-duty leisure activities has been documented (Kelly & Kanas 1994). Such activities can provide the crew with a welcome respite from the monotony and stress of the long winter. Cornelius (1991) noted that, although they depend on the individual, they can include: conversation, watching movies and videos, listening to music, short excursions outside, looking out the windows if there are any, or doing group projects (e.g., building a jacuzzi at South Pole Station). He noted that they also try to find an excuse for a party, not only the standard birthdays and holidays, but also to celebrate midwinter (which signifies roughly the halfway point of the expedition) and the sunset and sunrise (there is only one sunset, corresponding roughly with our vernal equinox, and one sunrise, at about our autumnal equinox, in the interior parts of the continent each year).

Still, anecdotal stories have been told that suggest that some marriages have failed as a result of the Antarctic experience. Stuster (1996) confirmed this when he wrote:

It is true that extremely disruptive and even dangerous relationships have developed among mixed-gender crews at both large and small Antarctic stations. Many relationships, including long-standing marriages, have dissolved while one or both parties were on the ice; other situations have been so bizarre that it is remarkable that the individuals were capable of coping with the experience. (p. 179)

He suggested that careful crew selection (as opposed to screening) was important, as well as special training about the many potential problems associated with life in isolation and confinement, which would allow most of the concerns about mixed-sex crews to dissipate.

Lugg has noted that marriages have been performed in Antarctica, and he also noted that some married couples have separated during their stay in Antarctica (personal communication May 9, 2003). He noted anecdotal stories that reveal that occasionally expeditioners may become involved with a new partner from the group, which can add additional stress to an already-stressful situation affecting established relationships. Today, people have psychological support services available by satellite phone, and doctors and many section leaders can also counsel those who winter over. Often, as well, the participants themselves can give useful support to those within the group who might need it.

12. Sex Research and Advanced Professional Education

It appears that no specifically focused sex research has been done in Antarctica. However, as can be noted from the previous sections, research has been done for NASA that has looked at the interpersonal relationships that occur in research stations there to help suggest what impact the psychosocial environment, in terms of isolation, confinement, deprivation, and risk, might have on extended spaceflights. In addition, personal accounts of expeditioners have drawn some attention to sexuality factors. Together, both can begin to suggest avenues of sex research that might be done in both environments, which, as I have argued elsewhere (Noonan 1998a), can be used to improve the sexual lives of everyone.

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