

2010

## The Age of Aquarius: The Reorientation of NASA after 1969

Junichi Miyamoto

*University of Nevada, Las Vegas*, [miyamotj@unlv.nevada.edu](mailto:miyamotj@unlv.nevada.edu)

Follow this and additional works at: <https://digitalscholarship.unlv.edu/award>



Part of the [History of Science, Technology, and Medicine Commons](#), and the [Other History Commons](#)

---

### Repository Citation

Miyamoto, J. (2010). The Age of Aquarius: The Reorientation of NASA after 1969.

Available at: <https://digitalscholarship.unlv.edu/award/4>

This Research Paper is protected by copyright and/or related rights. It has been brought to you by Digital Scholarship@UNLV with permission from the rights-holder(s). You are free to use this Research Paper in any way that is permitted by the copyright and related rights legislation that applies to your use. For other uses you need to obtain permission from the rights-holder(s) directly, unless additional rights are indicated by a Creative Commons license in the record and/or on the work itself.

This Research Paper has been accepted for inclusion in Calvert Undergraduate Research Awards by an authorized administrator of Digital Scholarship@UNLV. For more information, please contact [digitalscholarship@unlv.edu](mailto:digitalscholarship@unlv.edu).

# **The Age of Aquarius**

The Reorientation of NASA after 1969

By Junichi Miyamoto

## *I. Introduction*

On July 29, 1969, lobbyists for the National Aeronautics & Space Administration (NASA) eagerly approached Congress regarding their budget ambitions for the following year, hoping to capitalize upon their most recent accomplishment. Nine days before, humankind took its very first step upon the surface of another world. The thrilling voyage of *Apollo 11* was hailed by the *New York Times* as not just a historical triumph but as a “step in evolution.”<sup>1</sup> The elation of the public was shared by those in the government as well who were thrilled by the fulfillment of the seemingly impossible goal laid out by President John F. Kennedy eight years prior. When the crew returned on July 24, President Richard M. Nixon hailed them calling the past days “the greatest week in the history of the world since Creation.”<sup>2</sup>

So understandably, the NASA representatives on the 29<sup>th</sup> were dumbfounded by Capitol Hill’s earthbound reception. With the task complete, many wondered why NASA was asking for another \$225 million for more Apollo missions when the nation was imperiled in a massive fiscal commitment to a souring war in Vietnam. In the days before, Vice President Agnew was quick to set a new goal for American space science declaring that Americans would walk on Mars before the end of the century. Surprisingly, one of NASA’s chief congressional allies, New Mexico Senator Clinton P. Anderson, soberly retorted saying that from now on, NASA should take a “go-slow” approach.<sup>3</sup>

And go-slow they did. In the subsequent years, the government’s enthusiastic support for the institution came to a screeching halt. In 1970 and 1971, NASA was buffeted by a series of

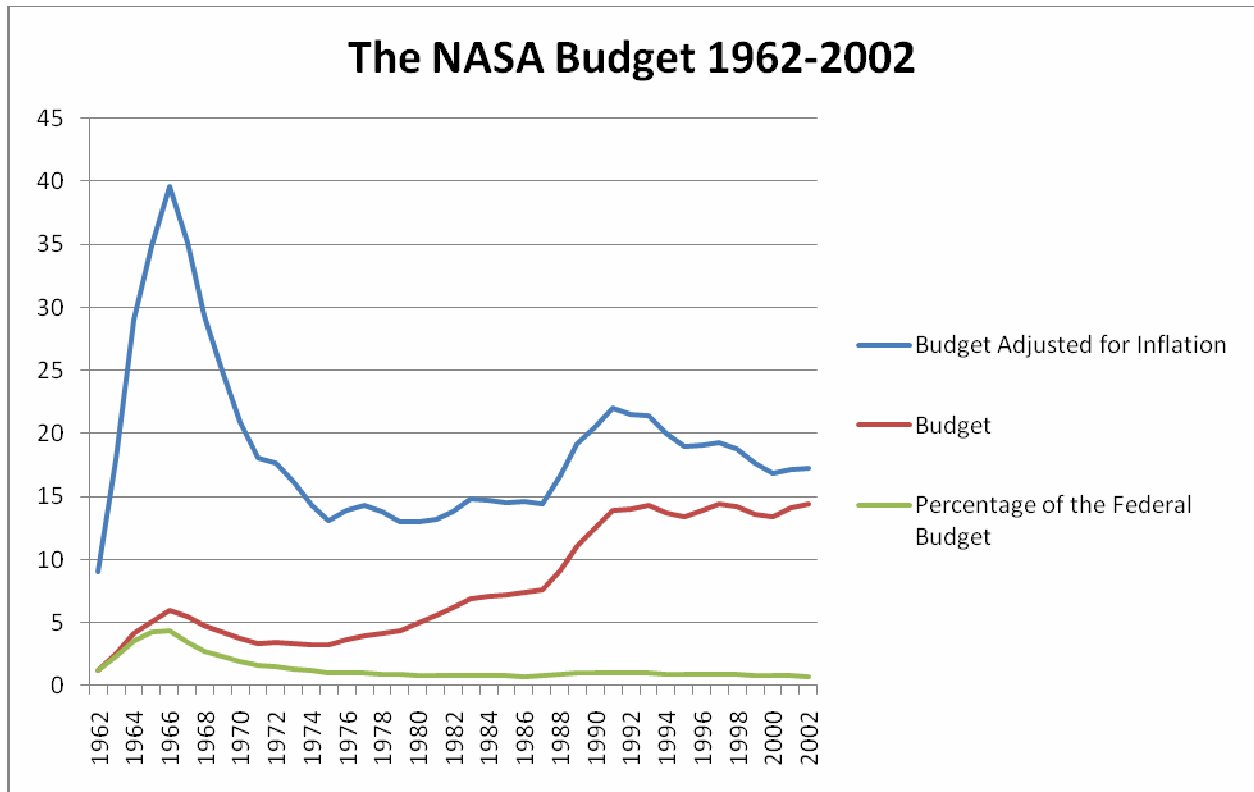
---

<sup>1</sup> “Evolution Into Space,” *New York Times*, July 20, 1969, New York edition.

<sup>2</sup> “Transcript of Nixon’s Talk on Carrier,” *New York Times*, July 25, 1969, New York edition.

<sup>3</sup> John W. Finney, “Apollo’s Success May Bring Fund Cut,” *New York Times*, July 30, 1969, New York edition.

gargantuan slashes to its budget.<sup>45</sup> The 12.5% cut in 1970 led to the cancellation of what would have been *Apollo 18, 19, and 20*.<sup>6</sup> By 1970, NASA's continued survival seemed uncertain.



Still, NASA did go on. And, in spite of these setbacks from congressional budget cuts, the NASA budget (Table 1) steadily increased since the harrowing budgetary troubles of the early 1970s. From this, it can be seen that somehow, NASA managed to stem the tide and by 1985, apparently reverse it. Unlike other aspects of the space program, this phenomenon has

<sup>4</sup> Richard D. Lyon, "12.5% Slash in NASA Funding Will Force Sharp Program Cut," *New York Times*, February 3, 1970, New York edition.

<sup>5</sup> John Noble Wilford, "Pressure Is Reported on NASA To Make Heavy Cuts in Budget," *New York Times*, November 19, 1971, New York edition. By now, even the *Apollo 16* mission seemed to be in jeopardy.

<sup>6</sup> William K. Stevens, "Scott Urges Restoring Canceled Apollo Flights," *New York Times*, August 13, 1971, New York edition. Even though NASA urged former moon mission commanders to rile up popular support against these decisions against Apollo, it was to no avail demonstrating the distance of the moon landings from the public mind.

<sup>7</sup> Table 1: Source of numbers from the Office of Management and Budget (OMB).

Percentage: <http://www.whitehouse.gov/omb/budget/fy2010/assets/hist04z2.xls>.

Budget: <http://www.whitehouse.gov/omb/budget/fy2010/assets/hist04z1.xls>.

Inflation calculated with the Bureau of Labor Statistics index for 2009:

[http://www.bls.gov/data/inflation\\_calculator.htm](http://www.bls.gov/data/inflation_calculator.htm).

gone largely uninvestigated by historians. This paper will attempt to address this issue directly by looking at NASA as an institution trying to navigate an unaccommodating sea of capricious politicians and an apathetic public. But before an attempt to illustrate how NASA came to thrive, it is necessary to discuss the body of literature that might intersect with the focus of this paper.

The body of historical literature that explores NASA in the years following *Apollo* is thin as it treads upon the gray area that blurs history and current events. The works that do exist almost focus exclusively on the characteristics and features of projects and events. For example, Sylvia D. Fries has written stirring accounts of Space Shuttle *Challenger* and its impact on American culture<sup>8</sup> and how subsystems in the International Space Station were designed around Congressional feuds.<sup>9</sup> Both tap into the cultural and political milieu surrounding NASA but the carefully engineered specificity of these studies limits their applicability to the broader interests of this paper. Because these articles are purposefully limited in scope, it will be productive to take a different path.

Others have made convincing cases concerning NASA and its role in the backdrop of United States-Soviet relations. Works such as Rita G. Koman's examination of the American space program as a headlong gambit to defeat the Soviet Union in the arena of space after the *Sputnik* humiliation<sup>10</sup> get closer to the heart of this paper in scope but the conclusions reached by these scholars are only tangentially applicable to NASA after 1969. While it is important to the complete history, it is also impossible to fully designate NASA's institutional spirit through the lens of anti-communism because its primary role under this framework ended two decades before the close of the Cold War.

---

<sup>8</sup> Sylvia D. Fries, "Dealing with Crisis: History and the Challenger Disaster," *The Public Historian* 10-4 (1988): 83-88.

<sup>9</sup> Sylvia D. Fries, "2001 to 1994: Political Environment and the Design of NASA's Space Station System," *Technology and Culture* 29-3 (1988): 568-593

<sup>10</sup> Rita G. Koman, "Man on the Moon: The U.S. Space Program as a Cold War Maneuver," *OAH Magazine of History* 8-2 (1994): 42-50.

There are also a small amount of works that look at NASA with wide analytical breadth. Scholars such as Herbert Friedman articulate a prevalent stance that views the moon landings as the apex of the institution and that it has been on an indisputable trend of decline that accounts for its modern day perils; today, NASA is “adrift in space,” a wandering, cumbersome relic well past its prime that is best at reveling in the wispy memory of the bygone glory days.<sup>11</sup> The conclusions, however, deserve careful reexamination and reconsideration. First, one must consider the evidence. The majority of the work relies on dire statements and warnings from dissatisfied NASA bureaucrats but it is important to keep in mind that their job is to present convincing cases to secure funding for their institution’s projects – it might be more problematic if no one was complaining. Moreover, it is difficult to make this position compatible with the clear budgetary successes of NASA in the last twenty years or so.

Although there is no direct literature that tackles the discrepancy between budget and attitudes, there are appurtenant works that one can look at to create a model that offers an explanation. A feature of science during the Cold War was the tension between science’s inherent tendency to move towards broad-based international collaboration and the polarization between communist nations and western democracies. Simone Turchetti et al explore a sphere of this in a study on the role of internationalism in evolving the region of Antarctica from being contended as grounds for nuclear submarines into its present day research orientation.<sup>12</sup> The argument is that diplomats used internationalism as a tool to defuse the potentially hostile military situation by preemptively declaring and establishing research aimed footholds on the continent. Although the article focuses on the geopolitical implications, one can infer that there were significant consequences for the sciences as a result of the political activity. Institutions and

---

<sup>11</sup> Herbert Friedman, “Adrift in Space,” *Proceedings of the American Philosophical Society* 140-1 (1996): 10-21.

<sup>12</sup> Simone Turchetti et al. “On Thick Ice: Scientific Internationalism and Antarctic Affairs, 1957-1980,” *History and Technology* 24-4 (2008): 351-376.

expeditions were funded and established that otherwise would have been shelved or marginalized. New outgrowths of science thrived in this international and collaborative environment, a strong counterpoint to the intense partisanship that allowed NASA to thrive in the same decade. This paper will argue that NASA sought relief after the end of the moon landings by crafting a platform out of the spirit of transnational cooperation.

Budget is, of course, only a part of the story; it is the readily apparent end result of a concerted and unified theme that NASA administrators have repeatedly and artfully executed in a series of bids to protect and further their interests. As NASA found itself without the disciplining patronage of an alert and interested government, there was a shift in institutional posture. With their resources freed from the centripetal pull of nationalistic forces bent on winning the Space Race, NASA's energy was dedicated to projects that had a distinct cosmopolitan tint. A cursory glance at NASA's marquee projects since Apollo makes this clear; the remnants of the scrapped Apollo program, the Space Shuttles, and the various space stations started the trend of missions inviting foreign astronauts. Today, a multinational crew is a routinized and common feature of NASA missions.<sup>13</sup> NASA's unmanned space program tapped into this spirit as well with the data returned to Earth open to international academia; nowadays, scientists from around the world can easily apply to get direct time with the orbiting space telescopes and some unprocessed mission data is even available to at-home amateur armchair analysts equipped with nothing but access to the internet.<sup>14</sup>

In the interim, it seems that this move was born out of necessity; NASA had no choice but to pursue less costly projects. However, if we carefully delineate this shift from scientific

---

<sup>13</sup> Peter J. Westwick, *Into the Black: JPL and the American Space Program* (New Haven: Yale University Press, 2006). Today, the Space Shuttle is a routine platform that carries crewmembers from other nations and the ISS is a nexus destination that docks with both American and Russian spaceships.

<sup>14</sup> The University of Arizona Department of Planetary Sciences and Lunar and Planetary Laboratory, "HiRISE: High Resolution Imaging Science Experiment," The University of Arizona, <http://hirise.lpl.arizona.edu>.

nationalism to scientific internationalism, the acceleration of this change coincides with the reclamation of the 1960s budget levels suggesting that this ideological transition became a successfully deployed motif to expand influence and meet goals. A look at the NASA timeline while keeping this in mind provides confirmation. As a result, this paper presents its findings in a chronological structure which will be delineated in to three main sections. The study starts by examining the impact of the postwar context on American space efforts and how this persisted through the decades up until NASA's first budgetary crises and how NASA's survivalist embrace of international collaboration to adapt to its new and unaccommodating situation planted the seeds for future institutional latitude. Then, the paper demonstrates that with this freedom from central dictations, NASA turned its infant internationalism into a fully fledged umbrella that allowed for the protection and attainment of otherwise endangered objectives throughout the 1970s and early 1980s. Finally, the study attempts to prove that this change continued to foster more opportunities in the years after and that NASA's most recent triumphs and the features of modern space science today can be fitted in to a continuity that finds its origins in the last forty years. It is also worth synthesizing and discussing these findings in a conclusion that pieces this study with NASA scholarship and explores possible broader implications and avenues for future study.

## *II. The Origins of Internationalism*

One of the aftermaths of World War II was the Allied scramble to capture valuable German technologies<sup>15</sup> some of which included revolutions in aeronautics like the flying wing, guided rockets, and jet engines. While most of this happened covertly in the background (e.g.

---

<sup>15</sup> And to a lesser extent, Japanese advancements as well. The United States inherited almost the whole of Unit 731 and its developments, the notorious Japanese organization responsible for pursuing and developing biological weaponry. Tsuzuki Chushichi, *The Pursuit of Power in Modern Japan, 1825-1995* (Oxford: Oxford University Press, 2000) 15.



Operation Paperclip<sup>16</sup>), the public in America and around the world also got the occasional glimpse into the extent of German technological excellence and imagination.

Just a month or so after the end of the war in Europe, the Army announced to the news organizations covering the war's end in Paris that it had uncovered plans that prove Nazi Germany was only "fifty or 100 years...[away from harnessing] the sun's rays to demolish nations at will and rule the world."<sup>17</sup> While a giant, orbiting magnifying glass that is capable of killing humans like ants has always been impossible, impractical, and comically unwieldy, such revelations irrevocably linked outer space with national security. Even after the realities of scientific limitations and boundaries set in and public expectations were somewhat tempered, scientists and policy makers routinely made the rounds to promote and discuss similar themes. In 1952, a scientist began to grandstand about the feasibility and applications of a man-made moon. To him, this meant a space station functioning as an orbiting weapons platform and that whichever nation built such a contraption first would enjoy an insurmountable advantage in the arms race.<sup>18</sup> When the Soviet Union realized the goal of an orbiting satellite with *Sputnik*, the outrageous firestorm against President Dwight D. Eisenhower came from a horrified public whose imagination was set alight by politicians like Senator Lyndon B. Johnson who claimed the Soviets were just steps away from developing the capability to "[drop] bombs on us from space like kids dropping rocks on to cars from freeway overpasses."<sup>19</sup> One can surmise from events a year after that this was not all just routine political posturing and that some important figures took such prognostications to heart; in 1958, British military officials openly wondered if the

---

<sup>16</sup> John Gimbel, *Science, Technology, and Reparations: Exploitation and Plunder in Postwar Germany* (Stanford: Stanford University Press, 1990) 209.

<sup>17</sup> Gladwin Hill, "Nazis' Scientists Planned Sun 'Gun' 5,100 Miles Up," *New York Times*, June 29, 1945, New York edition.

<sup>18</sup> "Man-Made Moon is Held Feasible," *New York Times*, December 6, 1952, New York edition.

<sup>19</sup> Ron Cowen, "Sputnik +50: Remembering the Dawn of the Space Age," *Science News* 172 (2007) 216-217, 221.

western defense grid was made obsolete by the *Sputnik* threat.<sup>20</sup> Even though an orbiting bomb lobber, let alone the envisaged Death Star of 1952, never materialized (and still has not today), the tone for the American response was set down firmly. Space became an arena for foreign policy and national security.

With these events in mind, the spike in the early 1960s NASA budget is accounted for. The sense of national urgency brought to it a high point in funding that has not been matched since.<sup>21</sup> The likely and common reaction to this is to conclude that these were NASA's golden years where the organization enjoyed clear direction and near unanimous support from the public and from Congress as is argued by Friedman. However, there are dimensions to the story that might inspire different interpretations that are perhaps obscured by the obvious and glaring specter of the unprecedented budget.

It is important to note that the enthusiasm from the public and Congress, and at times even from the internal scientific community, was mostly qualified. These groups provided fierce support for NASA – in 1963, when several Republican Senators began to question the wisdom and motives of pouring four to five percent of the federal budget into NASA, Senator Clinton P. Anderson openly challenged their patriotism<sup>22</sup> – but this only happened if they felt NASA was making sufficiently large strides towards the all important task of beating communism to the moon. When NASA did not meet the expectations of its supporters, they only offered harsh repudiation. One example where NASA ran afoul of its Congressional allies is the development of the Centaur payload stage for the Saturn rockets. Problems plagued its early development and when NASA persisted in conducting further tests, Congress launched an investigative hearing to

---

<sup>20</sup> Denis Healey, "The Sputnik and Western Defence," *International Affairs (Royal Institute of International Affairs 1994-)* 38 (1958) 145-146.

<sup>21</sup> Both in absolute amount and in percentage of the federal budget.

<sup>22</sup> Robert C. Toth, "Anderson Reproaches Critics of Moon Program," *New York Times*, May 28, 1963, New York edition.

censure NASA for wasting time and money on what Congress considered a proven failure.<sup>23</sup>

Ironically, Centaur was not only not the hapless dead-end it had been made out to be during the hearing but after its successful deployment in 1965, it became one of the most used and reliable workhorses of the NASA arsenal and remained in service for almost the next forty years.<sup>24</sup>

However the harsh Congressional criticism and negative publicity forced NASA to cancel Centaur's role in the Saturn rockets and the Apollo program and created a whole new component to fulfill the role.<sup>25</sup> Even some members of the scientific community outside of NASA lamented this turn of events and were quick to criticize wondering if such missteps doomed America to follow in the footsteps of the Soviet Union yet again.<sup>26</sup>

Looking back on these events, one must wonder if this period really constitutes a high point for NASA. NASA was bound closely to the political watchdogs of Congressional committees and existed in an age when the purity of scientific academia was intensely polarized by the always looming battle with communism. The Centaur program seemed to be a genuine attempt to conserve resources and to further develop a concept that had the trappings for success; but because it clashed with the preset timeline of forces outside of NASA, it was nearly abolished completely and smeared as a flagrant example of gross mismanagement. Even though NASA was endowed with a deep budget, its identity as an agent of scientific pursuit was

---

<sup>23</sup> "Companies Also Accused With NASA of Waste in Lunar Program," *New York Times*, October 4, 1963, New York edition. NASA was eviscerated along with its corporate partners as Congressmen characterized the decision as an obvious instance of Eisenhower's military-industrial complex.

<sup>24</sup> Virginia P. Dawson and Mark D. Bowles, *Taming Liquid Hydrogen: The Centaur Upper Stage Rocket 1958-2002*, (Washington D.C.: National Aeronautics and Space Administration Office of External Relations, 2004): vii. Centaur was never fully retired. The General Dynamics program made significant modifications to the design in order to match the capabilities of the European Ariane program and renamed the new product Atlas but the Centaur is still there in the core though indistinguishable from the outside.

<sup>25</sup> James E. Webb, "Saturn V Is Modern Caravel," *The Science News-Letter* 85-11 (1964): 165-166.

<sup>26</sup> Walter Wingo, "Russia's Ladder to the Moon," *The Science News-Letter* 84-20 (1963): 314-315. Even though the article makes the outright prediction that Soviets will walk on the moon before Americans, the author still tries to console the readership by assuring them that America will still remain "the leading producer of supplies for the booming Space Age."

arguably compromised; experimentation and innovation, some of the most basic hallmarks of science, were quashed if they came in conflict with the national security imperative.

Expedience is, of course, a point that any like organization has to contend with perpetually (NASA would revisit some of these themes again with the publicity of future Space Shuttle disasters, especially in the case of *Challenger*<sup>27</sup>). But in NASA's history, the decade following its rapid formation in 1958<sup>28</sup> was, without doubt, the height of the severity of these clashes. It seems that it would be an error to equate the budget then with power and influence since it was the growth of the budget that led to the suffocating oversight. Because of the single track focus of the government, the triumph of the moon landing meant the withdrawal of attention and with that, NASA's enormous budgetary discretion. On the flip side, however, it also meant NASA was no longer beholden to the policy goals of the Cold War.

Less than a year after the moon landing, NASA already found a way to operate separate from the mindset of being locked in a mortal competition with a nemesis that had global implications. It began the unprecedented step of talking to its Russian counterpart in order to negotiate a design for a universal docking system to be used in a possible event that called for a space rescue. In 1972, President Nixon and Soviet Premier Alexei Kosygin signed an agreement

---

<sup>27</sup> U.S. House. Committee on Science and Technology. *Investigation of the Challenger Accident (Vol. 1)*. (HRG-1986-TEC-0028; Date: June 10-12, 17, 18, 25, 1986). Text in: LexisNexis® *Congressional Hearings Digital Collection*; Accessed: October 6, 2009. Dr. Richard Feynman would play critical role in illuminating surprising gaping chasms between the realities in the minds of scientists and the expectations of the administrator by revealing technical flaws in *Challenger* that were known but discounted for the sake of a speedy launch. This, and the previously discussed clashes over specifics of Apollo, is good indicators of how bureaucrats might have the sometimes tragically consequential ability to affect processes. However, it is still important to remember that the bureaucrat can sometimes be more of an arm of the institution than an outsider emissary from the government. This study demonstrates this by highlighting some of the ways in which the administrator clashed with the legislator.

<sup>28</sup> Matt Bille, *The First Space Race: Launching the World's First Satellites* (College Station: Texas A&M University Press, 2004). On July, 29 1958, NASA was established after the enactment of the National Aeronautics and Space Act. In many ways, its very formation was also steeped in the charged political climate of the time; it absorbed its antecedent, the National Advisory Committee for Aeronautics (NACA) in part because the government felt that NACA lacked the agility necessary for a response to the Soviet Union and had done a poor job of keeping America afoot in aerospace developments in light of *Sputnik* and the several failed American rocket launches immediately after.

that called for an *Apollo* module to meet up with a Soviet spacecraft in 1975. This became the *Apollo-Soyuz* Test Project (ASTP) which involved docking the last usable Apollo command module with a Soyuz spacecraft.<sup>29</sup> On July 17, 1975, astronaut Thomas Stafford and cosmonaut Alexei Leonov exchanged the first international handshake in space. The crews exchanged gifts and interacted for nearly two days and conducted several joint experiments.<sup>30</sup>

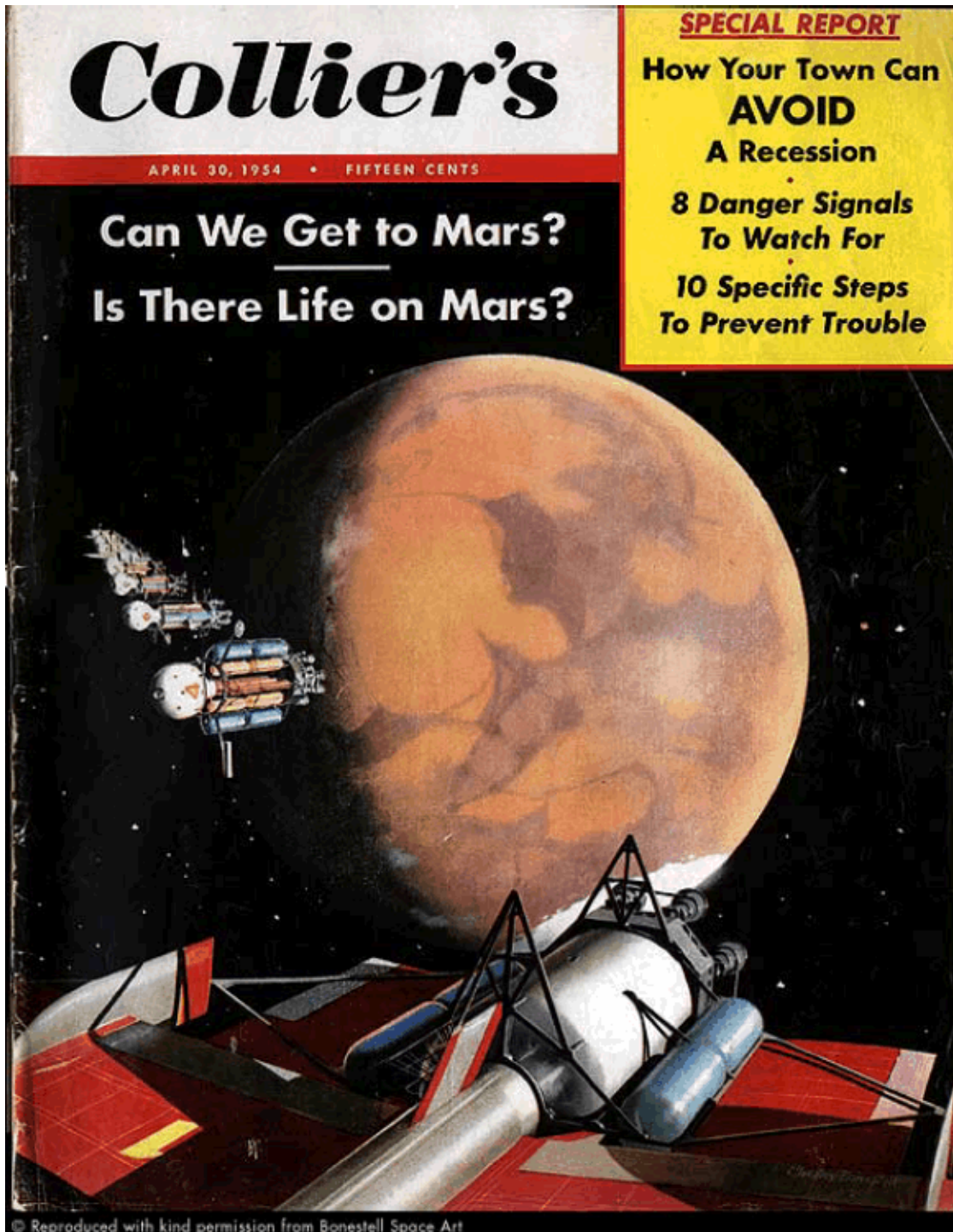
In the context of the Cold War, ASTP is a fairly clear example of *détente* which was the evolving policy orientation in both the United States and the Soviet Union; the scientists responsible for initiating the negotiations were not expecting anything to come to fruition with their existing technology and spacecraft and were quite surprised to learn that their governments consented to and accelerated what was only a theoretical and academic dialogue.<sup>31</sup> If we narrow the focus to only NASA, it is also probably reasonable to consider it a mission crafted out of frugality; after all, although the budget cuts ended *Apollo*, the leftover remnants were still operable and adequate for a mission of some sort. But there are elements of this mission that may be fitted to an overarching story.

---

<sup>29</sup> NASA, "Russian Soyuz TMA Spacecraft Details," National Aeronautics and Space Administration ISS committee, [http://www.nasa.gov/mission\\_pages/station/structure/elements/soyuz/spacecraft\\_detail.html#at\\_Soyuz](http://www.nasa.gov/mission_pages/station/structure/elements/soyuz/spacecraft_detail.html#at_Soyuz) is the preeminent workhorse of the Soviet Space Program and continues performing the same important role and functions even today in the International Space Station. In fact, its role might be elevated as it would serve as the only regular manned vehicle for trips to the space station if the current plans to cancel the Space Shuttle before the finalization of the Constellation replacement are realized. See: Warren Leary, "NASA Starts Planning to Retire Space Shuttle," *New York Times*, April 2, 2005, New York edition.

<sup>30</sup> Edward C. Ezell and Linda N. Ezell, *The Partnership: A History of the Apollo-Soyuz Test Project* (Washington DC: NASA Special Publications, 1978). Some of the gifts shared included American and Soviet flags and seeds of indigenous plant life that were planted in each nation after the conclusion of the mission. The scientific experiments conducted included pictures of the Sun's corona taken after maneuvering the *Apollo* module to block the Sun for a fake eclipse.

<sup>31</sup> *Ibid.*



Above: One of the *Collier's* issues that shared Dr. Wernher von Braun's vision of travelling to Mars. Note the complete absence of nationalistic insignia.

From 1952 to 1955, preeminent scientists and engineers at the behest of the government partnered with *Collier's* magazine and Disney's movie studios to run a series of public interest

media pieces to promote the concept of space travel. American readers of *Collier's* got a glimpse of some of the visions of what future space travel might look like from prominent Space Age figures like Willy Ley and Wernher von Braun. Colorful and detailed diagrams of spacecraft bound for distant worlds like the Moon and Mars and depictions of future societies permanently living in colossal space station habitats accompanied by clear and lucid descriptions of the necessary technological requirements to execute them dominated the pages. Disney carried much of the same imagery in video format in a three part movie series shown on television narrated by Dr. von Braun.<sup>32</sup>

The nature of the images is particularly striking. Not a single American flag or government insignia appeared on the spaceships illustrated in the *Collier's* publications or the Disney movies. This suggests that the idea of a transnational, if not fully international, ethos of space exploration already lay embedded in the minds of the individuals that would become the first important figures of NASA.<sup>33</sup> Reinforcement for this transnational ethos can be found in some of the writings of von Braun who, for all intents and purposes, was the face and heart of NASA in the early going.<sup>34</sup> In 1948, von Braun wrote a specific plan and vision for a future mission to Mars called *Das Marsprojekt*,<sup>35</sup> a work that supplied the basis for much of the speculation, technical minutia, and illustrations of the magazine run and movies. While it was primarily a technical manual, von Braun reflected upon the nature of humanity and space exploration in the first few pages.

Since the actual development of the long-range liquid rocket, it has been apparent that true space travel... can only be achieved by the coordinated might of scientists, technicians, and organizers belonging to nearly every branch of

---

<sup>32</sup> Ward Kimball, *Man in Space*. DVD. Directed by William V. Skall. Burbank, CA: Walt Disney Pictures, 1955.

<sup>33</sup> "Man Will Conquer Space Soon," *Collier's* 129 (1952): 22-36+ Many of the principle NASA rocket engineers were not Americans in the first place anyways. Most were captured from various factories and facilities in Germany.

<sup>34</sup> Michael J. Neufeld, *Von Braun* (Washington D.C.: Smithsonian Institution Press, 2007).

<sup>35</sup> Wernher von Braun, *The Mars Project* (Urbana: University of Illinois Press, 1962): 4.

modern science and industry... We space racketeers of all nations (where permitted) have made it our business to rally this kind of talent around the standard of space travel...

Even in a 1962 preface to an edition released at the height of the Space Race fervor, von Braun refrained from the use of nation-specific terminology and phraseology and congratulated all nations for the advances in rocketry up until that point in time (referring of course to the United States and the Soviet Union). The conspicuous absence of nationalistic spirit illustrates how the idea of cooperation beyond borders was so deeply embedded, a feature that helps to account for the ease and speed of abandoning the intellectual wall dividing the American and Soviet space communities.

However, it is worthy to note that the entire community was not completely unaffected by the events of the 1960s and there were still obvious and glaring tensions. James C. Fletcher, the head of NASA in 1973, attempted to secure more funding for NASA by resurrecting the fading memories of the moon race and replacing NASA back into the Cold War geopolitical milieu. Fletcher argued that the downward trend of scientific endeavors would force the United States “to regroup our space industry team and outrace another *Sputnik*.”<sup>36</sup> While the makings for the cosmopolitan NASA of today were there and the first steps had already been taken towards that destination, the change was only in its infancy.

### *III. Developing Internationalism*

Throughout the 1970s, several developments evolved the space sciences even further and created circumstances that made international outreach far easier to accept for NASA and the American government. The push for this was already there, brought forth by the budget cuts that left NASA grasping for ways to get funds and to lessen costs even from outside sources. But

---

<sup>36</sup> Robert A. Wright, “NASA Chief Seeks More Funds In ’73,” *New York Times*, October 3, 1971, New York edition.



since the Cold War reached a boiling point in Vietnam<sup>37</sup> and as Fletcher demonstrated in the 1973 NASA budget hearing, the Soviet Union was still considered in confrontational terms.

With the rise of the European Space Agency (ESA) in 1975, a group then comprised of countries friendly to the United States most of whom were members of the North Atlantic Treaty Organization (NATO), the inhibition against reaching out to the foreign community was substantially lowered. The idea for a space agency comprised of European member states arose from the ashes of World War II. With Europe broken, scientists realized that to reach parity and equal stature with the two superpowers would be impossible without drawing from the resources and expertise of the collective.<sup>38</sup> The organization was officially inaugurated with the merger of two precursors [European Launch Development Organisation (ELDO) and European Space Research Organisation (ESRO)] formed in the 1960s. While the ESA declared in their mission statement that the goal of the organization was to promote the space sciences in and for European states, it is important to note that the process was aided along and accelerated by the patronage of the United States in the earlier years. Because the ESA had no payload rockets or launch platforms, the first seven European satellites were put into orbit by NASA.<sup>39</sup>

And almost immediately, the relationship turned surprisingly bilateral with the American space program drawing benefits from the ESA as well. In 1970, NASA unveiled a proposal for a fleet of reusable manned spacecraft that would become the Space Shuttle. Because the announcement came at the tail end of the costly Apollo launches, the plans for the Space Shuttle came under hostile fire from almost all sides concerned about the cost.<sup>40</sup> While NASA was

---

<sup>37</sup> Robert C. Horn, *Alliance Politics Between Comrades: The Dynamics of Soviet-Vietnamese Relations* (Santa Monica: University of California Press, 1987) In the 1970s, the United States was still fighting in Vietnam, against an army that was mostly trained and supplied by the Soviet Union.

<sup>38</sup> Robert Musel, "European Joint Space Shot Slated," *Los Angeles Times*, February 13, 1966, Los Angeles edition.

<sup>39</sup> "European Conference Will Plan Space Effort," *Los Angeles Times*, November 4, 1970, Los Angeles edition.

<sup>40</sup> Brian O'Leary, "The Wild Blue Space Shuttle." *New York Times*, January 30, 1971, New York edition.

forced to make massive concessions,<sup>41</sup> it still persisted, in part because of promises to find ways to pay for it without burdening the American taxpayer excessively. In 1972, just months before President Nixon gave the go-ahead for the continuation of the program, NASA announced that fifteen percent of the cost would be shouldered by the ESA in exchange for access to Space Shuttle missions.<sup>42</sup> The ESA contribution was not just monetary. Over time, they even had a bridgehead on Capitol Hill, and began to function almost as NASA lobbyists; in 1989, ESA representatives worked with NASA to reverse a vote that threatened to end a joint project.<sup>43</sup>

This pattern of cooperative two-way enabling became a consistently reappearing theme. In 1978, NASA launched the International Ultraviolet Explorer (IUE) not just for the European Space Agency but as a partner in the program that promised to share data access with astronomers from seventeen other nations.<sup>44</sup> A daring joint NASA/ESA project involving a close rendezvous with the returning Halley's Comet in 1986 was scrapped because of cost and the Challenger disaster but was resurrected with even broader goals under the conglomerated aegis of NASA, the ESA, the Russian Federal Space Agency or *Roskosmos* (RKA), and Japan's Institute of Space and Astronautical Sciences (ISAS).<sup>45</sup>

However, the spirit of the times was not invariably transnational despite the changing tenor of space exploration. A well-known 1987 study commissioned by James C. Fletcher and

---

<sup>41</sup> T.A. Heppenheimer, *History of the Space Shuttle* (Washington D.C.: Smithsonian Institution Press, 2002).

<sup>42</sup> Walter Sullivan, "Space Shuttle Pact With U.S. Expected to Unite Efforts in Western Europe," *New York Times*, September 26, 1970, New York edition.

<sup>43</sup> John Noble Wilford, "Plan to End U.S.-European Space Effort Is Fought," *New York Times*, May 18, 1989, New York edition.

<sup>44</sup> "Satellite With Special Telescope Launched in International Mission," *New York Times*, January, 27, 1978, New York edition.

<sup>45</sup> John Noble Wilford, "Halley's Comet: Scientists Prepare the Welcoming Party," *New York Times*, October 26, 1982, New York edition. All four agencies together sent an armada of satellites to provide telemetry readings so the satellite built to approach it would have the most accurate data possible. It should be noted that the ESA was the leader of this mission as it provided the majority of the funding and contributed the *Giotto* satellite designed to approach Halley's comet up close. The mission was a stunning success, providing scientists with the closest and clearest images of a comet nucleus up until then. It also served as an introduction for Japan to bigger aspirations in space explorations as its satellite was a national first in interplanetary studies. Japan also became the first nation to send a man-made object out of Earth orbit, after the Soviet Union and the United States.

led by Sally Ride, the first American woman to go to space in 1983, titled *NASA Leadership and America's Future in Space*<sup>46</sup> (henceforth called the Ride Report) utilized the same old Cold War language to warn the government and the public that a decreased budget and loss of interest in NASA meant the cessation of leadership in key areas of space exploration. The report observed that

The Soviets are now the sole long-term inhabitants of low-Earth orbit. The first, and only, U.S. space station, *Skylab*, was visited by three crews of astronauts before it was vacated in 1974; the U.S. has had no space station since. The Soviets have had eight space stations in orbit since the mid-1970s. The latest, *Mir*, was launched in 1986 and could accommodate cosmonauts and scientific experiments for nearly a decade before the U.S. Space Station can accommodate astronauts in 1995. The United States has clearly lost leadership in these two areas, and is in danger of being surpassed in many others during the next several years.<sup>47</sup>

Despite the alarming tone, a later passage belies the softening definition of leadership by conceding that “leadership does not require that the U.S. be preeminent in all areas and disciplines of space enterprise. In fact, the broad spectrum of space activities and the increasing number of spacefaring nations make it virtually impossible for any nation to dominate in this way.”<sup>48</sup> This marks a clear departure from the embarrassment of being defeated in even one way that characterized and functioned as the engine of the space program in the 1950s and 1960s.

The text of the Ride Report is not the only evidence of multinational collaboration. Some of the missions pushed for by the Ride Report ended up assuming a distinct internationalist orientation despite the report's insistence that “the United States will not be a leader in the 21st century if it is dependent on other countries for access to space or for the technologies required to explore the space frontier.” One of the projects reviewed was a daring plan conceived in 1982

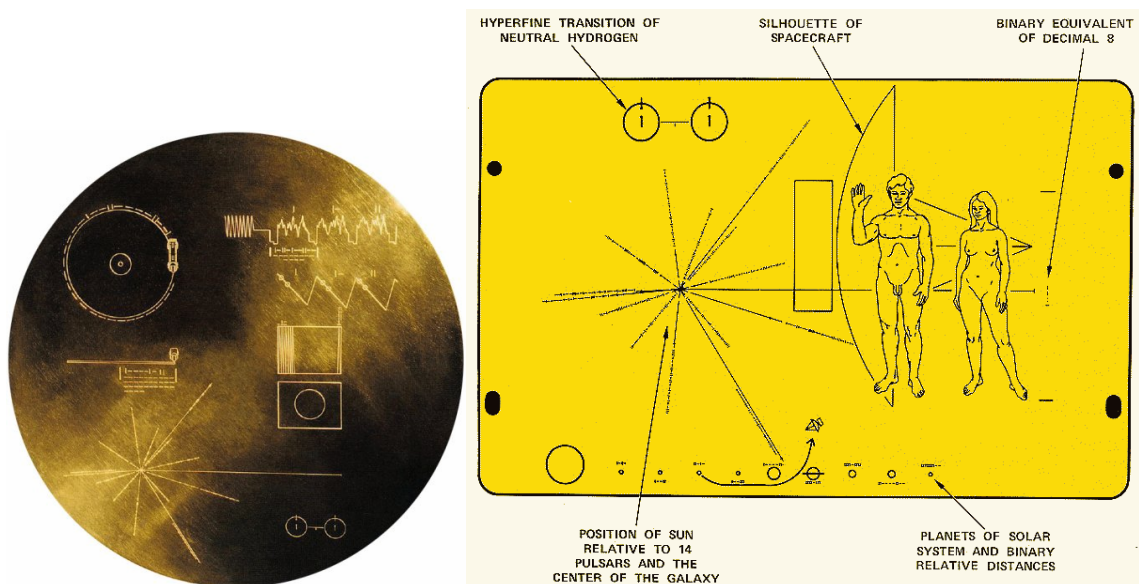
---

<sup>46</sup> The NASA History Foundation, “NASA Leadership and America's Future in Space,” The National Aeronautics and Space Administration, <http://history.nasa.gov/riderep/begin.htm>.

<sup>47</sup> *Ibid*, pg. 7

<sup>48</sup> *Ibid*, pg. 8

to study Saturn on an unprecedented scale. Although the report describes this as a mission to be carried out by NASA alone, the finalized plans in 1988 for *Cassini-Huygens*, one of NASA's most highly publicized unmanned missions, called for deep and extensive cooperation with the ESA. The ESA would not just be a partner but be the preeminent contributor with the headlining *Huygens* space probe, a spacecraft with the milestone mission to explore and impact Saturn's mysterious moon, Titan.<sup>49</sup> In fact, NASA acceded to this preeminence specifically to remedy the ESA's growing disenchantment at being confined to ancillary roles.<sup>50</sup>



Left: The record on *Voyager 2* with Earth sounds. Right: A diagram explaining the meaning of the symbols on the plaque carried by the four deep space bound satellites.

The scientific relationship for *Cassini-Huygens* also involved an agreement allowing the equal and full distribution of access to the data gathered from the satellite and the probe.

However, this was not unique to this program. It came after a long line of unmanned space probes throughout the 1970s and 1980s that initiated the process of declassifying mission data.

<sup>49</sup> Warren E. Leary, "En Route To Saturn, A Boost From Earth," *New York Times*, August 17, 1999, New York edition.

<sup>50</sup> Ralph Lorenz and Jacqueline Mitton, *Lifting Titan's Veil: Exploring the Giant Moon of Saturn* (Cambridge: Cambridge University Press, 2000).

Unlike the moon rocks which were guarded jealously for several years<sup>51</sup> or the findings of earlier satellites (e.g. *Explorer 1*) which were released only after exclusive review by American scientists,<sup>52</sup> the updates from the missions of the interplanetary flyby spacecraft *Pioneer 10*, *Pioneer 11*, *Voyager 1*, and *Voyager 2* were viewable simultaneously around the world. Interestingly, scientific questions arising from their ongoing operation today are still being worked on and debated by scientists in all nations.<sup>53</sup>

The evolution of geopolitics through the space programs is still only a fraction of the story. NASA also engaged and awed the public with several maneuvers to raise institutional awareness, probably in a bid to restore the conditions of the attention it enjoyed during Apollo. The *Pioneer 10* and *11* space probes are the standard bearers of NASA's public platform; both carried a plaque bearing a message from humanity for a would-be intelligent extraterrestrial interceptor. The twin plaques depicted, among other things,<sup>54</sup> a map of the Solar System relative to the locations of prominent interstellar objects and the likenesses of a man and a woman. *Voyager 2* carried a similar message and also bore a record of famous musical pieces from around the world, sounds of natural phenomena like ocean waves and animals, and a greeting

---

<sup>51</sup> Michael Goldstein, "Sheer Lunacy," *Los Angeles Times*, June 6, 2004, Los Angeles edition. The mineral samples from the moon were not released until after the completion of the final Apollo mission. A small amount of the rocks were given as gifts of goodwill to other nations, and barring burglary attempts like the incident described in the article where NASA interns stole moon rock samples and attempted to sell them on the black market, private ownership is not allowed. Not even a single astronaut from the Apollo program owns a moon rock.

<sup>52</sup> I. Harris and R. Jastrow, "Density Determinations Based on the Explorer and Vanguard Satellites." *Science* 128-3321 (1958): 420-421. Just days after the *Explorer 1* mission, American scientists were the only ones to publish findings.

<sup>53</sup> T.L. Wilson and H.J. Blome. "The Pioneer anomaly and a rotating Gödel universe," *Advances in Space Research* 44-11(2009): 1345-1353. The mystery of the twin *Pioneer* spacecrafts is that the most recent data indicates that they are inexplicably slowing down as they enter deep space and leave the solar system. This seems to go against the second law of Newtonian physics as nothing known can function as a strong enough opposing force to account for this. The "Pioneer Anomaly" sparks lively debates even among astrophysicists today. The article cited here is an example of one the many attempts to address this phenomenon.

<sup>54</sup> John Noble Wilford, "Voyager Heads Towards Planets Despite Snag After Its Liftoff," *New York Times*, August 21, 1977, New York edition.

spoken in fifty-five different languages.<sup>55</sup> These were certainly not sent out to achieve any practical objectives – the small size relative to the universe and the fact that they would stop emitting signals shortly beyond the realms of the Solar System renders any chance of an extraterrestrial encounter extremely small. Moreover, if such an event were to take place, it would be many millions, probably billions, of years in the future. However, the symbolic weight of Earthlings sending interstellar communiqués had a palpable impact on the cultural mainstream. The most prominent examples are some of the resulting *Star Trek* episodes and movies that deal with the outcome of aliens meeting these same space probes hundreds of years into the future.<sup>56</sup>

An even more direct link to *Star Trek* can be found in the introduction of the first functional Space Shuttle in 1976. The original name was supposed to be *Constitution* but *Star Trek* fans sent NASA a torrent of letters under which NASA relented and changed the name to *Enterprise* after the flagship of the United Federation of Planets in the *Star Trek* series.<sup>57</sup> Because of this and NASA's desire to heighten public interest, the entire cast was invited to attend a ceremony during the official rollout.<sup>58</sup>

---

<sup>55</sup> Timothy Ferris, "Seeking an End to Cosmic Loneliness," *New York Times*, October 23, 1977, New York edition.

<sup>56</sup> Harve Bennett, *Star Trek V: The Final Frontier*. DVD. Directed by William Shatner. Hollywood, CA: Paramount Pictures, 1989. Pioneer 10 was blown up by a Klingon cruiser in the movie *Star Trek V: The Undiscovered Country*. Human representatives in a *Star Trek* book introduced a copy of one of the plaques to nearby alien races who told the envoys that their civilizations never were able to decode the message. See: Judith Reeves-Stevens, *Star Trek: Federation* (New York City: Simon and Schuster, 1995) The fictional *Voyager 6*, shaped just like the two real *Voyagers* also made an appearance in the first *Star Trek* film as a probe turned into a powerful artificially intelligent being after drifting for centuries in space. See: Gene Roddenberry, *Star Trek: The Motion Picture*. DVD. Directed by Robert Wise. Hollywood, CA: Paramount Pictures, 1979.

<sup>57</sup> "A New Space Craft Is Named Enterprise," *New York Times*, September 9, 1976, New York edition.

<sup>58</sup> "Space Shuttle Shown Amid Palmdale Fanfare," *Los Angeles Times*, September 17, 1976, Los Angeles edition.



Above: The cast of *Star Trek* attends the rollout of Space Shuttle *Enterprise*.

Through the 1970s and 1980s, NASA reset itself on a successful balanced path. Many of its ambitious goals had been realized and the public had a rejuvenated interest. A comparison of this timeline with Table 1 indicates a correlation between these events and a rising and restored budget. This suggests that NASA's outreach to the culture and the world community at least partially addressed the issues of declining prominence and shrinking budget. The strongest evidence of this is seen in NASA's repeated ability to evade criticism by pooling foreign

contributions to its budget. But we can move beyond the mere correlation in the graph<sup>59</sup> by looking at the content of budget reports for certain years. In 1974, a whole new category in the NASA budget breakdown emerged called Cross-Agency Support Programs.<sup>60</sup> This was a turning point of sorts as it indicates the official institutionalization of the transnational ethos into space policy.<sup>61</sup>

However, these striking developments did not signify the end of this process. The Cold War, though winding down, still maintained a dominating presence in the minds of politicians. In 1985, the Space Shuttle carried two Israeli astronauts despite them having no prior training for spaceflight and there being no Israeli space program; under the same conditions, the Soviet Union sent two Syrians and, later on, Iranians along with a Russian crew for their own counter-mission of sorts.<sup>62</sup> But with the end of the Cold War, the tone changed as dramatically as it had in 1969. With the end of a bipolar world by the beginning of the 1990s,<sup>63</sup> the biggest foreign policy concerns that could impact NASA operations evaporated and NASA with agencies around the world pooled their resources and ingenuity to launch one of the grandest projects in the history of space exploration.

---

<sup>59</sup> Besides, as the discussion over the politics of the 1960s budget demonstrates, budget is not the final authority on institutional influence. Further, over time, technology gets cheaper to produce and the growth of a strong unmanned program means that some, if not most, objectives are accomplishable with a smaller purse. For example, the Soviet *Luna 16* moon lander brought back moon rocks at small fraction of the cost of *Apollo 11* and without the risk to human life. See: Bernard Gwertzman, "Luna 16 Picks Up Rocks From Moon, Heads for Earth," *New York Times*, September 22, 1970, New York edition.

<sup>60</sup> U.S. Senate. Committee on Aeronautical and Space Sciences. *NASA Authorization for FY74, Part 3*. (HRG-1973-ASP-0007; Date: April 3, 4, 10, 1973). Text in: LexisNexis® *Congressional Hearings Digital Collection*; Accessed: October 17, 2009.

<sup>61</sup> NASA. "National Aeronautics and Space Administration FY 2007 Budget Request," NASA, [http://www.nasa.gov/pdf/142458main\\_FY07\\_budget\\_full.pdf](http://www.nasa.gov/pdf/142458main_FY07_budget_full.pdf).

<sup>62</sup> "Rocket Sends Syrian and Two Russians on a Space Mission," *New York Times*, July 22, 1987, New York edition.

<sup>63</sup> China's upsurge always maintained a presence in the minds of American and Soviet/Russian policy bureaucrats but in 1990, it was not the up and comer it is today and it was certainly distant from the realm of space exploration as China's space program accelerated only in recent years. See: Elizabeth Wishnick, *Mending Fences: The Evolution of Moscow's China Policy, From Brezhnev to Yeltsin* (Seattle: University of Washington Press, 2001): 23-49.



#### *IV. The International Space Station and the Comet*

The commitment to the creation of international ties to foreign space programs continued in the following decade following the end of the Soviet Union in 1989. Because of the versatile and agile Space Shuttle, NASA enjoyed a great variety of mission planning and took its participation in other space programs to another level. The Russian *Mir* space station benefitted from several cargo runs from American shuttle missions and in 1997 even required assistance for several vital repairs after an accidental collision with another spacecraft.<sup>64</sup> NASA also rescued and repaired a Japanese satellite in 1996 by intercepting and capturing it while in orbit.<sup>65</sup> Prominent scientists from around the world gained more access into NASA's inner circles as well: the 1990 deployment of the *Hubble Space Telescope* (HST) required a wide network of scientists and facilities arrayed around the globe.<sup>66</sup> But attendance in these maintenance operations and hints of a slow uptick in international participation mark only the smaller morphs in spaceflight ideology. The principle change in this phase was a redefined remnant of Cold War space policy from the decade before.

In 1984, NASA drew plans to build a huge American space station in part as a response to the Soviet *Mir*. In the 1984 State of the Union address, President Ronald Reagan unveiled the project which was deemed Space Station Freedom. In the beginning, this gained momentum as it was fortuitously positioned in the middle of a precipitous upsurge in defense funding caused by the 1983 Strategic Defense Initiative (SDI) which was President Reagan's attempt to circumvent the Mutually Assured Destruction (MAD) doctrine by developing the ability to intercept and

---

<sup>64</sup> "Shuttle, With Critical Cargo, Docks With Russian Station," *New York Times*, May 17, 1997, New York edition.

<sup>65</sup> "Endeavour Returns Japanese Satellite to Earth," *New York Times*, January 21, 1996, New York edition. This mission and the mission with the delivery of supplies to *Mir* are specifically noteworthy as the primary objectives in both cases was to assist foreign programs in need. It is a striking, almost altruistic, departure from previous NASA policy where such undertakings would only take place coincidentally or if it netted concrete benefits for American space science.

<sup>66</sup> Warren E. Leary, "Eye Steady, Space Telescope Starts to See Forever," *New York Times*, May 21, 1990, New York edition.

destroy Intercontinental Ballistic Missiles (ICBM) midflight with a combination of terrestrial, atmospheric, and space weapons platforms. But SDI, along with the space station, was delayed well into the next administration as successive reports questioned and outright attacked the project's feasibility. Ultimately, SDI died essentially in 1987 when a study concluded the plan was not possible with existing technology.<sup>67</sup> Since future administrations did not see space as grounds ripe for warfare – because of a combination of technological hurdles and space treaties put into place decades before – space funding declined. Over the following years, the support for Space Station Freedom correlatively eroded; it was hit with a series of cuts that forced successively compromising redesigns. In 1991, a committee in the House of Representatives voted to cancel it outright.<sup>68</sup> Though this decision was reversed in later days, by 1993, the project lost all support when the Clinton Administration would not approve of any of NASA's proposed revisions.<sup>69</sup>

At the same time, other key players in space exploration (the recently formed Japanese Aerospace Exploration Agency or JAXA, the ESA, and the RKA) were contemplating and pursuing their own homegrown space station aspirations.<sup>70</sup> Coincidentally, these projects were all plagued with budget clashes that led to near cancellations. Because of this, leaders from all four space programs worked to create a new project that would be named the International Space Station (ISS) after Vice President Al Gore and Russian Prime Minister Viktor Chernomyrdin

---

<sup>67</sup> David E. Sanger, "Many Experts Doubt 'Star Wars' Could Be Effective by the mid 90's," *New York Times*, February 11, 1987, New York edition.

<sup>68</sup> J. Travis, "Space Station Gains Full House Reprieve," *Science News* 139-24 (1991): 375. The article reports that NASA administrators were shocked that politicians voted to end the space station as it was an atypical vote against popular "big science" works. This surprise suggests yet another sharp turn in NASA's attempts to maintain a foothold in labyrinthine Congressional politics demonstrating why NASA had to find other creative and unorthodox ways to collect enough backing.

<sup>69</sup> Warren E. Leary, "Fate of Space Station Is in Doubt As All Options Exceed Cost Goals," *New York Times*, June 8, 1993, New York edition.

<sup>70</sup> Steven A. Holmes, "U.S. and Russians Join in New Plan for Space Station," *New York Times*, September 3, 1993, New York edition.

announced a finalized agreement on September 2, 1993.<sup>71</sup> Through the ISS, these space programs preserved the original objectives by scaling back projects to a cost acceptable to their home governments and by contributing component laboratory modules for shared use and access.<sup>72</sup> Indeed, some astute critics suggest that perhaps this attempt to skirt the disapproval of thrifty politicians has been too successful; the cost of the ISS to America today has far exceeded the original estimates of Space Station Freedom that drew so much ire and despite this, there is significant momentum to extend the mission of the ISS by another five years.<sup>73</sup>

There are obvious cultural undertones that arose correspondingly with the creation of an internationally driven space station. The message of *Star Trek* communicated the virtues of a utopian future where global cooperation in space was an essential step in human progress and the unprecedented collaboration that went into the ISS carries the obvious hallmarks of this. The parallels were not lost on *Star Trek* writers either. The ISS was featured several times as a plot device and Commander Benjamin Sisko, the leader of a 24<sup>th</sup> century space station which functioned as the nexus of intergalactic relations in *Star Trek: Deep Space Nine*, displayed a model of the ISS in his office, seemingly intended to illustrate that it was an early ancestor to the spirit of the future one world government's mission to serve the interests of all people and races.<sup>74</sup> The idea of space exploration as being on the leading edge of human innovation was not just a futuristic view espoused by science fiction writers. In addition to the high profile peace symbolism of international convocations in space, another one of the principle arguments for the

---

<sup>71</sup> *Ibid.* Today, planned components from all four previously national space stations are joined together on the ISS. A good example of the types of budget issues that plagued other space station ambitions is the planned sequel to *Mir*, *Mir-2* which began construction in 1976 and was still unfinished in 1993. See: William J. Broad, "U.S.-Russian Space Mission Stumbles, With Delivery Delays at Customs," *New York Times*, November 29, 1994, New York edition.

<sup>72</sup> GAO Archive, "Space Station: Impact of the Expanded Russian Role on Funding and Research," General Accounting Office, <http://archive.gao.gov/t2pbat3/151975.pdf>.

<sup>73</sup> Rand Simberg, "The Uncertain Future of the International Space Station," *Popular Mechanics*, July 29, 2008.

<sup>74</sup> *Star Trek: Deep Space Nine*. *Star Trek*. CBS Television Distribution. January 3, 1993 – June 2, 1999.

manned space program was that experimentation done in a zero-gravity environment could have humanitarian implications and potentially lead to cures for diseases, more efficient agricultural techniques, and the creation of new synthetic materials.<sup>75</sup> Though impressive, even these developments were eclipsed in 1994 when NASA profited from a once in a lifetime opportunity to add a new dimension to this notion of being an advocate of humanity.

In 1993, astronomers Carolyn and Eugene Shoemaker and David Levy discovered an odd comet that appeared oddly deformed. Soon after, scientists realized that it was slightly elongated because tidal forces from Jupiter were tearing it apart and that it was bound to hit the planet in 1994. The excitement over this discovery reached a fever pitch in the scientific community and in all levels of society as no human had ever witnessed a collision on this magnitude before.<sup>76</sup> As the comet neared Jupiter, it was split into nine pieces that impacted separately and provided a hitherto unmatched spectacle of luminous explosions that left a string of impact scars across the surface.<sup>77</sup> Recent scientific theories about the extinction of the dinosaurs involved a stellar body smaller than Shoemaker-Levy 9 so the apocalyptic overtones of this mission were particularly sharp.<sup>78</sup> NASA wasted no time in capitalizing upon this event by entrancing the public with Earth-sized craters that were inflicted against the Solar System's most massive planet and reported that the impact of the largest single fragment released more than 600 times the energy of the world's nuclear arsenals combined. Scientists also began doing academic work concerning meteor, comet, and asteroid impacts in light of the newfound attention. A particularly

---

<sup>75</sup> Kenneth J. Frost and Frank B. McDonald, "Space Research in the Era of the Space Station." *Science* 226-4681(1984): 1381-1385.

<sup>76</sup> Malcolm W. Browne, "String-of-Pearls Comet Headed Toward a Crash," *New York Times*, June 1, 1993, New York edition.

<sup>77</sup> Malcolm W. Browne, "Comet Pummels Jupiter, Revealing Details," *New York Times*, July 18, 1994, New York edition.

<sup>78</sup> Arthur C. Clarke, "Killer Comets Are Out There. Now What?" *New York Times*, August 14, 1994, New York edition.

provocative study released in the same year reported that there is a higher chance of dying in a collision than in an airplane crash.<sup>79</sup>

The upshot of these events became evident in the following months and years. Before, NASA maintained a program designed to track and map small bodies that intersected with Earth's orbit or near-Earth objects (NEOs). The project sought to identify and give advance warning of objects that could potentially collide with Earth in light of the revelations of a giant impact crater on the Yucatan peninsula that dated back to the final extinction of the dinosaurs. While the project might have attracted academic interest, the attention it received from the public was minimal. With the Jupiter event attracting public attention, NASA responded with the establishment of the Lincoln Near-Earth Asteroid Research (LINEAR) program in 1996. LINEAR has identified over 200,000 asteroids, and over 2000 NEOs accounting for the overwhelming majority of the work done in this field.<sup>80</sup> In addition to scientific research, the new threats drew the interest of Congress which held hearings shortly after the Jupiter collision in order to explore possible techniques to destroy or alter the course of an object on an impact course with Earth. With LINEAR and other like projects keeping closer tabs on the sky, the public actually confronted a near miss asteroid situation when scientists detected the half kilometer wide asteroid 1996 JA1 ten days before it passed between the Earth and the moon.<sup>81</sup>

---

<sup>79</sup> David Morrison and Clark R. Chapman, "The Impact Hazard," in *Hazards Due to Comets and Asteroids* edited by Tom Gehrels (Tucson: University of Arizona Press, 1994): 59-91. Note that this was more than just an ivory tower work distributed among interested academics; Dr. Morrison was then a NASA researcher and today, the head of NASA's Asteroid and Comet Impact Hazards division. This work is also accessible at: <http://www.boulder.swri.edu/~cchapman/mcshaz.pdf>. The math works by calculating not just chance of occurrence but total devastation as well; in other words, if an asteroid of sufficient size hits Earth, everyone dies. Statistics from this book would be often quoted by the media and scientists in the future.

<sup>80</sup> Lincoln Laboratory, "LINEAR," Massachusetts Institute of Technology, <http://www.ll.mit.edu/mission/space/linear/>

<sup>81</sup> David L. Chandler, "Thank Heavens, Huge Asteroid is Only Passing By," *Boston Globe Newspaper*, May 18, 1996, City edition.

The public continued to take interest in NEO detection but in two years, awareness reached new heights. In 1998, two films<sup>8283</sup> (*Deep Impact* and *Armageddon*) were released in the summer blockbuster months that dealt with the subject of humanity confronting an impact extinction. Both plots begin with a large object headed for Earth that was discovered too late. The protagonists unfold in the drama amidst the backdrop of a harried NASA that scrambles to find a way to head off the danger. Scientists, elated by the weight of Hollywood pushing this issue into the mainstream, were quick to offer their own perspectives. While many felt that *Armageddon* took a few too many liberties with creative license, *Deep Impact* was acclaimed for its realistic depictions; this might have been expected as its creators had consulted a team of NASA experts.<sup>84</sup> The influence of these experts is clearly seen in the plot as the comet was discovered early on but only by an amateur astronomer who died in a car accident on the way to report the results; when someone else took notice several months later, it was too late. This reflected reality: until recently, the majority of the identifications of small heavenly objects were done by backyard astronomers.<sup>85</sup> Still, all scientists agreed that apathy and the existing underdeveloped technology presented a lethal combination; the chance of spotting such a threat from space was miniscule and any attempt to deflect it would most likely be futile.<sup>86</sup>

---

<sup>82</sup>Bruce J. Rubin and Michael Tolkin, *Deep Impact*. DVD. Directed by Mimi Leder. Hollywood, CA: Paramount Pictures, 1998.

<sup>83</sup> Jonathan Hensleigh and J.J. Abrams, *Armageddon*. DVD. Directed by Michael Bay. Burbank, CA: Touchstone Pictures, 1998.

<sup>84</sup> Constance Holden, "Random Samples," *Science* 280-5366 (1998): 1013

<sup>85</sup> In particular, two significant and highly publicized discoveries of very prominent and visible comets in the 1990s were surprisingly made by hobbyists. In 1995, Hyakutake was discovered by a Japanese astronomer looking at the sky with small binoculars. In 1997, two Americans, one searching for comets from his driveway and another looking at the sky through a university telescope discovered Hale-Bopp at approximately the same time. The fact that these two objects escaped networks of established professional astronomers in the age of space telescopes was taken by some to mean that the astronomical institution had devoted to NEOs a startlingly small and inadequate portion of resources. See: Malcolm W. Browne, "Astronomers Say New Comet May Be Brightest in Decades," *New York Times*, March 16, 1996, New York edition. and Henry Fountain, "Backyard Astronomers Enlist as Foot Soldiers of Astrophysics," *New York Times*, March 18, 1997, New York edition.

<sup>86</sup> Richard Monastersky, "Space Dust May Rain Destruction on Earth," *Science News* 153-19 (1998): 294.

With the movies in 1998 energizing the public, NASA went on the offensive. It pushed for the furtherance of the NEO monitoring programs by releasing more high profile stories to the media<sup>87</sup> and by forging new alliances in Congress. This time, NASA sought help from Republicans. Representative Dana Rohrabacher called the timing of the movies with the first potential catastrophic impact “uncanny” and implored Congress to not view the 1996 encounter as a false alarm but rather to “look at that as a fair warning to those of us on Earth that we need to pay attention to this threat of asteroids.”<sup>88</sup> In 1997, President Bill Clinton canceled an experimental mission meant to test a prototype system that could potentially alter the orbital course of an asteroid.<sup>89</sup> Sensing that the public might be taking the threat more seriously now, Representative Rohrabacher accused the White House of putting the Earth in the path of an impending apocalypse:

... While NASA likes to talk about its effort on this issue... it isn't just talking the talk. We're going to have to talk about the funding for this asteroid survey, which has been much less than has been recommended... At the same time, there's no trouble at NASA for finding \$50 million that could be spent on a satellite that will enable us to watch the Earth from a distance, as the Vice President decided. So NASA can't find the full \$5 million that we [need] to chart out objects out there that are dangerous to the Earth but it can come up with \$50 million like that, if Al Gore, Vice President Al Gore, has some harebrained idea about watching the Earth from a distance. I guess we could all sit back then and watch the Earth from a distance. I guess we could all sit back then and watch the Earth from a distance as it's being pulverized by asteroid. Wouldn't that be a wonderful picture to watch?<sup>90</sup>

While the anti-asteroid program remained canceled, this outing in Congress demonstrates NASA's ability to adapt to the changing cultural and political landscape. It also represents a

---

<sup>87</sup> Malcolm W. Browne, “Asteroid Is Expected to Make a Pass Close to Earth in 2008,” *New York Times*, March 12, 1998, New York edition. It is probably more than coincidence that the month before the first of the two collision impact films, NASA releases data that indicates a risk from an asteroid in the foreseeable future. The language in the article, that one should assume caution despite it probably not hitting Earth, is almost the exact rhetoric employed by NSA's allies in the later days, indicating a wide, coherent official NASA line.

<sup>88</sup> U.S. House. Subcommittee on Space and Aeronautics, Committee on Science. *Threat and the Opportunity of Asteroids and Other Near-Earth Objects*. (HRG-1998-SCI-0018; Date: May 21, 1998). Text in: LexisNexis® *Congressional Hearings Digital Collection*; Accessed: October 25, 2009: 3.

<sup>89</sup> Leon Jaroff, “Dreadful Sorry, Clementine,” *Time*, October 27, 1997.

<sup>90</sup> Subcommittee on Space and Aeronautics, *Threat of Near-Earth Object*: 2.

recent offshoot, if not an outright evolutionary step of internationalism; the message strongly implies that NASA's science efforts cannot stay complacent or misguided for the stakes of its mission is the world and humanity's continued survival. In recent years, the issue of collision catastrophe has made its way to the agenda at United Nations meetings with NASA scientists leading the call for global attention to this matter.<sup>91</sup>

## *VI. Conclusion*

The history shows that NASA's quest to overcome the considerable political challenges that emerged after Apollo is a part of a distinct directorial theme of internationalism. Additionally, it shows that NASA retained its role in the eye of the public as an important instrument of social progress. NASA's vulnerabilities in a disruptive environment were addressed by a plan to look beyond national borders for aid; through extended, forty year attempt to protect its interests, NASA evolved. The first stage was a move conceived from necessity as NASA hurried to steady itself upon the space programs of other nations after the sudden slashes to its support. These first forays into the unfamiliar world of cooperation in space exploration through events like the ASTP led to a repeating series of other missions cast in the same mold and reified international collaboration into the institutional mandate. International joint projects in the space sciences, originally an aberration became a dominant feature. With these arrangements in place, undertakings like the ISS deployed them into an unprecedentedly widened realm.

---

<sup>91</sup> Patrick Cooke, "The Asteroids are Coming! The Asteroids are Coming!" *Forbes*, September 25, 1995: 126. The first United Nations conference on NEOs took place in 1995. At the meeting, a NASA scientist introduced a scale (like the Richter Magnitude Scale or the Fujita Scale of Tornado Intensity) to determine the damage of a collision by assigning numbers to NEOs based on size and percent chance to hit Earth. Since then, American scientists have made several trips, always urging the world community to work together and create ways to deflect an extinction level harm. Over time, the effort seemed gain traction. In 2007, NASA and the Association of Space Explorers proposed a treaty to the United Nations whereby a world fund would be created to create a global "asteroid shield." A final version is scheduled to go up for vote in 2009. See: Russell L. Schweickart, "The Sky Is Falling. Really," *New York Times*, March 16, 2007, Late edition.



The change in cultural attitudes towards space and its relation to nationalism can be measured against a quantifiable procession in projects and budget but the less palpable undercurrents deserve equal mention. The growth of internationalism in space exploration corresponded with changing cultural attitudes. In the beginning, a few idealistic scientists seemed to have transnational aspirations but this was suppressed or lost in early Cold War tensions. As events at home and around the world led to attempts at reconciliation, the idea of international cooperation took root in the mass media in venues like *Star Trek*. This did not just manifest alone in the operations of NASA; both NASA and the popular culture developed an active relationship with the ability to affect each other (e.g. *Star Trek* episodes and the first Space Shuttle). With some astronomical luck in later decades, NASA manipulated the situation of Shoemaker Levy-9 and launched new set of programs as the mainstream took note of an always present menace from outer space; this directly permitted NASA's effective insistence that American space technologies would not just develop international relations but may one day be the key to the endurance of humankind.

But instead of ending here, it might be a beneficial exercise to step back even further and look at these events not just in a chronology but ruminate about their position in the entire sphere of science. Scholars have identified the 20<sup>th</sup> century as turning point in the nature of scientific advancement. With the world wars and the need to create complicated technologies rapidly (e.g. The Manhattan Project), science moved beyond the domain of the privileged elite and became a foremost matter of government policy. Previously, revolutions in science might come from an individual character (e.g. Charles Darwin or Isaac Newton) but with the state actively pursuing massive undertakings, a likewise enormous budget and armada of manpower marginalized the role of individual contributions. Understanding that one of the byproducts of this shift (generally

called “Big Science”) is that the state became the de facto dictator of scientific progress, some pondered the motivations and results. A convincing argument made by scholars such as Walter A. McDougall claimed that policy makers, especially after *Sputnik*, sought spectacular leaps in technology as a mode to enhance state status and prestige.<sup>92</sup> The article concludes by saying that space was just another avenue for a state to fight its battles and that the competition of nations persisted despite the hopes of idealists.

The experience of the moon race confirms this point as NASA at its inception was all about scoring humanity firsts before the competition. However, with the victory won, McDougall argues the government shed its interest and moved on, still the same ideologically despite the shared experience of the moon landing. But as this study demonstrates, there are other factors to consider. NASA’s position as the darling of a multi-partisan spirit persevered despite the initial unease and through this, NASA still managed to exert some sway in future political situations and, since McDougall wrote his article, a clear legacy of internationalist space exploration has emerged. Moreover, while the article thoroughly evaluates the role of the United States and the Soviet Union, it only glances upon the different needs of other states. While statecraft in the extremes of a bipolar world may have remained arguably static, there is an overwhelming amount of evidence presented here that indicates this did not hold true for other nations. Prestige through “one-upmanship” may be the rule for even less powerful actors but at least in some cases of space exploration, this is subsumed by the need to reach out and cooperate to achieve that end. One of NASA’s most significant effects since 1969 is to play the role of enabler for the space programs of other nations; the competitive spirit is blunted when one is forced to share the victory with another. Furthermore, it is hard to deny the deluge of events that

---

<sup>92</sup> Walter A. McDougall, “Technocracy and Statecraft in the Space Age – Toward the History of Saltation.” *The American Historical Review* 87-4 (1982): 1010-1040.

modified the culture to see the world and space exploration in transnational terms; surely states usually bow to overwhelming cultural pressures. Finally, the budgetary commitment of Congress still grew despite the absence of a real competition.

With this in mind, a focus on the highest levels of state alone does not appear sufficient enough to characterize modern science except in cases where it functions as a homogeneous actor. This might present another somewhat unaddressed problem as it means that the notion of “Big Science” seems to work best only when the state brings to bear the weight of its unified entirety. Since NASA’s history exhibits a condensed period where government interest peaked and sharply declined, we can make several inferences about the big science model. Even though NASA lost its deep budget after 1969, it gained freedom as the disinterested federal government saw no reason to dictate mission goals since there was nothing left to be gained. This is how NASA steadily forged ahead and gained approval from the government to pursue its many international projects in the last forty years and subsequently, evolve separately from the mainline political ideology. At the same time, because the government lost its stake, the institution decelerated and shrunk after a period of being accommodated to the inflated capacity granted by its old central relevance. Because NASA was used to its outsized capacity, it retained and attempted to maintain the momentum of its temporal and fleeting expansion. This quest led NASA to seek collaboration from other bodies with similar objectives. A rough evaluation of other scientific fields suggests that this might be a recurring development. The Superconducting Super Collider (SSC), a political statement planned to be the largest particle accelerator ever built, was abandoned by Congress halfway through construction after the dissolution of the Soviet Union. One of the principle arguments that led to the SSC’s abandonment was that

scientists could instead go to the Europe's planned Large Hadron Collider (LHC) and do the same type of work.<sup>93</sup>

Since World War II, policymakers and historians have claimed that "big science" was a preeminent causal factor in the uncontrollable budget growth of the postwar years.<sup>94</sup> In the case of NASA, this is not true. The immediate and sudden budget cuts prove the state was capable of quickly moving forward. In addition to the loss of full state backing, the congregation of scientific collaborators can disable efforts just as much as it enables. One of the reasons for the ISS's fiscal profligacy is that the Russian space program has failed many of its obligations and contributions.<sup>95</sup> With the most recent timeline for construction, upon completion of the space station, there will only be five years left until its planned termination date. "Big Science" projects that are created without the explicit devotion of the government suffer from a host of limitations. A NASA administrator seemed to recognize the issues in this in a 1998 hearing about NASA's role in the 21<sup>st</sup> century. Speaking of the delays surrounding the ISS, Marcia S. Smith, former executive director for the National Commission on Space opined:

It may be time to reevaluate international cooperation in large space projects... Does international cooperation really achieve cost savings? Should such projects have fewer participants to simplify management? How can political and funding be maintained in each partner country throughout the lifespan of a project? What problems result when space projects are tied to foreign policy agendas?<sup>96</sup>

Despite these misgivings, reliance on international cooperation for space exploration at all levels is here to stay at least in the near future. It is the only resort of an institution cast aside like NASA after the moon landing and it has led to the realization of significant and otherwise

---

<sup>93</sup> Jeffrey Mervis and Charles Seife, "Lots of Reasons, but Few Lessons," *Science* 302-5642 (2003): 38-40.

<sup>94</sup> W. Henry Lambright, "Downsizing Big Science: Strategic Choices," *Public Administration Review* 58-3 (1998): 259-268.

<sup>95</sup> William J. Broad, "Russia is Fumbling Its Contribution to Space Station," *New York Times*, January 27, 1997, New York edition. In 1997, the space station was already a decade overdue. Today, it is still incomplete.

<sup>96</sup> U.S. House. Subcommittee on Space and Aeronautics, Committee on Science. *NASA at 40: What Kind of a Space Program Does America Need for the 21<sup>st</sup> Century?*(HRG-1998-SCI-0024; Date: October 21, 1998). Text in: LexisNexis® *Congressional Hearings Digital Collection*; Accessed: October 25, 2009: 7.

impossible leaps in our understanding of the universe. However, what the long term holds for NASA and space exploration is uncertain. Global cooperation through the relations crafted in the previous decades continues unabated. But space programs from countries, like China<sup>97</sup>, that are outsiders to this network of western first world nations, seem poised to cause a reversion to where space policy once again becomes a preeminent concern of a nationally driven competitive policy.

---

<sup>97</sup> Marc Kaufman and Dafna Linzer, "China Missile Destroys Satellite; Test Raises Fear of Arms Race in Space," *Chicago Tribune*, January 19, 2007, Final edition. Without warning to the rest of the world, the Chinese used a missile to destroy one of its satellites as a test for its space warfare technologies, perhaps creating over 300,000 pieces of orbital debris. Observers questioned in the article saw this disregard as an early development that may lead to an arms race in space again.

## Secondary Sources

### *Books*

Bille, Matt. *The First Space Race: Launching the World's First Satellites*. College Station: Texas A&M University Press, 2004.

Chushichi, Tsuzuki. *The Pursuit of Power in Modern Japan, 1825-1995*. Oxford: Oxford University Press, 2000.

Dawson, Virginia P. and Mark D. Bowles. *Taming Liquid Hydrogen: The Centaur Upper Stage Rocket 1958-2002*. Washington D.C.: National Aeronautics and Space Administration Office of External Relations, 2004.

Ezell, Edward C. and Linda N. Ezell. *The Partnership: A History of the Apollo-Soyuz Test Project*. Washington DC: NASA Special Publications, 1978.

Gimbel, John. *Science, Technology, and Reparations: Exploitation and Plunder in Postwar Germany*. Stanford: Stanford University Press, 1990.

Heppenheimer, T.A. *History of the Space Shuttle*. Washington D.C.: Smithsonian Institution Press, 2002.

Horn, Robert C. *Alliance Politics Between Comrades: The Dynamics of Soviet-Vietnamese Relations*. Santa Monica: University of California Press, 1987.

Lorenz, Ralph and Jacqueline Mitton. *Lifting Titan's Veil: Exploring the Giant Moon of Saturn*. Cambridge: Cambridge University Press, 2000.

Neufeld, Michael J. *Von Braun*. Washington D.C.: Smithsonian Institution Press, 2007.

Westwick, Peter J. *Into the Black: JPL and the American Space Program*. New Haven: Yale University Press, 2006.

Wishnick, Elizabeth. *Mending Fences: The Evolution of Moscow's China Policy, From Brezhnev to Yeltsin*. Seattle: University of Washington Press, 2001.

*Journal Articles*

Cowen, Ron. "Sputnik +50: Remembering the Dawn of the Space Age." *Science News* 172 (2007) 216-217, 221.

Friedman, Herbert. "Adrift in Space." *Proceedings of the American Philosophical Society* 140-1 (1996): 10-21.

Fries, Sylvia D. "Dealing with Crisis: History and the Challenger Disaster." *The Public Historian* 10-4 (1988): 83-88.

Fries, Sylvia D. "2001 to 1994: Political Environment and the Design of NASA's Space Station System." *Technology and Culture* 29-3 (1988): 568-593

Koman, Rita G. "Man on the Moon: The U.S. Space Program as a Cold War Maneuver." *OAH Magazine of History* 8-2 (1994): 42-50.

Lambright, W. Henry. "Downsizing Big Science: Strategic Choices." *Public Administration Review* 58-3 (1998): 259-268.

McDougall, Walter A. "Technocracy and Statecraft in the Space Age – Toward the History of Saltation." *The American Historical Review* 87-4 (1982): 1010-1040.

Turchetti, Simone et al. "On Thick Ice: Scientific Internationalism in Antarctic Affairs, 1957-1980." *History and Technology* 24-4 (2008): 351-376.

## Primary Sources

### *Books*

Morrison David, and Clark R. Chapman. "The Impact Hazard," in *Hazards Due to Comets and Asteroids* edited by Tom Gehrels. Tucson: University of Arizona Press, 1994.

Reeves-Stevens, Judith. *Star Trek: Federation*. New York City: Simon and Schuster, 1995.

Von Braun, Wernher. *The Mars Project*. Urbana: University of Illinois Press, 1962.

### *Congressional Sources*

U.S. House. Committee on Science and Technology. *Investigation of the Challenger Accident (Vol. 1)*. (HRG-1986-TEC-0028; Date: June 10-12, 17, 18, 25, 1986). Text in: LexisNexis® *Congressional Hearings Digital Collection*; Accessed: October 6, 2009.

U.S. House. Subcommittee on Space and Aeronautics, Committee on Science. *Threat and the Opportunity of Asteroids and Other Near-Earth Objects*. (HRG-1998-SCI-0018; Date: May 21, 1998). Text in: LexisNexis® *Congressional Hearings Digital Collection*; Accessed: October 25, 2009.

U.S. House. Subcommittee on Space and Aeronautics, Committee on Science. *NASA at 40: What Kind of a Space Program Does America Need for the 21<sup>st</sup> Century?*(HRG-1998-SCI-0024; Date: October 21, 1998). Text in: LexisNexis® *Congressional Hearings Digital Collection*; Accessed: October 25, 2009: 7.

U.S. Senate. Committee on Aeronautical and Space Sciences. *NASA Authorization for FY74, Part 3*. (HRG-1973-ASP-0007; Date: April 3, 4, 10, 1973). Text in: LexisNexis® *Congressional Hearings Digital Collection*; Accessed: October 17, 2009.

### *Journal Articles*

Frost, Kenneth J. and Frank B. McDonald. "Space Research in the Era of the Space Station." *Science* 226-4681(1984): 1381-1385.

Harris, I., and R. Jastrow. "Density Determinations Based on the Explorer and Vanguard Satellites." *Science* 128-3321 (1958): 420-421.



Healey, Denis. "The Sputnik and Western Defence." *International Affairs (Royal Institute of International Affairs 1994-)* 38 (1958) 145-146.

Holden, Constance. "Random Samples," *Science* 280-5366 (1998): 1013.

Mervis, Jeffrey and Charles Seife, "Lots of Reasons, but Few Lessons," *Science* 302-5642 (2003): 38-40.

Monastersky, Richard. "Space Dust May Rain Destruction on Earth." *Science News* 153-19 (1998): 294.

Travis, J. "Space Station Gains Full House Reprieve." *Science News* 139-24 (1991): 375.

Webb, James E. "Saturn V Is Modern Caravel." *The Science News-Letter* 85-11 (1964): 165-166.

Wilson, T.L. and H.J. Blome. "The Pioneer anomaly and a rotating Gödel universe." *Advances in Space Research* 44-11(2009): 1345-1353.

Wingo, Walter. "Russia's Ladder to the Moon." *The Science News-Letter* 84-20 (1963): 314-315

#### *News paper Articles*

"A New Space Craft Is Named Enterprise." *New York Times*, September 9, 1976, New York edition.

"Endeavour Returns Japanese Satellite to Earth." *New York Times*, January 21, 1996, New York edition.

"European Conference Will Plan Space Effort." *Los Angeles Times*, November 4, 1970, Los Angeles edition.

"Evolution Into Space." *New York Times*, July 20, 1969, New York edition.

"Companies Also Accused With NASA of Waste in Lunar Program." *New York Times*, October 4, 1963, New York edition.

"Man-Made Moon is Held Feasible." *New York Times*, December 6, 1952, New York edition.

“Rocket Sends Syrian and Two Russians on a Space Mission.” *New York Times*, July 22, 1987, New York edition.

“Satellite With Special Telescope Launched in International Mission.” *New York Times*, January, 27, 1978, New York edition.

“Shuttle, With Critical Cargo, Docks With Russian Station,” *New York Times*, May 17, 1997, New York edition.

“Space Shuttle Shown Amid Palmdale Fanfare.” *Los Angeles Times*, September 17, 1976, Los Angeles edition.

“Transcript of Nixon’s Talk on Carrier.” *New York Times*, July 25, 1969, New York edition.

Broad, William J. “Russia is Fumbling Its Contribution to Space Station,” *New York Times*, January 27, 1997, New York edition.

Broad, William J. “U.S.-Russian Space Mission Stumbles, With Delivery Delays at Customs.” *New York Times*, November 29, 1994, New York edition.

Browne, Malcolm W. “Asteroid Is Expected to Make a Pass Close to Earth in 2008.” *New York Times*, March 12, 1998, New York edition.

Browne, Malcolm W. “Astronomers Say New Comet May Be Brightest in Decades.” *New York Times*, March 16, 1996, New York edition.

Browne, Malcolm W. “Comet Pummels Jupiter, Revealing Details.” *New York Times*, July 18, 1994, New York edition.

Browne, Malcolm W. “String-of-Pearls Comet Headed Toward a Crash.” *New York Times*, June 1, 1993, New York edition.

Chandler, David L. “Thank Heavens, Huge Asteroid is Only Passing By.” *Boston Globe Newspaper*, May 18, 1996, City edition.

Clarke, Arthur C. “Killer Comets Are Out There. Now What?” *New York Times*, August 14, 1994, New York edition.

Ferris, Timothy. “Seeking an End to Cosmic Loneliness.” *New York Times*, October 23, 1977, New York edition.

Finney, John W. "Apollo's Success May Bring Fund Cut." *New York Times*, July 30, 1969, New York edition.

Fountain Henry. "Backyard Astronomers Enlist as Foot Soldiers of Astrophysics." *New York Times*, March 18, 1997, New York edition.

Goldstein, Michael. "Sheer Lunacy." *Los Angeles Times*, June 6, 2004, Los Angeles edition.

Gwertzman, Bernard. "Luna 16 Picks Up Rocks From Moon, Heads for Earth." *New York Times*, September 22, 1970, New York edition.

Hill, Gladwin. "Nazis' Scientists Planned Sun 'Gun' 5,100 Miles Up," *New York Times*, June 29, 1945, New York edition.

Holmes, Steven A. "U.S. and Russians Join in New Plan for Space Station." *New York Times*, September 3, 1993, New York edition.

Kaufman, Marc and Dafna Linzer. "China Missile Destroys Satellite; Test Raises Fear of Arms Race in Space." *Chicago Tribune*, January 19, 2007, Final edition.

Leary, Warren E. "En Route To Saturn, A Boost From Earth." *New York Times*, August 17, 1999, New York edition.

Leary, Warren E. "Eye Steady, Space Telescope Starts to See Forever," *New York Times*, May 21, 1990, New York edition.

Leary, Warren E. "Fate of Space Station Is in Doubt As All Options Exceed Cost Goals." *New York Times*, June 8, 1993, New York edition.

Lyon, Richard D. "12.5% Slash in NASA Funding Will Force Sharp Program Cut," *New York Times*, February 3, 1970, New York edition.

Musel, Robert. "European Joint Space Shot Slated." *Los Angeles Times*, February 13, 1966, Los Angeles edition.

O'Leary, Brian. "The Wild Blue Space Shuttle." *New York Times*, January 30, 1971, New York edition.

Sanger, David E. "Many Experts Doubt 'Star Wars' Could Be Effective by the mid 90's." *New York Times*, February 11, 1987, New York edition.

Schweickart, Russell L. "The Sky Is Falling. Really." *New York Times*, March 16, 2007, Late edition.

Stevens, William K. "Scott Urges Restoring Canceled Apollo Flights," *New York Times*, August 13, 1971. New York edition.

Sullivan, Walter. "Space Shuttle Pact With U.S. Expected to Unite Efforts in Western Europe." *New York Times*, September 26, 1970, New York edition.

Toth, Robert C. "Anderson Reproaches Critics of Moon Program." *New York Times*, May 28, 1963, New York edition.

Wilford, John Noble. "Halley's Comet: Scientists Prepare the Welcoming Party." *New York Times*, October 26, 1982, New York edition.

Wilford, John Noble. "Plan to End U.S.-European Space Effort Is Fought." *New York Times*, May 18, 1989, New York edition.

Wilford, John Noble. "Pressure Is Reported on NASA To Make Heavy Cuts in Budget." *New York Times*, November 19, 1971, New York edition.

Wilford, John Noble. "Voyager Heads Towards Planets Despite Snag After Its Liftoff." *New York Times*, August 21, 1977, New York edition.

Wright, Robert A. "NASA Chief Seeks More Funds In '73." *New York Times*, October 3, 1971, New York edition.

### *Popular Magazines*

"Man Will Conquer Space Soon." *Collier's* 129 (1952): 22-36+.

Cooke, Patrick. "The Asteroids are Coming! The Asteroids are Coming!" *Forbes*, September 25, 1995: 126.

Jaroff, Leon. "Dreadful Sorry, Clementine." *Time*, October 27, 1997.

Simberg, Rand. "The Uncertain Future of the International Space Station." *Popular Mechanics*, July 29, 2008.

### *Video*

Bennett, Harve. *Star Trek V: The Final Frontier*. DVD. Directed by William Shatner. Hollywood, CA: Paramount Pictures, 1989.

Hensleigh, Jonathan and J.J. Abrams. *Armageddon*. DVD. Directed by Michael Bay. Burbank, CA: Touchstone Pictures, 1998.

Kimball, Ward. *Man in Space*. DVD. Directed by William V. Skall. Burbank, CA: Walt Disney Pictures, 1955.

Roddenberry, Gene. *Star Trek: Deep Space Nine*. *Star Trek*. CBS Television Distribution. January 3, 1993 – June 2, 1999.

Roddenberry, Gene. *Star Trek: The Motion Picture*. DVD. Directed by Robert Wise. Hollywood, CA: Paramount Pictures, 1979.

Rubin, Bruce J. and Michael Tolkin. *Deep Impact*. DVD. Directed by Mimi Leder. Hollywood, CA: Paramount Pictures, 1998.

### *Websites*

GAO Archive, "Space Station: Impact of the Expanded Russian Role on Funding and Research," General Accounting Office, <http://archive.gao.gov/t2pbat3/151975.pdf>.

Lincoln Laboratory, "LINEAR," Massachusetts Institute of Technology, <http://www.ll.mit.edu/mission/space/linear/>.

NASA. "National Aeronautics and Space Administration FY 2007 Budget Request," NASA, [http://www.nasa.gov/pdf/142458main\\_FY07\\_budget\\_full.pdf](http://www.nasa.gov/pdf/142458main_FY07_budget_full.pdf).

NASA, "Russian Soyuz TMA Spacecraft Details," National Aeronautics and Space Administration ISS committee, [http://www.nasa.gov/mission\\_pages/station/structure/elements/soyuz/spacecraft\\_detail.html#at](http://www.nasa.gov/mission_pages/station/structure/elements/soyuz/spacecraft_detail.html#at).

United States Department of Labor, “CPI Inflation Calculator,” Bureau of Labor Statistics, [http://www.bls.gov/data/inflation\\_calculator.htm](http://www.bls.gov/data/inflation_calculator.htm).

The University of Arizona Department of Planetary Sciences and Lunar and Planetary Laboratory, “HiRISE: High Resolution Imaging Science Experiment,” The University of Arizona, <http://hirise.lpl.arizona.edu>.

The NASA History Foundation, “NASA Leadership and America’s Future in Space,” The National Aeronautics and Space Administration, <http://history.nasa.gov/riderep/begin.htm>.

The Office of Management and Budget, “Outlays by Agency 1962-2014,” The White House, <http://www.whitehouse.gov/omb/budget/fy2010/assets/hist04z1.xls>.

The Office of Management and Budget, “Percentage Distribution of Outlays by Agency,” The White House, <http://www.whitehouse.gov/omb/budget/fy2010/assets/hist04z2.xls>.