

# SPACE EXPLORATION: IT'S IMPACT ON SOCIETY – A CRITICAL REVIEW

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## ABSTRACT

Humans have always been explorers. Space exploration obliges man to confront a hostile environment of cosmic radiation, microgravity, and magnetic field changes. Although the people who will go to Mars have been born, many new discoveries will be needed and new disciplines will have to be created before they can actually go there. All of this will have a tremendous impact on our health technology. For one thing, universities will work together with enterprises, creating a new way to carry out research. Space exploration has already generated new insight into osteoporosis, muscle atrophy, and motor coordination disorders. Space research has produced a long list of utilities including bone fixation devices and wheelchairs. Over the next 5 to 7 years, in the International Space Station many programs ranging from molecular biology to direct observation of human subjects will be developed. This will mean that, while awaiting the first expedition to Mars (which will take place after 2080), the collaboration of scientists with small and medium enterprises will continue to produce useful devices for people on earth.

**Key Words:** Exploration, Society, Confront, Collaborations

## Introduction

There are few moments in history more iconic than the first moon landing. The pivotal moment when a human being stepped foot on another world marked the end of one phase of human achievement and the beginning of a new one. Moments like these have not only expanded public perception but changed the course of human history.

Humans have always been explorers. The earliest known humans were primarily a hunter-gatherer species based on the continent of Africa. Over time they gradually traveled away from the continent, ultimately colonizing every accessible part of the world. Indeed, some biologists have remarked that from an evolutionary standpoint, humans did seemingly illogical things in an attempt to explore. This innate curiosity and drive have given people greater knowledge and changed culture and society in countless ways. People dreamed of reaching the heavens for a long

time but it wasn't until the late 1950's that a serious attempt was made. At first only animals were sent into space, but in 1961 the USSR successfully sent Yuri Gagarin into space aboard the Sputnik 1. He became the first human ever to orbit the Earth.

Yuri Gagarin's flight changed everything. It began an era of space exploration that would inspire generations of people worldwide. The **space race** refers to the 'race' between the USA and USSR for supremacy in human spaceflight. This competition made it partly a matter of national pride and spurred the USA to spend substantial amounts of money to achieve the goal of putting a man on Earth's moon. Just eight years later, millions watched as Neil Armstrong's famous first step was broadcast on television. However, this impact spread far beyond the national pride of the USA. It inspired thousands to study aeronautics, engineering, and physics.

While space exploration can cause people to reach for the stars, it can also inspire people to focus more on home. Many have commented that following the space race, humans finally had pictures of the earth as seen from the moon, and this helped emphasize how small and potentially fragile our home is. It's no accident that the environmental movement became far more significant around the same time. Rather than looking towards exploration, some took the opportunity to focus instead on protecting what we have through natural conservation efforts.

## Literature Review

The space race also led to significant technological advances. NASA, the National Aeronautics and Space Administration of the USA, developed all kinds of new technologies in order to put humans in space. Many of these technologies entered the public marketplace, which vastly altered society and culture worldwide. Advances in personal computers, space age fabrics, solar panels, freeze-dried food, memory foam, fire-fighting gear and LED lights have significantly changed the daily life of millions of people around the world. Today we rely on many of the technological advances that came as part of space exploration.

NASA's founding document, the National Aeronautics and Space Act of 1958, specifically charged the new agency with eight objectives, including "the establishment of long-range studies of the potential benefits to be gained from, the opportunities for, and the problems involved in the utilization of aeronautical and space activities for peaceful and scientific purposes. Although the Space Act has been often amended, this provision has never changed and still remains one of the main objectives of NASA. Despite a few early studies, the mandate to study societal impact has largely gone unfulfilled as NASA concentrated on the many opportunities and technical problems of space flight itself. As NASA celebrates its fiftieth anniversary, it is time to take up the challenge once again. Multi decade programs to explore the planets, build and operate large space telescopes and space stations, or take humans to the moon and Mars require that the public have a vested interest. But whether or not the ambitious space visions of the United States and other countries are fulfilled, the question of societal impact over the past fifty years remains urgent, and may in fact help fulfill current visions, or at least raise the level of debate.

It seems obvious that certain turning points in the history of space flight must have had an impact: Sputnik, the moon landing, the Space Shuttle disasters, and so on are etched in memory for better or worse. But unpacking the nature and extent of that impact is no simple task. Secondly, a commercial and economic component to space flight is undeniable. It ranges from a far-reaching aerospace industry to the famous (and sometimes literally legendary) "spinoffs;" it is a part of national and international political economy; and it has sometimes measurable, but often elusive, effects on daily life and commerce. Economic impact is closely related to a third area: applications satellites, which are in turn often inseparable from environmental issues and national security. Imaging Earth from space and global space surveillance have played an arguably central role in the increasingly heated debate over global climate change and have changed the manner in which national security issues are understood and interpreted. Just how central is a matter that only historical analysis can reveal. In a fourth domain, that of social impact, space activities have affected science, math, and engineering education; embodied questions of status, civil rights, and gender, among other social issues; and led to the creation of "space states" such as California, Florida, and Texas. Finally, space flight has affected culture in multiple ways, ranging from worldviews altered or completely transformed by the images of Earth from space and the spectacular views of space from Earth-orbiting spacecraft, to a sense of our place in the universe made possible by studies of cosmic evolution and the search for

extraterrestrial life, and the embodiment of these and other themes in literature and the arts.

These overarching themes raise further questions. What is the difference between social impact and cultural impact? What is the interplay between space flight and those enduring American values of pioneering, progress, enterprise, and rugged individualism? How does this interplay differ from experiences in the Soviet/Russian, European, or Indian milieu? How has space flight affected conceptions of self and others, as well as our understanding of our purpose in the universe? Despite the importance of the subject, very few systematic studies of the societal impact of space exploration have been undertaken over the past fifty years. One exception that stands out from four decades ago is *The Railroad and the Space Program: An Exploration of Historical Analogy*. Funded by NASA through the American Academy of Arts and Sciences, *The Railroad and the Space Program* focused on the uses of historical analogy to illuminate the problem of societal impact. Confident in the use of historical analogy as suggestive, but not predictive, of the future, the authors of the volume elaborated on two technological events whose beginnings were separated in time by 150 years. The railroad was, they said, an engine of social revolution that had its greatest impact a full fifty years after the start of the railways in America. As a transportation system, the railway had to be competitive with canals and turnpikes, and twenty years after the start of railways in America, more miles of canals were being built than railroads. It was not initially clear that railroads could be economically feasible. In the course of the nineteenth century, they represented human conquest of natural obstacles, with consequences for humans' view of nature and our place in it. Moreover, secondary consequences often turned out to have greater societal impact than the supposed primary purposes for which they were built. And though many technological, economic, and managerial hurdles needed to be overcome, railroads are still with us.

The space program has had, and still has, its technological challenges, and the economic benefits may be even longer term than the railroad. But by conquering the dimension of space as aviation did to a small extent in the thin skin of Earth's atmosphere, and as the railroad did on the surface, in the long run the space program's impact may exceed that of the railroad. Although originally suspicious of parallels with the past, present, and future, the authors in the end saw "the possibility of moving up onto a level of abstraction where the terrain of the past is suggestive of the topography of the present and its future projection." They cautioned that in taking such an approach as much empirical detail should be used as possible, and that analogies drawn from vague generalities should be

avoided. Four decades later, *The Railroad and the Space Program* still makes for relevant reading.

In addition to that early study, there have been other, sporadic forays. On the occasion of the sixtieth anniversary of the British Interplanetary Society, NASA was heavily involved in a special issue of its journal devoted to "the impact of space on culture." There NASA scientists Charles Elachi (now director of the Jet Propulsion Laboratory) and W. I. McLaughlin, as well as historian Sylvia Kraemer, among others, discussed the impact of space endeavors on space science, politics, the fine arts, and education. In 1994 the Mission from Planet Earth program in the Office of Space Science at NASA sponsored a symposium entitled, "What is the value of space exploration?" A variety of speakers ranging from Carl Sagan to Stephen Jay Gould discussed the scientific, economic, cultural, and educational impact of space exploration.

More recently, in 2005 the International Academy of Astronautics (IAA), which has a commission devoted to space and society, sponsored the first international conference on space and society in Budapest, Hungary. The IAA and the European Space Agency jointly sponsored a study published as *The Impact of Space Activities upon Society*, in which well-known players on the world scene briefly discussed their ideas of societal impact, ranging from the practical to the inspirational.

The authors of more general studies of space flight have on occasion tackled the subject of societal impact. In her book *Rocket Dreams: How the Space Age Shaped Our Vision of a World Beyond*, Marina Benjamin argues that space exploration has shaped our worldviews in more ways than one. "The impact of seeing the Earth from space focused our energies on the home planet in unprecedented ways, dramatically affecting our relationship to the natural world and our appreciation of the greater community of mankind, and prompting a revolution in our understanding of the earth as a living system," she wrote. Benjamin thinks it no coincidence that the first Earth Day on April 20, 1970, occurred in the midst of the Apollo program; that one of the astronauts developed a new school of spiritualism while others have also been profoundly affected spiritually; or that people "should be drawn to an innovative model for the domestic economy sprung free from the American space program by NASA Administrator James Webb." Space exploration shapes worldviews and changes cultures in unexpected ways; by corollary so does lack of exploration.<sup>7</sup>

Others have demonstrated the complex relation of space goals to social, racial, and political themes. One such study is De Witt Kilgore's *Astrofuturism: Science, Race,*

*and Visions of Utopia in Space*, where the author examines the work of Wernher von Braun, Willy Ley, Robert Heinlein, Arthur C. Clarke, Gentry Lee, Gerard O'Neill, and Ben Bova, among others, in what he calls the tradition of American astrofuturism.

## Impact of Space on Society:

There is no denying the fact that space activities have a positive and beneficial impact on everyday life and society and thus help people to understand that, despite the high costs of space activities, there is a tremendous return to the community in terms of scientific knowledge and technological knowhow, jobs and space spin-offs. Space activities, implemented through visionaries and pioneers, have helped create the concept of one World also termed as global village.

With the development of new sensors in the 21st century, the impact of space activities on the welfare of humanity will only increase. One of the most significant events of the 20th century was the landing of human on the surface of the Moon. It is expected that the expansion and insight of human into the cosmos will produce some of the more significant events in the 21st century. The period between 1957 and 1991 saw the dawn of the space age with flights to the planets, footprints on the Moon, the telecommunications revolution, satellite weather forecasting, mapping, mineral exploration, water resource management, disaster mitigation, national security or hundreds of the applications. In addition, the enormous knowledge already delivered through space exploration and the benefits and spin-offs of space technologies have been integrated so deeply in our modern society that life without these would now be quite difficult. Weather, Telecommunications, Environmental analyses and National Security are only the most obvious space technologies that humanity relies on, though spinoffs and transfers from space to non-space sectors provide many additional indirect benefits.

The last few decades, however, have brought about a new era of space exploration and international cooperation by developing sophisticated space technologies by nations. Some of the glaring examples are the images of distant stars and galaxies using Hubble telescope; research laboratory such as International Space Station to conduct experiments in biology, human biology, physics, Astronomy and meteorology under microgravity environment and testing of the spacecraft systems that will be required for missions to the Moon and Mars; High-resolution Satellites for continuous observations of our own planet earth. In a couple of decades, we would be able to have unlimited and clean solar energy from space for our industries as well as heating and lighting our

homes. In the near future, it would be possible to dispose-off our nuclear waste safely and inexpensively and release towards the Sun using a Space Elevator. We may become a tourist in Earth orbit or on the Moon. We may carry out extra-terrestrial mining and even introduce the development of a multi-planet economy. Education is also an integral part of space activities. Education or dissemination of knowledge from one generation to the next has been the driving force behind the progress of humankind. The duty of any generation is to educate the following one. Space is not only a fantastic tool for inspiring and educating youth, but also because of many disciplines involved and the expertise that space developments require. Furthermore, the introduction of 'space incubators' will afford young entrepreneurs the opportunities to take space technologies and create new products and services for the non-space sector – thus adding even more value to the investments in space.

Space activities stimulate the development of new technologies – as an innovation factor, as a competitiveness factor, and as a key to the consolidation of industrial capabilities, without which there are no space activities. As a result of such activities, both governments and the general public are today increasingly realizing the enormous potential of space technologies and just how it is being integrated into everyday life.

Although space programmes are expensive and the public might query that what space has contributed significantly to humankind against huge investments on space activities, because its impact upon society has largely been measured in numerical terms. For example, how many spacecraft have been launched by a given country? How many phone calls are made over a satellite? How many lives could be saved by search and rescue satellites? How much money was spent on space activities by a nation? Since space endeavors are, for the most part, funded through taxes from the general public, it becomes inevitable that the value and benefits of such space activities must be justified.

The response is very positive, because space has contributed significantly to humankind that have helped and improved society by providing communication and education services in remote areas, bringing information and entertainment to the masses, creating new materials for stronger and more durable structures, providing meteorological data so ships can be safer at sea, monitoring the threat of pollution, enhancing medical instruments for better health-care, enabling hikers and skiers to be located when lost, and many more. As no negative impact on space activities has been registered so far by the society, the investments made by the nations on space activities are justified and not the waste of money.

Space activities impact society in diverse ways. The path to gaining knowledge through scientific as well as technical discoveries which in their turn benefit society in many ways such as; the camera in space developed to take pictures of far-distant galaxies now used as a medical instrument to detect lymph-node cancer; the instruments on an orbiting spacecraft designed to discover more about the structure of planets can be packaged into a portable device for identifying the minerals in rocks on Earth; the Sun's rays can be harnessed to provide cheap and abundant solar energy to warm and light our houses. These spin-offs technologies would not have been possible without development of space technology. The search for life also drives space exploration. Are we alone in the Universe? Are we unique? We will never rest until we know. For the purposes of such exploration, we then have a need for new or improved technologies. Given that we have this built-in desire to explore, we will eventually develop the technologies to do this when the real need is there and when other enabling technologies and materials become cheap enough or feasible enough to do so. This may take years or centuries to achieve, but as is evidenced by human perceptions and thoughts such space activities will always have an impact on society and humanity.

## The Journey Beyond

As controversies swirl about funding, resources, motives and methods for spaceflight, it is well to consider the consequences of exploring space – and of choosing not to do so. Earlier essays have already analyzed in broad terms some of the potential consequences of not exploring, especially the lack of creativity that an inward-looking society may bring, by analogy with Ming China. Others have pointed out that the Age of Discovery was only a mixed blessing, especially when it came to culture contact.

The consequences of space exploration as already undertaken stand before us for examination. They occur on many levels: commercial applications, education and inspiration to youth, applications satellites, scientific benefits, and philosophical implications. All are open to analysis, and as we approach the fiftieth anniversary of the Age of Space, we should examine, with historical objectivity, precisely what the impact of the Age of Space has been. One feature unlikely to be paralleled with the Age of Discovery, at least in the near future, is contact with other cultures. Shipboard observers often carefully noted exotic plants and animals seen during the course of their voyages, and the ultimate experience was contact with exotic humans.

In the Age of Space, the search for microbial life has been

a main driver of space exploration, in particular with regard to Mars, but also now extended to more exotic environments like the Jovian moon Europa. With that search for life on new worlds, planetary protection protocols have been put in place, both for our own planet and others. Contact with intelligent extraterrestrials beyond the solar system will remain a more remote possibility, and when and if it happens we should learn from the history of culture contacts on Earth. But the immediate impact of the Space Age is far more diverse than the ultimate discovery of life in space. In her new book *Rocket Dreams: How the Space Age Shaped Our Vision of a World Beyond*, Marina Benjamin argues that space exploration has shaped our worldviews in more ways than one. "The impact of seeing the Earth from space focused our energies on the home planet in unprecedented ways, dramatically affecting our relationship to the natural world and our appreciation of the greater community of mankind, and prompting a revolution in our understanding of the Earth as a living system," she wrote. Benjamin thinks it is no coincidence that the first Earth Day on April 20, 1970, occurred in the midst of the Apollo program; or that one of the astronauts developed a new school of spiritualism; or that people "should be drawn to an innovative model for the domestic economy sprung free from the American space program by NASA administrator James Webb." Exploration shapes world views and changes cultures in unexpected ways, and so does lack of exploration.

Space has had more tangible impacts on society. To take only one, imagine where we would be without applications satellites. We now take for granted photographs of weather and Earth resources data from space, as well as navigation and worldwide communications made possible by satellite. Along with human and robotic missions, the late twentieth century will be remembered collectively as the time when humans not only saw the Earth as a fragile planet against the backdrop of space, but also utilized near-Earth space to study the planet's resources, to provide essential information about weather, and to provide means for navigation that was both life-saving and had enormous economic implications. Worldwide satellite communications brought the world closer together, a factor difficult to estimate from a cost-benefit analysis. Names like Landsat, GOES (Geostationary Operational Environmental Satellites), Intelsat and Global Positioning System may not be household words, but they affect humanity in significant ways not always appreciated.

Important as they are, applications satellites pale in significance to what space may represent for the future of humanity. While some argue that robotic spacecraft are cheaper and less risky than human spaceflight, it is my

belief that humans will nevertheless follow robotic reconnaissance as night follows day. Humans will not be content with a Space Odyssey carried out by robotic surrogates, any more than the other great voyages of human history. Robots extend the human senses, but will not replace the human mind in the foreseeable future, even with advances in artificial intelligence. HAL in Arthur C. Clarke's famous novel and movie was not as smart as he thought, and will not be for a long time. As President Bush said in announcing his new initiative in January 2004, humans will spread through the solar system, fulfilling the vision of what British philosopher Olaf Stapledon 55 years ago called "interplanetary man."

## Conclusion:

Eventually humans will spread into the cosmos at large. One cannot set a timeline, but by 3001 "interstellar humanity" will likely follow. We do not know what surprises and challenges we will find. But they will be there and humans will revel in them. That is the nature of humans with their inbuilt curiosity and penchant for exploration, one might say the very definition of what it is to be human. Historians and social scientists have analyzed this kind of argument, and not all agree that the utopian ideal of spreading humanity to outer space is a valid reason for going, or that utopia is what we will build when we get there. In a democratic society such arguments must be fully voiced. Others have demonstrated the complex relation of such space goals to social, racial and political themes. One such study is De Witt Kilgore's recent book *Astrofuturism: Science, Race and Visions of Utopia in Space*. In this book Kilgore examines the work of Wernher von Braun, Willy Ley, Robert Heinlein, Arthur C. Clarke, Gentry Lee, Gerard O'Neill and Ben Bova, among others in what he calls the tradition of American astrofuturism. Such studies remind us that, like it or not, the idea of space exploration has been woven into the fabric of society over the last 50 years, even as exploration has raised our cosmic consciousness. The historical analysis of that transformation, in ways large and small, should help us make informed choices about our future in space.

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