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The Gendered Anniversary: The Story of America's Women Astronauts

by Amy Foster, *special issue editor*

As this special issue of the *Florida Historical Quarterly* has generously acknowledged, the National Aeronautics and Space Administration (NASA) is celebrating its fiftieth anniversary. As important as that anniversary is to the people of Florida, 2008 marks an equally significant anniversary of the space age. June 18, 2008, was the 25th anniversary of the launch of STS-7, *Challenger's* second flight, and the first flight of Dr. Sally K. Ride. As many Americans will recognize the name, Sally Ride was the first American woman to fly in space.

Ride was selected as a Mission Specialist, a new type of astronaut created with the introduction of the Space Shuttle fleet, in January 1978, thirty years ago. Selected along with Ride were five other women and four racial minorities, making "Group VIII"—the identifier given to the eighth class of astronauts to join NASA—the first class to include astronauts outside of the typical white male persona. One reporter said of this new class that it looked like "an affirmative action poster."¹ These other nine new faces were Anna Fisher, Shannon Lucid, Judith Resnik, M. Rhea

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1. Donna Miskin, "In the New Astronaut Class," *Washington Star*, 19 November 1978, p. C-5.

Seddon, Kathleen Sullivan, Guion Bluford, Frederick Gregory, Ronald McNair, and Ellison Onizuka.² This group of “thirty-five new guys”—the nickname that the class gave itself—changed the image of what an astronaut was, and more importantly, what an astronaut should be. This essay will provide a brief overview of the history of women as astronauts.

While Sally Ride’s flight inaugurated American women’s participation in space flight, the history of women astronauts—or more accurately of women *trying* to become astronauts—at NASA is almost as old as the agency itself. After the selection of the Mercury Seven, America’s first seven astronauts announced in April 1959, the physician who served as the head of the medical exams for those astronauts, Dr. W. Randolph Lovelace of the Lovelace Clinic in Albuquerque, New Mexico, and the Chair of NASA’s Special Life Sciences Committee, and his Air Force compatriot in the Air Research and Defense Command, Brigadier General Donald Flickinger, undertook their own experiments to determine the fitness of women pilots. They decided to subject women pilots to the same medical tests used as part of the selection process for the Mercury Seven astronauts. They based the tests on the premise that spaceflight was an expensive endeavor and every weight-saving opportunity that NASA employed saved money and made it easier to lift a rocket off the ground.³ Because women tend to weigh less, use less oxygen, and eat less than men, including women as astronauts made practical sense.

The next development in the story is one that has been told often in recent years, in part due to renewed efforts in the late 1990s by Geraldyn “Jerrie” Cobb, the first of the women tested at the Lovelace Clinic, to earn a seat on the Space Shuttle.⁴ In February 1960, Cobb underwent the medical exams for the Mercury astronauts after Gen. Flickinger had selected her for the

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2. Sadly, Resnik, McNair, and Onizuka were all killed in the *Challenger* accident on 28 January 1986.
 3. The general rule of thumb is that for every pound of cargo or payload (that includes astronauts and their life support systems) a rocket requires an additional three pounds of fuel.
 4. For some of these treatments, see Margaret Weitekamp, *Right Stuff, Wrong Sex: America’s First Women in Space Program*, (Baltimore: The Johns Hopkins University Press, 2005); Martha Ackmann, *The Mercury Thirteen: The Untold Story of Thirteen American Women and the Dream of Space Flight* (New York: Random House, 2003) ; Stephanie Nolan, *Promised the Moon: The Untold Story of the First Women in the Space Race* (New York: Perseus Publishing, 2003).

study based on her impressive record as a pilot. She exceeded expectation, impressing Lovelace enough to present the results at the Space and Naval Medicine Congress in Stockholm, Sweden, in August of that year.⁵

Between January and July of 1961, eighteen additional women participated in the exams in Albuquerque. Ultimately, thirteen women passed the tests, including Cobb.⁶ The second phase of testing involved psychological studies performed in Oklahoma City by psychiatrist, Dr. Jay Shurley. Only three of the thirteen women—Cobb, Rhea Hurrle, and “Wally” Funk—completed Phase II. Phase III—an aeromedical component conducted at the Naval School of Aviation Medicine in Pensacola, Florida—was to be the final portion of the tests for these women. Unfortunately, without NASA’s confirmation of the agency’s support for a women-in-space program, the Navy chose not to continue with its participation in Phase III. Only Jerrie Cobb had her day at Pensacola, again showing her skills as a potential astronaut candidate. Disappointingly for these women, their chance to fly in space was slim even from the time Lovelace and Flickinger hatched their idea. For American women, their timing was all wrong.

When these women completed Phase I of the testing, NASA still had not achieved the first orbital flight of an American astronaut; that would not happen until February, 1962 when John Glenn flew aboard *Friendship 7*. But already in July 1961, the agency was faced with a greater challenge than a manned orbital flight: in May, President John Kennedy committed America—meaning NASA—“to put a man on the Moon and return him safely to the Earth.”⁷ NASA had at most nine and a half years to advance from a suborbital flight to the Moon and back. The challenges that the agency and all its employees faced were extraordinary and the idea of retrofitting even a single-person Mercury spacecraft for the sole purpose of

5. Margaret A. Weitekamp, “The Right Stuff, Wrong Sex: The Science, Culture, and Politics of the Lovelace Woman in Space Program, 1959-1963,” (Dissertation, Cornell University, 2001), 170-1.

6. They were Myrtle “K” Cagle, Geraldyn “Jerrie” Cobb, Jan Dietrich, Marion Dietrich, Wally Funk, Sarah Gorelick [Ratley], Jane Hart, Jean Hixson, Rhea Hurrle [Woltman], Irene Leverton, Bernice Steadman, Gene Nora Stumbough [Jesson], and Jerri Sloan [Truhill].

7. The full text of Kennedy’s May 25, 1961 speech is available at the JFK Library online. See <http://www.jfklibrary.org/Historical+Resources/Archives/Reference+Desk/Speeches/JFK/003POF03NationalNeeds05251961.htm>. Last accessed 11 October 2008.

launching a woman into space was little more than a distraction, even if it did mean a potential checkmark in the “win” column for the United States against the Soviet Union in the space race.

Needless to say, the thirteen women, called the Fellow Lady Astronaut Trainees (or FLATs) by their self-appointed leader, Jerrie Cobb, felt they had been misled about the realistic possibility that they would get their chances as astronauts if they passed the medical exams. After all, these were the best women pilots that America had to offer and they had shown they were more than physically qualified through their performances in Albuquerque and subsequent test locations. In making the arrangements for all of their tests, Randy Lovelace had been deliberately vague and ambiguous with the women about their chances to move on to NASA.⁸ Why he chose that approach remains a mystery. (Lovelace and his wife died in a private plane crash in 1965.) But it is realistic to assume that because NASA had not given him any encouragement or financial backing for the experiment, he made his message to potential test subjects purposefully unclear to prevent the women from rejecting the invitation to participate as a frivolity and a waste of time.

Jerrie Cobb and fellow FLAT, Jane Hart, the wife of Michigan Senator Philip Hart, did not take NASA’s rejection well. In fact, they took their petition for consideration by NASA to Washington, DC. In July 1962, the two women testified before a special hearing on the question of sexual discrimination at NASA, alleging that the agency purposefully denied women the opportunity to fly as astronauts even after they had proven themselves medically, in some cases, psychologically, and as pilots.

In response to the Cobb and Hart allegations of sexual discrimination, NASA sent the director of spacecraft and flight missions, George Low, to present the agency’s perspective. Low explained that the requirements NASA management, with the input of President Dwight Eisenhower, had established for the Mercury astronauts were so specific that no women were yet qualified. He argued further that changing the national plan to include a woman in space would greatly slow progress towards putting a man on the Moon by the end of the decade.⁹ Astronauts John

8. Weitekamp, pp. 203-4.

9. William McPherson, “Glenn Would Yield Space in Space,” *The Washington Post*, 19 July 1962, p. 2, NASA HQ; “2 Astronauts ‘Scrub’ Bid of Women Pilots,” *Chicago Tribune*, 19 July 1962, p. 14, NASA Headquarters, Washington, DC, hereafter, NASA HQ.

Glenn and Scott Carpenter, in their testimonies before the committee, echoed Low's statement, suggesting that women would fly in space eventually. However, the space program's tight schedule and the will of American society could not support such a move at that time.¹⁰

Although Low, Glenn and Carpenter undermined the allegations of deliberate sexual discrimination, Jackie Cochran, the only American woman who had flown a jet aircraft (her close personal friendship with aviation legend Chuck Yeager had made that flight possible), provided the greatest disappointment as she torpedoed Cobb and Hart before the Special Committee. Cochran had provided some of the funding for the eighteen women to travel to Albuquerque for the testing. She had hoped to be the first woman in space herself, but her advancing age (she was 56) and her declining health made her own selection impossible. Funding the testing for these women was her way of participating in and advocating for the first women-in-space program. When her time came to speak before the special hearing, however, she declared, "I do not believe there has been any intentional or actual discrimination against women in the astronaut program to date." For Cochran, the inclusion of women in the space program "should not depend on the question of sex but on whether it will speed up, slow down, make more expensive or complicate the schedule of exploratory space flights."¹¹ While the women performed well during each of the three phases of testing in which they participated, there was not sufficient evidence to determine how women compared physically and psychologically to men, and specifically to the men selected as part of the Mercury program. Under the circumstances, the idea of promoting a woman astronaut over a male astronaut was a risk that Cochran suggested might be too great for America to take in the race against the Soviet Union.

In addition to her denial that NASA had sexually discriminated against the FLATs, Cochran presented her own case for why women should not be promoted as astronauts. She warned that if politicians pushed for a women's space initiative, Congress must be prepared to shoulder the cost of training

10. "Glenn Would Yield...", 2.

11. Robert C. Toth, "Women Pilots Make Bid for a Chunk of Space," *New York Herald Tribune*, 18 July 1962, NASA HQ.

women who would ultimately leave the program without having ever flown. Based on her own experiences and observations as the head of the Women Airforce Service Pilots (WASPs) during World War II, she predicted that forty percent of the women selected for the space program would drop out due to marriage and pregnancy.¹² Representative James G. Fulton (R-Pennsylvania), one of the strongest backers of the protesting FLATs, reminded Cochran that all the male astronauts had children, some very young, and that the astronauts and Americans saw children as an asset to their lives, not problems. Cochran quickly replied, "It would not be an asset while you were having the babies."¹³ Perhaps more than any other person who testified before the special congressional committee, Cochran's testimony deflated any hopes that the federal government would mandate a change in NASA's astronaut qualifications to open doors for women. The thirteen women and others who hoped for the chance to fly as a NASA astronaut were forced to wait for something to change before they would get that opportunity. That change happened when NASA introduced the Space Transportation System or the Space Shuttle.

On January 3, 1972, President Richard Nixon announced his support for the construction of a fleet of Space Shuttles. As part of NASA's approach to gain approval for the Shuttle, the administration sold the new vehicles as a lower cost, reusable system unlike the capsules in which the Mercury, Gemini, and Apollo astronauts flew.¹⁴ Not only did they expect the Shuttle to serve as the new launch vehicle for NASA, the Department of Defense, commercial users, foreign clients, and U.S. intelligence agencies, it also would provide a platform for scientific research. Since his vice-presidency in the 1950s, Nixon had been, at best, a lukewarm supporter of the space program. However, in the political game of space flight, the flexibility of the Shuttle gave him an excuse to support a new launch vehicle and space station and encourage the Shuttle program.

12. Charlotte Moulton, "It Shouldn't Be a Stag Club," *The Washington Daily News*, 18 July 1962, p. 4, NASA HQ.

13. "Of Sex and Spacniks: Cochran Briefs Congress," *New York Daily News*, 18 July 1962, NASA HQ.

14. For a discussion of how NASA sold the Space Shuttle, see John M. Logsdon's article "The Decision to Develop the Space Shuttle," *Space Policy*, Vol. 2, no. 2 (May 1986), 106.

NASA Administrator James Fletcher was present at that press conference when Nixon announced his support for the Shuttle. Fletcher provided the technical expertise to explain the role of the Shuttle in America's space program. He described the Shuttle as part of a new era of space flight, unlike the experimental days of the 1960s. He observed that, "No special flight training would be required for passengers, making it possible to send scientists, doctors, artists, photographers—both men and women—into space."¹⁵ This marked the first occasion when a NASA administrator publicly acknowledged that the agency had real plans to put women into space. Commitment to a role for women in space built on a generation of advancements by American women in traditional male areas of math and science. Following the launch of the Soviet satellite *Sputnik I* on October 4, 1957, the United States had initiated a concerted effort to encourage the nation's children to study math, science, and engineering. By the 1970s, when the Space Shuttle was slated to start flying, women were graduating from college with degrees in those areas, making them legitimate candidates for a seat on the Shuttle.

In their book *The Real Stuff: A History of NASA's Astronaut Recruitment Program*, Joseph Atkinson and Jay Shafritz outlined the professional requirements for the astronaut corps. All members of the first three classes of astronauts had to be qualified jet test pilots. This requirement practically guaranteed that the astronauts would have military experience as that was the only real opportunity to accumulate the necessary hours in high performance aircraft. Beginning with the fourth class of astronauts, selected in 1964, candidates could qualify through their achievements in the sciences. The chances of women qualifying for the astronaut corps was extremely low in the 1960s given how few women had completed undergraduate degrees in science or engineering or were licensed pilots. However, the number of women in those pipeline careers improved during the years that the Shuttle was under development, thereby increasing their chances to be in the next class of astronauts selected to fill the needs of the Shuttle

15. "Statement by Dr. Fletcher," 3 January, 1972, p. 11, File 87-12 Box 58, George M. Low Papers, Renssellear Polytechnic Institute Archives, Troy, NY, hereafter Low Papers.

program.¹⁶ Perhaps women would not yet qualify as pilots, but they were more likely to qualify as mission specialists.

In September 1972, the NASA center directors met with Administrator James Fletcher and Deputy Administrator George Low, in part, to discuss the inclusion of women and minorities in the Shuttle program. The Memorandum for the Record from that gathering identified two priorities laid out by Low. First, the agency as a whole, specifically at the center level, needed to take “positive, deliberate steps to develop sound, affirmative action plans and to see to it that these plans are carried out.” Second, Chris Kraft, the long-time flight director and the center director of Johnson Space Center (JSC), the home of the astronaut corps, needed to develop a plan to assure not only that NASA had enough trained astronauts ready to fulfill the demands of the Shuttle program, but also that whatever plan JSC put in place it took “into account present equal employment opportunity policies and practices.”¹⁷ Both priorities suggest that NASA understood the importance of introducing women as Shuttle astronauts.

The memo could be interpreted as NASA’s attempt to pay lip service to the new Equal Employment Opportunity Amendment to the Civil Rights Act of 1964. Enacted on March 24, 1972, it required all federal agencies to abide by the nondiscrimination regulations. However, Low remained committed to pressing his subordinates to perfect the plan. After reviewing the “Astronaut Selection Program” plan in December 1975, Low wrote back to John F. Yardley, the Associate Administrator for Space Flight, “The plan does not indicate a method for insuring application by minorities and/or women in the new astronaut group and mission specialist group. I am sure that you are aware of the importance to NASA that every opportunity be presented to these potential candidates to encourage application, and if qualified selection.”¹⁸ In no uncertain terms, NASA’s upper management wanted to see women and minorities in the astronaut corps.

16. To date, the most thorough discussion of women as scientists and engineers is Margaret Rossiter’s *Women Scientists in America: Before Affirmative Action, 1940-1972*, Vol. 2 (Baltimore: The Johns Hopkins University Press, 1998). For discussion of women as pilots, see Deborah G. Douglas’s *American Women in Flight Since 1940*, (Lexington, KY: University Press of Kentucky, 2003).

17. George M. Low to NASA Center Directors, September 18, 1972, File #87-12, Box 35, Low Papers.

18. George M. Low to Associate Administrator for Space Flight, December 15, 1975, File #87-12, Box 13, Low Papers.

NASA announced its call for astronauts to make up Group VIII on July 8, 1976. In the public recruiting statement, agency officials stated upfront, "NASA is committed to an affirmative action program with a goal of having qualified minorities and women among the newly selected astronaut candidates. Therefore, minority and women candidates are encouraged to apply."¹⁹ Following the announcement, NASA sent some of its own people on recruiting missions. With previous calls for astronauts, the military and the National Academy of Sciences (in the case of the two classes of scientist-astronauts) vetted the candidates. This time NASA assumed responsibility for the lion's share of the work involved in screening the applicants. To make sure that the selection committee had an adequate number of applicants, NASA management embarked on a program to encourage people to apply.

Dr. Carolyn Huntoon played a particularly important role in the recruitment and selection process for Group VIII. Already recognized for her leadership role at NASA and having turned down the opportunity herself to become an astronaut, Huntoon became the first woman ever to serve on an astronaut selection committee.²⁰ She was also the only woman on the selection board for the class of 1978. As part of NASA's efforts to drum up interest in applying for the astronaut corps, Huntoon traveled to universities to meet with students in science and engineering departments, and delivered special addresses to potential female applications, targeting members of organizations such as the Society of Women Engineers (SWE). She knew that strong encouragement to eligible women was crucial if highly qualified women were to be selected as NASA's first female astronauts.

As part of the agency's effort to court those "non-traditional" applicants, NASA pulled out a big gun. In 1977, the agency teamed up with Nichelle Nichols, who played Lt. Uhura on *Star Trek*, and the

19. "Astronauts Wanted: Women, Minorities Are Urged to Apply," *New York Times*, 8 July 1976, p. 12, Women in Space, 1977-79 file, NASA HQ.

20. When JSC Director Chris Kraft asked Huntoon whether she was interested in being an astronaut and then asked her to serve on the selection committee, she had been serving as an assistant in the Director's Office as part of a mentoring program for NASA's up-and-coming leaders. Carolyn Huntoon, interview with author, Barrington, RI, 6 June 2003; Carolyn Huntoon, interview with Rebecca Wright, Barrington, RI, 5 June 2002. Available at http://www.jsc.nasa.gov/history/oral_histories/NASA_HQ/Herstory/HuntoonCL/huntooncl.pdf. Accessed last on 20 October 2008.

company she co-founded, Women in Motion, Inc., to promote technological careers particularly to females and racial minorities.²¹ She toured the country giving talks and encouraging people to apply. It is unclear how many applicants the selection committee received as a consequence of Nichols' efforts, but after six months of touring and lecturing, applications increased from 1500 to 8000.²²

From those approximately 8000 applications, the selection committee for Group VIII, with the approval of JSC Director Chris Kraft, chose fifteen pilot-astronauts and twenty mission specialists. Six of the mission specialists were the first American women to be chosen as Astronaut Candidates (ASCANs), their status until they completed astronaut training. The announcement of the Group VIII astronauts, the first class of astronauts selected by NASA since 1967, attracted its share of public interest given their roles in the new Shuttle program. However, most of the interest centered on the class's racial and sexual diversity.²³ Kathy Sullivan, who first flew in October 1984 aboard STS-41G, remembered that first media appearance, "That was a huge wall-to-wall interview day. I think we were introduced at ten in the morning and then there was immediate availability from eleven on. Of course, 'the twenty-six average white guys' were done at 11:15. Then it was our turn, 'the nine strange people,'" meaning the six women and the three black astronauts. She continued, "The twenty-six standard White guys had the rest of the day off from about 10:30 on and the nine strange people were there till I don't even remember how late, forever."²⁴

Unlike the thirteen women who tried and failed at their attempts to become astronauts, the six women in 1978 were the new media darlings (despite their hatred of that very fact). The real challenge, however—as it would have been in 1962 had Jerrie Cobb and Jane Hart succeeded in their petitions—was to build a spacecraft that would accommodate their physiologies. The added

21. "New Astronauts," *Today* (FL), 6 May 1977, p. 14A.

22. "Nichelle Nichols...Lt. Uhura in 'Star Trek: The Wrath of Khan,'" *The Baltimore Afro-American*, 5 June 1982, Nichelle Nichols (Star Trek) file, NASA HQ.

23. Group VI, selected in September 1967, was the second class of scientist astronauts and the last class that NASA selected before 1978. The Group VII astronauts transferred to NASA from the U.S. Air Force Manned Orbiting Laboratory program. For a limited discussion of Group VII, see Joseph Atkinson and Jay Shafritz's *The Real Stuff: A History of NASA's Astronaut Recruitment Program*, (Westport, CT: Greenwood Publishing Group, 1985).

24. Kathryn D. Sullivan, interview with author, Columbus, Ohio, 19 November 2002.



Posing with a mock-up of the Personal Rescue Enclosure (PRE), the first six women selected as astronauts are (L-to-R) Rhea Seddon, Kathy Sullivan, Judy Resnik, Sally Ride, Anna Fisher and Shannon Lucid. (Photo: NASA).

complication was that these women would be flying alongside men, ultimately raising issues of propriety.

With a brand new vehicle design in the works, bringing women into the astronaut corps could not have happened at a better time. To accommodate men and women onboard, engineers had to consider a multitude of design components to fit both body types: seats for launch and landing had to support more variation in body sizes, suits used by the astronauts had to fit a woman's hourglass shape as well as a man's triangular shape (or at least have interchangeable parts to mix-and-match for an individual's needs) and fit a wider range of sizes. Designers had to consider how living quarters would be constructed to provide a modicum of privacy, and waste containment systems—also known as the toilet—needed to work for both male and female anatomies.²⁵ The toilet and its accompanying systems created the greatest challenge.

25. There have been some recent books on the evolution of spacesuits. See Lillian Kozlowski's *U.S. Space Gear: Outfitting the Astronaut* (Washington, DC: Smithsonian Press, 1994) and *US Spacesuits* by Kenneth S. Thomas and Harld J. McMann (Praxis Publishing, 2006). I discussed a number of these particular technical and logistical issues dealing with the introduction of women to the astronaut corps in *Sex in Space: The Politics and Logistics of Sexually Integrating the Astronaut Corps*, (Dissertation, Auburn University, 2005).

Astronauts rely on the Waste Containment System (or WCS) for collection and storage of urine and feces during flight. Designing such a device that both men and women could use—the issue of weight as well as limited space on the Shuttle required that one piece of equipment work for both sexes—was simple at some levels and complicated at others. Hamilton Standard, known for its toilets on earth, won the bid to design the space toilet. The company based its design on a typical airplane toilet, but with a more contoured seat as well as restraints to keep the astronaut from floating away. Both design elements helped to create a tighter seal between the seat and the body than a ground-based or airplane toilet.

The complicated part of designing the space toilet involved finding a way to compensate for the absence of gravity, which performs a good portion of the work when people urinate or defecate in the Earth's environment. To solve the problem, Hamilton Standard engineers designed a fan system that circulated air through gaps underneath the toilet seat into the WCS. Sally Ride described the experience of using the space toilet as similar to the sensation of "sitting on a vacuum cleaner."²⁶

In space, having a seal between the body and toilet seat was crucial to sanitation. The toilet's vacuum system needed to pull all the waste into the containment system for storage. Creating a seal and preserving the airflow for the suction system were the two keys to making the space toilet work. Once the engineers had an effective prototype, the system needed to be tested. The toilet needed to work for both men and women, and both sexes had to test the prototype. By 1972, NASA had a prototype but did not have a contingent of women to fly aboard a zero-g airplane—a modified KC-135 known as the "Vomit Comet," and test the toilet. The plane flew in a series of parabolas. During the rapid descent portion of each parabola, the crew experienced weightlessness. Because weightlessness was such an unusual feeling, NASA wanted to conduct the testing with women "familiar with the flight environment, thus able to become comfortable quickly during the parabolic flight sequence and while working within

26. Sally Ride, Sally Ride Science Festival event, George Mason University, Fairfax, VA, 24 April 2004. She also describes the toilet in her children's book written with Susan Okie, *To Space and Back*, (New York: HarperCollins Publishers, 1986).

the test protocol."²⁷ To meet their need for suitable test subjects, NASA turned to the Air Force for help.²⁸ For three weeks in September 1972, four female flight nurses from Wright-Patterson Air Force Base tested the proposed seat and waste collection system. In 1974 NASA repeated the tests on two modified prototypes, one from General Electric's space division and the second from Hamilton Standard, both based on the evaluations and comments that the female nurses gave the engineers during the 1972 testing.

The other factor in designing the collection process related to weight. All human waste has a high water content, which makes it heavy. Astronauts reduced the weight and volume of the waste they brought home through a process of vacuum drying the solid waste and venting the liquid along with any urine not collected for testing and other wastewater into empty space. To separate the solid and liquid wastes, the toilet was equipped with an external urination hose. Each astronaut had a personal funnel attachment to help direct his or her urine stream into the containment system. The male version of the funnel was a simple cone. Because the space toilet needed airflow to replace gravity, the male astronauts did not "hard dock" with the funnel attachment."²⁹ Male astronauts found they could direct their urine well, resulting in little need for clean-up.

Because women were not as physically capable as men of controlling their direction of their urine streams but still needed to use the urine hose for separation and collection purposes, the crew systems engineers needed to design special female urine collection funnels. The best plan for women astronauts was to "hard dock." Not only did the funnels need to fit a woman's anatomy, they had to be designed with special slots to preserve the airflow that the men had naturally by not making contact with the funnel. Eventually, the engineers in consultation with the original six women astronauts narrowed the options to four funnel designs.

27. Charles Berry to Lt. General Robert A. Patterson, Surgeon General, USAF, 16 April 1973, Shuttle files, Box 008-14, Johnson Space Center Archives, University of Houston-Clearlake, Clearlake, TX. Hereafter, JSC.

28. Charles Berry to Command Surgeon, Wright-Patterson AFB, "Request for Female Subjects to Support 0g Testing of Prototype Shuttle Waste Management System," 6 April 1972, Shuttle files, Box 007-34, JSC.

29. K. C. Chhipwadia, personal conversation with author, Houston, TX, 2 July 2004.

One was conical, like the male funnel. The other three were oval variations. Astronaut Rhea Seddon described the testing and evaluation process, however, as “totally strange.”³⁰

The only way to flight test the funnels to determine if they would work in a zero-g environment was to have the women try them out on the Vomit Comet. Seddon recalled, “The [engineers] wanted to try several different designs and we went up there and tried it. The problem is, of course, you’ve got this [very short] period of time [of weightlessness]. We talked about it ahead of time; we planned it out. You’d fill up your bladder before you left and hope there wasn’t any delay in the take-off or in the line at the toilet. And then we’d each go in there and in 30-seconds, you wait, you get lined up, you get situated. Then when you’re at 0-g, you pee. And of course, it’s hard to pee on cue. Then if it starts to leak, if you don’t have a good seal, and you’ve got a full bladder, you’re trying to stop. You can do that sort of. But then, do you restart? Do you wait for the pullout [at the bottom of the parabola]? Do you stay in there during the 2-g pullout? It was just kind of bizarre.”³¹

The women repeated this exercise for each of the four funnel designs. Pre-flight experiments of the waste containment system onboard the KC-135 identified some problems, but the real test of the funnels came only after they were in orbit. According to Seddon, “you had to get there and try it a few times and have plenty of tissues around so that if you didn’t place it quite in the right place or have a good seal, you could mop up. Over the course of several days you got to be reasonably good at it. But it took some practice.”³²

After every Shuttle flight, the crews participated in a technical debriefing when they reported back to the engineers and flight surgeons about habitability issues. Based on these reports, the engineers learned what needed to be adjusted, retrofitted, or completely abandoned in favor of a new design.³³

Generally, the space toilet worked well enough with only minor glitches. On STS-8, the five-man crew reported, “The WCS proved to be very easy to use in the urine collection mode. Although the airflow seemed adequate, there was usually some liq-

30. Rhea Seddon, phone interview with author, 27 July 2004.

31. Ibid.

32. Ibid.

33. Allen J. Louviere, Chief of Engineering Technology Branch, to William D. Ray, 21 January 1972, Shuttle files, Box 007-25, JSC.

uid remaining on the inside of the funnel after use that had to be cleaned up with tissue.”³⁴ The handling of solid waste created problems initially. A device commonly called the “slinger” chopped up the feces and hurled it against the wall of the toilet’s internal canister so that the waste had the largest surface area for freeze-drying. But chopping up the feces created “fecal dust.” The STS-8 crew reported, “From the first five flight days, the WCS also worked well in the slinger mode. The crew was very conservative in use of tissues, since the presence of significant amounts of tissue in the slinger had been blamed for causing problems on previous flights.”³⁵ After just a few flights, the astronauts adjusted their procedures for “flushing” all their used toilet paper and instead stowed most in sealed bags that were disposed after landing, only flushing the bare minimum of tissue. The slinger, though, still struggled. The flight report continued,

Commencing the morning of flight day 6, the slinger began making sounds which led the crew to believe that solid materials were loose and being slung around within the cavity. Several crewmembers also noticed particles floating or being ejected from the gate valve area. These particles varied in size from dust to centimeter size and the larger ones were encountered outside the WCS area. Later that day, the slinger began laboring during use and continued to do so until WCS closeout on entry day. Although the slinger was still functional, the crew was concerned about WCS health had the flight duration been extended a day or two.³⁶

As flights got longer and NASA looked forward to the construction of a space station, the engineers knew that these reports were invaluable to retooling the Shuttle’s toilet for future design.

Providing the astronauts with a sense of privacy was an important aspect of the Shuttle’s design, both for comfort and to address American standards of propriety. Ideally that meant providing sleeping bunks, as NASA had done for the crew members aboard Skylab in the 1970s. When the Shuttle started flying in 1981, it

34. Lyndon B. Johnson Space Center, “STS-8 Flight Crew Report,” July 1984, Vertical files, JSC.

35. “STS-8 Flight Crew Report,” JSC.

36. “STS-8 Flight Crew Report,” JSC.

could carry up to four bunks. Mounted on the starboard bulkhead of the mid-deck, three bunks laid horizontally and one stood vertically near the access to the flight deck (where the Commander and Pilot sit for launch). Each bunk had a sleeping pallet, sleep restraints to keep the astronaut and bed sheets from floating away, a pillow, light, ventilation ducts, a fan, communication system, and a sound suppression blanket.³⁷ The sleep stations provided the privacy that NASA wanted, but the bunks took up a lot of room. Consequently, the crews usually flew without the bunks. (They are no longer used at all.) NASA's alternative to bunks was to allow crewmembers to sleep wherever they found comfort, and crews worked out issues of privacy and propriety as each saw fit. On STS-41G, the first Shuttle mission with two women aboard, Bob Crippen slept in the commander's seat on the flight deck, Sally Ride slept in the pilot's seat, and Kathy Sullivan bunked behind them on the aft flight deck. Downstairs, Dave Leestma and Paul Scully-Power fit into sleeping bags strapped to the starboard bulkhead. Marc Garneau floated free in a sleep sack designed for the Apollo flights to the moon. Jon McBride, the pilot, snuggled between the two spacesuits in the airlock.³⁸ Without the privacy of individual sleeping berths, however, NASA astronauts did encounter a new issue—sleepwear.

At a meeting of the National Aviation-Space Education Convention, Robert Overmyer, NASA's deputy manager of construction for Space Shuttle *Columbia* and the pilot of STS-5, noted that with women participating in Shuttle flights, the "problem of nightwear" came up in discussion. As he explained, astronauts on NASA's previous all-male missions, "usually just stripped down to their skivvies and slept wherever."³⁹ Overmyer said that the women had requested some sort of "nightie" to wear to bed in orbit and observed, "It does shed a different light on the subject of space flight."⁴⁰ JSC's crew systems office, which exercises responsibility for all the astronauts' wardrobes and suits, came up with the solution to the nighttime wardrobe problem by issuing gym shorts and a t-shirt for each member of the crew to don at night.⁴¹

37. John F. Kennedy Space Center, "NASA Facts: Life Aboard the Space Shuttle," January 1983 (KSC 337-82), US Government Printing Office, 7.

38. "STS 41-G Flight Crew Report," 20 December 1984, Vertical files, JSC.

39. Beth Dickey, "New Shuttle problem: 'nighties' for crew," *Today*, 24 July 1980, p. 1B.

40. *Ibid.*

41. Kathy Sullivan, email communication with author, 29 July 2004; Rhea Seddon, email communication with author, 29 July 2004.

Having solved the issue of clothes to wear at night and American standards of cleanliness, the astronauts still had to change clothes in rather cramped confines. As the flight of America's first female astronaut approached, newspaper articles suggested a growing public concern over how NASA and the astronauts planned to handle interactions between the sexes.⁴² Typically, rather than management-dictated behavioral codes, crewmembers reached some agreement among themselves over how to handle issues of privacy. Kathy Sullivan, the first American woman to perform a spacewalk or Extra Vehicular Activity (EVA), recalled, "Every crew finds its own equilibrium with these things."⁴³ In Sullivan's case, the issue of privacy came to a head when she and fellow spacewalker Dave Leestma met for their first EVA dress rehearsal. No separate facilities had been provided for her to change into her Liquid Cooling and Ventilation Garment (LCVG), a suit of long underwear lined with tubes for running water to keep the astronaut from overheating in the protective outer suit. Surrounded by a room of male technicians, as Sullivan recalled, "We're standing side-by-side holding these things, and there suddenly was this unstated moment where you kind of realize that this is the moment where normally the two guys just stripped down and get in their LCVGs with everyone standing around and nobody much cares." But this time was different because Kathy was a woman. Sullivan turned to Leestma and said, "Dave, let me tell you how I feel about modesty at a moment like this. I have none." Dave said, "Fine," and the two proceeded to disrobe. The technicians, on the other hand, were apparently unprepared to watch the two astronauts strip. As Sullivan remembered, the technicians could not leave the room fast enough.⁴⁴

The space walks themselves created a difficult challenge for the engineers when it came to accommodating a woman's body. The key feature of the Shuttle-era suit was its modular design.⁴⁵ The main piece of the suit was the hard upper torso section, which served as the connection between the suit and the primary life support sys-

42. Thomas O'Toole, "Sally Ride Soars at Her First News Session," *The Washington Post*, 25 May 1983.

43. Sullivan, interview, 19 November 2002.

44. *Ibid.*

45. NASA Headquarters, "Spacesuit Guidebook," (Washington, DC: National Aeronautics and Space Administration, 1991).

tem backpack and the building block for the rest of the suit. Instead of making an entire EVA suit from scratch for each astronaut, the engineers simply assembled a suit with the prefabricated modular sections to fit an astronaut's individual shape and proportions.

In December 1978, six months into Group VIII's astronaut training, NASA released a news statement announcing that the engineers at Hamilton Standard, the company responsible for the suit design and production, were redesigning parts of the suit to "accommodate extra-small sizes for women."⁴⁶ Making the suit pieces smaller helped, but, anatomically, female astronauts needed more than just a smaller suit. Compared to men, women typically have narrower shoulders, wider hips, and breasts. Wider hips were not much of a problem; Hamilton Standard's size range of lower torso pieces usually met the need. But a woman's shoulders and breasts made the fit of the upper torso section difficult. The upper torso was a hard shell; if an astronaut's arms did not fit into the armholes of the suit, his or her mobility would likely suffer. Given that almost all the work the astronauts performed as part of an EVA involved one's arms, shoulders, neck and hands, mobility as well as upper-body strength were crucial.

As one of her technical assignments, astronaut and physician Anna Fisher worked on spacesuit design. In her comments to the aerospace correspondent for *The Washington Star*, Fisher reported that smaller female astronauts found it difficult to move when wearing the suits designed to fit the men.⁴⁷ Specially tailored spacesuits made fitting the smaller women possible, but as Fisher further explained, performing an EVA would still tax their strength. When Kathy Sullivan performed the first spacewalk by an American woman on October 11, 1984, *The Washington Post* suggested that she might well be the last woman for a while to do so, based on the fact that she was the only female astronaut of the eight in the corps at the time who had been fitted for an EVA suit! As the reporter noted, "At 5 feet 6 and 150 pounds, she is also the most robust of the eight."⁴⁸ Sullivan's height and strength gave her an advantage as a spacewalker over the smaller women in her class.

46. "Space Suits Smaller For Women," 29 December 1978, Women in Space: 1978-1990 file, NASA HQ.

47. James Schefter, "Space Chores Awaiting The Touch of Women," *The Washington Star*, 26 March 1981, p. A-5.

48. Thomas O'Toole, "Female Astronaut walks in Space," *The Washington Post*, 12 October 1984, p. A6.

Until January 1986, the problem of fitting women into space suits only affected spacewalks. But in response to the *Challenger* accident, which killed July Resnik, one of the first female astronauts, along with six others, NASA required everyone aboard the Shuttle to wear a protective suit during launch and re-entry. Known as the LES (or Launch/Entry Suit), engineers designed the garment to protect against the loss of cabin pressure up to an altitude of 100,000 feet, cold atmospheric and water temperatures, and contaminated atmospheric conditions. These suits, along with the new full pressure Advanced Crew Escape Suit (ACES) introduced in 1995, came in a range of sizes based on the air force twelve-size system from extra extra small to extra large tall.⁴⁹ With the range of sizes and the flexible material used to make the suit itself, it was possible to fit LES and ACES for everyone in the astronaut corps. But the key design factor for the launch-entry suits was still mobility. The human factors engineers added the option of a special pair of gloves or an individualized tool that gave the astronaut the extra capacity she needed to escape from the Shuttle in an emergency. For Kalpana Chawla, the smallest person in the astronaut corps prior to the selection of the 2004 class, the crew systems engineers manufactured individualized gloves small enough to keep her fingers from backing out towards the palm section of the gloves when she moved her arms.⁵⁰ NASA designed the launch-entry suits so effectively that the female astronauts reported very few problems. However, to truly accommodate women, the design of suits evolved over twenty years of Shuttle flights.

From time to time, NASA discovered a new gender- or sex-specific issue that either the astronaut office or the engineers needed to address. Aboard the Shuttle, NASA paid particular attention to the design of the seats, making sure that women would fit without compromising safety.⁵¹ In designing the Space Station, engineers were acutely aware that the size of the architecture was important. In zero-g, an astronaut's legs naturally pulled up towards the chest

49. K.C. Chhipwadia, personal conversation with author, Houston, TX, 2 July 2004; NASA Neurolab website, <http://neurolab.jsc.nasa.gov/lessuit.htm>. Last accessed 20 December 2004.

50. K.C. Chhipwadia, 2 July 2004.

51. Robert F. Thompson, Space Shuttle Program Manager, to NASA Headquarters, "Anthropometric Design Specifications to Accommodate Female Passengers in the Space Shuttle," 14 July 1975, Shuttle files, Box 011-36, JSC.

as if in a partially seated position. Consequently, taller astronauts fit into a smaller space than they would on Earth. By the same logic, the smaller astronauts benefitted from smaller architecture. According to NASA Standard 3000, NASA's handbook of guidelines for human factors engineering, the aim was for all workstations "to meet the functional reach limits of the smaller of the defined crewmember size range and yet shall not constrict or confine the body envelope of the larger of the defined crewmember size range."⁵² Because women were generally smaller than men, women astronauts were naturally better suited to the architecture.

When the women astronauts arrived on the scene, they and the engineers designing the equipment for their use faced plenty of technical challenges. But technical challenges are easily solved compared to the challenges the women faced from culture and tradition within NASA. When Group VIII arrived at Johnson Space Center to begin training, employees were not surprised to see that women were a part of the class. After all, NASA management had been talking about the roles women would play as astronauts in the Shuttle program since 1972. Carolyn Huntoon recalled, "We had to get things ready for women at the center. Attitude was the biggest thing we had to work on."⁵³ When asked whose attitudes needed to change, she admitted, "Whose attitudes? Just about everybody."⁵⁴ Despite Center Director Chris Kraft's acknowledgment that the selection committee needed to pursue applications from female candidates actively, when women first reported to work, Huntoon remembers that some people responded with "Oh, we're going to have women astronauts!?"⁵⁵

The changes that NASA veterans witnessed in the 1970s as a result of the introduction of women could not have been fully anticipated. Huntoon explained, "Some people were glad, and some people were not happy. But they had the good sense to keep their mouths shut about it."⁵⁶ Prior to the Civil Rights Act of 1964 and the EEO Amendment of 1972, a gender hierarchy had existed. Given that, in 1978, many JSC scientists, engineers, and even

52. NASA-STD-3000 Man-Systems Integration Standards, Section 8.6.3.1.

53. Carolyn Huntoon, interview with Rebecca Wright, Barrington, RI, 5 June 2002.

54. Huntoon, interview with author, 6 June 2003.

55. *Ibid.*

56. *Ibid.*

secretaries came from an older generation with different ideas about gender than the new class of astronauts, one should hardly be surprised that some ill feelings arose despite the years in anticipation of female astronauts.

The generational ideas about women did create some issues with which Carolyn Huntoon, as the “mother hen” for the women of Group VIII, had to deal. When the first six women came to NASA, they wanted and expected to be held to the same standards as their males counterparts. But from Huntoon’s perspective, “That’s the sort of thing that we had to get over, that we have got to treat them the same. We’ve got to expect the same out of them. They’re going to train the same, we’re going to expect them to behave the same, and we’re not going to let the women by with something we don’t let the men by with or visa versa.”⁵⁷ But as Huntoon related, the older generation experienced a number of difficulties in dealing with the incoming women astronaut candidates. She advised, “Don’t go start trying to make them into something, some caricature of an astronaut because you’ve got in your mind what a female astronaut ought to look like.”⁵⁸

Huntoon came to the astronauts’ defense more times than the women probably ever knew—often in ways that forced opponents to defuse the issue on their own. One day someone asked her, “Did you see what [unnamed woman] had on today? She had on a pair of jeans and a t-shirt!” Huntoon replied, “Well, what did Tom, Dick, or Harry have on?” “Well, they had on jeans and a t-shirt, too.” Huntoon rested her case.⁵⁹

Kathy Sullivan generously acknowledged the interference that Huntoon ran for the first six: “She had been the voice of sanity on our behalf. The previously all-guy world said, ‘Well, what’s the dress code for women astronauts?’ ‘Well, what’s the dress code for the guys?’ ‘Oh, gosh, there isn’t one. You couldn’t tell a guy what to wear. But what if [the women] wear inappropriate things?’ ‘Well, what if a guy wears inappropriate things?’ ‘Well, I guess there’s not a dress code.’ ‘Well, I guess that’s right.’ ‘Well, what if their husband doesn’t want to move?’ ‘Well, what if his *wife* doesn’t want to move?’ ‘Oh, I think they’d just figure that out.’ ‘Well, their marital business I guess is just their business.’

57. Ibid.

58. Ibid.

59. Ibid.

She ran a bunch of this 'manly jack' kind of thing to these guys."⁶⁰ Huntoon admitted that she, like others in middle management, noticed generational distinctions between herself and the new ASCANs. But Huntoon remained adamant that different expectations for men and women must not continue at NASA.

In 1990, NASA took the last step in breaking down the sexual barriers in the astronaut corps with the announcement of the Group XIII class of astronauts. Five women were a part of that class, but it was the selection of United States Air Force officer Eileen Collins as the first female pilot-astronaut that drew attention. While women who had been selected before Collins were able to enter those scientific and engineering pipeline careers to become mission specialists by the late 1970s, Collins, who got almost all her pilot training and experience in the Air Force, had to wait until 1976 before women were permitted to fly military aircraft. She was a member of the second class of women to graduate the Air Force Undergraduate Pilot Training program.⁶¹ After becoming just the second woman to graduate from the Air Force Test Pilot School at Edwards Air Force Base, she reported to Johnson Space Center as an ASCAN.⁶²

With the launch of STS-63 in February 1995, Collins became the first female Shuttle pilot. Present at the launch as her guests were seven of the thirteen FLATs. What the FLATs had hoped for themselves in the 1960s, Eileen Collins completed in the 1990s. Her achievements continued in July 1999 when she became the first female Shuttle commander of STS-93. Collins also commanded STS-114, the "return-to-flight" mission in July 2005 following the *Columbia* disaster. While only two other women have served as Shuttle pilots (Pamela Melroy and Susan Still Kilrain) and only

60. Sullivan, interview, 19 November 2002.

61. The U.S. Navy opened pilot training to women in 1973, the Air Force in 1976. The Army's helicopter training school graduated its first women in 1974, but only permitted them to fly Blackhawk helicopters in non-combat roles. Until the Clinton Administration lifted the strictest bans on women serving in combat roles in 1993, few opportunities for women to fly in the military existed, thereby justifying the decision not to open pilot training to them. See Douglas's *American Women in Flight* for a discussion of women's opportunities in military aviation.

62. Astronaut Biography for Eileen Marie Collins available through NASA's Johnson Space Center's website. See <http://www.jsc.nasa.gov/Bios/htmlbios/collins.html>. Accessed last on 20 October 2008.

one woman has continued on to serve as a Shuttle commander (Melroy), it is historically significant that Eileen Collins and those who have followed in her footsteps have successfully established the precedent for women as pilots and commanders at NASA.⁶³

Thirty years after the selection of NASA's first women astronauts, we might hope that we could look back at those years with pride and contentment. Unfortunately, one glaring stain mars that history. In February 2007, police arrested Mission Specialist Lisa Nowak at Orlando, Florida's McCoy International Airport on charges of attempted kidnapping and murder of Air Force Captain Colleen Shipman, Nowak's romantic rival for the interests of Nowak's fellow astronaut, Navy Commander William Oefelein.⁶⁴ Nowak had driven from Houston, Texas to Orlando to confront Shipman. What America saw and remembered, however, was the disheveled mug shot of a fallen female astronaut.

Now, over a year and a half after Nowak's arrest, the impact of this incident on the historical achievements of women astronauts at NASA appears to be minimal; the story has fallen out of the headlines as more dramatic stories appear. But as a result of one woman's act NASA was required to reevaluate its approach to psychological evaluation of its applicants and active astronauts.⁶⁵ When the selection committee compiled its expectations for selecting the first class of Shuttle astronauts, it was already understood that the crews would be both mixed sex and the largest crews NASA would launch in its history. The committee members recognized that selecting candidates who were good at what they did, but who could also work well as a team, was an important aspect to their work. However, as Carolyn Huntoon understood, "We have some psychiatr[ic] and psychological testing to screen out people who have mental disorders or pathology or borderline pathology. But as far as good-personality types of screening, there isn't such a thing... There are not psychological test for 'screening in' people;

63. It should be noted that astronaut Peggy Whitson, while a scientist by training and a mission specialist, served six months as the commander of Expedition 16 to the International Space Station, completing her tour in April 2008.

64. Orange County prosecutors dropped the alleged murder charges almost immediately.

65. "NASA To Review Astronaut Screening Process: Space Agency Will Evaluate Its Psychological Screening Following Love Triangle Arrest," 7 February 2007. See CBS News at <http://www.cbsnews.com/stories/2007/02/07/national/main2441540.shtml>. Last accessed 20 October 2008.

we have lot of 'screen out.'"⁶⁶ There was no way for NASA to predict as part of its selection process—and probably during an annual evaluation—that Nowak would find herself in such a situation and make the choice that she did. Nevertheless, from a public relations standpoint, NASA was held responsible for the actions of one female astronaut.

After thirty years of “firsts” for women as astronauts, there have been grand triumphs (Sally Ride and Eileen Collins’ groundbreaking flights), tragic accidents (the loss of three female astronauts and one female civilian along with their ten male crewmembers aboard the Space Shuttles *Challenger* and *Columbia*), and one great mystery (the events surrounding Lisa Nowak). At the same time that we look at the thirty years of women as astronauts, it is equally important to know about the years that women were not participants of the space program. Those years reflect the history of gender in America. While there were valid technical reasons for not putting women in space, much of why women were denied the opportunity to fly comes down to America’s expectations about what women could and *should* do with their lives. Even when women did enter the astronaut corps, those questions about whether women really belonged and could do the job remained. It took that first class of women astronauts—and a team of engineers to design for their physical needs—to resolve those issues. The combined history of women trying to and then finally participating in space flight serves as a hope for the future of women at NASA and in other cutting-edge careers. The history of these women can be seen as a beacon of light for young women with great aspirations. More importantly, this narrative helps us *understand* the history of women astronauts and the path they took, and know that their story is not something to be separated out of the larger history of the United States.

66. Huntoon, interview, 6 June 2003.