The Case for Space

GEORGE F. SOWERS JR.

I'd like to thank the AIAA southeast student chapter for inviting me to speak this evening. So after receiving this invitation, I got to thinking about what to say to students. What do I want to convey to the next generation of aerospace engineers? I imagine most of you are space geeks like I am. That's the reason you're in this field. So I know you have the emotional underpinnings for your allegiances to space. What I'd like to do this evening is provide you with reasons for humankind to pursue space exploration and colonization. I want to appeal to your reason. I aim to convince you that expansion into space ought to be one of the salient goals of humanity. And your contributions toward achieving those goals can provide you with purpose and meaning throughout your careers and lives.

It is my firm conviction that the twin objectives of space exploration and colonization should be central to any human agenda. In my talk tonight, I will justify my conviction through three main arguments, each standing somewhat alone, but ultimately reinforcing each other into a coherent whole. First is the argument from psychology. Second is the argument from resources and third is the argument from risk. Together these three arguments make a compelling case: **the case for space**.

1. The Argument from Psychology

I begin with the argument from psychology

Humans have several deep-seated psychological drives that can best be satisfied (at least in today's world) by the colonization and exploration of space. I will distinguish two of these drives which we can call the spirit of colonization and the spirit of adventure. The spirit of colonization—the pioneer spirit—is the drive to seek a better life for oneself, one's family and one's descendents. It's the drive which produced the original dispersal of humans around the globe, and later the Western settlement of the Americas and Australia. The spirit of adventure, on the other hand, is the urge to test

oneself against the harshest conditions imaginable. It is the drive to see new and different things: "to boldly go where no man has gone before." It is the spirit of Marco Polo, Magellan, Lewis and Clark, Amundsen, Hillary and Armstrong. Together, these two elements of our psychology embody what many regard as that which is most noble, most to be admired about the human spirit—that which is most human.

The roots of these psychological drives can be traced back into the evolutionary past that shaped our brains and minds. Humans evolved on the dry savannas of Africa as a wandering, nomadic species. The variability of resources in this environment drove our ancestors to continuously move in search of food. Since the emergence of the modern human species, at least 90% of our history has been spent in small bands of hunter gatherers. Hunter-gatherer societies must roam to survive. It has only been in the last 10,000 years or so that some of our ancestors settled down to become sedentary agriculturists.

Besides the search for food, there were other motivations for the wanderlust affecting our species. For example, young adults often left their own bands to join others in search of mates. Living space was also a motivation. Certainly, multiple bands of hunter gatherers competing for the same limited resources leads to inter-band conflict. There is ample evidence of those conflicts in the archeological record, and the territorial aspects of human nature are widely acknowledged. There was a selective advantage to avoiding conflict by moving on in search of new territories, new horizons, new opportunities for oneself and one's offspring. The end result was the expansion of modern humanity from its birthplace in Africa over 100,000 years ago first to the Middle East, and later into Southeast Asia, reaching Australia about 60,000 years ago. Humans moved into the colder reaches of East Asia and Europe about 40,000 years ago and finally into North America around 15,000 years ago. Testimony to the magnitude of this expansionist tendency lies in the fact that it took a mere 1000 years for humans to expand to the tip of South America once they reached North America across the Bering land bridge.

The history of human exploration and expansion is tantamount to human history itself. The waves of prehistoric emigration eventually enveloped virtually all terrestrial land mass (with the exception of Antarctica). Human exploration and expansion

continued into the historical era with the great voyages of discovery so familiar to every schoolchild. The historian Daniel Boorstein has chronicled this period in his masterful work "The Discoverers." He captures the spirit and importance of this era and the spirit of discovery in this passage:

> My hero is Man the Discoverer. The world we now view from the literate West—the vistas of time, the land and the seas, the heavenly bodies and our own bodies, the plants and animals, history and societies past and present—had to be opened for us by countless Columbuses. In the deep recesses of the past, they remain anonymous. As we come closer to the present they emerge into the light of history, a cast of characters as varied as human nature.

So what motivates the discoverers? Clearly it is more than fame and greed. Balboa lost two thirds of his men in the brutal traverse of Panama, a route still not spanned by any road. His reward was to gaze across the Pacific Ocean—the gateway to half the world. Magellan was savagely murdered for his trouble and his hubris in attempting to circle the globe, that after suffering the fury of the seas and the scourge of malnutrition. Merewether Lewis, depressed and bored by life after his three year adventure in the American West, descended into alcoholism and eventual suicide. To such men, infected as they were, the spirit of adventure was life itself.

George Mallory captured the spirit of adventure with his famous response to the mundane and obvious question: Why? Why climb mountains? Why endure cold and wind and altitude and exhaustion? "Because it's there" was his laconic reply. His ambition and his spirit of adventure, with an assist from Mount Everest, eventually killed him. The motive comes from within, an urge, a drive, a compulsion to expand ones boundaries. My own youth was filled with adolescent versions of Mallory's quest: long backpacking trips and an obsession with rock climbing. As the piquancy of a particular adventure wore off, I escalated the experience: free solo climbing in the lonely canyons of my Colorado home. The intensity of that experience, poised hundreds of feet above the ground on vertical rock, with only feet and fingers to rely on, was a drug, an addiction. The rise of extreme sports and the new adventure travel genre represent a popularization of this spirit. Even the crass "Survivor" television series allows the masses to sate their appetites for adventure vicariously through the contestants.

The existence of the American frontier has often been credited with stimulating the innovation and energy which fueled the incredible expansion of the American economy. In the words of the turn of the century American historian Frederick Jackson Turner (quoted by Bob Zubrin):

> To the frontier the American intellect owes its striking characteristics. That coarseness of strength combined with acuteness and inquisitiveness; that practical, inventive turn of the mind, quick to find expedients; that masterful grasp of material things, lacking in the artistic but powerful to effect great ends; that restless, nervous energy; that dominant individualism, working for good and evil, and withal that buoyancy and exuberance that comes from freedom—these are the traits of the frontier.

Frontiers demand innovation. They are a crucible for invention and new ideas, survival pressure forcing better solutions to novel problems.

Today, our world is rapidly changing; it is getting smaller, more homogeneous; we are loosing our diversity. Today there are perhaps 5000 active languages around the world. One hundred years ago there were perhaps twice that many. One hundred years hence there may be half as many or less. Bowing under the pressures of technology and globalization, unique cultural identities are becoming lost. One can walk down the street in Beijing or Tokyo or Zurich or New York or Denver or Tuscaloosa and see a McDonald's restaurant. You can walk down those same streets and find a Chinese restaurant as well. There are no places you can go in the world today untouched by modern culture, and precious few places where local indigenous culture remains even grossly intact. Yet, it's diversity that adds much to the richness in life: the appeal of travel, the fascination we have with different cultures and ways of life.

Where does all of this lead us? First, humans have deep psychological needs that I have labeled the spirit of colonization and the spirit of adventure. These needs are increasingly unable to be satisfied within the modern world. The opportunities for adventure have been reduced to those we can manufacture artificially and the opportunities for colonization, to experience the intellectual fecundity of the frontier, have become non-existent. Clearly, the only means to restore these experiences to the human condition is to pursue space, not just robotically, but at a personal level, as explorers and colonists. The alternative is to grow ever more inward, satisfying our psychological needs through manufactured experiences, drugs, or virtual reality

simulations or other high tech means not yet conceived. But that, I fear, is the path to degeneracy and ultimately to extinction.

2. The Argument from Resources

My second argument is the argument from resources.

Humankind is a prodigious consumer of resources. From energy to minerals, from food to living space, the great bounty of our home planet is being depleted at ever increasing rates. Yet, this trend represents more than mere wastefulness. The history of humanity is one of ever increasing physical power. That we seek ever increasing power is one of the fundamental features of our species, and one of the keys to our success. Unfortunately, increasing power generally leads to increasing demands for resources.

The trends toward ever increasing resource utilization are easy to recognize. For example, per capita energy consumption in America has increased many-fold in the last 100 years, though it has been flat for the last 30. The standard of living enjoyed by a country can generally be related to per capita energy consumption and by this measure America has the highest standard of living in the world. Now I take it as given that higher standards of living are more desirable. Humans want better, more abundant life.

But the resources available to the earthbound are finite, though there has been much debate as to the precise value of that finite quantity and when exactly we may expect to run out. The debate with respect to oil reserves gets particularly contentious with the competing forces of the gasoline addicted public and their guzzling SUVs backed by the profit hungry oil companies versus the environmentalist wackos and the less extreme but powerful, politically correct left. (I'll let you guess which side I'm on.) But beyond politics, it is easy to see that all of our energy resources are limited, assuming our future is earthbound. We have enough oil to last perhaps another 50 years; natural gas and coal will stretch somewhat farther. Nuclear energy from fission also depends on a finite resource of fissionable material and creates the problems of waste and safety. Fusion energy has yet to live up to its original promise. Solar energy is bounded by the energy flux incident to the earth. Mineral resources are similarly bounded.

Of course, new technology can always change the equation, allowing for increased standards of living while staying within the bounds of resources available on earth. Fusion may become practical and cheap, fuel cells have near term potential, technology may reduce the demands on energy, and other unforeseen developments may come to pass. Yet it is risky to rely on pulling the technological rabbit out of the hat time after time. Only by breaking our bonds to the earth can we truly remove the resource constraint from the equation of increased living standards. For example, vast arrays of space based solar cells could supply energy either back to Earth or to Mars or some other colony. The asteroid belt contains great mineralogical resources. It is estimated that a typical rocky asteroid contains a trillion dollars in minerals, primarily metals. The list of potentials is limited only by our imaginations.

But I would contend, the resource in most precious supply on Earth, the resource most constraining to our Earth bound quality of life, is living space. People need space, room to stretch, room to create, room to roam—room to be free. It may be that here I am taking a personal preference and generalizing to the human condition as a whole. I have been to Tokyo where indeed it seems that people are content to be squashed together, elbow to elbow. But fundamentally, the need for space is akin to the psychological drives mentioned earlier. In part it was the lure of land that drove the Westward expansion of the American frontier. Settlers wanted space for their farms and ranches and families, and would risk everything to get it.

Land for ownership and space for expression are resources in ever diminishing supply in today's world. In many countries, unless one is born with land, property ownership can only remain a dream. It has become problematic just to find empty space for walking. Even in my home state of Colorado, arguably one of the least crowded places in the world, one can encounter relative hoards of hikers on popular wilderness trails. A few years ago I was able to wander without seeing another person for seven consecutive days in a remote corner of Wyoming, but such experiences are becoming more and more difficult to find. On the other hand, Mars offers a land area equal to that of all the Earth's continents, completely untrammeled, except by a few little rovers. The prospect of an ever shrinking earth jamming humanity closer and closer together is

anathema. We are not herd animals! We are wolves, born to run free across the universe!

3. The Argument from Risk

Third is the argument from Risk.

So how long can humanity survive? There are many different ways one could approach this question, but the tack I take is pragmatic. What can we do to maximize our odds of survival? Furthermore, as humans we desire much more than mere survival. We also wish to grow in our capabilities and enjoy not only continued life but an ever increasing abundance of life. In this light the question becomes one of risk management. How can we best avoid any large-scale events that would either threaten our survival or significantly degrade our quality of life or limit our ability to grow and expand?

Risk management is a fairly standard technique practiced in the management of large scale engineering projects. The logic of risk management is straightforward. A risk is an event that has adverse consequences. It is quantified by two numbers: the probability of the event and the severity of the consequences. The risk management process consists of several basic steps. First is risk identification, followed by risk assessment and finally risk handling. Risk identification involves the recognition of possible future adverse events. Risk assessment is the process of estimating the probability of occurrence and consequences of the identified events. Finally, risk handling is determining and executing a set of actions to reduce the overall risk level, the point of risk management.

So, what kinds of future events should we be worried about? Top of the list are the existential risks, risks that threaten the existence of the species, risks of extinction. Among these are asteroid impact, run-away climate change, nuclear holocaust, badly programmed super-intelligence, and genetically engineered biological agents. We can think of others that don't have existential consequences but can cause grave harm to human objectives. Examples include anti-technology sentiment generated by religious or environmental groups, economic crisis spurred by energy scarcity or regional conflict or simply the chaotic dynamics of economies. So much for risk identification. You can add

your own favorites. Clearly there is no lack of things to worry about, as Hollywood frequently reminds us.

The final phase of risk management is risk handling. Standard risk management identifies four risk handling techniques: avoidance, control, assumption, and transfer. Risk avoidance means eliminating the event as a possibility. For example, we could avoid the risk of a genetically engineered disaster by refusing to pursue genetic engineering. Risk control consists of taking actions to either reduce the probability of occurrence or reduce the severity of consequences or both. It is what we traditionally think of as risk mitigation. Risk assumption occurs when we resign ourselves to the fact that a particular risk exists and there is not much we can do about it. Risk transfer is shifting the consequences of the event to someone else. Buying insurance is an example of this.

The exploration and colonization of space falls into the category of risk control for the risks I just identified. To see this it is only necessary to recognize that the effects of these risks are confined to a particular limited spatial locale, namely Earth. Hence, distributing the species across space reduces the consequences of such an event to only that portion of the population resident in that particular spot. This phenomenon is well known in biology. If you look at the wide diversity of biological species, the ones at greatest risk for extinction are those who are geographically isolated. Most modern extinctions have been species indigenous to one or a handful of islands. Species that are wide spread are far more resilient. The reasons are simple. Just one bit of bad luck can wipe out an island species: the introduction of a new predator, a new more virulent disease, a change of climate, the loss of food sources, etc. But if a species is geographically diverse, one of these kinds of events will lead to only local extinction.

The analogy is straightforward: humanity is on an island called earth. As long as we are confined to this one locale, we are vulnerable to various calamities: nuclear war, bio-terrorism, global warming, asteroid impact, invasion by a super intelligent race, or some nano-tech experiment run amok. Once humanity becomes dispersed among the planets and eventually the stars we become far less exposed to extinction by our own stupidity or just bad luck.

4. Conclusion

To me, these three arguments are related, tied together by an underlying principle. It's my belief that in a very basic sense, space is where we *ought* to go; pursuing space is what we *ought* to do. And I use the term 'ought' in a manner every bit as strong as a moral imperative. I realize this is a fairly extraordinary claim. Unfortunately the complete explanation would be far too long for this talk, which has been long enough already; however, let me give you just a taste as part of my conclusion.

The goal of space exploration and colonization is, I submit, but a facet of a broader goal, a goal that has moved our species since its conception, a goal that can be viewed as a veritable definition of our species. This broader goal is power, not the base, crass power of Hitler or Stalin or Khadafy, of man over fellow man, but the power of Frances Bacon: the power of scientific knowledge and technology and the cooperation of peoples toward worthy aims. In my view, the ultimate goal of humanity—the purpose of humanity—is to extend our power as far as possible, reaching for omnipotence and claiming the universe as our own. In that grandiose scheme the goals of space are but a single step.

One of the great limitations of humanity is that we are constrained to exist in only a tiny speck within the vast extent of the universe. This constraint is analogous to the limitation of our short life spans: we are limited to only a tiny blip within the time span of the universe. Most people would agree to the goal of extending our life-spans but seem divided or ambivalent about extending our presence into space. I am advocating both. In the same vein, we are limited by our puny understanding of the vast universe. Therefore the pursuit of scientific knowledge is also a central aspect of this larger objective.

So I have presented three arguments as to why space exploration and colonization should be part of the human agenda. I believe that in aggregate these arguments are compelling. Hence, all of <u>you</u> should be space advocates. All humans should be space advocates.

For myself, I am swayed by the emotion of space, the feelings of being part of the greatest era in human history, that time when we stepped off our lonely, comfortable home, as children taking our first hesitant steps into the endless ocean. Humanity has

continuously sought to expand its boundaries. Whether to push back the edge of the unknown geographical world, a la Columbus, or to push back the edge of ignorance as in the quest of modern science, this expansion is a central theme in the pursuits of man. Space is the next great chapter in that story. I close with a passage by Buzz Aldrin, one of the first two people to walk on the moon:

> Watching the moonwalks on film, we feel like it all happened yesterday, so titanic were the achievements of Apollo and so timid our subsequent efforts. Yet those images are now [*decades*] old. Robotic probes have returned impressive pictures and invaluable information, but if you send a robot with a camera to Paris and peruse the pictures at home, you haven't really done Paris. [] it is humans who must go into space, to "wander far worlds and meet once more the dread unknowns, the dry-mouthed fears of the old explorers." The people who settled our continent were not afraid of risk; and beyond personal ambition, there was also a desire to be part of something epochal. If we balk before the challenge of space we will become less than the people who lifted us to the present.

I agree with Buzz. I too wish to be part of something epochal. And since you are listening to me tonight, I'm guessing you do as well.