

The “Von Braun Paradigm” and NASA’s Long-Term Planning for Human Spaceflight

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In 1994, political scientist and space historian Dwayne A. Day coined the term “von Braun paradigm” to describe what he saw as an entrenched—and counterproductive—NASA long-term strategy for human spaceflight.¹ Roughly speaking, he boiled that strategy down to: space shuttle → space station → Moon → Mars. Day was responding to the ignominious failure of President George H. W. Bush’s Space Exploration Initiative (SEI) from 1989 to 1990, which he, like many others, blamed on the space agency’s penchant for gigantomania in its human exploration program. In response to the presidential announcement on the steps of NASM on the 20th anniversary of Apollo 11, NASA’s 90-day study group advocated building, on the foundation of the Shuttle and then-projected space station, a lunar base and an ambitious spacefaring infrastructure that within 20 or 30 years would lead to a permanent human foothold on Mars. The cost turned out to be politically suicidal: several hundred billion dollars. The 90-day study reprised the Space Task Group report of 1969, which was an almost equally ignominious political failure. From that earlier proposal for a grand (or grandiose) post-Apollo space program, NASA salvaged only a scaled-back version of its first goal: a winged, reusable Space Shuttle.²

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1. © Smithsonian Institution. Portions of this paper have been excerpted from Michael J. Neufeld, “Von Braun and the Lunar-Orbit Rendezvous Decision: Finding a Way to Go to the Moon,” *Acta Astronautica* 63 (2008): 540–550, also © Smithsonian Institution.
 2. Dwayne A. Day, “The Von Braun Paradigm,” *Space Times* (November–December 1994): 12–15; Day expanded that opinion piece in the AAS newsletter as “Paradigm Lost,” *Space Policy* 11 (1995): 153–159. On SEI, see Thor Hogan, *Mars Wars: The Rise and Fall of the Space Exploration Initiative* (Washington, DC: NASA SP-2007-4410, 2007).

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Day traced this strategy back to the German-American rocket engineer Wernher von Braun, of course, specifically the series of articles the space visionary wrote or cowrote in *Collier's* magazine between 1952 and 1954. These laid out his grand vision, which Day argued “had its greatest influence on *how the U.S. space community envisions space*. Von Braun convinced those who worked in the field that space was worthy of a concentrated, integrated human exploration effort.”³ In fact, his vision was controversial from the start, drawing vigorous objections from many rocket engineers, but it was undeniably influential over the long run, especially on spaceflight true believers inside the movement and in the general public.⁴

Since Day coined that term, it has gained a certain currency in space history and policy. Particularly my esteemed NASM colleague, and former NASA Chief Historian, Roger Launius, has both popularized and expanded the use of the “von Braun paradigm” as an analytical term for describing a pattern in American space development. In his book *Space Stations*, Roger increases the list of von Braun’s essential stages to six, including preliminary ones of robotic satellites and nonreusable piloted vehicles. But in the most recent formulation, in his important book with Howard McCurdy, *Robots in Space*, the two posit *five* stages as the core of von Braun’s thought: 1) “Development of multi-stage rockets capable of placing satellites, animals and humans in space; 2) “a large, winged, reusable spacecraft . . . to make space access routine”; 3) “a large, permanently occupied space station” for observing Earth and launching “deep space expeditions”; 4) “human flights around the Moon, leading to the first landings” and eventually to “permanent lunar bases”; and 5) assembling “spaceships in Earth orbit for the purpose of sending humans to Mars and eventually colonizing that planet.” Launius and McCurdy also posit the existence of an anti-von Braun, “Rosen/Eisenhower/Van Allen Alternative,” for a more measured, and more robotic, space program.⁵

The primary aim of this paper will be to examine von Braun’s history of space advocacy carefully, to see how much his ideas actually correspond with the later construct of a von Braun paradigm. My secondary objective is

3. Day, “The Von Braun Paradigm,” p. 12. See also “Paradigm Lost,” p. 154.

4. On the controversy, see esp. Howard McCurdy, *Space and the American Imagination* (Washington, DC: Smithsonian Institution Press, 1997), chap. 2.

5. Roger D. Launius, *Space Stations: Base Camps to the Stars* (Washington, DC: Smithsonian Institution Press, 2002), pp. 26–27; Launius and Howard E. McCurdy, *Robots in Space: Technology, Evolution, and Interplanetary Travel* (Baltimore, MD: Johns Hopkins University Press, 2008), pp. 64–65 (quotes) and chap. 3 (generally).

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to look briefly at the history of later NASA human spaceflight planning to try to discern von Braun’s influence or at least that of his so-called paradigm. My conclusions are 1) that von Braun was not a systematic and consistent space planner, but rather was often driven by enthusiasm and by a Moon obsession that meant he was as interested in going straight to the lunar surface as using the “logical” steps he laid out in *Collier’s*; 2) that although von Braun himself may have been inconsistent, his public advocacy in the 1950s did tend to consolidate a paradigm among space advocates focusing on the *four* main elements of shuttle, station, Moon, and Mars; 3) that while there was always opposition to his plans, the “Rosen/Eisenhower/Van Allen Alternative” is an artificial construct that conflates different ideas from different times; 4) that von Braun’s direct influence, still important in the 1960s, diminishes drastically from the 1980s on; but 5) that the classic four-element von Braun paradigm does seem to have been a shaping factor in NASA’s planning, from the 1969 Space Task Group to the 2004 Vision for Space Exploration. However, its influence was weakest in the latter case, and its persistence may in part be due to other factors, notably the loss of Venus as a feasible destination and the lack of interest (until the 1990s) in asteroids, which tended to foreclose other possible options for human deep space exploration besides the Moon or Mars.

Did von Braun Have a Paradigm?

Von Braun’s career in space advocacy began when he was literally and figuratively in the wilderness in the late 1940s. Relatively underemployed at Fort Bliss, outside El Paso, Texas, when budget cuts forced the U.S. Army to reduce its guided missile projects, including the ones he and his group of about 120 German and Austrian engineers were working on, von Braun sought an outlet for his boundless creative energies. He decided that he needed to sell the American people on spaceflight, so he set out to prove the feasibility of a human expedition to Mars, based on conservative projections of late-1940s technology. Showing how much he was ahead of almost everyone, he felt that it was *too easy* to demonstrate a human Moon landing. But to make his Mars study palatable to the general public, he concluded in 1947 that he had to package it inside a science fiction novel.⁶

6. See Michael J. Neufeld, *Von Braun: Dreamer of Space, Engineer of War* (New York, NY: Alfred A. Knopf, 2007), chaps. 9–10, for elaboration; key sections on the novel are excerpted in Michael J. Neufeld, “‘Space Superiority’: Wernher von Braun’s Campaign for a Nuclear-Armed Space Station, 1946–1956,” *Space Policy* 22 (2006): pp. 52–62.

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By then, von Braun had been making informal plans and back-of-the-envelope calculations for at least 15 years. Arthur Rudolph, later (in)famous as the only member of von Braun's group forced to leave the United States for involvement with concentration camp labor, tells a story of staying up nights at the Kummersdorf officer club in about 1935, calculating trajectories and payloads for a Mars expedition. But von Braun's central obsession was the Moon, specifically leading an expedition to it himself—a dream that seized him as teenager during the German spaceflight fad of the late 1920s. Several anecdotes attest to his continuing fascination with a lunar landing throughout the Nazi period; one or two even speak of a specific proposal, but we have no details as to whether he was speaking of a direct launch from Earth or an assembly in Earth orbit near his space station, another major obsession. He may have contemplated both. Brief comments he made to the press and the public in El Paso, Texas, in winter 1946–47, however, described the station as a “refueling” stop on the way to the Moon.⁷

His plans for a large, rotating, wheel-type space station appear to have developed in parallel to his Moon and Mars ideas. A major influence were the writings of his hero, the German-Rumanian spaceflight theoretician Hermann Oberth, but the wheel format seems likely to have come from the 1929 book by the Slovenian-Austrian Hermann Noordung (pseudonym for Potočnik), although von Braun never acknowledged the influence. From Oberth, von Braun definitely drew his ideas of the station as a superweapon for observing and dominating Earth. Following the revelation of the atomic bomb and his arrival in the United States, he reconceived it as a battle station controlling co-orbiting nuclear missiles; he became convinced that he had the key to defeating the Soviet Union and winning the Cold War. His ill-fated science fiction novel, originally titled *Mars Project: A Technical Tale*, has a fascinating

7. Arthur Rudolph OHI by Michael J. Neufeld, 4 August 1989, NASM Archives; Daniel Lang, “A Romantic Urge,” in *From Hiroshima to the Moon* (New York, NY: Simon & Schuster, 1959), pp. 191–192, originally published in *New Yorker* 21 (April 1951): 75; Peter Wegener, *The Peenemünde Wind Tunnels* (New Haven, CT: Yale University Press, 1996), pp. 41–42; Hans Kehrl, *Krisenmanager im Dritten Reich* (Düsseldorf: Droste, 1973), p. 336; Jak. van den Driesch to Wernher von Braun, 6 January 1969, in U.S. Space and Rocket Center (USSRC), von Braun Papers, file 423-4; Wernher von Braun, “Survey of Development of Liquid Rockets in Germany and Their Future Prospects,” in *Report on Certain Phases of War Research*, by Fritz Zwicky (Pasadena, CA: Aerojet, 1945), pp. 66–72; “German Scientists Plan Re-fueling Station in Sky on Route to Moon,” *El Paso Times* (4 December 1946), copy in NASA KSC archives, Debus collection; Wernher von Braun (Rotary Club speech, 16 January 1947), in USSRC, Huntsville, AL, Wernher von Braun Papers, file 101-3. For more on the history of von Braun's Moon plans, see Neufeld, “Von Braun and the Lunar-Orbit Rendezvous Decision.”

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and disturbing opening, “A.D. 1980.” It is set after the USSR is destroyed by nuclear strikes from his space station, “Lunetta,” a name he treasured from a science fiction story he wrote as a teenage boy. In his early 1950s writings, he discussed using preemptive atomic attacks to protect the station—making the speculation that he was later a model for Dr. Strangelove seem not unjustified!⁸

In order for his station to be useful as a reconnaissance and bombing platform against the Soviets, it had to be in a polar or near-polar orbit, which he set at a 2-hour period at 1,075 miles (later shown to be infeasible when the radiation belts were discovered). This orbit was in the wrong plane for his Mars expedition, which needed to depart in the ecliptic plane of the solar system so as to minimize the energy needed to reach the Red Planet. Thus, in the novel, his gigantic fleet of 10 spaceships, each with a mass of 8.2 million pounds and carrying seven men (and only men) apiece, was *not* assembled next to the station. Temporary living quarters for the work crews were set up inside the Mars ships instead. He thus believed a station was not essential to launching a human Mars expedition, but he took it for granted that it would come first as mankind’s initial foothold beyond Earth.⁹

To orbit 82 million pounds of hardware and propellants (mostly the latter) required a huge logistics operation he developed at length. In the novel, he alludes to an earlier class of “Jupiter” multistage boosters, but for Mars, the “United States of Earth” develops the “Sirius” class, a huge three-stage rocket much squatter and heavier than the later Saturn V. The first and second stages are recovered at sea and reused. The third is the winged rocket freighter that delivers materials and people into orbit. The assumption that humans would fly in craft with wings was not original to him, of course, as space advocates like the Austrians Max Valier and Eugen Sänger had already argued that the transition was most natural from an atmospheric rocket plane to what we

8. Neufeld, “Space Superiority”; Wernher von Braun, “Survey . . . ,” in *Report on Certain Phases of War Research in Germany*, by Fritz Zwicky (Pasadena, CA: Aerojet, 1945), pp. 66–72; Wernher von Braun, “Questions and Answers on A-9, A-10 and A-11,” July 1946, in National Archives, College Park, MD, RG156, E.1039A, file “Ch. II New Material—Revision Material,” box 79; “Giant Doughnut is Proposed as Space Station,” *Popular Science* (October 1951): 120–121; Wernher von Braun, “Crossing the Last Frontier,” *Collier’s* (22 March 1952): 24–28, 72–73, and the accompanying magazine editorial on p. 23, “What Are We Waiting For?”; Wernher von Braun “Space Superiority,” *Ordnance* (March–April 1953): 770–775.

9. The original “Mars Project” typescripts are in USSRC, Wernher von Braun Papers, file 204-7 (German), 205-1 (English); the failed novel was recently published as *Project Mars: A Technical Tale* (Burlington, ON: Apogee Books Science Fiction, 2006); what originally appeared in print was his revised mathematical appendix, Wernher von Braun, *Das Marsprojekt* (Frankfurt, Germany: Umschau, 1952), and *The Mars Project* (Urbana, IL: University of Illinois Press, 1953).

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would now call a space shuttle. To von Braun, wings were needed above all for reentry, as no one had yet conceived of an ablative heat shield for a ballistic return. He pictured a glide halfway around Earth and put active cooling in the wings and nose to prevent them from melting. Of course, landing on a runway also made believable the airlinelike operations needed to fire two giant boosters *per day* and accomplish 950 launches in eight months! Complete reusability and the essential economies it provided were critical to all of von Braun's early spaceflight conceptions, even more critical than a station. It was the only way he could justify the economic feasibility of his monumental space infrastructure.¹⁰

As is well known, von Braun's often woodenly written novel was rejected by something like 18 publishers, but his revised mathematical appendix did appear in German in 1952 and in English in 1953 as *The Mars Project*. By that time, he had made his great breakthrough in the *Collier's* magazine series, together with several other authors, notably his friend Willy Ley. The first issue, on 22 March 1952, and the first book that came out of the series, *Across the Space Frontier*, introduced the public to aesthetically improved versions of his booster and station as redrawn by artists Chesley Bonestell, Fred Freeman, and Rolf Klep. The magazine endorsed von Braun's militant Cold War argument for using the space station to establish "space superiority" over the Soviet Union. In two more issues in October 1952, and in the spinoff book, *Conquest of the Moon*, von Braun presented his conception of the first lunar expedition, which involved three ships and 50 men and took six months to assemble in the space station's polar orbit. He reveled in imagining huge space voyages, but he was far from committed to it as the only strategy, as he earlier and later discussed small, direct expeditions to the Moon.¹¹

The popularity of the space issues caused *Collier's* and its series editor, Cornelius Ryan, to put off the projected Mars number and ask von Braun and some of the other collaborators to generate articles on the training and preparation of "space men" (the word "astronaut" was not then used for that

10. Wernher von Braun, *Project Mars*, pp. 23, 113–120, 215–31; Wernher von Braun, *The Mars Project*, pp. 9–36.

11. Neufeld, *Von Braun*, pp. 246–247, 251–269; Neufeld, "Space Superiority"; Wernher von Braun, "Crossing the Last Frontier," *Collier's* (22 March 1952): 24–28; Wernher von Braun, "Man on the Moon: The Journey," *Collier's* (18 October 1952): 24–28, 51–58, 60, 72–73; Wernher von Braun (with Fred L. Whipple), "Man on the Moon: The Exploration," *Collier's* (25 October 1952): 38–40, 42, 44–48; Cornelius Ryan, ed., *Across the Space Frontier* (New York, NY: Viking, 1952) and *Conquest of the Moon* (New York, NY: Viking, 1953). On von Braun's other Moon plans, see Neufeld, "Von Braun and the Lunar-Orbit Rendezvous Decision," and footnote 6 in this chapter.

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Figure 1: Von Braun in 1955 against the backdrop of a famous Chesley Bonestell painting from the first *Collier's* space issue of 1952. He is holding a model of the Disney version of his winged space shuttle. U.S. Army photo courtesy of NASM

purpose). In the spring of 1953, Ryan also asked von Braun to speculate on space exploration before humans went up. Von Braun produced an article on a biological satellite he called the “baby space station,” in which several monkeys would spend two months in weightlessness before being euthanized prior to satellite burnup. Even the three-stage expendable booster he proposed for this mission was 150 feet high and 30 feet in diameter at the base.¹² Prior to this time, he had taken little interest in the preliminary stages of space exploration and thought not at all about robotic spaceflight. His Mars expedition is the first mission of any kind to the Red Planet. He had little faith that spacecraft would work without humans on board to fix them, and he was simply uninterested in any other form of exploration. For him, as for other space advocates of his generation, sending humans was the point.

12. Wernher von Braun (with Cornelius Ryan), “Baby Space Station,” *Collier's* (27 June 1953): 33–35, 38, 40; Neufeld, *Von Braun*, pp. 272–273.

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Yet, at almost the same time, von Braun conceived in the classified world an absolute “minimum” satellite booster and craft, dubbed “Orbiter” in late 1954, using his new Redstone ballistic missile as the first stage. The satellite in its initial version would have been only a 5-pound inert ball or balloon.¹³ Writing von Braun’s biography, I was struck by the apparent contradiction in his character: on the one hand he reveled in gigantism when he conceived of the space future, and on the other he was a very conservative rocket engineer. He and his Army group were *not* on the cutting edge of missile propulsion or structures in the 1950s because of that engineering conservatism. He had two sides: a vivid imagination that led him into romanticism and a deep-seated pragmatism that shaded into naked opportunism; but he did not see it as a contradiction, as he expected that small, practical steps in the near term would lead quickly to the glorious future he imagined.

The *Collier's* series ended in April 1954 with the much-delayed Mars issue. By then von Braun was already moving beyond his original *Mars Project* conceptions. He had come under attack from his colleagues in the American Rocket Society for gigantomania, and his associate Ernst Stuhlinger was studying ion propulsion for interplanetary voyages. But his busy schedule meant that he did not want to rethink his 10-ship expedition in 1954. When von Braun, Ley, and Bonestell’s book version, *The Conquest of Mars*, was finally published two years later, however, he cut the expedition back to two ships, in response to criticism, but stuck with chemical propulsion.¹⁴

In the interim, the Walt Disney Company had become interested in space-flight for its new television series and hired von Braun and Ley to be its consultants and on-screen spokesmen, along with an ex-German space medicine expert. Disney presented to a television audience of millions between 1955 and 1957 yet another version of von Braun’s vision: giant booster with winged spacecraft, orbiting wheel station, Moon exploration (a preliminary circumlunar voyage in this case), and a Mars expedition (using Stuhlinger’s solar-powered, ion-engine ships). It is fair to say that Disney helped solidify a “von Braun paradigm” of four main elements (shuttle, station, Moon, Mars) in the minds

13. Michael J. Neufeld, “Orbiter, Overflight and the First Satellite: New Light on the Vanguard Decision,” in *Reconsidering Sputnik: Forty Years Since the Soviet Satellite*, ed. Roger D. Launius, John M. Logsdon, and Robert W. Smith (Amsterdam, Netherlands: Harwood Academic Publishers, 2000), pp. 231–257.

14. Wernher von Braun (with Cornelius Ryan), “Can We Get to Mars?,” *Collier's* (30 April 1954): 22–29; Willy Ley, Wernher von Braun, and Chesley Bonestell, *The Exploration of Mars* (New York, NY: Viking, 1956); Neufeld, *Von Braun*, pp. 270–272, 275–277, 286; Tom D. Crouch, *Rocketeers and Gentlemen Engineers* (Reston, VA: AIAA, 2006), pp. 134–137.

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of the public, which was now more likely to believe that spaceflight would soon become a reality.¹⁵

One interesting lacuna no one ever talks about is the virtual absence of Venus in the *Collier’s*-Disney popularizations of von Braun et al. Here was a planet almost exactly the same size as Earth and actually slightly closer and more accessible than Mars, and one also the frequent subject of science fiction, both written and filmed. Science fiction movies (mostly bad) about landing on Venus continued to be made into the 1960s. One popular speculation was that there must be a steamy swamp world under the impenetrable blanket of clouds, as the planet was closer to the Sun. It was not until Mariner 2’s flyby in December 1962 that we knew for certain that the beautiful evening and morning star was actually a hellish world with temperatures hot enough to melt lead. The causes of this neglect by von Braun and his compatriots are not far to seek: the Western cultural obsession with Mars that had flourished since telescopes improved our view in the late 19th century, showing an apparently Earth-like planet with probable life, as opposed to the blank white mystery of Venus. Von Braun’s *Mars Project* novel featured an updated version of Percival Lowell’s Red Planet with canals designed by an older, superior civilization to move water from the polar caps to its cities. It is unclear how much he still believed in a Lowellian Mars in the 1950s, but he clearly had become deeply fascinated by the idea in his youth and never completely lost it thereafter.¹⁶

Shortly before the first broadcast of the last Disney program in December 1957, the program about Mars, the Soviets launched two Sputniks. Von Braun immediately proposed a crash project that bore no resemblance to the winged vehicle he had recently depicted as the necessary first step in human space travel. To launch a man (I use the term advisedly) as soon as possible, he argued for using a Redstone to lob a fairly primitive capsule on a brief suborbital flight. Called “Man Very High” and then “Project Adam” (for “first man”), this idea was famously dismissed by NACA Director Hugh Dryden in the spring of 1958 as having “about the same technical value as the circus stunt of shoot-

15. Neufeld, *Von Braun*, pp. 284–290, and for the impact of *Collier’s* and Disney on the public, see esp. McCurdy’s seminal *Space and the American Imagination*.

16. Robert Markley, *Dying Planet: Mars in Science and the Imagination* (Durham, NC/London, U.K.: Duke University Press, 2005), esp. pp. 2–3, 21–22; Wernher von Braun, *Project Mars*; Neufeld, *Von Braun*, pp. 28–29; Launius and McCurdy, *Robots*, pp. 66, 271n11. I have found a single reference to Venus in the *Collier’s* series, in a Wernher von Braun answer to a question in a “Space Quiz” of miscellaneous information put together by the editors, *Collier’s* (22 March 1952): 38. He states that a space station would have to be built around Venus before humans could land there.

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ing the young lady from the gun.” But the idea quickly reappeared, albeit as part of a technically more sophisticated NASA program, Mercury, for putting a man into orbit.¹⁷

Soon thereafter, von Braun outlined a direct trip to the Moon in a popular magazine. His fame magnified by his central role in launching the first American satellite, he was finally able to realize his frustrated ambitions as a science fiction writer. In the fall of 1958 and spring of 1959, the Sunday newspaper supplement *This Week* published his novella, *First Men to the Moon*, in four parts, detailing a two-man expedition to that body using a huge rocket and a direct launch from Earth. Turning around as it approached the Moon, his spacecraft ignited a landing stage to alight on the lunar surface without going into orbit; that stage provided the launch platform for the two astronauts in their winged reentry vehicle to propel themselves back to Earth. It seems likely that this concept went back to some of his original German ideas, as one anecdote of the Nazi period indicates he was thinking of a two-man expedition. The story was skillfully illustrated by one of his *Collier's* collaborators, Fred Freeman. Padded with popular science material on spaceflight, it appeared as a short book in 1960. That same year, the magazine published a modified excerpt from his failed Mars novel, depicting the encounter between his adventurers and the inhabitants of the Red Planet.¹⁸

At almost exactly the same time as *First Men to the Moon* was first published, from 1958 to 1959, von Braun and his Army associates developed their first detailed lunar exploration plans. The context was the red-hot space race, interservice rivalry with the U.S. Air Force, and a search for missions for their new Saturn launch vehicle, then going into development. It would combine eight engines in the first stage for an unprecedented 1.5 million pounds (6.67 million newtons) of thrust. Lacking the authority to develop the gigantic launcher needed for direct ascent, which NASA would soon call Nova, and needing to justify Saturn, von Braun and his advanced missions people, Ernst Stuhlinger and H. H. Koelle, favored assembling and fueling the lunar landing vehicle in orbit around the home planet using many launches. This was the conservative approach that von Braun advocated to NASA at the end of 1958 when trying to sell Saturn, and it came up again

17. Dryden quoted in Neufeld, *Von Braun*, p. 329.

18. “First Men” corr. in USSRC, Wernher von Braun Papers, file 200-31; Wernher von Braun, *First Men to the Moon* (New York, NY: Holt, Rinehart and Winston, 1960); Klaus H. Scheufelen, *Mythos Raketen: Chancen für den Frieden. Erinnerungen* (Esslingen, Germany: Bechtle, 2004), pp. 82–83.

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in Project Horizon, an Army lunar base study carried out in 1959. These studies helped shape NASA’s long-range plan of that year, which rated an accelerated human circumlunar voyage as a goal at least as important as an Earth-orbital station. It was the first step on the road to a rush trip to the lunar surface to beat the Soviets. Von Braun, as a lifelong Moon obsessive, was thrilled at the possibility, and even more so after Kennedy made it real in 1961. He was quite willing to postpone the shuttle and station until later. He was, as we have seen, a romantic not rigidly committed to the plans laid out in *Collier’s* and Disney.¹⁹

With the completion of his group’s transfer to NASA in July 1960, von Braun’s days as a visionary were essentially over. He spent the next decade as the Director of MSFC and as chief salesman for the Agency’s programs, primarily Apollo-Saturn. While he made suggestions for, and critiqued, many NASA-funded studies of space stations and lunar and planetary exploration, the ideas were no longer really his. His influence stemmed largely from the impact of *Collier’s* and Disney on a generation of rocket engineers and space enthusiasts. I will explore further the impact of his ideas on NASA planning below.

Thus I agree with Day and Launius; there was indeed a von Braun paradigm that was a product of his popular activities in those two media outlets in the 1950s, and I agree with Day that it consisted of only four fundamental elements. The addition of one or two preliminary stages does not correspond to von Braun’s very limited public discussion of the early phases of spaceflight in public (consisting essentially of one solicited article on the “baby space station”), nor to his disinterest in robotic probes and his obsession with monumental human exploration. I might add that he was not rigid either in describing the relationship between the stages, especially in the case of the space station, which did not always have to serve as a base for launching lunar and planetary expeditions and did not necessarily have to come before going to the Moon.

In short, one must distinguish between von Braun and the von Braun paradigm, as there were several von Brauns. One was the pragmatic and

19. Courtney G. Brooks, James M. Grimwood, and Loyd S. Swenson, Jr., *Chariots for Apollo: A History of Manned Lunar Spacecraft* (Washington, DC: NASA SP-4205, 1979), pp. 4–6; Frederick I. Ordway III, Mitchell R. Sharpe, and Ronald C. Wakeford, “Project Horizon: An Early Study of a Lunar Outpost,” *Acta Astronautica* 17 (1988): 1105–1121; NASA, “The Long Range Plan of the National Aeronautics and Space Administration” in *Exploring the Unknown*, ed. John M. Logsdon, vol. 1, *Organizing for Exploration* (Washington, DC: NASA SP-4407, 1995), pp. 377–378 (introduction), 403–407 (document).

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conservative engineering manager who had a burning desire to accomplish something right now (especially if he could put his name on it) and proposed short-term, “quick fix” programs like Orbiter and Adam. Another was the Moon obsessive fascinated by traveling there, if possible personally, with the result that he privately worked out what it would take to make a direct trip as early as the 1930s. It led him, I think, into a Faustian bargain with the Nazis.

What of Launius and McCurdy’s “Rosen/Eisenhower/Van Allen Alternative”?²⁰ As indicated earlier, I do not believe it is a useful analytical device. It conflates criticism of von Braun, the von Braun paradigm, and large-scale human spaceflight made at different times for different reasons. I will take the three named protagonists in turn.

Milton Rosen served as chief engineer for NRL’s Viking and Vanguard programs and made himself famous in October 1952 for debating von Braun at the Hayden Planetarium in New York. At issue was von Braun’s March *Collier’s* proposals for a giant booster and nuclear-armed battle station. Rosen expressed a widespread feeling among engineers in the American Rocket Society, who thought that the German’s grandiose plans were infeasible and would prove a massive distraction from urgent guided-missile work; indeed, von Braun’s plans were a threat to national security. Rosen and his American Rocket Society compatriots were in part misled by von Braun’s, and the magazine’s, disinterest in describing the preliminary stages of spaceflight and by von Braun’s willingness to paint a grand picture to sell the public on space, even as he acted in his day job as a rocket engineer every bit as conservative as they were. After Sputnik, Rosen would become as caught up in the space race as anyone else. He advocated building the gigantic Nova launch vehicle for a “direct ascent” mission to land on the Moon, even after von Braun and other NASA engineers had already switched to Earth-orbit or lunar-orbit rendezvous as the way to go during Apollo. So he will hardly serve as the leading name in a united front of anti-human-spaceflight advocates.²¹

President Dwight Eisenhower’s secret motives in establishing the first scientific satellite project as a stalking horse for a reconnaissance satellite are now well known, as is his public, post-Sputnik attempt to contain the growth rate of space spending. Motivated by traditional fiscal conservatism, he was worried that human spaceflight programs would grow so large as to add mas-

20. Launius and McCurdy, *Robots*, pp. 64–70.

21. Rosen OHI by Michael J. Neufeld, 24 July 1998, NASM Archives; “Journey into Space,” *Time* (8 December 1952): 62–64, 67–70, 73; Crouch, *Rocketeers*, pp. 134–137.

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sively to a national debt already ballooned by the Cold War and nuclear arms race. He was often exasperated by the now German-American’s penchant for loud public speaking on behalf of such programs. Eisenhower’s vision for NASA, as Launius, McCurdy, and others have detailed, was of an Agency with a billion-dollar-a-year budget focusing mostly on robotic spacecraft for applications and exploration. It was a vision quickly overthrown by Kennedy and Johnson, who quintupled NASA’s budget.²²

James Van Allen was an Iowa physicist forever linked to von Braun by the iconic picture of the three holding up a replica of Explorer I on the night the first United States satellite was launched (the third was the Director of JPL, William Pickering). Several months later, he became even more famous as the discoverer of the radiation belts because of his Explorer experiment. His opposition to expensive human spaceflight programs grew up as a result of Apollo and the perceived lack of meaningful science return for the money expended, as opposed to the output of robotic exploration of Earth’s cosmic environment and deep space. He became the most vocal spokesman, mostly from the 1970s on, for the skepticism about human spaceflight in the scientific community, an attitude still common there today. Van Allen’s vision of NASA’s ideal program thus bears resemblance to Eisenhower’s, but his motivation was rather different.²³

In sum, there has been opposition to von Braun’s ideas, the von Braun paradigm, and large-scale human spaceflight from the beginning until now, but it is more differentiated and complex than is easily encapsulated in a single “alternative.” It bears some resemblance to the more complex reality of von Braun and his paradigm, which I have outlined above, and deserves further study. But I will turn my attention back to the last part of my examination of the paradigm thesis, that of its apparent influence on later planning.

22. Walter A. McDougall, . . . *The Heavens and the Earth: A Political History of the Space Age* (New York, NY: Basic Books, 1985); David Callahan and Fred I. Greenstein, “The Reluctant Racer: Eisenhower and U.S. Space Policy,” in *Spaceflight and the Myth of Presidential Leadership*, ed. Roger D. Launius and Howard E. McCurdy (Urbana/Chicago, IL: University of Illinois Press, 1997), chap. 1.

23. Abigail Foerstner, *James Van Allen: The First Eight Billion Miles* (Iowa City, IA: Iowa University Press, 2007), pp. 250–257. On p. 66 of *Robots*, Launius and McCurdy speak of Eisenhower adopting the “Rosen-Van Allen point of view.” I doubt there is any evidence that he paid attention to Rosen’s ideas as reported in *Time* back in 1952, and Van Allen had not started campaigning yet at the time of Eisenhower’s decision-making on space, from 1955 to 1960. The only Van Allen references they give in the endnotes on p. 271 date to the 1980s. Eisenhower’s scientific advisers, notably George Kistiakowsky and James Killian, were likely the sources of his arguments for the superiority of scientific satellites.

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My analysis of this topic will be briefer, primarily because I have not done the depth of research equivalent to my work on von Braun. The topic is large and sprawling, covering as it does nearly a half century of NASA plans; I will leave detailed examination to others. My primary purpose is to try to test the other part of Day's original thesis, as extended and amplified by Launius and McCurdy, namely, that the von Braun paradigm has exercised a profound influence on NASA's vision for human spaceflight after Apollo, pushing the Agency to build large, expensive programs focusing on the four main objectives: shuttle, station, Moon, and Mars. There have been three milestone events, the Space Task Group (STG) of 1969, the SEI of 1989, and the Vision for Space Exploration of 2004, the first two of which motivated Day's thesis. There have also been less visible proposals and studies, notably two not long before the SEI: the 1986 National Commission on Space and the 1987 Ride Report, neither of which fit neatly the paradigm thesis.

The first of these three major events, the STG, can be interpreted as an attempt to return to the script of the von Braun paradigm after the Moon landing, and it was the only one on which von Braun exercised any direct influence. Shortly after President Richard Nixon's inauguration, which came only weeks after the spectacular circumlunar voyage of Apollo 8, he asked Vice President Spiro Agnew to produce a proposal for a post-Apollo NASA program. The STG's direction and content were largely driven by Administrator Thomas Paine, who had a strong ally in the Vice President, a former Maryland governor with zero space expertise. Paine, an engineer who fondly remembered the *Collier's*-Disney series and was a fan of von Braun, was determined to exploit the Apollo success to get the maximum program he could out of the political system, which he pictured in classic paradigm fashion as a large human spaceflight program culminating in a Mars landing. When the Associate Administrator for Manned Spaceflight, George Mueller, produced an "integrated program plan" that spring for a shuttle, station, and cislunar nuclear shuttle to support continuing Moon exploration, Paine asked von Braun's Center to add a Mars expedition using those elements.²⁴

The MSFC Director gave a famous viewgraph presentation to the STG and to a Senate committee in early August 1969, just two weeks after Apollo 11. It

24. Paine OHI by Logsdon, 12 August and 3 September 1970, file 4185, NASA History Division; David S. F. Portree, *Humans to Mars: Fifty Years of Mission Planning, 1950–2000* (Washington, DC: NASA SP-2001-4521, 2001), pp. 47–48; Heppenheimer, *Space Shuttle Decision*, pp. 159–174.

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Figure 2: President Richard Nixon announces NASA Acting Administrator Thomas Paine's nomination as Administrator on 5 March 1969. Vice President Spiro Agnew is on the right. Agnew and Paine would push an ambitious shuttle-station-Moon-Mars strategy for the post-Apollo space program that Nixon refused to support. *NASA Image 69-H-225*

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audaciously gave an exact date in November 1981 for the departure of such an expedition from Earth orbit. He did so, I believe, in spite of harboring doubts about Paine's risky strategy. Before the Administrator's request, he had not pushed a human Mars program, knowing that public opinion was unlikely to support it. A year later, no doubt influenced by hindsight, he told political scientist John Logsdon: "I have never in the last two or three years strongly promoted a manned Mars project People . . . have tried to cast me in the image . . . of the Mars or bust guy in this agency, which I am definitely not." A little earlier in the interview, he said: "I, for one, have always felt that it would be a good idea to read the signs of the times and respond to what the country really wants, rather than trying to cram a bill of goodies down somebody's throat for which the time is not ripe or ready."²⁵

Like many in NASA's human spaceflight establishment, he thought a space station more salable and was committed to it as necessary infrastructure. A winged shuttle, an idea strongly pushed by Mueller in the late 1960s, von Braun and his counterparts conceived largely as a station adjunct, a logistics vehicle needed to transfer crew and cargo (the station components themselves would be launched on a Saturn V or other heavy-lift vehicle). With the almost instantaneous failure of Paine and von Braun's Mars initiative in the summer of 1969, followed by the slow death of the fall STG report, which laid out shuttle-station-Moon-Mars proposals differing only in timetable, it was the station and shuttle agenda NASA returned to. But the station's purpose was unclear to the politicians and gained no traction with the public. In the end, only the Space Shuttle, oversold as a vehicle that would revolutionize the economics of spaceflight, was politically feasible in the brutal post-Apollo budgetary environment. As the other elements of a big human program faded into a vague and distant future, the Shuttle became for a decade an end in itself—not so much a space policy as an excuse not to have one.²⁶

None of what transpired in the STG and its aftermath obviously conflicts with the von Braun paradigm thesis. The NASA human spaceflight establish-

25. Wernher von Braun OHI by Logsdon, 25 August 1970, file 2629, NASA History Division.

26. Joan Hoff, "The Presidency, Congress, and the Deceleration of the U.S. Space Program in the 1970s," in *Spaceflight*, ed. Launius and McCurdy, pp. 98–100, 103–104; STG report, September 1969, in *Exploring the Unknown*, ed. Logsdon, vol. 1, *Organizing for Exploration*, pp. 522–543. The STG report covers actually a much larger spectrum of space policy, including space science and military space projects, so the centrality of the von Braun paradigm is not so easily visible there. Yet the emphasis placed on a big human program leading to Mars is clear in the emphasis Paine put on it that summer of 1969.

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ment seems to have accepted the centrality of the four basic elements (the scientific and robotic spacecraft communities were another matter). If I have any second thoughts about the thesis as it applies to this episode, it is that the solar system itself seemed to foreclose other options for near-term human exploration, at least within the framework of discussion before 1975. With the 1962 confirmation that Venus was uninhabitable, there was apparently no place else to go after the Moon. There had been discussion of human flybys of Venus in the 1960s, but only because certain Mars trajectories required a gravity-assist from the second planet in one direction or the other. As robotic missions to the planets succeeded, the scientific return of human planetary flybys seemed scarcely credible for the expense anyway. Human spaceflight advocates were still fixated on the colonization of planetary surfaces, based on the analogy of the voyages of world exploration, and in the United States, especially, of the western frontier. But it would be hard to attribute that exploration and colonization focus primarily to von Braun or the paradigm, as it was embedded in the assumptions of the space travel movement since its origins. Similarly, the winged Space Shuttle had a long prehistory in space advocacy based on the analogy of aeronautics. So if the von Braun paradigm has any analytical meaning, it has to be in the centrality of the four elements, probably in the usual order, but not necessarily rigidly linked to each other.²⁷

In the 1970s and 1980s, however, other options for human exploration of the inner solar system appeared. Gerard O’Neill popularized the idea of huge space colonies at the libration points of the Earth-Moon system, based on mining of the Moon and building solar-powered satellites for Earth. Robert Farquhar demonstrated, with the robotic spacecraft ISEE-3, the feasibility of libration-point halo orbits and the possibilities of exotic trajectories when he used lunar swingbys to send it to a comet. The growing concern in the 1980s and after about the threat of asteroid and comet impacts focused attention on those possible targets for human missions.

This changing context had a visible impact on the 1986 National Commission on Space, led by ex-Administrator Paine, which attempted to produce a new space policy for the Reagan administration. In its ill-timed report, which appeared just after the Shuttle *Challenger* accident, Paine’s group once again painted a vision of a massive human spaceflight program. Paine even inserted a visual salute to von Braun as the frontispiece: a reproduction of the classic

27. Portree, *Humans*, pp. 20, 26, 32, 37; McCurdy, *Space and the American Imagination*, chap. 6; Launius and McCurdy, *Robots*, pp. 55–61.



Figure 3: On 20 July 1989, at NASM, President George H. W. Bush announces the SEI, a new attempt to implement the von Braun paradigm. Among those present were the Apollo 11 crew, Vice President Dan Quayle, and NASA Administrator Richard Truly. *NASA Image 89-H-380*

Bonestell painting of the shuttle, station, and space telescope from *Collier's*, paired with a modern version of the same trio painted by Robert McCall. But as O'Neill was a member of the National Commission on Space, the report also broke somewhat with the paradigm in discussing space colonies and libration-point missions. That only added to its flavor of impractical utopianism, and it was quickly dismissed in Washington. NASA instead commissioned astronaut Sally Ride to produce a report. Her group also strayed somewhat from the paradigm in 1987 by proposing a robotic "Mission to Planet Earth" as one focus and discussing an option of going straight to human Mars missions without necessarily going back to the Moon, although a lunar base was also an option.²⁸

So why did the classic von Braun paradigm apparently reappear only two years later in George H. W. Bush's SEI and the 90-day study NASA produced in response to it? Part of the reason was that in the meantime, NASA had sold

28. United States National Commission on Space, *Pioneering the Space Frontier: The Report of the National Commission on Space* (New York, NY: Bantam Books, 1986); Portree, *Humans*, pp. 67–75; Hogan, *Mars Wars*, pp. 27–32.

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the Space Station to President Reagan from 1983 to 1984 at the apogee of early Shuttle optimism. The Station decision might be interpreted as another return to the traditional script, as one of its missions would be to support later lunar and planetary exploration. When President Bush cast about for an ambitious new space policy in 1989, NASA engineers and managers from the human spaceflight side were the primary influences on the staff of the new NSC, which was headed by his Vice President, Dan Quayle. Bush’s SEI speech singled out the Station, Moon bases, and Mars outposts explicitly, linking them together as stepping-stones, letting Agency engineers and space planners off the hook for even bothering to think about another strategy. It should be added that if a big human program was viewed as foundational, the lack of other targets—or at least the ability to imagine other targets—remained fundamental. By the end of the 1980s, the fad for O’Neill’s space colonies had faded as their utopian character became clear; they would have to follow extensive lunar colonization anyway. The asteroid and comet impact issue had not yet risen to the level of public interest it would in the 1990s, when it resulted in two Hollywood movies. So an entrenched mindset at NASA that might be described as the von Braun paradigm appears central to SEI and its rapid failure, reinforced again by the apparent lack of any other place to go with humans.²⁹

In contrast to the Space Task Group, however, von Braun (who had died in 1977) was essentially invisible in this episode. Bush did not mention him, nor did anyone in the Agency invoke his name much.³⁰ Since it is difficult to prove a negative—why von Braun’s name was absent—I can do little but offer speculative explanations. Primarily, I think, he already was a figure from the distant past by 1989, as his last substantive ideas were formulated three decades earlier. The growing controversy about his Nazi past in the late 1980s might also have made his name somewhat “politically incorrect,” at least outside his hometown of 20 years, Huntsville, Alabama, where even now denial is the order of the day. Following the October 1984 revelation that Arthur Rudolph had voluntarily left the United States and renounced his citizenship to avoid a

29. Hogan, *Mars Wars*, chaps. 3–5; Portree, *Humans to Mars*, chap. 9; copy of Bush speech, 20 July 1989, file 9008, NASA Historical Reference Collection, NASA History Division, NASA Headquarters, Washington, DC.

30. The study NASA did in response to the Bush speech does mention von Braun’s name once as a precursor in planning, attributing to him the 1969 plan; see “Report of the 90-Day Study . . .,” November 1989, page 2-1, in NASA History Division, file 17922, and the viewgraph summary by Mark Craig, 18 January 1990, in file 9007. Similarly, von Braun gets a single mention under “Mission Scenarios” in an earlier NASA briefing for NSC and OMB staff: Franklin Martin, “Exploration Background Briefing . . .,” 25 August 1989, file 17923.



Figure 4: President George W. Bush speaks at NASA Headquarters on 14 January 2004 on the Vision for Space Exploration. It would depart from the classic von Braun paradigm, notably in ending the Space Shuttle Program and marginalizing the Space Station. *White House Official Photo P-37074-33*

denaturalization hearing over his involvement with concentration camp labor, newspapers around the world ran major stories. Subsequently, investigative journalists dug up a lot of dirt on the Third Reich records of von Braun and his key associates. Always a problematic hero, he posthumously became a touchy problem for NASA.³¹

The failure of the SEI put NASA long-term human spaceflight planning once again on the back burner. Faced with the unpopularity of more ambitious objectives, Agency leaders circled the wagons around Space Station

31. The most important pre-1989 publications on the Nazi issue were Linda Hunt, "U.S. Coverup of Nazi Scientists," *Bulletin of the Atomic Scientists* (April 1985): 16–24, and Tom Bower, *The Paperclip Conspiracy: The Battle for the Spoils and Secrets of Nazi Germany* (London, U.K.: Michael Joseph, 1987). Hunt appeared on CNN pursuing von Braun team members in their Huntsville driveways, and Bower had a major special on the PBS-TV program *Frontline* in early 1988. On von Braun's record in particular, see Michael J. Neufeld, "Wernher von Braun, the SS, and Concentration Camp Labor: Questions of Moral, Political, and Criminal Responsibility," *German Studies Review* 25 (2002): 57–78. Monique Laney is studying the history of the Germans in the city and its connection to the memory of the Nazi rocket program; see "'Operation Paperclip' in Huntsville, Alabama," in *Remembering the Space Age*, ed. Steven J. Dick (Washington, DC: NASA SP-2008-4703, 2008).

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Freedom, as it was then called, to protect NASA’s budget and human spaceflight establishment. New planning began only at the end of the 1990s, late in the term of Administrator Daniel Goldin. In the meantime, Red Planet enthusiasts like Robert Zubrin and his Mars Society had popularized an alternative they called “Mars Direct”—rejecting the Moon as a way station and emphasizing the exploitation of in situ resources to avoid the massive infrastructure of the von Braun approach. Zubrin explicitly criticized the German-American.³² Inside NASA, the Decadal Planning Team, as Goldin dubbed it, did consider whether to skip the Moon and whether the now-ISS was a worthwhile investment. But it was not until the crisis provoked by the Shuttle *Columbia* disaster in early 2003 that a new space policy could emerge under President George W. Bush.³³ While it is too early to analyze this process in detail as the first historical work is only now being done, what emerged as the Vision for Space Exploration in 2004 was in some ways the anti-SEI. Big budget increases and any global money numbers that might be politically toxic were to be avoided; the Shuttle and Station were de facto rejected. The Columbia Accident Investigation Board had already recommended phase-out of the Shuttle as dangerous; the gigantic cost overruns and lengthy delays of the ISS had left a bad taste in everyone’s mouth. One way of financing a new human space program on the cheap was to try to get out of those two obligations as soon as possible. However, the international dimensions and sunk cost of the ISS made it impossible for the United States to get out of the Shuttle quickly or abandon the Station entirely, and sending humans to Mars was simply impractical based on existing technology—targets closer to home were needed to test the new spacecraft and habitation modules. Under the new Administrator, Mike Griffin, the Explorations Systems Architecture Study in 2005 brought the Moon back to the fore as the next critical objective; Mars quickly began fading into the background.³⁴

Do all these developments mean that the von Braun paradigm is dead or has little influence any longer? How one answers that question depends a great

32. For a later version, see Robert Zubrin, *The Case for Mars: The Plan to Settle the Red Planet and Why We Must* (New York, NY: Touchstone, 1997), pp. 47, 66.

33. I am indebted to Glen Asner and Stephen Garber, former and current historians at NASA, respectively, for lending me drafts of chapters from their forthcoming history of the Decadal Planning Team and Vision for Space Exploration. What I know of this history depends heavily on them. For Bush’s space policy statement, see NSPD 31, 14 January 2004, file 12886, NASA Historical Reference Collection, NASA History Division, NASA Headquarters, Washington, DC, virtually the only primary document available in these files as of October 2008.

34. *Exploration Systems Architecture Study: Final Report* (Washington, DC: NASA TM-2005-214062, 2005), chap. 1, electronic copy courtesy of Glen Asner and Stephen Garber.

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deal on how one defines the term, which is slippery when one gets past the fundamentals of a massive human spaceflight infrastructure and shuttle → station → Moon → Mars. If we have already built the Space Shuttle and International Space Station, does it matter if we dump them as long as we follow the allegedly logical order of the four steps? Von Braun would never have expected the first two to be abandoned, seeing them as necessary infrastructure for human spaceflight, but then he did not link the steps rigidly either—at least in the case of the Station, which might or might not serve as an orbital base for construction of interplanetary ships. What one can say is that the paradigm has weakened as an entrenched mindset in the NASA human spaceflight establishment; the disillusionment with the reusable space plane is the most visible sign of that. But not all aspects of the paradigm are dead. Even though I am a Moon buff, having grown up in the 1960s, and think there is much interesting science to be done there, its lingering influence is certainly one possible explanation for NASA's commitment to building a big lunar base, which will likely not be built because it would become another giant money sink like the ISS. And why the determined resistance to discussing the proposals of Bob Farquhar and others for asteroid missions instead, especially in view of our long-term need to build a planetary defense? But here I have strayed from the role of historian into that of commentator, as these events are too recent to provide the historical perspective and research needed to judge them.

In conclusion, I would agree that Dwayne Day's thesis of a von Braun paradigm consisting of *four* main elements remains a plausible interpretative device for analyzing a half century of U.S. human spaceflight planning, especially up to 1989. However, a distinction must be made between von Braun and the paradigm, although he was the one who created it in *Collier's* and Disney. As we have seen, it by no means represented all the dimensions of his enthusiasms, thoughts, and actions.

As for the paradigm he launched, it appears to have flourished in NASA because it offered an alluring vision of the future for human spaceflight enthusiasts and a program of action for engineers and planners that was "logical" yet malleable in its details. Its continuing influence was perhaps aided by the discovery of Venus's inaccessibility, which did nothing to disturb a Western and American cultural obsession with Mars as a possible abode of life. The Red Planet also appeared to be the only habitable, Earth-like objective anywhere in the neighborhood, even as robotic scientific discoveries showed it to be less appealing than hoped. The availability of the Moon relatively close by, and the focus on colonizing planetary surfaces, also tended to reinforce the paradigm while marginalizing other possible destinations like the libration points and

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the asteroids, not to mention the possibility of rejecting human spaceflight altogether to concentrate on robotic exploration. There are certainly other factors—social, cultural, and professional—that shaped the thinking of NASA engineers and space planners. It could well pay space historians and policy analysts to further test this thesis, as such investigations can cast new light on the fundamental assumptions behind the human spaceflight enterprise in the United States.