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## **THE GREAT DIVIDE: SOCIOLOGY AND AEROSPACE**

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### **Abstract**

Recently, a new section in astrosociology has been proposed and is in progress of formation within the American Sociological Association. Among its areas of interest are the roles that sociology play or potentially could play in the field of aerospace. This report presents the author's discovery of the sociology in the space enterprise and her own "on the ground" experience with bringing sociology to the aerospace industry.

### **Introduction**

When Jim Pass contacted me before the 2004 ASA meeting about starting an astrosociology section within the American Sociological Association, I had two thoughts:

- 1) It's about time!
- 2) And, boy, is he in for some hard knocks!

I knew from long experience that the great divide between sociological work in aerospace venues was a yawning chasm about as wide and deep as the Cosmos itself. When that other Jim -- Jim Kirk -- intones in the opening credits of the vintage *Star Trek* re-runs "Space, the final frontier," I snicker a little bit. And, that is because I know that the *real* final frontier is bringing the "queen of the sciences" kicking and screaming to examine what Jim *Pass* terms "astrosocial phenomena." Astrosocial phenomena, according to his conceptualization, are any type of human social patterns with a connection to space. This could be a concern at-the macro level like comparing American and Russian attitudes toward space exploration and seeing if there is a correlation to the level of funding of their space programs per capita. Or, it could be a concern at the micro level, like determining the causes of conflict and dysfunction in a single space mission crew.

When I first began to look for the social sciences in the aerospace field, I did not expect to find the incredible level of ignorance in every corner at the intersection of those disciplines. I cannot think of a nice way to put it. And, it is not just an ignorance of "not knowing," it is an ignorance of "don't want to know." Aerospace scientists and engineers who advocate for inclusion of the

social sciences in their work have been tarred as being something less than team players. Social scientists who could bring applicable insights to the aerospace industry were shown the door, and thought of being a little weird within their own disciplines. So, social psychologists who had made enormous discoveries in their work designing the American nuclear Navy were discounted in their bids to share their knowledge with NASA regarding similar issues of contained space crews on orbit. NASA scientists who called for the study of social phenomena in space milieux were called on the carpet by their superiors. In the meantime, NASA has squandered opportunities to increase the public interest from a lack of knowledge of how society works, opportunities that could translate out to a larger national space agenda and increased agency budget. That probably has something to do with the institutionalization of NASA as a federal bureaucracy. This is something that I've become keenly aware in interacting with the agency. The educational outreach of NASA does not do enough to dispel the public's notion that space exploration, while of interest, is of little worth and those who study aerospace issues are not serious scholars. The social and organizational forces are enormous that keep sociology and the aerospace field apart.

I am going to take an autobiographical approach to this topic in order to recount the various issues that emerged as I attempted to bring sociological knowledge to aerospace and aerospace issues to sociology.

## **NASA in the Northland and the Arctic Analog of Space -- 1978 - 1989**

I came of age during the Golden Age of spaceflight, watching the news about the *Mercury*, *Gemini*, *Apollo*, and *Viking* programs on a grainy black-and-white vacuum tube television. As an elementary school student at the end of the 1950s and dawn of the 1960s, the *Weekly Reader* told me and my cohort that we would live and work under the sea and in space, have homes on the Moon and Mars, and the pressures of the Space Race made our school districts force us to study science and learn the New Math. Then, we beat the Soviets to the Moon and the pressure was off. Viet Nam began to take the place of space on the old vacuum tube TV. I took a Minor in Social Sciences and marched off to the Viet Nam Era Army.

*My first professional* encounter with the aerospace field was through the use of aerospace photographic and satellite imagery products that had been shot by NASA and the National Oceanic and Atmospheric Administration (NOAA). I was in graduate school and also doing independent research under the umbrella of the Geophysical Institute of the University of Alaska, Fairbanks. I was interested in a range of phenomena. Using thermal satellite infrared imagery, I looked for small islands and shoaling zones in the Arctic shelf sea pack ice, among the last crumbs of planetary geographic discovery that had been started by the great north polar explorers. Using NASA-NOAA aerial infrared photography, I was able to make inferences about past volcanic activity in the Arctic that melted permafrost and caused catastrophic flooding. Field geologists later verified those inferences. That work was among the first instances of recognizing the kinds of processes that might cause the traces of hydrological patterns on the planet Mars. I also discovered and mapped many dozens of new archaeological sites through the use of the

same photography. I made inferences about human and whale migrations in the Arctic through the NASA and NOAA photography and imagery.

While in Alaska, I became aware of a couple of the NASA tracking stations there. I had visited the Teamsters who worked at Gilmore Tracking Station on union business. And, I was there when NASA put a gigantic Scientific Atlanta dish on the top of the eight-story Geophysical Institute building to track a handful of new satellites. At Poker Flats Rocket Range, I was on hand when the space shuttle crew of STS-39 trained with a variety of cameras and film while photographing the aurora borealis for their flight that carried a hush-hush Department of Defense payload. As a result of that visit, I became a member of a NASA academic panel that pontificated on space sciences issues. Later, in Fairbanks, I began to study the issues of social interactions of people living and working in a small biosphere project that was planned a few miles from the University of Alaska campus.

So, as a result of all these things, the aerospace field had become real to me, like my service in the military had been real to me, something more than grainy black-and-white images on television. I realized that serious issues emerged in these venues, worthy of serious social scientific study.

## **Exchange Theory, Disaster Sociology, and Space – 1989 - 1995**

In 1989, I was accepted into a sociology doctoral program at The University of South Carolina. On the side, I was still working on a project with a University of Alaska team of geoscientists, proposing for NASA money to attempt to map permafrost on Mars from *Mariner 9* and *Viking Orbiter* imagery. One of my sociology professors saw what I was doing, recognized a funding opportunity, and told me he thought his work in exchange theory might be useful in studying things like communications between Mission Control and space crews. He had gotten the idea from Karen Cook, his competitor in the field, who is now in the sociology department at Stanford. Indeed, she had published a paper along these lines. While my professor never did anything with the idea, this let me know that professors with some substantial background were at least thinking about and writing a little bit on the sociology-aerospace boundary.

I was predisposed to think about studying the interactions of work crews in extreme environmental situations. I had real experience from being on Army mountainclimbing teams with the 172nd Arctic Light Infantry Brigade. And, I had left Alaska for my South Carolina doctoral program just after the wreck of the *Exxon Valdez* that had made such an impact on Alaskans, its economy, and its environment. That fresh in my mind, I began to study interactions of bridge crews just prior to some of the great tanker disasters of recent history- *Amoco Cadiz*, *Torrey Canyon*, *Arco Merchant*, the *Maryland*, and, of course, the *Exxon Valdez*. Now, it should not have been a quantum leap to understand the similarities between oil tanker crews who are often confined on their ships for long periods of time and who often face disaster and space and polar crews, always a few inches from death and destruction. But, it took me five more years to make the connection. Had there been more of a sociological interface with aerospace, I might have made an immediate connection.

## NASA, Houston, 1995

Five years down the road, in my role as a NASA academic space sciences panel member, I was notified of an important Space Medicine and Life Sciences Conference jointly sponsored by NASA, the National Institutes of Health, the U.S. Air Force, and the American Institute of Aeronautics and Astronautics. At this meeting, I met an engineer by the name of Cletus Booher, who was the head man in charge of the team of human factors specialists who wrote the federal engineering standards for the space shuttle and space station. My association with Clete Booher has been the source of many research ideas since that time.

From Clete, I learned that there were a few engineers who were not solely focused on just the "nuts and bolts" of space hardware and the technology-human interface. Clete was interested in what sociology and psychology could offer spacecraft design and mission planning. He was a pioneer and very different from most of those engineers around him. He had been at Johnson Space Center in Houston since it was cow pasture, and had come out of an earlier NASA work history involving biomedical monitoring. Clete encouraged me to explore the social sciences and aerospace boundary and is still one of my most valued mentors.

I gave a presentation at this meeting, held in Houston in 1995. I talked about the Arctic small biosphere project that I had advised. However, in wanting to connect it to a larger body of long-duration space simulation literature I supposed existed, I discovered that much of the literature about space simulations was proprietary, like a Boeing 90-day simulator study or the information being bogarted by the original Arizona Biosphere II Crew. Generalizable data existed from the study of the nuclear Navy, but most of that was classified. I brought this up in my presentation. A San Francisco Bay Area psychiatrist bounded down the aisle, stuffed several of his papers from his briefcase into my hands, and told me to keep up this work. From those papers, I was able to see in one place some of the core literature at the intersection of sociology and aerospace that had been published by disparate journals and other media. Thus encouraged, I came back to my doctoral program department and discussed with my major professor the possibility of changing my doctoral topic from a comprehensive study of the *Exxon Valdez* disaster to something about space crews. We spent over six months poring over the literature and chasing down more material. We came up with a number of different studies. One study went on to be ensconced on a Russian International Space Station simulator studying Russian and International crews isolated for varying time periods. Our study aboard the simulator took its inspiration from the nuclear Navy research of Irwin Altman, a distinguished social psychologist who had tried to unsuccessfully to interest NASA in the methods he and his research colleagues were using to help the Navy design submarines and put together crews which could stay submerged for months at a time. Another study examined several sociological assumptions that larger, more heterogeneous groups working and living in extreme environments for longer periods were apt to have more deviance, conflict, and dysfunction than smaller, more homogeneous groups in those same environments for shorter periods. We collected data from numerous Russian and American space missions and Arctic and Antarctic polar expeditions. Those assumptions were completely turned on their heads by that data quantitatively examined by us. That larger, more heterogeneous groups, whose members spend a longer time together are less dysfunctional, is a social phenomenon begging to be examined in group homes, prisons, refugee camps, and other venues.

## Ten Missions and Expeditions, 1996 - 2000

The study of ten of those space missions and polar expeditions procured National Science Foundation funding for me from the NSF sociology and social science programs that has enabled me to freight an ongoing research program. Many of my students have collected and analyzed data from a number of polar, space, and mountaineering teams. My colleagues and I have made secondary analyses of those data. Several publications have emerged from this ongoing study. This led to another discovery about doing work at the sociology-aerospace interface. Most of my publications have occurred in engineering and medical journals as a natural consequence of presenting at conferences to which my colleagues and I have been invited by an aerospace industry slowly awakening to the fact that human factors have more interfaces than the technology-human interface.<sup>1</sup> We have yet to press the issue of publishing widely in sociology and psychology journals. The times that I have attended sociology conferences with an eye toward developing presentations into publications, I have noticed that the subject matter of this study is initially grasped as an organizational-type study. I have yet to advance the case that this work represents a deviance study, that it is a study at the science, knowledge, and technology borderline, that it represents an example of public sociology, and that it also represents some methodological accomplishments. With the advent of astrosociology, it is yet another study to be subsumed under that category.

## Moscow, 1998

At different times throughout 1998, I worked in Russia under the auspices of the Institute of Biological Problems of the North (IBPN) and the Institute for Biomedical Problems (IBMP). The latter, the IBMP, is the major institution concerned with cosmonaut health. My work stints in Magadan and Moscow provided me with illuminating comparatives between Russian and Western production of biological and medical knowledge. I remember vividly a long and lively discussion, oft times, heated, with various Russian physicians and psychologists where I had to hold firm to my Western ideas of the scientific method in getting my study ensconced in the Russian space station simulator. I thought the scientific method was the same everywhere, but as that experience taught me, there are cultural variations on what "doing science" means in even fairly comparable, modern societies.

As I later went on to study NASA and Russian Space Agency interaction regarding several joint *Mir* space station missions, I appreciated firsthand the struggle between the two cultures and political systems in their social interactions to fly the missions and meet their goals. The chore of international organizations collaborating on large, one-of-a-kind advanced technological projects is harder than most people can imagine. Before an international team can be expected to plant a Moon Base or explore Mars together, it will be necessary to include a multi-domain, multi-

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<sup>1</sup> When industries begin to deploy a more comprehensive perspective of the human factors than just the human-technology interface, to include the human-environment and the human-human interfaces, then that will be a watershed event. Avenues of innovation will become boulevards of creativity.

cultural team of sociologists, psychologists, political scientists, anthropologists, communications, and education experts just to proceed on and maintain those projects.

The cultural and political aspects of the sociology-aerospace boundary on the international scene make for a boundary that draws a crooked and convoluted line over the epistemological landscape.

## **Mars Arctic Research Station, 1999-2000**

I participant-observed firsthand that a similar kind of problem obtained by working on projects that combined various science and engineering professionals working in conjunction with space enthusiasts (who might even also have had some science and engineering education). The kinds of cultural and political differentials, though on a smaller scale, are almost as startling as two international groups working on a complex project. These considerations dictate how a project is planned and proceeds. And, because of them, a NASA-related Mars mission rehearsal facility that I helped design and project manage nearly came to ruin. One of the crowning low moments came when a Marine Reserve KC-130T para-dropped some of the more important components of the facility, including a crane, over the Eastern High Canadian Arctic. The components and the crane were trashed all over Devon Island, while scientist and enthusiast alike stood aghast at the sight. As a result of that and similar disasters and machinations, what would have been a fairly sophisticated rehearsal facility was scaled down into something more like a playhouse for amateurs for a few weeks every July. In his after-action report that will soon appear in the *The Journal of Aerospace, Transactions of the Society of Automotive Engineering, 2004*, the chief architect of the facility enumerates the many differentials that created difficulties that were evident to the social scientists on the scene. There were a few social scientists in the evolution of the project in advance of the para-drop incident. I recall that the chief architect was as guilty as other participant-observers in pooh-pooing the advice of the social scientists that might have been used to level down cultural and political obstacles.

Despite my participation in this project, several months before the ill-fated para-drop, I became the first sociologist in the active application files for NASA Astronaut Candidate that are kept at Johnson Space Center in Houston, Texas. It was not an easy entree. The issue of getting into those active application files is a stunning example of sociological academe and the space exploration community's mutual exclusion of one another's expertise. On the actual astronaut application there was a statement to the effect that "no sociologists need apply." I overcame this barrier by convincing then Head of Manned Spaceflight, JSC Director George Abbey, that I wasn't just a sociologist, but also an experimental social psychologist and a planetary scientist. Now, I found the "no sociologists" rule incredible. In 47 years of human spaceflight, during all those years that NASA has attempted to do public outreach, they had been shutting out of the astronaut selection process the very people who study society and social forces. However, on the other side of the barricade, I found out while applying for academic sociology teaching jobs in "space states" a woeful lack of sociologists and serious sociology studies dealing with space in the university departments of those states. I think one of the more salient examples of that is at the University of Houston Clear Lake that is just across the road from Johnson Space Center. In

proofing some chapters of a book in which colleagues and I were contributing authors, we were also asked to review a chapter that had begun life as a student group paper in a social sciences Master's program at UH-CL. It was a total pipedream about a kind of hippy commune on Mars only a few years hence that included travel to other star systems. The authors seemed to have no sense about the kind of technological evolutionary timeline that would even begin to enable their scenario. Their sociological input was similarly juvenile. An investigation into the origins of the paper showed that a group of five senior Master's students had received an "A" for this work that was supposed to be a serious exercise!

But, I shouldn't be so hard on the students. The initial feedback that Jim Pass received in introducing the Astrosociology Section within the ASA was even more discouraging. Some sociologists thought he meant to study the sociological aspects of people's belief in astrology, UFOs, crop circles, and alien abductions.

## **Projects, 2000 - Present**

I stay incredibly busy at the sociology-aerospace interface despite the fact that my university does not pay me to do research at that boundary- Mainly, I do a lot of free work for NASA<sup>2</sup> taking sociology public in their venues. For example, I assembled a research team of social scientists to propose an organizational behavior analysis study of the International Space Station Program Office in Houston. The same team that helped me make a study of the joint NASA-*Mir* missions and I are currently looking for several million dollars from NASA to make more quantitative our study of human factors in regard to space station safety. We are looking for a metric that will allow us to detect emerging safety problems and offset them before they become a problem. Another research team that I assembled has proposed to study Mission Control at JPL and the dysfunctions created by the phasing of the Mars Exploration Rover crew shifts created by the two disparate temporal regimes between Earth and Mars. In the recent past, a research partner and I gave NASA a plan outlining how to expand the space shuttle and space station engineering standards to allow for something more than the human-technology interface of the human factors. In this, we were expanding on the ideas of the now-retired Cleve Booher.

## **The Future**

Public and private space exploration holds some potential for doing public sociology. But, it will be slow to arrive. There will be a lot of "wheel re-invention" as the human factors field scrambles to re-learn the lessons of sociology and other social sciences contributions. Some have said that it will probably take death and destruction to bring those lessons home. However, let me note, that we have already lost two space shuttles, so my question is, to parody the great Bob Dylan, "How many deaths will it take till NASA knows that too many people have died?" The demise of those

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<sup>2</sup> NASA "bootleg" projects such as continuation work on past NASA and NASA contractor studies, surface operations for crews of different sizes and skill sets in the "Return-to-the-Moon" scenario, timing issues between Mission Control and long-duration space crews, etc.

two space shuttles can be traced to more than just cold O-rings and ice-laden foam strikes. Bringing the social science perspective to bear readily shows the organizational dysfunctional things that blithely led up to the accidents.

Any time we expand the human ecology, the experience is a hard one for us. More people are bound to die, even with sociologists and others looking out for them. That is the nature of humans exploring frontiers. However, bringing sociology together with the aerospace enterprise will minimize the risk that humans face in their encounter with the Cosmos.

**This is a work still in progress. Bibliographic material is available upon request and commentary is welcome.**

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