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Space Migrations: Anthropology and the Humanization of Space*

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Abstract

Because of its broad evolutionary perspective and its focus on both technology and culture, anthropology offers a unique view of why we are going into space and what leaving Earth will mean for humanity. In addition, anthropology could help in the humanization of space through (1) overcoming sociocultural barriers to working and living in space, (2) designing societies appropriate for permanent space settlement, (3) promoting understanding among differentiated branches of humankind scattered through space, (4) deciphering the cultural systems of any extraterrestrial civilizations contacted.

Space is being humanized. We are learning to live and work in orbit; the era of the actual settlement of the Moon, Mars, and other portions of our solar system seems almost at hand; and talk of eventually migrating to other star systems is growing. My task here is to consider what role the discipline of anthropology might play in understanding and in facilitating this process of humanizing space.[1]

At first glance, anthropology might not seem to have much to contribute to such a highly technical and futuristic enterprise as expanding into space. For example, a recent NASA publication entitled *Social Sciences and Space Exploration* includes chapters on economics, history, international relations and law, philosophy, political science, psychology, sociology, and future studies, but not on anthropology (Cheston, Chafer, and Chafer 1984). That omission is perhaps understandable, because anthropologists have typically focused on the long past of humanity rather than on its future and, when they have studied living peoples, they have usually worked with small tribal or peasant groups rather than with large industrial societies. Yet, despite this seeming fascination with the archaic and the small-scale, the perspective of anthropology applied to space can help us comprehend the human implications of leaving Earth and can facilitate that process.

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[1] A separate paper could be devoted to how remote sensing from space is being used by anthropologists to search for buried or otherwise obscured archaeological sites (see "NASA . . ." 1985), to survey land use patterns of living peoples, and even to track reconstructed voyaging canoes as they are being sailed over the Pacific navigated by Polynesian non-instrument methods (Finney et al. 1986).

An Anthropological Vision

First, and most important, anthropology offers a perspective on humankind that extends back some five million years to the appearance of the first hominids, but it does not end with the evolution of modern human beings and the development of the current high-technology society. Anthropology can help us think about where we are going as well as where we have been. From the perspective of anthropology, we can view our species as an exploring, colonizing animal which has learned to develop the technology to migrate to, and flourish in, environments for which we are not biologically adapted (Finney and Jones 1985). This process began when our distant ancestors developed those first tools for hunting and gathering (see fig. 1), and there is no end in sight. Settling the Moon, Mars, or even more distant bodies represents an extension of our terrestrial behavior, not a departure from it. The technology of space travel, artificial biospheres, and the like may be immensely more complicated than anything heretofore developed on Earth. But, in voyaging into space and attempting to live there, we are doing what comes naturally to us as an expansionary, technological species.

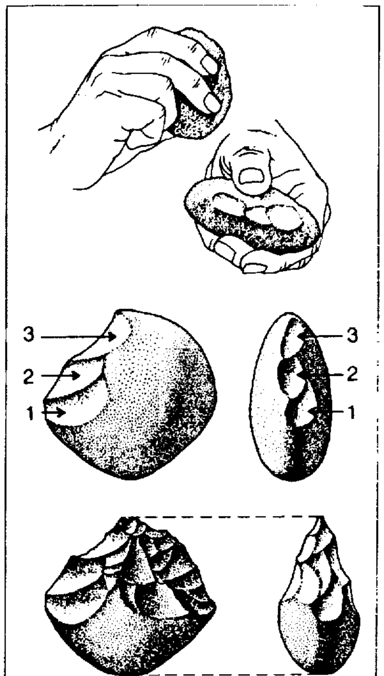

Figure 1

The Beginnings of Technology

Through the development of technology, our distant ancestors were able to spread out of East Africa over the entire globe and to thrive in harsh environments for which we, as basically hairless, tropical animals, are not biologically adapted. The invention of the shaped chopping tool some two million years ago was a major benchmark in this process of technological development. By hitting one rock against another so as to chip off a series of flakes, one can make a crude tool to use in many tasks, such as slicing meat, working hides, and shaping wood and bone into new tools.

Artist: Biruta Akerbergs

Taken from Jolly and Plog 1986, p. 275. Reproduced with permission of McGraw-Hill, Inc.

Yet, settling in space will be a revolutionary act, because leaving Earth to colonize new worlds will change humankind utterly and irreversibly. Anthropologists focus on technological revolutions and their social consequences. The original technological revolution, that of tool-making, made us human. The agricultural revolution led to the development of villages, cities, and civilization. The industrial revolution and more recent developments have fostered the current global economy and society. Now, this same anthropological perspective tells us that the space revolution is inevitably leading humanity into an entirely new and uncharted social realm.

Cultural Analysis

Speculation about revolutionary developments is not, however, immediately relevant to a most pressing question about human adaptation to space: How can groups of people live and work together without psychological impairment or the breakdown of social order in the space stations, lunar bases, and Mars expeditions now being planned? Psychological and social problems in space living constitute, as both Soviet and American space veterans attest (Bluth 1981, Carr 1981), major barriers to be overcome in the humanization of space.

Coping with isolation from Earth, family, and friends and with the cramped confines of a space module or station has been enough of a challenge for carefully selected and highly trained spacefarers of the U.S.S.R. and the U.S.A. As those cosmonauts who have been "pushing the endurance envelope" the farthest attest, staying longer and longer in space provokes severe psychological strain (Bluth 1981; Grigoriev, Kozerenko, and Myasnikov 1985; Oberg 1985, p. 21). Now life in space is becoming even more complicated as "guest cosmonauts" from many nations join Soviet and American crews; as women join men; and as physicians, physicists, engineers, and other specialists routinely work alongside traditional cosmonauts and astronauts of the "right stuff" (see fig. 2). How will all these different kinds of people get along in the space stations of the next decade and the lunar bases and martian outposts which are to follow? What measures can be taken which would reduce stress and make it easier for heterogeneous groups of people to work efficiently and safely and to live together amicably for months or even years in these space habitats?

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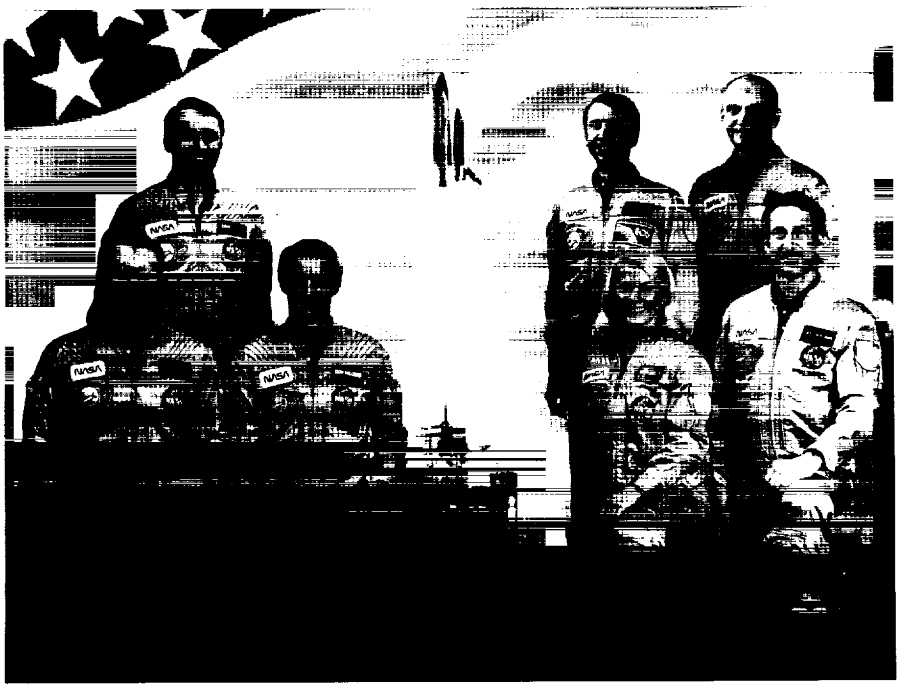

Figure 2

Space Shuttle Mission 51D, Crewed by K. J. "Bo" Bobko, Dave Griggs, Don Williams, Charlie Walker, Rhea Seddon, E. J. "Jake" Garn, and Jeff Hoffman

Space crews are becoming larger and more heterogeneous. Where once space was virtually the sole preserve of military test pilots from just two of Earth's nations, now women, "guest cosmonauts" from a wide range of countries, and physicians, scientists, engineers, and other specialists routinely join traditional astronauts and cosmonauts in space flight.

This trend can be seen in many of the Space Shuttle crews. In this case, Commander Karol J. "Bo" Bobko (Colonel, USAF) and Pilot Don E. Williams (Captain, USN) were joined in their flight, April 12-19, 1985, by Mission Specialists S. David Griggs (another test pilot, with an M.S. in administration), Jeffrey A. Hoffman (Ph.D., astrophysics), and M. Rhea Seddon (M.D.) and Payload Specialists Charles D Walker, representing McDonnell Douglas Corporation, and E. J. "Jake" Garn, representing the U.S. Senate.

In the coming era of international space stations, and one day on lunar bases and missions to Mars, a major challenge will be how to structure crew relations so that men and women of many nations, cultures, and occupational specialties can live and work together synergistically in space.

Among social scientists it has been primarily the psychologists (Helmreich 1983), with a few jurists, sociologists, and political scientists joining in, who have tried to address these problems of space living. However, inasmuch as among the diverse lot of people who call themselves anthropologists there are those who are intensely interested in interpersonal relations and small group behavior, it should not be surprising that anthropologists might also be attracted to work in this field. Interestingly, some recent recruits come from maritime anthropology, where they have worked on the dynamics of small-boat fishing crews.

These and other anthropologists interested in space can bring to the field a degree of "hands-on" experience in working with "real" small groups—be they fishing crews, Antarctic scientists (see fig. 3), or hunting and gathering bands (see fig. 4). And they bring a tradition of nonintrusive ethnographic observation and description, which might usefully supplement the more clinical and experimental approaches used by psychologists and other social science researchers. Beyond this, moreover, anthropologists can bring a needed cultural perspective to this pioneering phase of space living.

Figure 3

American Station at the South Pole

This station provides one of the closest analogs we have on Earth to a rudimentary base on another planet, in terms of both living conditions and dependence on supplies from outside. The station consists of several buildings—laboratories, service structures, and habitation modules—within a geodesic dome approximately 100 meters in diameter. The South Pole station is continuously inhabited. Crewmembers arrive and depart by air during the summer, but during the long Antarctic winter the dozen or so scientists and support staff live completely isolated from the rest of the world—almost as though they actually were on the Moon.

While the occupants can venture outside with protective clothing ("space suits") during the winter, they are mostly dependent on the shelter provided by the geodesic dome and the buildings within the dome, much as they would be at a Moon or Mars base. Most of the supplies must be brought in by air, but some use is made of local resources. Local ice is used for water, and, of course, local oxygen is used for breathing and as an oxidizer for combustion, including operation of internal combustion engines.

Photo: Michael E. Zolensky

It is through the concept of "culture" that anthropology has made perhaps its greatest contribution to the formal understanding of human life. In this context, anthropologists mean by *culture* those patterns of beliefs, practices, and institutions shared by a particular ethnic population, a profession, a religion, or another grouping. This concept has diffused beyond the social sciences and, in the United States, has become a common tool for thinking about problems within our multicultural society. It has even crossed the threshold into big business and government agencies such as NASA. One can now read books extolling the "culture" of this or that successful corporation, and I have heard NASA managers explain differences between the Johnson Space Center and other NASA centers as being "cultural" in nature. Here I wish to suggest two specific areas in which this cultural perspective of anthropology could be useful: (1) in addressing the problems of cross-cultural relations among heterogeneous space crews and societies and (2) in the application of cultural resources to develop models for space living.

Figure 4

Agta Men Burning Hair and Dirt From the Skin of a Wild Pig

Here, watched by helpers and children in front of a residential lean-to at Disabungan, Icabela, the Philippines, an Agta man performs the first step in the butchering of a wild pig. He burns the hair and outer skin, which he will then scrape off. After this, the hunter will cut the pig into shares to be distributed among the band members, and sometimes offered for sale to loggers, farmers, and fishermen who have moved into the area.

Before the invention of agriculture, all of our ancestors lived by gathering wild plant food, hunting wild animals, and fishing. The Agta are representative of the few hunter-gatherer groups still found in the humid tropics of Southeast Asia, Central Africa, and South America. The Agta live in small bands of from 15 to 30 family members along the coast and in the mountains of eastern Luzon Island in the Philippines. They hunt wild pig, deer, and monkey, and they also fish, gather wild plant foods, and plant small gardens of root crops, rice, or maize.

Photo: P. Bion Griffin

Guest Astronauts and Cosmonauts

Foreign Payload Specialists on the Space Shuttle

Ulf Merbold, West Germany, Spacelab 1, November 28-December 8, 1983

Marc Garneau, Canada, Canadian Experiment (CANEX), October 5-13, 1984

Patrick Baudry, France, Echocardiograph Experiment and Postural Experiment, and Sultan Salman Abdelazize Al-Saud, Saudi Arabia, Arabsat-A, June 17-24, 1985

Reinhard Furrer and Ernst Messerschmid, West Germany, and Wubbo Ockels, the Netherlands, Spacelab 4, October 30-November 6, 1985

Rodolfo Neri Vela, Mexico, Morelos Experiments, November 26-December 3, 1985

*Cosmonauts From Outside the Soviet Union**

Vladimir Remek, Czechoslovakia, 1978

Miroslaw Hermaszewski, Poland, 1978

Sigmund Jaehn, East Germany, 1978

Georgiy Ivanov, Bulgaria, 1979

Bertalan Farkas, Hungary, 1980

Pham Tuan, North Vietnam, 1980

Arnaldo Tamayo, Cuba, 1980

Jugderdemidyan Gurragcha, Mongolia, 1981

Dumitru Prunariu, Romania, 1981

Jean-Loup Chrétien, France, 1982 and 1988

Rakesh Sharma, India, 1984

Muhammed Faris, Syria, 1987

Aleksandr Aleksandrov, Bulgaria, 1988

Abdul Ahad Mohmand, Afghanistan, 1988

**List compiled by James E. Oberg, space researcher and author.*

Cross-Cultural Relations

First, consider the issue of cross-cultural personal relations on international space missions. Space is no longer an arena for just two nations. More and more citizens from a growing number of countries are joining their Soviet and American colleagues in space (see list). If this trend continues, it would be easy to imagine a time when crews aboard permanent space stations or the inhabitants of a lunar base would in effect form miniature multicultural societies.

It could be argued that the highly trained and motivated persons who would participate in such future missions would share a common high-technology space culture that would submerge local cultural differences and any problems that might arise from these. That might describe some future situation wherein crewmembers grow up in a common space culture and thereby share common experiences, expectations, and values. However, as long as crewmembers are born and reared in diverse terrestrial cultures, we cannot ignore cultural differences and their potential for generating problems during international missions.

Cultural misunderstandings, stemming from a difference in interpretation of a command or comment or from a clash in behavioral styles, might be deemed trivial and passed over in a terrestrial setting. But they could become greatly magnified on a hazardous mission where people must put up with one another in cramped quarters (see fig. 5) for months, or perhaps even years, at a time. The Soviets, who have had the most experience with international spacefaring, have admitted to cultural difficulties—even though their guests may speak Russian and share a common ideology with their hosts. As Vladimir Remek, a guest cosmonaut from Czechoslovakia, puts it, unique cultural "mental features" can "disrupt the harmony among crew members" (Bluth 1981, p. 34).

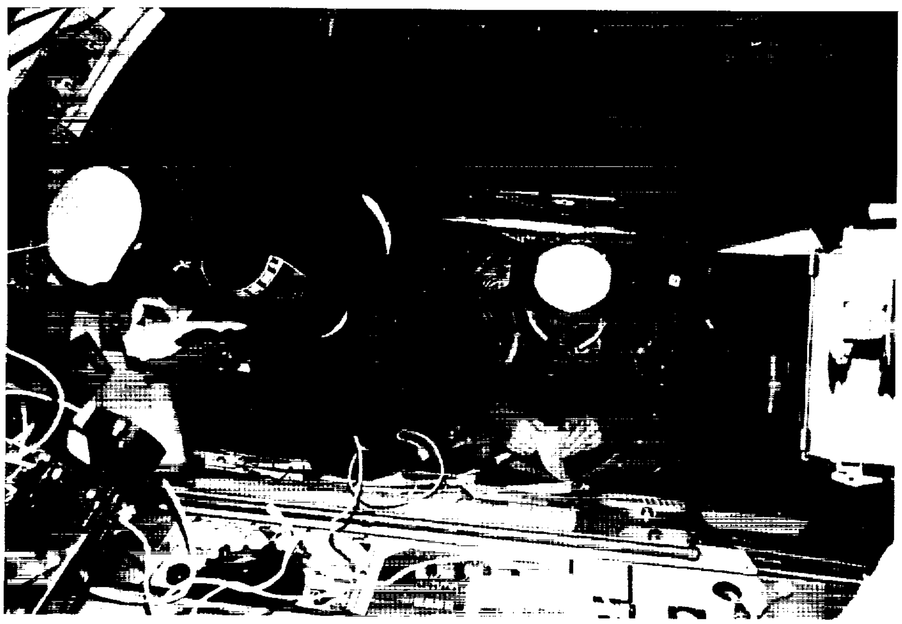

Figure 5

Cramped Quarters

Cosmonauts Valeriy N. Kubasov and Aleksey A. Leonov are seen in the Soyuz orbital module during the joint U.S.A.-U.S.S.R. Apollo-Soyuz Test Project docking in Earth orbit. This photograph was taken by one of the three American astronauts on the mission—Thomas P. Stafford, crew commander; Donald K. Slayton, docking module pilot; or Vance D. Brand, command module pilot. The American and Soviet spacecraft were joined together in space for 47 hours, July 17-19, 1975.

The 47-hour ASTP rendezvous was a success both technologically and culturally, but the cramped quarters of the Soyuz spacecraft [the Apollo spacecraft was equally cramped (see the photo on p. 12)] and the differences in national styles demonstrate the potential for cultural clashes on longer missions with mixed crews.

One prerequisite for group harmony is good interpersonal communication. Basic to that communication is what the anthropological linguist Edward Hall calls the "silent language" of facial expression, gesture, body posture, and interpersonal spacing (Hall 1959). Members of the same culture tend not to perceive how much is communicated nonverbally, because their shared ways of gesturing and moving their bodies may be so culturally ingrained as to be virtually unconscious. They can therefore be greatly taken aback when confronted with members of another culture who gesture or use their bodies differently. Americans, for example, commonly experience a bewildering sense of discomfort when conversing with Middle Easterners, who habitually stand closer to their conversational partner than the American norm. Conversely, Middle Easterners may interpret Americans' greater conversational distance as a sign of coldness or dislike. Take conversational distance and all the other elements of the "silent language," mix well with an international crew in a crowded space habitat (especially one located in a microgravity environment, where facial expressions are made even more difficult to read because of the puffiness of the face from fluid pooling in the head), and you have a recipe for cultural misunderstanding.[2]

Cultural Resources

Cultural factors should not, however, be viewed solely in terms of impediments to successful space living, for they may also constitute valuable human resources to be tapped in adapting to space. In addition to seeking to promote cultural harmony among heterogeneous space crews, we might also seek out, from the multitude of cultural traditions among the Earth's societies, those practices and institutions which could best promote harmonious and productive life in space.

As an example, consider interpersonal problems in a space habitat. J. Henry Glazer, an attorney who has pioneered the study of "astrolaw," warns against exporting to space communities the adversarial approach to dispute resolution based on "medieval systems of courtroom combat" (Glazer 1985, p. 16). In small space habitats, where people

[2]For another perspective on cross-cultural relations in space, see Tanner (1985).

cannot escape from one another but must work out ways of interacting peacefully and productively, adversarial proceedings would irritate an already sensitive social field. And how could the winners and losers of bitter courtroom battles live and work with each other afterwards?

One obvious suggestion is that systems which are designed to detect interpersonal problems early and head them off through mediation should be considered for space living. Glazer, for example, calls for a new kind of legal specialist—not an adversarial advocate, but someone who settles disputes on behalf of the interests of all spacefarers on a mission. He draws his model from the *Tabula de Amalfa*, the maritime code of the once powerful Mediterranean naval power of Amalfi. Their code provided for a "consul" who sailed aboard each merchant vessel with the power to adjudicate differences between master, crew, and others on board (Glazer 1985, pp. 26-27; Twiss 1876, p. 11). In addition to looking to this and perhaps other maritime analogs, it is tempting to suggest that, with an eye to the more distant future of large space settlements, we also examine major contemporary societies in which harmony and cooperation is stressed. The example of Japan, with its low crime rate and relative paucity of lawyers, comes to mind—although its utility as a model for international efforts may be limited in that Japan is such an ethnically homogeneous society (Krauss, Rohlen, and Steinhoff 1984; Vogel 1979).[3]

New Cultures, New Societies

Once we have learned how to live together amicably in space and to work safely and efficiently there, once we have developed ways of avoiding the health problems of ionizing radiation, microgravity, and other hazards of nonterrestrial environments, and once we have learned how to grow food in space and to produce air, water, and other necessities there, then humankind can actually settle space, not just sojourn there. New cultures and new societies will then evolve as people seek to adapt to a variety of space environments.

[3]See Schwartz (1985) for a comprehensive analysis of the utility of various institutional responses to colonizing opportunities made by migrant farmers from a variety of world cultures.

This process of building new cultures and societies will undoubtedly contain many surprises. Yet, all the resultant sociocultural systems must provide the basic prerequisites for human existence if they are to be successful. Here is where the seeming disadvantage of the anthropologist's penchant for studying small communities may actually prove advantageous.

The sine qua non of anthropological experience is a long and intense period of field work in a small community, during which the investigator attempts to obtain a holistic understanding of the group (see fig. 6). For example, I once spent a year living on a small island in the middle of the Pacific with only 200 inhabitants, during which time I learned the language, became well acquainted with every individual and his or her position in the community, and gathered data on everything from fishing and house building to marriage and religion. Because of this holistic experience of studying a small, relatively self-sufficient community and trying to figure out all its parts and how they fit together, I find most discussions of space settlement curiously incomplete. Typically, they go to great lengths to explain how habitats will be built on a planetary surface or in space, how food will be grown in these habitats, and how the community will earn its way by mining or manufacturing some valuable product; then they skip on to few details about domestic architecture, local government, and the like.

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Figure 6

a. Building a Canoe in Polynesia

Men of Anuta Island rough out the hull of an outrigger fishing canoe. This Polynesian community, located on a tiny volcanic island off the eastern end of the Solomon Islands, well away from regular shipping routes, has a population of less than 100 people. Its small size and relative isolation makes Anuta an intriguing community for thinking about life in a small settlement on the Moon or elsewhere in our solar system.

Photo: Richard Feinberg

b. Thatching a Roof in Polynesia

A communal working group thatches a roof on the island of Nukuria, a Polynesian atoll located in the Bismarck Archipelago near New Guinea. In this atoll community of some 200 inhabitants, people work cooperatively on such chores as roof thatching, much as early American farmers used to help each other out with barn-building "bees." The isolation, small size, and relative self-sufficiency of such island communities allows the anthropologist studying them to gain a holistic perspective on all facets of life from birth to death. This holistic perspective in turn may enable anthropologists to foresee critical human elements in future space settlements that planners who are inexperienced in the functioning of small, relatively self-contained communities may ignore.

Photo: Barbara Moir

Among the crucial elements of human life omitted, or glossed over, in these futuristic projections is the most basic one for the survival of any society: reproduction. How mating, the control of birth, and then the rearing of children are to be arranged is seldom even mentioned in discussions of space settlement.[4] Yet, if our ventures in space were limited to communities of nonreproducing adults whose number would have to be constantly replenished with recruits from Earth, we could hardly expand very far into space.

Of course, it could be argued that no great attention will be required in this area—that people will carry into space whatever reproductive practices are current in their earthside societies. But, would that mean a high percentage of single-parent households and low birth rates? A distinguished demographer, whom Eric Jones and I invited to a conference on space settlement, explained his lack of professional interest in the subject by saying that he really did not think there would be much population expansion into space. He argued that the nations most likely to establish space settlements are those which have passed through the demographic transition from high to low population growth and that, furthermore, the highly educated, technology-oriented people who would be the ones to colonize space are those inclined to have the fewest children, perhaps not even enough for replacement of the population.

A population's demographic past is not necessarily a reliable predictor of its future, however, as we should have learned after the surprise of the post-World War II baby boom in the United States (Wachter 1985, pp. 122-123). It seems obvious that, when people perceive that it is to their advantage to have many children, they will do so. For example, Birdsell (1985) has documented how, in three separate cases of the colonization of virgin islands by small groups, the population doubled within a single generation. Figure 7 (Birdsell 1957) graphs the population growth on Pitcairn Island from 1790 to 1856. Unless radiation hazards, low gravity, or some other aspect of the nonterrestrial environment constitutes an insuperable obstacle to our breeding in space, there is every reason for optimism about the possibility of population expansion in space.

[4]But times may be changing. NASA psychologist Yvonne Clearwater (1985, p. 43) has recently raised the issue of sexual intimacy in space, and law professor Jan Costello (1984) has just published an inquiry into the issues of family law in space.

Nonetheless, the export into space of some current features of mature industrial societies, such as the high cost of educating children, the desire of both parents to have full-time professional careers, and the lack of institutions to aid in child rearing, would certainly act to slow expansion. Space settlers interested in expanding their populations should structure community values and services in such a way that people would want to have more than one or two children and would be able to afford to in terms of both time and money. An anthropological perspective could aid space settlers in constructing a socioeconomic environment for promoting population growth; first, by helping them to break out of the assumption that the way things are currently done in mature industrial societies represents the apex of human development; and, second, by informing them of the wide range of reproductive practices employed by the multitudes of human societies, past and present.

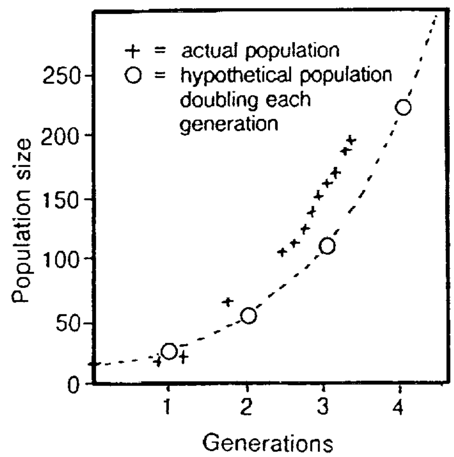

Figure 7

Population Growth on Pitcairn Island, 1790-1856

If physical conditions can be made favorable for human existence on other planets or in orbiting space habitats, the experience of small groups of people colonizing uninhabited islands suggests that our spacefaring descendants may expand rapidly—until checked by resource limitations. In 1790 six English mutineers from the H.M.S. Bounty, *eight or nine Tahitian women, and several Tahitian men settled on the tiny, uninhabited island of Pitcairn. Despite genocidal and fratricidal quarrels among the Tahitian men and the mutineers, the population more than doubled each generation, reaching almost 200 in 1856, when lack of food and water forced evacuation of the island.*

Adapted from Birdsell 1957.

Some of the practices from our remote past might even be relevant to our future in space. Suppose, for example, that the harshness of the airless, radiation-intensive environments of space, combined with the economics of constructing safe human habitats, dictates that the first space settlements would have to be small, containing well under a hundred people (Oberg 1985, p. 183). Pioneering space colonies might therefore be in the size range of the hunting and gathering bands in which most of our ancestors lived before the discovery of agriculture and the consequent rise of urbanization. If so, space settlers might face some of the same problems relating to reproduction as did their distant predecessors: the genetic dangers of inbreeding, random imbalances in the sex ratio of children born into the group, and what might be called the "kibbutz effect," wherein children reared close together are not markedly attracted to one another upon coming of age (Spiro 1965, pp. 347-349).

Our predecessors could avoid these problems with one simple institution: the practice of exogamy, whereby youths had to marry someone from outside their natal group, thus enlarging the effective breeding community to encompass hundreds of persons, not just a few dozen. Of course, it could be argued that sperm and egg banks, in vitro fertilization, and even in vitro gestation and genetic engineering may be so advanced by the era of space colonization that there would be no need for exogamy. Yet, marrying outside of one's group can bring benefits that may not be obtainable by other than social means.

Exogamy can promote social solidarity by binding together otherwise separate and scattered communities into a network of units which, in effect, exchange marriageable youths. Although the Australian aborigines, for example, lived scattered over their desert continent in small bands averaging 25 men, women, and children, they were linked together in tribes of some 500 people (Birdsell 1979). This larger tribal community was more than a breeding unit. At appointed times, the members of all the bands would gather together to arrange marriages, conduct rituals, and enjoy the fellowship of friends and relatives from other bands. Just as this tribal community provided the aborigines with a needed wider social group, so might a space age confederation of intermarrying space colonies help their pioneering inhabitants fight the loneliness of space (Jones and Finney 1983).

Of course, a space age exogamy system would probably not replicate all the features of its archaic predecessors. Take, for example, the custom of female bride exchange, whereby the marriageable young women were sent to other groups, which in turn supplied brides for the young men who remained at home. Space age young women would surely object, on the grounds of gender equality, to any rule that required that they leave home to marry, while their brothers could stay. Conversely, adventuresome young men might not relish the idea that they must remain at home and import their brides. More than likely, if the ethos of space communities is explicitly expansionistic, then both males and females will vie for the opportunity to leave their natal community and, taking a mate from another established community, go off to found a new colony.

Role of Anthropology

Assuming that someday it becomes widely accepted that anthropological insights and findings could help us understand human expansion into space and aid in that process, the question arises: How are those insights and findings to be applied and who applies them?

The suggestion that a corps of anthropologists be recruited to facilitate smooth cross-cultural relations in international space stations, to design appropriate institutions for permanent space communities, and to forecast the biocultural impact of moving into space might bring approval from my space-oriented colleagues and hope to many a new anthropology graduate trying to find a job in today's tight academic market. However, I would not advocate that anthropologists be elevated to the status of elite experts in planning human expansion into space. Anthropology is not an exact science in the sense that it can make accurate and precise predictions. Anthropological gurus of space expansion would hardly be infallible prophets or unerring social engineers. Instead, I foresee a more modest role for anthropologists as students of space expansion and advisors in that process.

The ideal recipients of that advice would not be some earthside planners charged with designing the social structure of space stations, lunar bases, and even more futuristic endeavors. Ultimately, the people who should receive the most appropriate advice on anthropological matters

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are those who will actually live and work in space. Call it self-design, home rule, or just plain independence, the underlying premise is the same: those who will actually reside in space stations, planetary outposts, and the first true space colonies should have a crucial role in the initial design of their particular community and, above all, in the inevitable modifications to that design which would arise through experience. In this light, the burden of space anthropologists—some of whom must do field work in space if they are to live up to their calling—would be to come up with relevant insights, findings, and recommendations derived from both terrestrial societies and groups in space and to communicate these to the spacefarers and colonists.

Two centuries ago a group of gentlemen farmers, lawyers, and politicians, faced with the task of constructing a viable nation out of a disparate collection of ex-colonies, came up with a remarkable document, the Constitution of the United States, which set out a form of democratic government that has since proved most successful (see fig. 8). This document, and the resultant form of government, was the product of a concerted design process based on a comparative study of forms of government instituted at different times and places through history, a study undertaken not by outside experts but by those who had to live in the resultant nation. I look forward to many such occurrences in space when the space settlers themselves—not earthside planners or even a space-based planning elite—sit down, sift through the accumulated human experience, and come up with principles for the design of new societies adapted to their needs in space. Here is where the anthropological record—from both Earth and space—and the principles derived therefrom could make a major contribution to the humanization of space.

Figure 8

Framing a Constitution for a New Nation, Philadelphia 1787

In framing the Constitution of the United States, a group of gentleman farmers, lawyers, and politicians, representing a tenuous union of ex-colonies, drew upon models of political organization provided by ancient Greece and Rome and other earlier states, as well as the writings of Enlightenment philosophers, to construct a totally new form of government suited to the needs and aspirations of Europeans transplanted to a New World.

Some time in the future, when and if spacefaring and spacedwelling technology is sufficiently developed, similar scenes may be reenacted as space settlers—drawing on the accumulated experience of terrestrial polities and inspired by space age philosophers—set out to devise new forms of government adapted to the needs and aspirations of developing nations in space.

Artist: Howard Chandler Christy

If We Are Not Alone

While the solar system appears to be the sole province of humankind, we do not know whether we are alone in the galaxy. Should we have company and should we or our descendants make contact with extraterrestrials, then anthropology might have a new role in space. The experience of anthropologists in trying to bridge cultural gulfs could be applied to the immense task of comprehending an extraterrestrial civilization.

Ten years ago a group of anthropologists and other social scientists published a book entitled *Cultures Beyond Earth* (Maruyama and Harkins 1975) exploring just such an "extraterrestrial anthropology." They assumed actual physical contact, via interstellar travel, between us and the extraterrestrials. To scientists engaged in the Search for Extraterrestrial Intelligence (SETI), however, the prospect of actually making physical contact is extremely remote. They argue that the physical problems and great cost of interstellar travel, as opposed to the relative ease and economy of radio communication, plus the great value that advanced civilizations would place on information, as opposed to physical experience, mean that contact will be made via the electromagnetic spectrum, not in person (Morrison, Billingham, and Wolfe 1977). Although the view that interstellar travel will never occur is arguable, a case can be made that, even if physical contact eventually takes place, speed-of-light radio communication would precede it (see fig. 9). Hence, the question is "What role could anthropology play in cultural analysis at a distance?"

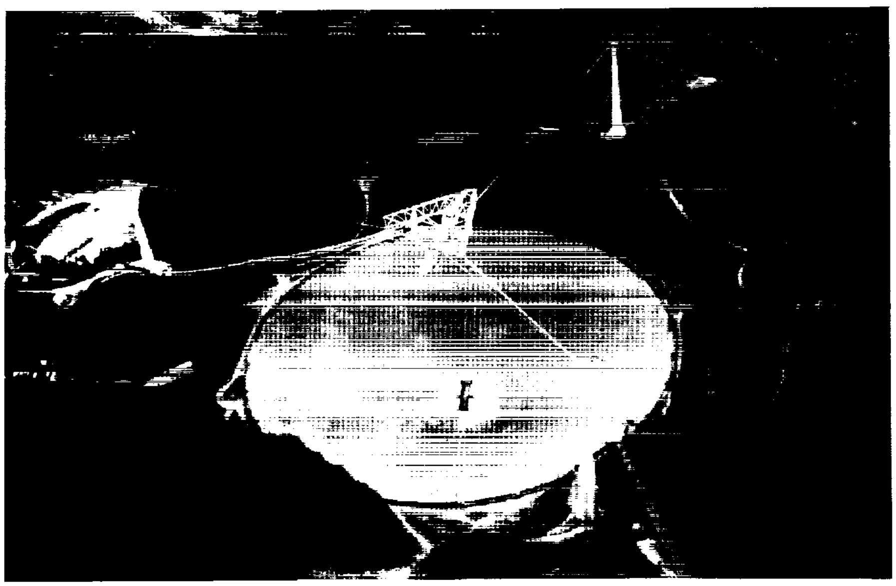

Figure 9

Radio Telescope at Arecibo, Puerto Rico

The world's largest radio telescope (305 meters in diameter), at Arecibo in Puerto Rico, is operated by the National Astronomy and Ionosphere Center at Cornell University under contract to the National Science Foundation. The Arecibo telescope will soon be used by NASA in a systematic search for radio transmissions from other star systems in the galaxy, transmissions that might indicate the presence of extraterrestrial intelligence.

The physics of the formation of the universe suggest that in the millions of galaxies with their billions of stars planetary systems may be the rule rather than the exception. The chemistry of the development of life on Earth, together with the discovery of organic molecules even in the depths of interstellar space, leads many scientists to consider the development of life on other planets as very likely.

The SETI program will search for life that has achieved intelligence and developed technology by looking in the quietest band of the electromagnetic spectrum (1000 to 100 000 MHz) for radio signals that may have leaked or been beamed from such highly developed civilizations on other planets. NASA's Ames Research Center will conduct a targeted search of stars like our Sun using the largest radio telescopes, including the one at Arecibo. The Jet Propulsion Laboratory will conduct a complementary survey of the other 99 percent of the sky, using the 34-meter-diameter telescopes in NASA's Deep Space Network. The SETI program is developing a spectrum analyzer that will sample millions of frequency channels looking for narrowband emissions that may be continuous or pulsed signals. Should such deliberately created signals be found, anthropologists will find ample work in interpreting the signaling culture to the receiving one and vice versa.

With extraterrestrial contact rephrased in terms of radio communication only, it might seem that anthropologists and their skills would have little or no role to play in this grand intellectual venture—at least in terms of the common SETI scenario. That scenario envisages the reception of a purposefully transmitted signal containing some mathematical truth, physical constant, or other noncultural knowledge that would presumably be universally shared among intelligent species scientifically advanced enough to engage in radio communication. The next step in this scenario would be to build upon this universal knowledge to develop a common logical code or language—either through a patient and clever tutelage directed by the transmitting civilization or through a lengthy dialog across the gulf of however many light years might be involved (Freudenthal 1960). Signal processing experts, mathematicians, cognitive scientists, and linguists would seem the obvious specialists to participate in this radio contact process, not anthropologists.

However, it would be a mistake to assume that once a common code was shared, the rest of the task would be easy. Philip Morrison, whose joint paper with Giuseppe Cocconi (Cocconi and Morrison 1959) stimulated the SETI effort, wisely points out that a "complex signal will contain not mainly science and mathematics but mostly what we would call art and history" (Morrison 1973, p. 338). To decode such a signal would be difficult enough. To interpret the cultural material would call for an immense effort. Just think of the scholarship involved in deciphering the hieroglyphs and in reconstructing ancient Egyptian culture, even though the ancient Egyptians are of the same species as their modern investigators and in part culturally ancestral to them and even though they left the Rosetta Stone! (See figure 10.) Interpreting an extraterrestrial culture would be a never-ending task, which would generate a whole new scholarly industry, calling for the talents of specialists from all disciplines, especially anthropology. Anthropologists concerned about the disappearance of independent cultural entities on Earth should be among SETI's most ardent supporters. If the search is successful, anthropologists will have more than enough to do—for millennia to come.

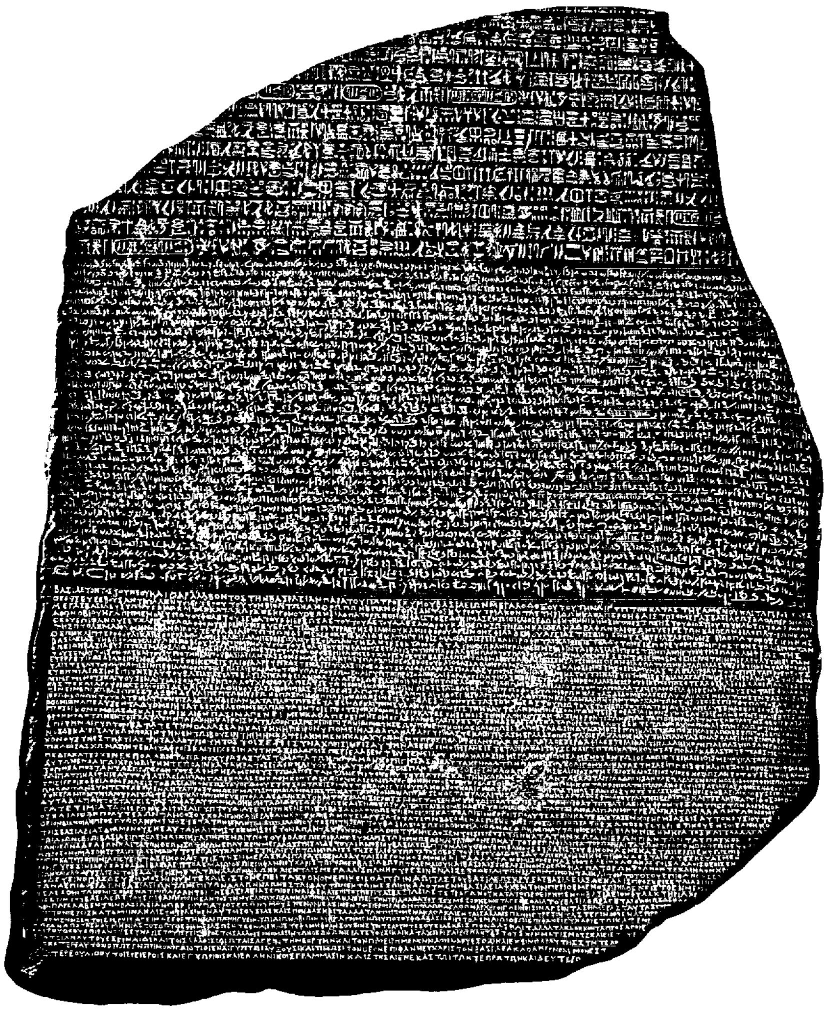

Figure 10

The Rosetta Stone

A slab of black basalt, rescued from demolition in A.D. 1799 by a squad of Napoleon's troops in an Egyptian village called Rosetta, and containing a decree passed by a council of priests in 196 B.C., provided the key to the decipherment of Egyptian hieroglyphics.

The officer in charge of the squad, Lt. Pierre François Xavier Bouchard, is credited with having realized almost at once that the three inscriptions on the stone were versions of the same text. The content of the decree was soon known from a translation of the Greek capital letters in the bottom inscription. But the nature of the other two scripts—Egyptian hieroglyphics in the top portion and the cursive Egyptian script called demotic *which appears in the middle—was not fully understood until 1822. Neither form of Egyptian writing had been used for 1,370 years.*

A blocking misconception was the idea that, while hieroglyphics were merely pictorial, demotic was strictly phonetic. An English scientist turned linguist, Thomas Young, broke through this block and provided the link that the two Egyptian scripts were related through an intermediary script called hieratic. *His translation of the demotic and the work of W. J. Bankes on the phonetic nature of royal names led French scholar Jean François Champollion to the conclusion that both Egyptian scripts on the Rosetta Stone contained symbolic* and *alphabetic elements. His knowledge of Coptic, the language of the Christian descendants of the ancient Egyptians, which was written in a sort of cross between Greek and demotic, helped him to finally decipher the Egyptian language in its most ancient script—hieroglyphics.*

And, of course, with knowledge of the language came a great increase in knowledge of the culture of the ancient Egyptians.

Explanation taken from Carol Andrews, 1981, "The Rosetta Stone," published by the British Museum.

Photograph reproduced by courtesy of the Trustees of the British Museum.

Even if we are the only intelligent species in the galaxy, or at least our corner of it, we might not be alone for long. If our own technology for settling space really works and enables some of our descendants to disperse throughout the solar system, a dramatic cultural rediversification of humankind would occur as the widely scattered colonies develop (through cultural drift or conscious choice) new ways of living. Then, if adventurous citizens of the solar system one day migrate to other star systems, their separation into small, self-contained breeding communities light years from their neighbors would virtually ensure biological speciation (Finney and Jones 1985). Earth-descended, though increasingly disparate, cultures and species would then be faced with the problem of understanding each other. Within such a galaxy of differentiating intelligent life forms, "astroanthropology" would be an essential tool for comprehending and relating to others beyond one's own cultural and biological experience.

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