

Astrosociology and Space Exploration: Taking Advantage of the *Other* Branch of Science

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Abstract. The space age marches on. Following President Bush's Vision for Space Exploration (VSE) and our recent celebration of the fiftieth anniversary of spaceflight on October 4, 2007, we should now take time to contemplate where we have been as it relates to where we are going. Space exploration has depended most strongly on engineers and space scientists in the past. This made sense when crews remained small, manned missions tended to operate in low Earth orbit and on a temporary basis, and the bulk of missions were carried out by robotic spacecraft. The question one must now ask is this: What will change in the next fifty years? One fundamental answer to this question involves the strong probability that human beings will increasingly go into space to live and work on long-duration missions and begin to live in space permanently. This article addresses the need to utilize the *other* neglected branch of science, comprised of the social and behavioral sciences along with the humanities, as it relates to the shift to a more substantial human presence in space. It focuses on the social science perspective needed to make this possible rather than the practical aspects of doing so, such as the engineering of functional habitats. A most important consideration involves the permanent establishment of a formal collaborative mechanism between astrosociologists and the engineers and space scientists who traditionally comprise the space community. The theoretical and applied aspects of astrosociology each have much to contribute toward the human dimension of space exploration, both on the Earth and beyond its atmosphere. The bottom line is that a *social* species such as ours cannot determine how to live in space without the input from a social science perspective, namely astrosociology.

Keywords: astrosociology, astrosociological imperative, human dimension, missing perspective, social sciences, space exploration

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INTRODUCTION

For the first fifty years of the space age, NASA and the other constituents of the space community have relied nearly exclusively on the work of engineers to manufacture robotic systems along with space scientists (e.g., astronomers, cosmologists, and planetary geologists) to complete their missions. Engineers have constructed a relatively small number of spacecraft for human spaceflight during the same period. This approach makes sense as long as humanity remains content with exploring space (1) indirectly via robotic missions while allowing only a few privileged citizens to participate in space operations and (2) confined to low Earth orbit (LEO). Unquestionably, this approach has yielded amazing scientific results.

But how far could we continue in this mode before progress begins to slow down? Strictly limiting our species' focus on space operations in LEO equates to "playing it safe." At some point, progress becomes hindered.

Diversion from the current historical pattern [of space exploration] requires the development of astrosociology and the utilization of its contributions by the space community. While its absence in the past was tolerable due to humanity's proclivity to stay in its own backyard (i.e., the Earth-Moon system)... , our future expansion into the solar system calls for a new approach (Pass, 2007).

A strategy characterized by "playing it safe" flies in the face of humanity's rich history of exploration of the Earth. Essentially refusing to venture beyond our own backyard reflects a very misguided understanding of humanity's

future needs. It fails to match our historical pattern of migration on Earth as remaining on our home planet is akin to remaining in Africa with no inclination to migrate to other parts of the world. Continuing this approach will result in serious consequences. Thus, the author makes a huge assumption in this article. The rate of progress for any particular society will inevitably decline over time if it fails to adopt a new orientation that favors exploration of our solar system as the next major step. If this failure occurs on the largest macro-level scale, then humanity as a whole will witness an even more generalized decline. A plan such as President Bush's *Vision for Space Exploration* (VSE), a "new approach" in the era of the space age, potentially puts the United States and any partners that may join the effort on the correct course that is in line with traditional terrestrial exploration before the advent of flight. Human spaceflight oriented toward space operations in LEO was our short-term fate until the VSE reoriented our approach to place *human* explorers at the forefront of space exploration. Based on the human record of exploration, the first fifty years of the space age represent an uncharacteristic effort in the sense that *humans* relinquished most of their investigations to robots of various types.

Finney and Jones (1986) postulated over twenty years ago in the context of space exploration that human beings were unique in their ability to utilize technology in order to adapt to new environments. "However, it is not simply the technological ability to build spaceships, life supports systems, and the like that will drive the expansion into space. Whereas technology gives us the capacity to leave Earth, it is the explorer's bent, embedded in our biocultural nature, that is leading us to the stars" (Finney and Jones, 1986).

If this hypothesis is indeed correct, then we must look at the first fifty years of space exploration as a foundation – that is, a very small first step in humanity's exploration of the space frontier. A continuation of the uncharacteristic approach to exploration explained above is highly unlikely during the next fifty years. In fact, President Bush's speech laying out his VSE served to change the basic orientation of the NASA mission by emphasizing human spaceflight over the space and Earth sciences – the latter of which suffered more devastating budget cuts. While it is not guaranteed to succeed – as we witnessed with the almost complete indifference to his father's call for a *Space Exploration Initiative* – it has resulted in changes in NASA's organizational structure and supportive actions by Congress. If it succeeds, does the VSE represent a good direction for space exploration? Or, as many fear, is it the beginning of a decline for America's space agency? Many analysts, including this author, believe that NASA will find a balance eventually, one that most likely favors spaceflight more than in the past.

In contrast to the first fifty years, then, humanity seems destined to expand its presence into our solar system in the form of human exploration with robotic assistance as the twenty-first century unfolds. Robots will serve as the first ambassadors into new regions of space with human explorers following with the assistance of additional robotic supporters. If this major assumption proves correct, then it behooves our species to study the social, cultural, and psychological effects of space just as we already assume we should understand the physical effects on human physiology or the engineering principles to keep a habitat on the Moon or Mars functioning. Regarding the latter example, the continued functioning of a space habitat on the physical level is no guarantee of the survivability of the inhabitants even while the habitat continues to function properly. An expansion of our knowledge into the untraditional realm of the social sciences, to an unprecedented extent (far beyond "human factors"), is now required. Astrosociology can fill this new role in science by adding the rich tradition of the *other* branch of science to the study of space exploration.

Astrosociology is in an excellent position to represent the social sciences as a single recognizable field for both the space community and the social science community. This article makes the case for the need to develop this relatively new field in both communities in order to take advantage of *both* branches of science. It also provides arguments supporting the need to bridge the "Great Divide" in order to understand the *human* component in space exploration much more scientifically than was possible in the past – as the first fifty year period of the space age was characterized by an inadequate level of participation by social scientists. In the future, engineers, space scientists, and others in the space community will need to collaborate with astrosociologists as human beings become more commonplace in the solar system. Finally, the *astrosociological imperative* is defined vis-à-vis this prediction of an ever-growing human presence in non-terrestrial environments.

THE MISSING PERSPECTIVE

Astrosociology, the study of social and cultural patterns related to outer space, was established by the author in July 2003 in order to fill this void both in the social sciences (Pass, 2006a; Pass, 2004a) and in the space community

(Pass, 2006b). Within the social sciences, the field serves to bind together social scientists interested in space research who typically work in isolation due to their colleagues frowning upon outer space as a proper subject matter (Pass, 2004c). Isolated within their own disciplines and fields generally, and their departments more specifically, those engaged in space research are typically separated from colleague in their disciplines and those conducting similar research among different disciplines.

In the space community, astrosociology provides to recognizable field for engineers and space scientists. In the social science community, traditionalists have a difficult time accepting space as a serious subject matter (Pass, 2004c). Social scientists' general unwillingness to formally support astrosociology falls outside the purview of this discussion, though it should be mentioned that this state of affairs is slowly changing in a positive direction – especially at the regional level within the sociological discipline. Because this author is a sociologist by training, it may be fairly stated that astrosociology began its existence as a sociological subdiscipline even with the lack of enthusiasm initially paid to it by the sociological community.

Still, a few progressive sociologists paved the way for the establishment and development of astrosociology through their advocacy for space activities, now known as *astrosocial phenomena*, as an important element of social life. While the work of Allen Tough (1998) directly influenced the author to establish astrosociology (Pass, 2004a), the others kept the idea alive over the years. Most sociologists, perhaps nearly all, have simply ignored outer space as an irrelevant and perhaps illegitimate subject matter. Harrison (2005) has commented that astrosociology will experience difficulties similar to what SETI faced before it was finally accepted by the scientific community.

However, this indifference is not a universal attribute characteristic of all sociologists. B.J. Bluth (1983), for example, advocated the study of space issues from a sociological perspective long ago. Bainbridge (1991) made an important observation about sociology's indifference. Part of his argument involved the recognition that in the face of a substantial interest in space on a societal scale (among citizens and space scientists), sociologists are less well prepared to deal with it compared to the scientists in the so-called "hard sciences." Rudoff (1996), in considering the importance of astrosocial issues, asked a simple though very revealing question: "And where is sociology?" A simple conclusion thus presents itself. Bluth, Bainbridge, Rudoff, along with Tough (1998) and many others, have long recognized the potential value of the "sociology of space" to the discipline and to society. Proponents of astrosociology continue to marvel at its absence in the face of this untapped potential (Pass, 2004b).

These pioneers and many others – including those from other disciplines – deserve enormous credit for their fortitude and the enlightenment they provided during an era in which their efforts went largely unrecognized. Despite their invaluable contributions, and the fact that they sometimes presented a unified theme at conferences and even reports and other publications, their overall impact has never led to the development of a unifying field until the establishment of astrosociology. On a formal basis, then, their important contributions to their disciplines and fields tended to remain underappreciated. Their work characterized astrosociology long before its introduction. The current experiment to formally develop a single field called "astrosociology" signifies the missing perspective in space exploration theory and research because it formalizes their general approach. It brings in the *other* branch of science comprised of the social sciences that were long treated as secondary perspective to the successful conduct of space exploration. The research of social science pioneers serves as the foundation of astrosociology on which the unified field can move forward. This fact deserves recognition as astrosociologists must not lose sight of the lessons learned in the past. The space community's underutilization of its findings cannot continue if human societies and conglomerates decide to move social groups into the solar system and eventually beyond.

The significance of astrosociology relates to the notion that no dedicated field existed for focusing on the social-scientific issues until its establishment. Of course, the pattern of human migration into space may occur during the *third* fifty-year period of the space age. Even if we choose to isolate ourselves as a species and remain content to fly humans around in circles in low Earth orbit (LEO), then astrosociology would still prove important because astrosocial phenomena still impact humanity as long as its connection to space exists in some form. Social science disciplines have severely undervalued the importance of these social and cultural patterns during the first fifty years. In truth, the collaboration between the astrosociological and space communities will yield research findings impossible exclusively from a natural or physical scientific perspective.

The purview of astrosociology as proposed by this author is both wide-ranging and integrative. The purpose of this approach relates to the need to place commonly disparate subject matters under one encompassing field so that

greater collaboration among them becomes possible. The subjects listed below are proposed as specializations under astrosociology's purview. This approach also possesses educative relevance in the sense that existing departments and programs will need to consider whether they want to embrace the "astrosociology" label and how this would reorient their current approaches. (Educational issues are discussed in more detail later in this article). Proposed specializations include:

1) new focus on astrosocial phenomena; 2) astrosocial change; 3) astrosocial education and advocacy; 4) social impact of astrosocial phenomena; 5) cooperation and conflict in space; 6) culture, including support for space exploration, Earthcentric vs. spacecentric distinctions, and other implications; 7) futures studies related to outer space; 8) history of astrosocial phenomena (even preceding the "space age"); 9) human isolation issues; 10) material culture related to space infrastructure; 11) military issues in space; 12) private vs. public astrosocial phenomena; 13) privatization of space; 14) influences of science fiction; 15) space law and space policy; 16) space migration and space societies (colonies/settlements); 17) space tourism; 18) influences of space sciences on society (including solving social problems); 19) influences of space sciences on society; 20) social [, psychological, and ethical] aspects of space medicine [i.e., *medical astrosociology*];...21) space-capable society vs. spacefaring society [;and 22) social and cultural ramifications of planetary defense strategies] (Pass, 2006c).

Folding all of these areas of research into one multidisciplinary field will prove complex. It will require a new approach to the study of space exploration as it relates to human beings. Indeed, it *does* add perspectives from the other branch of science. In the end, it will prove synergistic as existing scholars and researchers become even more familiar with one another's work, resulting in greater collaboration. Moreover, new "recruits" will join them due to their growing familiarization with astrosociology. In the end, the successful development of astrosociology will require students to pursue this new field as the focus of their professional careers – we will need to create new generations of "astrosociologists."

The Human Dimension

Thus, based on history, we can extrapolate where humanity is headed. What we do not know for certain involves the exact changes that will occur in the next fifty years. The second fifty years may well be characterized by a much more intense human presence in space than the first fifty years. Rather than relying on robotic spacecraft to explore the solar system, human beings will work beside them in cooperation. Each type of explorer will enhance the strengths of the other, making their combined effort more capable than either one alone.

As the twenty-first century unfolds, humans in space will almost certainly increase their scope and their variety of activities. The *human* element of space exploration was emphasized in a book by Albert A. Harrison (2001) called *Spacefaring: The Human Dimension*. It serves as a groundbreaking social psychological examination of the key issues that human beings will encounter in space environments, whether in spacecraft, orbiting space habitats, or in bases on planets and other space bodies. It represents a good example of pioneering work before the establishment of astrosociology. In 2001, it focused attention on the need to understand issues from a social-scientific point of view and how this missing perspective is actually complementary to the natural/physical branch of science.

The development of astrosociology goes a step further by giving a name to this approach along with all the ramifications that go along with it. The human dimension brings with it all of the positive *and* negative aspects of human behavior. We may very well settle on Mars, for example. But will we do so peaceably? Unfortunately, it is not too difficult to imagine factions of Mars fighting over scarce resources and territory. After all, it remains commonplace on Earth. Astrosociologists would study such outcomes of the future, just as social scientists study them on Earth. Additionally, perhaps astrosociological research findings can assist space explorers and settlers to learn from the rich past of their species' history, and thereby avoid making the same costly mistakes. We must keep the *other* branch of science in mind when we design both short-term missions and long-term expeditions. We must plan them with the human dimension firmly in mind.

Fifty Years and Counting

The twentieth century marked both the first unaided airplane flight and the first rocket trip into space by a human

being. When compared to the previous history of our species, these two achievements represented technical unmatched progress in so short of a time. The rise of science and technology as partial replacements for religion, and their interaction, has produced rapid social change in all aspects of social life. Social institutions have incorporated new discoveries and technologies into their everyday practices. Economies have flourished due to new product innovations. Citizens of post-industrial nations have benefitted greatly from an ever-increasing living standard unparalleled in history. Developing countries receive benefits from these developments. When one considers all of these types of advancements, it is safe to say that a great many of them became possible due to the research associated with space program in the United States and Soviet Union/Russia. Recently, other space-capable nations have emerged. How will they affect the future? For example, will humanity peaceably pursue the exploration of space or will the militarization of space characterize the next fifty year period?

For half a century now, the space community has operated quite successfully with an approach to space exploration that focused primarily on the natural and physical sciences. This approach worked because human beings remained on terra firma for the most part. Spacefarers were always the elites of society, whether select as part of an astronaut core or wealthy capitalists or entertainers who could afford the exorbitant fee to visit the International Space Station. The masses were never involved directly. The human dimension, and thus the field of astrosociology, has become more relevant due to plans to live on the Moon and Mars – plans by both governments and private organizations. In reality, however, astrosociology was relevant even before the space age as the connection between humanity and the cosmos partly shaped human cultures from the time humans organized themselves in groups.

Given the history of the space age, we can now only do something about contemporary conditions and determine how we want to shape our future with regard to space exploration. We currently find ourselves at fifty years and counting in the human exploration of space in both its indirect and direct modes. What will we decide for our future? The answer to such questions falls under the purview of astrosociology. As such, it is important to develop it as it will benefit us all at the societal and humanity levels

The Great Divide and the Need for Collaboration

It is important to look at the practical consequences of treating the human dimension as less important than the machine dimension. For one thing, it kept the two branches of science nearly totally separate from one another regarding the study of space issues, as discussed earlier. Human spaceflight did occur, of course, including seven Moon missions and the current ISS and Shuttle programs. Thus, psychologists were involved to a limited extent in studying individual adaptation to spacecraft (the human-mechanical interface category of human factors) and the effects of “weightlessness” and the space environment on individual physiology and psychology. However, sociology and the other social sciences were involved only on a very limited basis as a very small percentage of social scientists relevant to the total numbers of their disciplines participated.

Nevertheless, many social scientists worked in the area of space research despite the difficulties. Their circumstances made it quite easy for them to recognize the barrier to their participation by the space community, including Albert A. Harrison (1997) and Alvin Rudoff (1996). More recently, Marilyn Dudley-Rowley (2004) has termed this state of affairs the “*Great Divide* between sociology and aerospace,” though it more broadly applies to the social sciences as a whole and the entire space community. The divide may be envisioned as a canyon with each branch of science, and their corresponding representatives, on either side. The *Great Divide* favors the physical/natural sciences as that is where the space program resides. For the first fifty years of the space age, the human dimension sat on the other side largely out of touch. Even when relevant ideas and research findings materialized, social scientists were unable to contribute on a reliable and sustained basis.

The consequences of ignoring the various elements of the human dimension of space exploration have not come to the forefront enough to require a change in this general approach. For one thing, failures always seemed to involve problems associated with engineering. Remaining in its own backyard, humanity could ignore the effects manifested on missions due to their short stay in space as astronauts and cosmonauts could normally return before they became too severe. Moreover, participants in the space program failed to encounter other astrosociological issues altogether that would have occurred on a longer mission or one involving a larger crew. Some of these issues do arise on the ISS though research tends to focus on biology and human physiology. In the future, planning and execution of future space missions will need to increasingly involve social science issues at the level of conceptualization (and variables at level of operationalization) to the extent that we send larger social groups into

space for longer durations. At some point, the complexity will also escalate when it begins to involve both the national space agencies *and* private corporations as the process of the privatization of space becomes a reality. At that point in time, issues related to political economy, international relations, and political science become relevant. When societies located in space begin to interact with terrestrial and other terrestrial societies, then *interplanetary relations* will emerge more strongly as a relevant specialization of astrosociology (Pass, 2005; Pass, 2004b). Thus, the field of astrosociology will become more relevant as the twenty-first century unfolds.

Historically, the enormity of the Great Divide has been quite a formidable obstacle though the author argues that we can now utilize astrosociology to metaphorically link the two sides of this great chasm. To carry this metaphor a bit further, this bridge must exist as a formal collaborative structure that connects the two sides of the chasm (i.e., the two branches of science) on a permanent basis. At the present, the acceptance of astrosociology is more pronounced among members of the space community. The “sociology/social sciences” side exhibits weaker support astrosociology even though its disciplines must actually educate new astrosociologists. In general, though, both sides are becoming more supportive of astrosociology on a general scale. The development of the field will both depend upon, and result in, additional advocates and practitioners joining the movement as time passes from both sides of the divide.

An area relevant to the collaboration made possible by bridging of *Great Divide*, and one that complements the main theoretical orientation, is that of *applied astrosociology*. It utilizes the knowledge acquired through research as the basis for practical applications in space exploration. In this capacity, astrosociologists will work with their space community counterparts to plan and solve problems that each one alone could not accomplish. Examples include the complex process of replicating societies in space and helping to plan for precautionary measures along with responses to planetary defense-related incidents. Applied astrosociologists will utilize knowledge regarding the human dimension to make concrete contributions to space missions. This represents another area of synergy in which the two branches of science come together in cooperation with one another to ensure the successful exploration of space by *human beings*.

TAKING ADVANTAGE OF THE *OTHER* BRANCH OF SCIENCE

With the *Great Divide* finally bridged, even if that structure is still a bit rickety, we can now move forward. The foregoing discussion clearly describes how the social and behavioral sciences, the humanities, and the arts were only minimally involved with the space exploration. Yet, as also demonstrated above, the addition of a social science perspective such as astrosociology allows humanity to explore the stars by considering the human dimension in addition to the inanimate world. The *other* branch of science already possesses a great wealth of theoretical constructs and observational data regarding human behavior on Earth that (1) will prove directly or indirectly applicable to space and (2) focuses precisely on the study of space analogs on Earth. In the form of astrosociology, this knowledge could become both available to the social scientists who pursue this new field and the space community members through collaboration with them. In fact, natural scientists already pursue the study of space analogs from a natural science perspective. Astrosociologists should join them.

An example of existing knowledge applicable to space involves society’s institutions in the context of replicating a society in space (i.e., a space society) (Pass, 2007a; Pass, 2006a). In order to place a population of human beings in an isolated and dangerous space environment, planners must construct these institutions (e.g., government, family, economy, and criminal justice) to regulate social life just as they function to do so on Earth. Though social groups will adapt to space the best they can manage, the basic organizational patterns have been tested over thousands of years. They are unlikely to change on a fundamental level. Thus, data available from the study of space analogs is especially relevant to early settlements as well as the early history of all new ones.

In space, the impact of astrosocial phenomena on human beings and their social systems seems rather obvious. Early space settlers will experience great hardship on physical, social, and emotional levels. On the Earth, in contrast, it is easy to overlook the fact that most humans involved with space today, and throughout the space age, live on our species’ home planet. Only elite astronauts and wealthy individuals have traveled into space thus far. Yet everyone is affected by astrosocial phenomena. Astrosociologists must remember to investigate astrosocial phenomena wherever they impact on human beings, including in terrestrial societies.

It makes no sense to send humans into outer space without input from the fields and disciplines that developed to understand human behavior – and the connections between social constructs and other elements of the physical world; or psychological reactions to social, cultural, and physical manifestations. In the area of space medicine, for example, *medical astrosociology* focuses on the social, cultural, psychological, and ethical dimensions of risk to exposure and other dangers along with elements associated with treating patients in space. Economic concerns will also play a role as “medical” decisions may well hinge on weighing treatment options against costs and the availability of resources.

Bringing Outer Space into Social Science Classrooms

The current movement in the educational institutions (i.e., at primary, second, and postsecondary levels) to improve the quality of STEM education (i.e., natural sciences, technology, engineering, and mathematics) continues the old tradition of ignoring the social sciences. The tendency to evaluate the natural sciences as vital and the social sciences as secondary continues unabated within the space community. NASA has committed a great many resources help improve STEM education in terms of its quality and the number of graduates it produces. The various NASA programs bring the wonders of space into the STEM classroom to accomplish this.

With the growing recognition of astrosociology, however, a high expectation exists that this new field will become adopted by existing social science programs and departments to counter this trend at least minimally. It is well past the time to bring space into the social science classroom and, in doing so, train potential astrosociologists (Pass, 2007b). Students in STEM classes are motivated to learn when space is utilized in the classroom. For those students who favor the social sciences, space can increase educational attainment and the level of educational achievement as it does for STEM students. Astrosociology does interest many students (Pass, 2007c; Pass, 2007b).

Courses that teach STEM subjects, including astronomy, can also benefit from putting the natural sciences into a social science context. In terms of the matter at hand, the connections between human societies and various elements of space exploration would bring new insights into the minds of students. Perhaps some of those who ultimately decide to pursue a social science will still remain focused on space research

Probably the biggest obstacle to the permanent establishment of astrosociology relates to whether or not its supporters can establish its presence in academia. Can space do the same for social science classrooms? We shall see as astrosociology advocates seek to bring space (and astrosociology) into the social science classroom. We will need to utilize knowledge from the social sciences in conjunction with the traditional STEM subjects that comprise the natural sciences. Therefore, a serious movement to place astrosociology in academic programs serves as a crucial component of the astrosociological imperative. Otherwise, astrosociology will fail to develop beyond a topic brought up at conferences. Interested students will have nowhere to turn for astrosociology education.

THE ASTROSOCIOLOGICAL IMPERATIVE

Human beings are social animals. The social sciences developed prior to the era known as “the space age” due to the need to apply the scientific method to human behavior. For a number of known and unknown reasons, none of the social sciences developed subfields strictly dedicated to astrosocial phenomena or their similar concept. Simultaneously, the space community focused on practical matters involving engineering and the physical/natural sciences in the form of astronomy as one example. The human dimension received only scant attention in order to make human spaceflight possible for short missions.

Based on their subject matters emphases, the natural and physical sciences cannot address the social, cultural, and psychological dimensions of more complex forms of space exploration. Moreover, human beings cannot venture into space successfully on a scale that overwhelms the capacity of the national space agencies to cope unless an astrosociological perspective becomes integrated into the planning and operation of human activities in space. Astrosociologist will need to study trends and effects related to astrosocial phenomena in both the public *and* private sectors of societies.

Thus, the *astrosociological imperative* refers to the idea that because humanity will spread itself beyond the Earth, a complementary approach provided by the social sciences, in the form of astrosociology, will prove necessary. It is

an imperative because the very first attempt to place a group of people in a space environment will make obvious the need to understand human behavior and not just machines. In fact, contemporary and past human spaceflight should have made this clear, but the lesson did not take hold for reasons discussed in this article. It is imperative that trained astrosociologists participate in future missions planned for beyond LEO so that we can avoid potential tragedies that result not from engineering failures, but from problems associated with human behavior.

CONCLUSION

Space exploration in the next fifty years will be plagued by failures to the extent that (1) human beings themselves conduct space exploration *and* (2) social scientists (in the form of astrosociologists) fail to participate for whatever reason. The first condition makes the second necessary. The human dimension will allow humanity to explore more thoroughly than their robotic counterparts. There are greater complications, however. One involves the difficulty that arises with keeping humans alive, healthy, and comfortable in dangerous space environments. Another problem involves making it possible for them to live together in an organized social system. Meeting their social psychological and psychological needs will also prove complex as will solving their social problems. Nevertheless, these challenges can be overcome, but they will require taking advantage of the other branch of science. In fact, it will require a formal collaborative structure between both branches of science.

Thus, the *other* branch of science will prove indispensable. Space exploration cannot advance very far beyond contemporary conditions without the increased presence of human beings in our solar system. Those individuals content with robotic missions fail to grasp the significance of this potentially transitional epoch in human history, with the looming expansion of the human presence in space potentially heralding a major step toward the development of a *spacefaring society* (Pass and Harrison, 2007). At some point during the twenty-first century, unless societies somehow revert to dystopias, as due to nuclear war, this social migratory pattern *will* emerge.

Again, humanity is a *social* species. The social and behavioral sciences developed on Earth due to the need to understand human behavior in terrestrial societies. Human beings need to understand themselves in the social environments in which they live. Can we live, work, recreate, and explore outer space without the same need to understand ourselves? Social environments in isolated extraterrestrial locales will prove challenging similar to, but even more difficult than, what the pioneers and explorers faced on the Earth in the past. We need to develop astrosociology because it is the only contemporary field of science that focuses simultaneously on the human dimension *and* space exploration. New behavioral patterns will emerge in space while others will be familiar to social scientists and historians due to their similarities to patterns from past and contemporary societies on Earth. In both cases, a dedicated field can bring together all of the relevant information that we presently tend to dismiss as either unimportant or irrelevant.

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