Subjects of Enclosure: Pre-NASA Astronauts in the USAF Space Cabin Simulator

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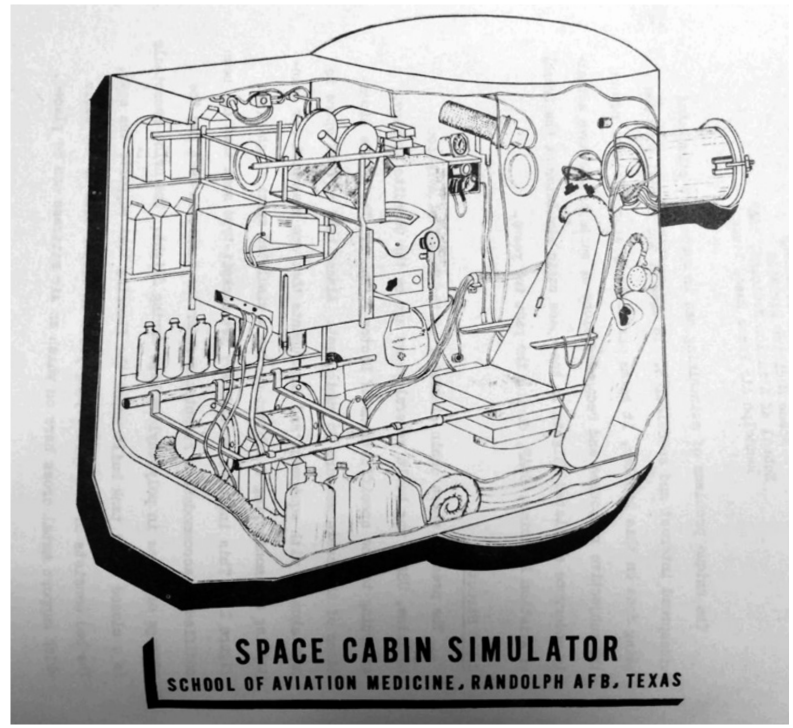
In February 1958, doctors and psychologists at the United States Air Force (USAF) School of Aviation Medicine (SAM) conducted the first-ever simulation of a spaceflight. They sealed a young airman inside a cramped chamber designed to mimic aspects of living and working in space (Fig. 1).[1] During the week-long "flight to the Moon and back," experts in the nascent field of space medicine closely monitored the subject's health and performance in the artificial atmosphere and on simulated astronaut work they had devised. However, the airman they selected to play the role of astronaut wasn't a seasoned test pilot like those later chosen by the National Aeronautics and Space Administration (NASA) for Project Mercury.[2] In this early moment, between the shock of Sputnik in October 1957 and the creation of NASA in October 1958, air force doctors chose a twenty-three-year-old accounting clerk from the base's controller's office. They didn't expect that future astronauts would need to be pilots, and the simulated work in the cabin didn't resemble controlling a craft. Instead, the simulator anticipated a different kind of astronaut: a lower-skilled, passive system monitor, similar to other push-button soldiers of the early Cold War.[3] Not a daring aviator-engineer but the kind of soldier sealed in an underground missile silo or dispatched to an Arctic radar base. This portrait of an unfamiliar protoastronaut offers more than just a glimpse of a path not taken in personnel selection. Surveillance and automation, elements of spacecraft design that profoundly shape



— 1. Detailed accounts can be found in George R. Steinkamp, Willard R. Hawkins, George T. Hauty, Robert Burwell, Julian E. Ward, "Human Experimentation in the Space Cabin Simulator: Development of Life Support Systems and Results of Initial Seven-Day Flights," in *Supporting Documents Historical Report School of Aviation Medicine, USAF* 29 (Air University, July–September 1959): 1–32, and George T. Hauty, "Human Performance in the Space Travel Environment," *Reports on Space Medicine—1958* (Randolph AFB, Texas: Air University, 1959).

— 2. Matthew Hersch, *Inventing the American Astronaut* (London: Palgrave, 2012).

— 3. Paul N. Edwards, *The Closed World: Computers and the Politics of Discourse in Cold War America* (Cambridge, MA: MIT Press, 1996), Edward Jones-Imhotep, "Maintaining Humans," *Cold War Social Science: Knowledge Production, Liberal Democracy, and Human Nature*, ed. Mark Solovey and Hamilton Cravens (London: Palgrave-Macmillan, 2012).

the subjectivity of real-life astronauts, extend from this alternate genealogy of enclosure, rather than pilots and cockpits. Revisiting the push-button astronaut inside the USAF's first space cabin simulator highlights how much enclosure shapes real-life space missions.

Part of the nature of enclosures is that they form new subjects and subjectivities.[4] Astronauts are perhaps the ultimate subjects of enclosure since their very existence depends on sealed artificial environments. Without the total enclosure of a spacesuit or spacecraft, astronauts could not exist.[5] This essay builds on recent scholarship in Science and Technology Studies (STS) and space history about the formative dynamics between people and spacecraft. For example, historian of technology Slava Gerovitch sees the New Soviet Man in the design of early Russian space capsules.[6] Anthropologist of extreme exploration Valerie Olson characterizes astronauts as environmental subjects, managed through body-enclosure relationships. In the first spaceflight simulation, we find an astronaut defined by the passive virtue of vigilance rather than the pilot virtue of active control. High levels of surveillance and automation show how space enclosures produce a distinctly Cold War subjectivity separate from pilot identity that is still with us today, one that persists mostly unquestioned in the culture of spaceflight operations.

Enclosure within simulators and simulations has become a major part of astronaut life. The USAF space cabin simulator concept outlined here was duplicated many times over, with two- and three-person variants quickly appearing at NASA centers and military defense contractors, including Boeing and Honeywell. From the beginning of NASA's Project Mercury, simulation was seen as a key practice for training astronauts. During the Gemini and Apollo programs, astronauts spent increasing numbers of hours in an array of complex spacecraft mock-ups rehearsing myriad possible scenarios. But simulations are more than just technical acts of preparation. Simulations are social models. Microcosms of larger space organizations that operate them, simulations materialize and reproduce existing power relations.[7] They also indoctrinate by instilling new values, virtues, and practices not only in their subject but in everyone involved in the operation.[8] Simulations also advocate for their real-life counterparts. They promote specific mission types, specific targets, and specific styles of engagement with space.[9] For example, simulated missions to Mars, including the Mars Society's Mars Desert Research Station (MDRS) and NASA's Hawaii Space Exploration Analog and Simulation study (Hi-SEAS), make the case for real missions to Mars. They are technical preparation but also political persuasion. In this way, simulations advertise a grand vision of human involvement in space, the specificity of which is not always obvious. Space simulations indoctrinate all of us, not just those directly participating.

On the morning of February 8, 1958, Airman First Class Donald G. Farrell woke up and went to work at Randolph Air Force Base in San Antonio, Texas. Instead of his desk in the controller's office, he headed toward the south end of the sprawling establishment, to SAM's human performance laboratory.[10]

— 4. In *Space Settlements*, Fred Scharmen observes that "new environments create or deny new subjectivities." Fred Scharmen, *Space Settlements* (New York: Columbia University Press, 2019), 33.

— 5. Nicholas de Monchaux, *Spacesuit: Fashioning Apollo* (Cambridge, MA: MIT Press, 2011), Roger Launius, "Heroes in a Vacuum: The Apollo Astronaut as Cultural Icon," *Florida Historical Quarterly* 87, no. 2 (Fall 2008): 174–209.

— 6. Peder Anker, "The Ecological Colonization of Space," *Environmental History* 4, no. 2 (April 2005): 239–268; Slava Gerovitch, "'New Soviet Man' Inside Machine: Human Engineering, Spacecraft Design and the Construction of Communism," *Osiris* 22 (2007): 135–157; Valerie A. Olson, *Into the Extreme: U.S. Environmental Systems and Politics beyond Earth* (Minneapolis: University of Minnesota Press, 2018).

— 7. Janet Vertesi, *Shaping Science: Organizations, Decisions, and Culture on NASA's Teams* (Chicago: University of Chicago Press, 2020).

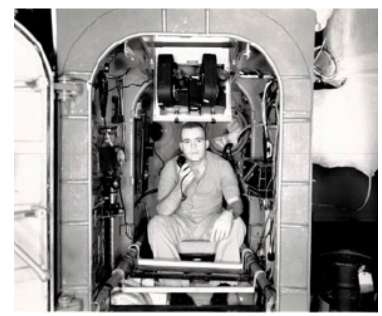
— 8. Chihyung Jeon, "The Virtual Flier: The Link Trainer, Flight Simulation, and Pilot Identity," *Technology and Culture* 56, no. 1 (2015): 28–50.

— 9.Lisa Messeri, *Placing Outer Space: An Earthly Ethnography of Other Worlds* (Durham: Duke University Press, 2016).

— 10. Green Peyton, *50 Years of Aerospace Medicine: 1918–1968* (AFSC Historical Publications Series, no. 67-180, 1968): 177–181.

Doctors working under Hubertus Strughold, the school's leading expert in space medicine, had picked Farrell from a pool of volunteer applicants for a special assignment that was about to commence. As Farrell approached building S-760, a single-story barracks-like structure, he noticed armed guards stationed at the entrance. Inside, he was met by Julian Ward, a fresh-faced flight surgeon in a white coat with thick, black-rimmed glasses. Farrell exchanged his crisp, blue air force uniform for a set of pale green medical scrubs. Ward used a razor to shave Farrell's back and then attached a series of electrodes with special adhesive tape. Farrell winced slightly each time the cold metal met his skin. Once wired and suited in scrubs, Farrell walked to an adjacent room where he could hear a din of excitement. Through the mix of doctors, technicians, senior air force officials, reporters, and photographers Farrell caught a glimpse of his spaceship: a cramped, windowless, metal chamber he had been training in for the past two weeks. With flashbulbs popping he climbed inside, and technicians wheeled shut the heavy hatch. Everyone in the room wondered how long he would last in there. A day? Maybe three? A whole week seemed ambitious. SAM psychologists had already translated this question of endurance into a problem of vigilance: How badly would the effects of isolation, confinement, and monotony degrade his proficiency at simulated work? Inside, Farrell heard no countdown, just the steady hiss of the cabin's thin, oxygen-rich artificial atmosphere being established. He gulped a breath of the new air. America's first simulated astronaut was now in make-believe space.

For the duration of this inaugural mission, Farrell was not to have any direct verbal communication with the ground team stationed mere meters away. This explored the possibility that a direct voice link might fail or might not be strategically desirable. From his seat Farrell surveyed his tight enclosure. His eyes followed wires and pipes snaking in all directions. For the next week, this was it (Fig. 2). His slim cockpit-style chair could convert into a cot, but he wasn't able to move around or even fully stand up. To his immediate left was a tall, rectangular



panel with unlit indicator lights in rows of four. This was the command panel. Below each light was the name of a different task associated with his mission. Anytime a light on the board lit up, Farrell would need to complete the corresponding task as quickly as possible. Directly in front of him was a television screen where his simulated astronaut work would appear at predetermined intervals. Below the screen was the instrument panel, a console with three sets of buttons, two metal toggle switches, and a large dial. When simple problems flashed across the screen, Farrell would have to respond correctly with different combinations of button, switch, and dial work. With his time highly structured by the indicator lights and his work a game of electronic call-and-response, Farrell wasn't in control, he was under control.

Farrell also noticed multiple forms of surveillance. A closed-circuit television (CCTV) camera was pointed directly at him. Instantly, he felt self-conscious. People, including Strughold, were just outside . . . watching him, studying him closely, intently—or at least they could be. He assumed they always were. In addition to the CCTV camera, there was also an automatic still camera, a concealed microphone, and a series of peephole-like viewing portholes that allowed doctors outside a one-way glimpse inside. The psychologists also supplied Farrell with a diary and encouraged him to jot down his subjective experiences of life in a closed world. Finally, there were those electrodes connected to long wires Ward had stuck to his back. When connected to the simulator, these would supply the "ground crew" outside with real-time biomedical data representing his heartbeat and respiration. Farrell had these wires neatly draped over his right shoulder, dangling like half an untied necktie. Suddenly, a light on the rectangular command panel lit up. The words underneath read ECG PICKUP. Farrell knew this meant the doctors outside wanted him to plug himself in. He connected the wires to a port mounted on the simulator's wall and dutifully pressed a button below the light, switching it off and signaling he had accomplished the task. Another light flicked on: BEGIN WORK.

The idea to build a spaceflight simulator was floated at the first-ever space medicine conference held in Chicago in March 1950. The conference was a debut of sorts for USAF's new forward-looking Department of Space Medicine, created in 1949 to investigate the biological hazards of spaceflight. Directing this research was Hubertus Strughold, a controversial German physiologist and medical doctor who during World War II had been head of the Luftwaffe's Aviation Medicine Research Institute in Berlin.[11] Despite his connections to heinous lethal experiments on concentration camp prisoners, Strughold was recruited to work for USAF through Operation Paperclip and later became known as "the Father of Space Medicine." With a staff composed of three other German scientists, brothers Heinz and Fritz Haber and Konrad Buettner, the Teutonic quartet set out to solve the medical problems of spaceflight for the United States. These included the intense g-forces of rapid acceleration and deceleration; thin, low-pressure atmospheres; temperature extremes; radiation exposure; and the strange state of zero-G, or weightlessness.[12] They also foresaw psychological problems, including the mental effects of isolation, confinement, monotony, and sensory deprivation, which became a special focus of the space cabin simulator. Most Americans recall how Wernher von Braun, a member of the Nazi Party and the SS, built NASA's most famous space rockets, including the Apollo program's massive Saturn V. Very few know that a team of former Luftwaffe doctors led by Strughold began the work of designing the human—the astronaut—who would ride inside.

Strughold explained that the *suprema lex for space medicine was to keep a human alive in an artificial enclosure. When sealed in air-tight spaces, humans quickly ruin the atmosphere. They produce*

— 11. John P. Marbarger, ed., *Space Medicine: The Human Factor in Flights beyond the Earth* (Urbana: University of Illinois Press, 1951); Maura Phillips Mackowski, *Testing the Limits: Aviation Medicine and the Origins of Manned Spaceflight* (College Station, TX: Texas A&M University Press, 2006).

— 12. Jordan Bimm and Patrick Kilian, "The Well-Tempered Astronaut," *Nach Feierabend: Der Kalte Krieg*, ed. Silvia Berger Ziauddin, David Eugster, Christa Wirth (Zurich: Diaphanes, 2017): 85–107.

heat, humidity, and carbon dioxide that, if left unmanaged, make conditions lethal.[13] Strughold and his German colleagues at SAM viewed the astronaut reductively and functionally as an energy and gas converter: "The task of keeping a person alive in a hermetically sealed cabin seems simply to consist of providing enough food, water, and oxygen on one side, and on the other, to remove feces and urine and to absorb carbon dioxide, water vapor, potentially harmful gases and odors." At the conference in Chicago in 1950 it was Buettner who made the case for a new kind of research tool to practice this balancing act, what he called an "experimental sealed cabin" inside which normal conditions would need to be maintained. In 1953, Strughold made the connection to spaceflight explicit, introducing the American public to the idea of sealed cabins acting as simulators as part of a famous series of articles in *Collier's magazine, which included a colorful illustration of the device he hoped the* air force would build for him. "The chamber will be like the interior of a rocket ship—functional, pressurized and cramped," the article explained. It would help "make a space man out of an earth man."[14]

"The astronaut is not going to be a space vehicle 'pilot'" was the blunt assessment from Bryce O. Hartman, one of the SAM psychologists designing simulated work for the space cabin occupant. "He is going to function as the operator of a complex, semi-automatic system in a manner much like operators of many other advanced weapons systems."[15] Hartman had studied

— 13. Hans G. Clamann, "Continuous Recording of Oxygen, Carbon Dioxide and Other Gases in Sealed Cabins," *Journal of Aviation Medicine* 23 (August 1952): 330–333; Hubertus Strughold, "Living Room in Space," *Epitome of Space Medicine: 1950–1957* (Randolph AFB: Air University, USAF School of Aviation Medicine, 1957): 9; Hubertus Strughold, "Space Medicine of the Next Decade as Viewed by a Physician and a Physiologist," *United States Armed Forces Medical Journal* 10, no. 4 (April 1959): 40.

— 14. Cornelius Ryan, "Man Will Conquer Space Soon: Man's Survival in Space: Testing the Men," *Collier's* (March 7, 1953): 57.

— 15. Bryce O. Hartman, "Experimental Approaches to the Psychophysiological Problems of Manned Space Flight," in *Lectures in Aerospace Medicine, 1961* (San Antonio: School of Aviation Medicine, 1961), 15.

these types of lonesome Cold Warriors and how they succumbed to the mental hazards of isolation, confinement, and sensory deprivation.[16] After hours of watching a screen or a lightboard, human subjects nodded off, became highly irritated, or reported strange mental experiences. Hartman worried humans were the weakest link in these vital new defense systems. From conducting test runs of these kinds of human-machine linkages he knew that humans failed first from fatigue, and sometimes after monitoring automatic systems for hours on end, they reported vivid hallucinations. One participant recalled that "the instrument panel kept melting and dripping to the floor, while another said the "indicator showed a hippopotamus smiling at me."[17] These were hazards of the cabin—of artificial, technology-packed spaces—rather than the space environment.

The SAM psychologists also sought to study and promote a positive corrective virtue in their subject: vigilance. Vigilance was the virtue the SAM psychologists saw as definitive of their early astronaut. Vigilance, the state of being constantly alert and able to respond to signs of impending danger, has had currency in American culture since the Revolutionary War, when it was said that the price of liberty was eternal vigilance. However, it took on urgent new life in 1941, following Japan's surprise attack on Pearl Harbor, which many saw as a failure of vigilance. During the Cold War, the worry that a surprise Soviet air attack on mainland US cities could come at any time made vigilance central to a new American way of life.[18] Soldiers needed to be constantly alert, but so did the public in order to take shelter at the first sign of an attack. Vigilance, however, was never something primarily associated with pilots. Pilot culture celebrated the virtue of active control above all else. Vigilance was the passive virtue of a lower-skilled, lower-

— 16. George R. Steinkamp and George T. Hauty, "Simulated Spaceflights," in *Psychophysiological Aspects of Space Flight*, ed. Bernard E. Flaherty (New York: Columbia University Press, 1961): 75–79.

— 17. Hauty, "Human Performance."

— 18. Joseph Masco, "Life Underground: Building the Bunker Society," *Anthropology Now* 1, no. 2 (September 2009): 13–29.

status push-button soldier. The radar watcher needed to be vigilant in order to notice the appearance of enemy aircraft and sound the alarm. The launch control officer needed to be vigilant to respond quickly when given the order to fire a missile. In Strughold's space cabin simulator we find an astronaut defined by vigilance rather than one defined by active control.

Back in February 1958, Farrell was doing his best to adapt to life in the simulator. The psychologists had dispensed with a normal twenty-four-hour schedule, noting that in space there would be no day-night variation anyway. Instead, they put Farrell on a new work/rest cycle: four hours of work, followed by four hours of rest, over and over and over. Three cycles per day, twenty-one in the mission. Farrell found the repetition disorienting and struggled to sleep. The interior was brightly lit at all times to facilitate the visual surveillance—all Farrell was afforded was a sleep mask. Despite the radio silence, Farrell could use some buttons on the command panel for rudimentary communication. For example, one of the twenty-two "commands" was labeled I'M O.K. When its corresponding light lit up it meant "the station [ground crew] it is asking the question 'Are you alright?' If your answer is *yes* turn off the light."[19] Another, labeled REPEAT, could prompt the team outside to resend a command. During the work or rest periods, Farrell could touch a button marked MUSIC to have the ground crew pipe in records he selected in advance. One psychologist wryly noted, "All the subjects enjoyed music during the work period but soon found that their favorite recordings were highly irritating as they were repeated."[20]

Problems manifested on the third day. Farrell became testy when his work period was interrupted by the ECG pickup light on the command panel. This meant the ground crew was having trouble receiving biometric data and wanted him to change the electrodes attached to his back—an awkward and painful process. Farrell wrote in his diary: "Signaled back that I would accomplish same after finishing what I was presently doing. . . . Such inconsiderate people." On the fourth and fifth days, right when the imaginary spaceship would have been rounding the Moon headed back to Earth, Farrell's performance on the simulated work—the measure of vigilance—nose-dived. On the sixth day, a number of minor annoyances built up into major frustration. An audible *click* made every three minutes by the automatic still camera was getting to him, as was the feeling of constant surveillance. He wrote: "HA! Just caught someone peeping thru the porthole covering. . . . What a ridiculous situation. People sneaking around and peeping thru tiny holes at me!" Farrell could not wait for it all to be over: "Getting a little anxious to get the hell out of this box."

On the seventh day, hours from completing the mission, the ECG PICKUP light lit up again. This time Farrell lost his temper:

> HA! I knew it. Got the change electrodes signal. It never fails, 17 hours left in this abortion and now they want me to change electrodes. Got a good mind to tell them — — — — ... I only yank out about 99,000 hairs from my back and shoulders every time I remove that — adhesive tape.

Later he added:

> Finished with reapplying the ECG electrodes. Nice and raw back there on both shoulders like beefsteak. Oh, well, maybe I'll get disability out of this—one percent. That'll be all I'll get. ——won't even give me hazardous duty pay for this "ride." Chintzy slobs![21]

The doctors could tell Farrell was spiraling. Some argued that keeping him in there was dangerous. Instead, the decision

— 19. *School of Aviation Medicine, USAF, History, July 1– September 30, 1959* 24 (Randolph AFB: Air University, School of Aviation Medicine, 1959): AFHRA IRIS: 0480890.

— 20. Willard R. Hawkins and George T. Hauty, "Space Cabin Requirements as Seen by Subjects in the Space Cabin Simulator," *Reports on Space Medicine—1958* (Randolph AFB, Texas: Air University, 1959).

— 21. Hauty, "Human Performance."

was made to break radio silence. They praised Farrell for his efforts and informed him of the dignitaries arriving for the conclusion of his "flight." When Farrell finally exited the simulator, he stepped into a packed room. Wobbly after so many days sitting down, he needed assistance to greet eight dignitaries seated on folding chairs next to the simulator. The first to rise and offer a hearty handshake was Lyndon Johnson, then the powerful senate majority leader from Texas.[22] Johnson had been a big supporter of SAM's forward-thinking work in his home state since the early 1950s. Farrell and Johnson shook hands, with Strughold looking on. Johnson sensed a good political opportunity and scooped up Farrell and Strughold and headed for the airport. Their first stop was New York City, where Farrell was interviewed on TV and radio, then on to Washington, DC, where Johnson had Strughold speak about space medicine at a luncheon packed with politicians. For Johnson's political purposes, the experiment was a success: a human survived spacelike enclosure! But back at SAM, the psychologists had serious doubts about Farrell's descent into frank hostility. Pouring over the films, photos, and—most tellingly—those journal entries, it became clear he had not been a good choice. When Farrell returned from the media tour, he found he had been quietly dropped from the program. The doctors decided "to conduct all subsequent flights with pilots of appropriate background experience."

The social world constructed by Strughold and his colleagues in the enclosure was bleak, with its automation and many sensory limitations. With actions determined by the light-up command panel, the astronaut was being conditioned to obey automatic signals, not necessarily coming from another human. It would not have taken much to simply eliminate the "ground crew" and connect the command panel to a computer. In fact, the design of the cabin ensured that the subject inside would be unable to perceive the difference. In addition, the multiple forms of surveillance encouraged Farrell to assume he was always being monitored and to act accordingly, even if no one was actually watching or even physically present. It is telling that space medicine experts addressed Farrell's failure not by modifying or rethinking the enclosure but by switching out the human. Treating the human as a mere system component—an energy and gas converter, or an unreliable information processor—led experts in charge of the space cabin simulator to forget that human spaceflight should also be *humane spaceflight*. Spacecraft enclosures continue to dehumanize astronauts through unstimulating sensory input, relentless schedules, repetitive technical work, and limited interaction with other humans.

What Farrell learned the hard way is that space is not a utopian, transformative place. Space is a place where all our earthly problems are reproduced or even amplified. Space exploration is not a departure from or a transcendence of history, politics, or ourselves—space is a crucible, space is a mirror. The push-button soldier was replaced by experienced jet pilots, but hazardous aspects of enclosure endured. When the Mercury Seven were selected one year later, they weren't stepping into a void; they had this older version of the astronaut to contend with, and they famously resisted the passive role they were expected to play. Automation, surveillance, isolation, confinement, and the sometimes-tense relationship with ground controllers—especially with flight surgeons—carried over into actual spaceflight and continue to shape astronaut subjectivity in profound ways that have yet to be fully recognized. Farrell, trapped in an extreme environment, submissive to technology, and constantly under electronic surveillance by mysterious and distant experts, highlights these mundane yet enormously consequential dimensions of spaceflight that currently fly under the radar. The push-button soldier helps us see the astronaut in a new light: not a utopian hero of the Space Race, but a dystopian creature of the early Cold War.

— 22. "Airman Successfully Ends 7-Day Test 'Flight' to Moon," *New York Times*, February 17, 1958, 1.

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