

The Transhumanist Case for Space

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A series of arguments is offered as to why transhumanists should be vigorous supporters of space exploration and colonization. The argument from psychology claims that there are deep aspects of the psychology of humankind that require a continuum of new experiences and frontiers to satisfy. Striving to increase the length of human life without a corresponding increase in the richness of that life—embodied by the diversity of experiences available to be savored—would only lead to boredom and frustration. The argument from resources posits that the continued escalation of quality of life requires an accelerated use of resources—resources that are limited here on earth. The argument from risk claims that the concentration of all of humanity within the confines of a single planet makes us vulnerable to any of a number of potential catastrophic events, from nuclear and biological holocaust to alien invasion or nano-technological disaster. Finally, the argument from transhumanist first principles posits that fundamentally, transhumanists seek to increase the power of humanity through the use of technology. This increased power must be applied not only to lengthen life, but also to broaden its spatial distribution—its scope. In aggregate these arguments are compelling. The resulting alignment of the transhumanist agenda with space objectives is so strong that it would be inconsistent for any transhumanist to be ambivalent on space issues.

1. Introduction

Why should transhumanists be space buffs? What does space exploration and colonization have to do with the transhumanist movement? To some of us the answers to these questions are almost self-evident—we know in our guts that transhumanists ought to be space advocates. Others, perhaps more interested in the personal enhancement aspects of transhumanism (longevity, enhanced mental capability, etc.), need some convincing. For example, Robin Hanson, one of the world’s preeminent transhumanists has commented, in response to John Hickman’s article¹ on the pragmatics of funding large space projects that “The lack of private investment may well be telling us that these projects are in fact not worth the trouble.” He further comments “But if we can gain most of the benefits from economic activity in space without the expense of putting humans in

space, I don't wee why I should want more humans up there." Even some of my fellow editors of this e-zine don't see the connection. Mark Walker has written:

As a sociological observation, it is probably true that most Transhumanists find technology intrinsically appealing and fascinating, but this does not form a part of the theory of Transhumanism. Thus, for example, encouraging space exploration is sometimes mentioned as being part of the Transhumanist project and on occasion even works its way into definitions of Transhumanism. Unless it can be shown that the exploration of space is somehow directly connected with the project of reengineering persons, this seems to me to be a mistake. The insistence that one have a certain protechnology attitude beyond achieving the ideals of Transhumanism would, in my view, be an unnecessary accretion to the theory.²

On the other hand, the transhumanist declaration, as Mark alludes, does acknowledge confinement to planet earth as one of the conditions of humanity likely to be transcended by future technology.³

It is my firm conviction that the twin objectives of space exploration and colonization should be central to any transhumanist agenda, of equal import as such items as personal enhancement items. In this article, I will justify my conviction through four main arguments, each standing somewhat alone, but ultimately reinforcing each other into a coherent whole. The first argument, the argument from psychology, is presented in Section 2. Section 3 gives the argument from resources. The argument from risk is laid out in Section 4 and the argument from transhumanist first principles is given in Section 5. Finally, in Section 6, I will bring all four arguments together into a compelling case: the transhumanist case for space.

2. 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 great human diasporas, the original dispersal of humans around the globe, and later the Western

settlement of the Americas and Australia. The spirit of adventure 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. Most importantly from a transhumanist perspective, these are aspects of humanity we should seek to preserve in the transhumanist transition.

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 such an environment drove our ancestors to continuously move in search of food, whether animal or vegetable. This is in contrast to our cousins the chimpanzees and gorillas whose ecological niche confined them to relatively localized jungle locales. Since the emergence of the modern human species, *Homo sapiens sapiens*, at least 90% of our history has been spent in small bands of hunter gatherers. Hunter-gatherer societies must roam to survive. The !Kung bushmen of the Kalahari desert spend their lives wandering over a region the size of Los Angeles County, rarely camping in the same place. As an adaptation to their wandering lifestyle, the !Kung have developed a highly sophisticated geographically oriented language and spend a tremendous amount of time discussing the details of their spatial world. 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 are other motivations for the wanderlust affecting our species. For example, young adults often leave their own band to join another in search of mates. Living space is 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 must have been 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 of this internal pressure 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, New Guinea and 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 pressure 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.⁴

The history of human exploration and expansion is tantamount to human history itself. The great human diasporas, 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. Discoveries become episodes of biography, unpredictable as the new worlds the discoverers opened for us.⁵

What motivates the discoverers? Clearly it is more than fame and greed. Vasco Nunez de 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, descended into alcoholism and eventual suicide. To such men, infected as they are, the spirit of adventure is 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 is 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, often solo, 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 so-called 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 Zubrin⁶):

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, or traits called out elsewhere because of the existence of the frontier.⁷

Frontiers demand innovation. They are a crucible for invention and new ideas, survival pressure forcing better solutions to novel problems. This pressure applies even to societal norms, old modes of organization, old institutions being found inadequate for the challenge.

Our world is rapidly changing; it is getting smaller, more homogeneous; we are losing 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 Madrid or New York or Toronto or Denver and see a McDonald's restaurant. Not to be outdone, 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 is diversity that adds much of 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? What can we conclude? First, humans have deep psychological needs that I have labeled the spirit of adventure and the spirit of colonization. These needs are increasingly unable to be satisfied within the modern world. Technology has shrunk our world and led to a mixing of peoples and a homogenization of cultures. 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 (or transhuman) condition is to pursue space, not just robotically, but at a personal level, as explorers and colonists. The establishment of space colonies can reinstate the variety of culture, the freshness of ideas necessary for the long term viability of our species. The alternative is to grow ever more inward, satisfying our psychological needs through drugs, or virtual reality simulations or other high tech means not yet conceived. The concept of Larry Niven to plug an electrical stimulant directly into the pleasure center of the brain comes to mind.⁸ That, I fear, is the path to degeneracy and ultimate extinction.

In summary, I ask the transhumanist community: What use is increased duration of life without a corresponding increase in the richness of life? Would not more intelligent transhumans demand such richness?

3. The Argument from Resources

Man 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 as it is utilized, generally leads to increasing demands for resources. After all, in a Newtonian sense, power is simply the rate of energy expenditure.

The trends toward ever increasing resource utilization are easy to recognize, especially in the modern world where such statistics are actually recorded. For example, per capita energy consumption in America has increased many-fold in the last 100 years even though enhancements in energy efficiency have slowed that increase in over the last 20 years or so. 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, and indeed, higher standards of living are consistent with transhumanist objectives. As I have argued above, we desire not just longer life, but better life.

It is a truism that 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;⁹ natural gas and coal will stretch somewhat farther. Nuclear energy from fission also depends on a finite resource of fissionable material and creates the problem of waste. 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 increasing standards of living while staying within the bounds of resources available on earth. That is exactly what has happened over the last several hundred years. Fusion may become practical and cheap, fuel cells have near term potential, nano-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 increasing 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 presumably contains great mineralogical resources. The list of potentials is limited only by our imaginations.

But the resource in most precious supply on Earth, the resource most constraining to our Earth bound quality of life, is living space—*lebensraum*, to use somewhat notorious terminology. 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 race 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 above, the spirit of adventure and the spirit of colonization. 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 also 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 first 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 five 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 the Earth's continents, completely untrammelled, except by a few derelict spacecraft lying about. The prospect of an ever shrinking earth jamming humanity closer and closer together is anathema. We are not herd animals! (Tell that to the folks on the Tokyo subway.) We are wolves, born to run free across the universe!

4. The Argument from Risk

How long can humanity (or transhumanity or post-humanity) survive? Will we really be able to achieve transhuman or posthuman status? These are questions of obvious interest to transhumanists and anyone else with a view toward the future. There are many different ways one could approach this question, but the tack I wish to take is pragmatic.

Instead of speculating as to our collective odds of survival via the Fermi paradox or the Doomsday argument, I will ask the following question. What can we do to maximize our odds of survival, irrespective of what those odds might actually be? Furthermore, as humans or aspiring transhumans, 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 our technology?

Risk management is a fairly standard technique practiced in the management of many (if not most) large scale engineering projects, especially those involving significant amounts of technological development. It came of age in the era of the massive nuclear power plant projects¹⁰ and has become stock and trade in the aerospace and defense industry.¹¹ The logic of risk management is straightforward. A risk is an event that has consequences adverse to the achievement of the project's goals. It is quantified by two numbers: the probability of the event and the severity of the consequences. Typically, the severity of the consequences is measured in dollars of additional cost or weeks of schedule delay or some technical measurement of the performance of the system. The risk management process consists of several basic steps. First is risk identification, followed by risk assessment and analysis and finally risk handling. Risk identification involves the recognition of possible future adverse events—events with consequences detrimental to the projects goal's. Risk assessment and analysis is the process of estimating the probability of occurrence and consequences of the identified events. Since uncertainty is a significant element of risk, a key element of risk analysis is bounding the uncertainties on the estimated probabilities and consequences. Finally, risk handling is determining and executing a set of actions to reduce the overall risk level, the point of risk management.

By now you may be wondering what all this has to do with transhumanism and space. The transhumanism agenda can certainly be seen as embodying a set of goals, among them being extended life and mental capabilities for individual humans/transhumans. Furthermore, it is clear that there are possible future events that would severely curtail, or prohibit our ability to achieve those goals. Those events

constitute risks to the transhumanist movement, and risk management techniques can be applied to mitigate them. My claim here will be that the expansion of humanity into space, colonizing other planets and eventually other solar systems, provides substantial mitigation for the most severe risks facing transhumanists and the human species as a whole.

What kinds of future events should we be worried about? Nick Bostrom has taken a credible stab at developing a list.¹² Although he was ostensibly looking at existential risks—no, not the risk of becoming like Camus, but risks that threaten the existence of the species, risks of extinction—his list is a good starting point for general risks to the transhumanist future. Among the items he mentions are deliberate or accidental misuse of nano-technology, nuclear holocaust, badly programmed superintelligence, genetically engineered biological agents, and asteroid impact. We can think of others that don't have existential consequences but can cause grave harm to transhuman objectives through derailment and delay. For example, anti-technology sentiment generated by religious or environmentalist groups, economic crisis spurred by energy scarcity or regional conflict or simply the chaotic dynamics of economies, global environmental or climatic catastrophe leading to economic crashes—any of these might severely curtail the technological progress necessary for transhumanist aims. Of course, eventually the earth will be consumed by the death of the sun, an event we should have a few billion years to prepare for. So much for risk identification. You can add your own favorites. Clearly there is no lack of things to worry about.

Next comes risk assessment and analysis. In this phase we attempt to estimate the probability of occurrence and severity of consequences for the identified events. For proper risk assessment, the estimates should include not only a point estimate but also confidence intervals, as the range of possibilities is important to the mitigation planning phase. A detailed assessment of these risks is far beyond the scope of this article, but let me make a few general comments. In order to make the probability estimate precise, we need to specify the time horizon, say the next 100 years or the next 1000 years. For example, we could say that the probability of a significant asteroid strike (greater than x tons) to the earth within the next 100 years is $y \pm \delta y$ to 95% confidence. It happens that the probability of an asteroid strike is perhaps the easiest of all to estimate given the

available astronomical data. The other events are devilishly hard to get credible numbers for, so we would resort to a relative likelihood. The severity of consequences is again very difficult to predict but would generally range from complete extinction through collapse of civilization to a relatively mild economic downturn. Here it is helpful to devise some common system of measurement in order to facilitate comparison of different risks. For example, each risk could be quantified in terms of the resulting time delay to achieving some transhumanist milestone. In this case, extinction would be tantamount to an infinite delay, where an economic crash might delay things only a few years.

The third and final phase of risk management is risk handling or risk mitigation. 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 nano-technology disaster by refusing to pursue nano-technology research. I am not advocating that course of action. 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 and is typically used when considering the financial consequences of an event, i.e., who pays for the disaster.

The exploration and colonization of space falls into the category of risk control for the risks we have identified above. To see this it is only necessary to recognize that the effects of these risk events 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 of the modern extinctions have come from 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.¹³

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 or transhumanity becomes dispersed among the stars we become far less exposed to extinction by our own stupidity or just bad luck.

5. The Argument from Transhumanist First Principles

The last argument I offer is perhaps logically prior to the other three. Yet I save it for last because in my mind it is the strongest and subsumes the others. It is 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 that this is a fairly extraordinary claim. Unfortunately the complete explanation would be far too long for this article; however, we can get there in part by examining the basic principles of transhumanism.

The fundamental principle of transhumanism as espoused by the WTA and other transhumanist organizations is to advocate (at least accept) the use of technology to overcome the biological limitations of humanity and to actively pursue the transition of humanity to transhumanity, a technologically augmented version of our species.¹⁴ This goal, I submit, is 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 Hussein of man over fellow man, but the power of 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 become godlike, reaching for omnipotence and claiming the universe as its own. In that grandiose scheme the goals of transhumanists are but a single step. The use of technology to enhance the capabilities of

individuals is certainly consistent with the overarching goal of power, as is the goal of extending the human presence into space.

But if the definition of transhumanism is to advocate the use of technology to overcome the biological limitations of humankind, then how could expansion into space not be included? One of the great limitations of humanity (so far) is that we are constrained to exist in only a tiny speck within the vast spatial 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 temporal extent of the universe. Transhumanists are unanimous about the goal of extending our temporal presence (pursuing longer lifespans) but seem divided or ambivalent about extending our spatial presence. I am advocating both. Why ignore three of the four space-time dimensions? It seems inconsistent. We seek not just immortality, but omniscience and most fundamentally, most all encompassing, omnipotence—the ultimate aim.

Other more restrictive definitions of the transhumanist project have been offered. For example, Mark Walker advocates that the goal of transhumanism should be to seek the perfection of humanity through technological means.¹⁵ However, he doesn't precisely define which qualities constitute perfection or how we could measure it, beyond the assumption that intelligence is one of the components. He has suggested that perhaps we should hold off on space exploration, concentrating our efforts on engineering more intelligent transhumans, and let these smarter, wiser beings decide whether and how to pursue space.

I believe this approach would be misguided. First, I would equate Mark's goal of perfection with my goal of power, the later being definite and quantifiable. In that context, intelligence is but a means to the larger end—intelligence as the path to knowledge; knowledge being a form of power. Second, the technology to enhance intelligence, whether genetically, through AI or via nano-technology, is very difficult, exacting, finicky and still in its infancy. I would place no bets on when that technology will deliver the end results we are looking for. Besides the tremendous technical difficulties, the ethical and political obstacles are daunting. Finally, what would be the point in ignoring other forms of power, specifically that accrued through space exploration and colonization, but generally all other varieties of science and technology,

in order to wait for an unknown time for an uncertain outcome. Science and technology are not singular endeavors, but are built brick by brick on the foundation laid by those who have gone before. Work we do now will benefit those who follow, even if they are much more intelligent than we are.

My conclusion: we should press ahead on all fronts with all due haste.

4. Summary and Conclusions

I have presented four arguments as to why space exploration and colonization should be added to the transhumanist agenda. Each argument could perhaps be countered individually. For example, one might argue that sending robots instead of people into space could solve the resource issue. That is true. NASA's robot planetary exploration program has been quite successful. Yet that ignores the argument from psychology and the argument from risk. Other counter arguments can be similarly refuted. Hence I conclude that in aggregate the arguments for space are compelling. Transhumanists should align their goals with space advocates.¹⁶

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 of our lonely, comfortable home, as children taking our first hesitant steps into the endless ocean. Humanity has continuously sought to expand its boundaries. Whether it be 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, along with the other transhumanist pursuits, is the next great chapter in that story. I will 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 achievement of Apollo and so timid our subsequent efforts. Yet those images are now more than a quarter-century 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. As this book contends, 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.¹⁷

I too wish to be part of something epochal.

George Sowers, April 2002.

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NOTES

¹ [Hickman, 1999].

² The quotation is from [Walker, 2002].

³ See the declaration at the World Transhumanist Association website, <http://www.transhumanism.org/declaration.htm>.

⁴ A wealth of information about this phase of human history is contained in [Cavalli-Sforza, 1995] and [Diamond, 1999].

⁵ From the prologue to [Boorstein, 1983].

⁶ Robert Zubrin is one of today's most virulent space advocates. A former employee of Lockheed Martin Astronautics, my current employer, Zubrin quotes Jackson in his fascinating and passionate book, [Zubrin, 1996].

⁷ [Turner, 1920].

⁸ Larry Niven's known space series has always been one of my favorites. One dangerous vice of his time is to plug in to direct stimulus of the pleasure center of the brain. This experience is so intense that unless the session is controlled by an electronic timer, the subject would eventually die of neglect, unwilling to take care of basic needs such as food and water. [Niven, 1970] is probably the most famous book in this series.

⁹ Forecasts of the remaining oil reserves versus demand are notoriously unreliable. In the 1920's, the projection was for oil to last until 1940. In the 1970's, the experts predicted 1992. For a recent, fairly objective assessment of the oil situation see [Mann, 2002].

¹⁰ A brief history of the risk industry as applied to financial management, as well as a lot of other interesting stuff on the history of probability is in [Bernstein, 1996]. For engineering risk management see [Florman, 1987].

¹¹ For example, the department of defense has a 250 page manual on risk management for defense acquisition projects, [DSMC, 1989]. One of my duties as Chief Systems Engineer for the Atlas V rocket program is to run the risk management process.

¹² [Bostrom, 2002].

¹³ E.O. Wilson's charming book [Wilson, 1999] discusses extinction in general. David Quammen specifically addresses the subject of island biogeography in [Quammen, 1996].

¹⁴ See the transhumanist websites

¹⁵ This is from Mark's comments on the original draft of this article.

¹⁶ There are vast Web based resources for space advocates. See for example the planetary society founded by Carl Sagan at <http://www.planetary.org/> and Bob Zubrin's Mars Society Page at <http://www.marssociety.org/>. NASA maintains a set of excellent web pages and most of its missions have their own dedicated page. For example, for the latest from Mars Global Surveyor (built & operated by Lockheed Martin here in Denver) see <http://mars.jpl.nasa.gov/mgs/>.

¹⁷ This is from Aldrin's forward to a marvelous little book by Wyn Wachhorst [Wachhorst, 2000].