

1-30-2014

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DISCRIMINATION AGAINST WOMEN IN THE AMERICAN SPACE
PROGRAM: THEN AND NOW

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SPST503 B001 Fall 13: Chronology of Space
Dr. Jerome Gideon
January 30, 2014

I. Introduction

The first group of American astronauts, known as the Mercury 7, was selected in 1959. None of them were women. Women were not considered eligible to be astronauts, even though the group of women known as the Mercury 13, were more than qualified. The first female in space was Cosmonaut Valentina Tereshkova in 1963. An American woman did not achieve this accomplishment until 1983. In the early days of the US space program, women were discriminated against much like they were in the workplace in general. That unfortunate history is at risk of being repeated, if not for the same reason, with similar results. NASA must act now to prevent further discrimination of women in the space program

II. Mercury 13

"Until you change these qualifications there is no possibility of a lady becoming an astronaut?" Congressman R. Walter Riehlman, 1962¹

The Mercury 7 astronauts were all military jet test pilots. Prior to being chosen as astronauts, the men underwent rigorous physical, mental and medical tests designed by physician William Randolph "Randy" Lovelace II, who would later become NASA's Director of Space Medicine. These tests were meant to assure that the men would be able to survive and function in a space environment that was as yet unknown. Some of the tests, such as the sensory isolation

¹ US House of Representatives, *Hearings before the Special Subcommittee on the Selection of Astronauts of the Committee on Science and Astronautics* (Washington, DC: US Government Printing Office, 1962), 64.

tank,² might be considered extreme in the 21st century, but as the peculiarities of space flight were unknown at the time, erring on the side of caution seemed wise.³

The U.S. Air Force Air Technical Service Command set up its Flight Test Training Unit in 1944.⁴ The Navy followed with its United States Naval Test Pilot School (USNTPS) in 1945, when supersonic jets were a major area of research for both military and civilian interests.⁵ President Eisenhower felt that the men that had completed the training for test piloting such aircraft were particularly suited for space travel and mandated that as a requirement, citing also that the necessary security clearances would already be in place.⁶ Since females were not allowed to enter test pilot training, they were necessarily excluded from consideration as astronaut candidates. However, Lovelace was nevertheless interested in how women would perform in his tests and invited Geraldyn "Jerrie" Cobb to undergo the tests.⁷

Jerrie Cobb was a young pilot from Oklahoma who first flew at the age of twelve and began "barnstorming" by the age of sixteen in a Piper Cub. She earned both her private and commercial pilot licenses by the age of eighteen. In her twenties she set new world records for speed, distance, and altitude. Before she was thirty she held several records, including the world altitude record for lightweight aircraft at 37,010 ft; received many awards, including the Amelia

² This sensory isolation tank involved submerging the test subject into a tank of water exactly matched to their internal body temperature for as long as the subject could bear it. Deprived of sight, sound, touch, smell and taste, a common effect is hallucinations.

³ "The Class of 1978 and the FLATs," NASA, http://www.nasa.gov/topics/history/features/flats_prt.htm.

⁴ "U.S. Air Force Test Pilot School History," Edwards Air Force Base, <http://www.edwards.af.mil/library/factsheets/factsheet.asp?id=6586>.

⁵ "History," US Naval Test Pilot School, <http://www.navair.navy.mil/usntps/history.htm>.

⁶ Marie Lathers, "No Official Requirement: Women, History, Time, and the U.S. Space Program," *Feminist Studies* 35, no. 1 (2009): 18.

⁷ Elaine M. Marconi, "Women Who Reach for the Stars," NASA, http://www.nasa.gov/missions/highlights/f_mercury13.html.

Earhart Gold Medal of Achievement; and had logged over 7,000 hours of flight time. In 1961 she was appointed to NASA as a consultant to the space program.⁸ Needless to say, she was an ideal choice for Lovelace's testing battery and she passed all three phases, including surviving nine hours in the sensory deprivation tank, longer than that of any of the Mercury 7 astronauts. With her help, Lovelace recruited nineteen more women to the testing and twelve of them passed Phase I, resulting in the unofficial designation "Mercury 13". It should be noted that neither NASA nor any official government funds were offered for this program: another female pioneer aviator and friend of Lovelace, Jaqueline "Jackie" Cochran, offered to fund the project.⁹

All of the women were under thirty-five years of age, held a four-year bachelor's degree or better, and had no less than 2000 flight hours.¹⁰ They were prepared to enter the next phase of testing, which would have taken place in Pensacola, FL at the Naval School of Aviation Medicine. Sadly, unbeknownst to these women, their testing was not officially connected to NASA in any way, although later interviews revealed that the women believed that their passing would admit them into the astronaut pool. Apparently, the doctors administering the tests did, too, as transcripts of Jerrie Cobb's results include language such as, "I believe she has very much to recommend her for selection as an astronaut candidate."¹¹ Since the women were not involved in an official NASA capacity, they were denied use of the Naval facilities and further testing was cancelled. When asked why NASA had not supported the testing, NASA Chief of Manned Space Flight George M. Low answered mysteriously, "if NASA had requirement [presumably he

⁸ US House of Representatives, *Hearings before the Special Subcommittee*, 6.

⁹ Margaret A. Weitekamp, "Lovelace's Woman in Space Program," NASA History Program Office, <http://history.nasa.gov/flats.html>.

¹⁰ Mary Wallace "Wally" Funk had the most at 2000 flight hours. A very interesting woman, there is more about her on page 25. As of 2014 she has logged over 18,000 hours.

¹¹ US House of Representatives, *Hearings before the Special Subcommittee*, 83.

means a requirement for female astronauts], or there were qualified women applicants, most certainly we would give them the tests that are needed in the selection.”¹²

After learning that the women of Mercury 13 would not be considered for space travel and that according to both the Pentagon and the Navy, the cancellation was due to NASA, Jerrie Cobb turned her energies towards taking their plight to Congress.¹³ In July of 1962 she, along with sponsor Jackie Cochran and also-aviatrix, fellow Mercury 13 member, and wife of Senator Philip Hart, Janey Hart, were granted a three-day public hearing before a special Subcommittee on the Selection of Astronauts by the House Committee on Science and Astronautics.

At the hearing, (which was mysteriously and unexpectedly shortened to two days),¹⁴ Cobb argued that NASA’s astronaut selection process unfairly discriminated against women and testified that no taxpayer dollars were spent "to ascertain that at least thirteen women pilots in the United States can pass the Mercury astronaut selection tests and prove by so doing that they are worthy of consideration for further training as space crewmembers."¹⁵ Cobb also revealed that none of the other twelve women knew each other and that, as they had hoped for word that they would be accepted into the astronaut training program, they had all agreed to keep their identities secret. Since no funding was available to bring all the other eleven women to the hearing, Cobb gave brief biographies of each of them.

The passing of the Civil Rights Act, preventing discrimination against women and minorities, was still two years away. Cobb testified that she and the other women wished to be a

¹² Ibid., 71.

¹³ Ibid., 19.

¹⁴ Ibid., Appendix I.

¹⁵ Ibid., 3.

part of pioneering space exploration research and "are not trying to join a battle of the sexes."¹⁶ She pointed out that female astronauts would have some advantages over male, including weighing less and consuming less oxygen and food. She also stated that women are more resistant to radiation and less prone to heart attacks. She claimed that scientific evidence suggested that women are "less susceptible to monotony, loneliness, heat, cold, pain and noise" than their male counterparts.¹⁷ She also offered Congress thirteen American "volunteers" to become the first woman in space. Russian Valentina Tereshkova would make that accomplishment in 1963, less than eleven months later.

The next statement was made by Hart, mother of eight. She reiterated that she and the other women were not pursuing this hearing in order to make an anti-discrimination statement, but that they eagerly desired a chance to contribute to space exploration. She reminded the Committee that women were once thought to be too fragile to work in hospitals, yet all must agree that, as women truly excelled in that field a century later, that old idea now seemed laughable. She lamented at the immense talent that was lost to such thinking and suggested that if women are not allowed into the astronaut program, it would be at the same cost. She argued that reinstatement of the testing program would both furnish valuable data and encourage young women to pursue careers in space sciences and that it would be a "serious mistake" not to at least finish the research to see whether women would be valuable contributors to the exciting new prospects of space exploration. She was clearly worried that the discrimination against women that prevented women from entering the space program in 1962 was firmly entrenched and

¹⁶ Ibid., 5.

¹⁷ Ibid.

would prevent women from achieving these goals for many more years.¹⁸ This was an eerie bit of foreshadowing, for she would be proved correct.

Committee Chairman Victor Anfuso was sympathetic, even asking Hart if she felt her participation in space travel would encourage young women. She answered yes, basing her answer on the many letters she had received from high school and college students.¹⁹ After describing some of the tests and showing the Committee some photos of herself in the testing, Cobb was asked by Anfuso what she thought the minimum qualifications for being an astronaut should be. She responded that she was not qualified to answer that but revealed the crux of the matter of allowing women into the program when she said, "The qualifications that the authorities of NASA have set down, have made it impossible for women to qualify as astronauts or even demonstrate their capabilities for space flight...*it is the jet test pilot experience that makes it impossible for a woman to meet the qualifications.*"²⁰ The only test pilot schools were operated by the military and the military did not allow women to be pilots. In answer to the question of whether she thought a person must be qualified as a test pilot to be an astronaut, she said *no*, "an astronaut must pilot a spacecraft -- not test jet fighters" and pointed out that the women in the group had averaged more total flight hours (4,500 each) than the men (only 1,500 were required).²¹ She further argued that the experience of *flying* was more important than the experience of *test pilot flying* when flying a spacecraft. The accumulation by the women of so many hours of flight time would not have been possible without making split-second, life-and-

¹⁸ Ibid., 7-9.

¹⁹ Ibid., 10.

²⁰ Ibid., 12. (Emphasis added).

²¹ Ibid., 13.

death decisions, involving "flawless judgment, fast reaction, and the ability to...control the aircraft."²²

Although several members of the House were sympathetic, including Committee member James G. Fulton, who tried to argue that women might prove to be superior to men astronauts, neither woman was willing to agree to that, only stating that they were equal to the task. Careful reading of the hearing transcript makes it clear that some of the concerns of the Committee were that if something "tragic" were to happen to an American woman astronaut that the repercussions to the worldwide prestige of America would not be worth the risk.²³ Cobb later remarked that while everyone was in agreement that women would ultimately go into space sometime, "as long as it *eventually will happen, why not here* before any other nation accomplishes the major first in space exploration."²⁴ Fulton mentioned that as taxpayers, women ought to have the same opportunities to use the equipment (i.e. the Naval testing facilities) and only somewhat in cheek pointed out that all of the dogs and monkeys that had gone to space were female.²⁵

Inexplicably, in her statement to Congress, Jackie Cochran, the highly distinguished, world-record-setting pilot that had financed the initial testing of the women, did not support the inclusion of women in the astronaut pool. Although she agreed that women were as fit as men to be astronauts, her recurring argument was that, in the interest of the Nation's time and money, and the fact that plenty of qualified men were already available (i.e. jet test pilots), there was no good reason to include women. She further stated that, in her experience with female pilots, many of them are lost due to marriage, also a poor use of training dollars, and that it would be

²² Ibid.

²³ Ibid., 16.

²⁴ Ibid., 21. (Emphasis added).

²⁵ Ibid., 22.

unlikely that a female astronaut could be a proper mother and wife and keep up with the training (an odd statement considering that all of the Mercury 7 astronauts were married and five had children). She contradicted her earlier statement that women were as qualified as men by later stating that there was no proof that they were and that more research was needed. She added that she did not think the Air Force Academy should be open to women "maybe never."²⁶ Many authors writing on the subject of the Mercury 13 speculate that Cochran was jealous of the attention the thirteen were receiving, particularly Cobb; that it detracted from her fame; and that she wished to put the brakes on the program that she herself had funded.²⁷

Day two of the hearing include a statement by NASA Chief, who gave the list of requirements for the upcoming selection of astronauts for the Gemini and Apollo programs, and statements by two of the Mercury 7: John Glenn and Scott Carpenter. Glenn essentially sealed the fate of the Mercury 13 when he answered the question as to whether test pilots were necessary: "the person who can best perform all these functions is still represented most nearly by the test pilot background. That is the cadre of people we have...available immediately for selection for a program of this type more than any other single source we know of."²⁸ Carpenter put a different spin on the subject when he stated, "I believe there is nothing magical about a test pilot, although...they have had the opportunity to demonstrate that they have the capabilities required of the job."²⁹ No one would argue with Low who further added that the goal was to find the person most qualified for the job and, in 1962, the consensus was that test pilots were the most qualified. Committee member Fulton did his best to argue on the side of the women, even

²⁶ Ibid., 22-5.

²⁷ Lathers, "No Official Requirement'," 19, 30.

²⁸ US House of Representatives, *Hearings before the Special Subcommittee*, 49.

²⁹ Ibid., 50.

pointing out that by the new standards, which required an engineering degree, American hero Glenn would not have been qualified nor accepted into the astronaut corps.³⁰ Chairman Anfuso echoed support for the women stating that women should be admitted to the military test pilot schools, (which would then have made them qualified for astronaut candidacy).³¹ In the end, rightly or wrongly, the jet pilot testing requirement ruled out women for the Mercury and Gemini programs although Low allowed that the regulations *could* change for the Apollo program (they weren't).³²

The day two-testimony of Low, Glenn, and Carpenter offered no satisfying reason why women were effectively excluded from astronaut selection, nor any expectation that there was a desire to change the rules anytime soon. The Congressional Committee recommended that NASA make the decision to create a training program for women and even suggested that Congress would look favorably on a request to supply more money for such a program.³³ However, Low, with the backing of Glenn, dug in and hid behind the false idea that such a plan would disrupt the current objective to go to the moon. Representative Fulton later asked President Kennedy to add to his space objectives that of putting the first woman in space. Nevertheless, the next selection of astronaut candidates was made, rules unchanged and no women were considered. In his testimony before the Committee, John Glenn had summed it up: "this gets back to the way our social order is organized."³⁴

³⁰ When John Glenn was selected as a candidate, *equivalent experience* was accepted in lieu of the engineering degree. That language had been removed by 1962, however, Glenn had earned an engineering degree after he was selected as an astronaut.

³¹ US House of Representatives, *Hearings before the Special Subcommittee*, 60.

³² For a full list of the astronaut qualifications used for the Gemini program see: *ibid.*, 44-5.

³³ *Ibid.*, 72.

³⁴ *Ibid.*, 67.

III. First Woman in Space

"...nor do I believe that we Americans should do something simply because the Russians do it..." Congressman Joe D. Waggoner, 1962³⁵

At the 1962 hearing, the Committee asked Cobb if she thought the Russians allowed females in jet pilot training. She said she believed they were. Regardless of the accuracy of her statement, which is difficult to prove or disprove, the women in the Russian program in the early 1960s, including Valentina Tereshkova, were high-altitude, amateur parachutists. In June of 1963, Tereshkova became the first woman in space and logged almost three days in orbit -- more time in space than all of the American astronauts to date combined. As one writer reported, "the Soviet Union stole the thunder again."³⁶ One might speculate that the Russians savored the idea of adding another first to their list of space accomplishments more than quibbling over whether women belonged there based on physical ability, experience, or social acceptance.

This Soviet accomplishment surely had stirred the hearts of Americans in a couple of ways: for the American patriot, another Soviet Cold War victory in space must have been frustrating and worrisome: it not only signaled Russia's willingness to look upon all its people, men and women equally, for contributions to the cause, but it also suggested a softer side to communism, rather than the evil empire that was America's Cold War enemy. For American women, and especially the Mercury 13, it must have been somewhat heartbreaking and at the same time inspiring. According to social historian Robert Griswold, Tereshkova's flight "became a symbol of possibility, a dramatic, worldwide display of what women—American women—

³⁵ Ibid., 70.

³⁶ Walter Wingo, "The Scramble into Space," *Science News-Letter* 84, no. 22 (1963), <http://www.jstor.org/stable/3946565>.

might accomplish if only given the opportunity to do so" while also proving Russian superiority in space.³⁷

Undoubtedly, the Soviet accomplishment must have been embarrassing to NASA and the reaction from the agency tried to downplay the feat.³⁸ An important message that was not lost on the American public, but was apparently not worthy of NASA's attention, was that a woman could perform splendidly in a man's world while still maintaining her femininity, contradicting what the Special Committee and John Glenn had presumed just a few months earlier. The media loved Tereshkova and questioned why the first woman in space had not been an American. The *Houston Post* lamented that the US had lost its "only chance to have a first in space."³⁹ A *Los Angeles Times* article quoted a NASA spokesperson as saying that the idea of [American] women in space made him "sick to his stomach."⁴⁰ So, while the jet test pilot requirement was a handy excuse, the obvious reason that NASA was not interested in changing the policy was simply that they did not want to include women in the program, qualified or not. NASA continued to cling to this attitude for twenty years before sending Sally Ride into space. It then took another ten before Eileen Collins became the first female to pilot an American spacecraft.

³⁷ Robert L. Griswold, "Russian Blonde in Space': Soviet Women in the American Imagination, 1950-1965," *Journal of Social History* 45, no. 4 (2012): 882.

³⁸ *Ibid.*, 893.

³⁹ *Ibid.*, 896.

⁴⁰ Meg Waite Clayton, "Female Astronauts: Breaking the Glass Atmosphere," *Los Angeles Times*, June 15, 2013.

IV. First American Female Astronaut

"How come nobody ever asks Rick [a fellow male astronaut] those questions?" Sally Ride, 1983 NASA press conference⁴¹

The 1962 Special Committee meeting encouraged the women to "wait" for their opportunity in space and wait they did.⁴² In 1972, the Equal Employment Opportunity Act was legislated, completing the work started by the Civil Rights Act of 1964: discrimination against women and minorities was illegal in the workplace. After nine years of no new astronaut selection events, the eighth group of NASA astronauts to be chosen, selected in 1978, and at thirty-five (the biggest class yet), included six women. Finally, the Space Shuttle, with a proposed crew of seven had room for women aboard. Of the total NASA astronaut corps since 1959, these women represented barely over 5%. (It should be noted that only 20% of the originally 6,339 applicants were women and of the final thirty-five, 17% were women.⁴³ This is a decent ratio given the lack of female applicants.) The *Washington Post* reported that when Johnson Space Center Director Christopher Columbus Kraft was asked why there had been no women astronauts selected before this class, he responded that there had been "few qualified...women the last time astronauts were chosen in August, 1967."⁴⁴ He did not mention that women were still largely disqualified due to the test pilot requirement. All of the women, along with sixteen men, in Astronaut Group 8 were designated as a new class of astronaut: "mission specialist," which did not include the jet pilot requirement. The astronaut pilot still held

⁴¹ Michael Ryan, "A Ride in Space," *People Magazine* 19, no. 24 (June 20, 1983), <http://www.people.com/people/archive/article/0,,20085312,00.html>.

⁴² US House of Representatives, *Hearings before the Special Subcommittee*, 21, 71.

⁴³ "Women, Blacks Join Astronaut Corps," *Science News* 113, no. 3 (1978): 36.

⁴⁴ "NASA Announces List of 35 New Astronauts," *Washington Post*, January 17, 1978.

this requirement. One can't help but wonder if this was yet another way to keep women out of the stag club of pilots.

Among the first six chosen was Sally Ride, who would become the first American woman in space in 1983. *Slate* magazine author Laura Helmuth, in an article written at the time of Sally Ride's death in 2012 said, "the fact that it took until 1983 to have a female astronaut just emphasized NASA's nasty history of sexism."⁴⁵ The five years between Ride's selection as an astronaut and her flight were accompanied by much media attention due to her gender, including a question at a press conference a week before her historic flight asking if she ever wept "when things go wrong on the job?" In the same press conference, in which she was accompanied by her fellow astronauts, she remarked that it was "too bad that our society isn't further along and that this is such a big deal."⁴⁶ She insisted that she didn't see herself as a woman breaking a gender barrier. Instead, she saw herself simply as "an astronaut,"⁴⁷ a sentiment echoing Glenn at the 1962 hearing who twice said he was just "pro-space" (as opposed to against women).⁴⁸ When Ride's astronaut classmate Rhea Seddon, who had completed a repair onboard the Shuttle that involved sewing and some string, was complemented for her "seamstress" skills by a man at Mission Control, Ride assured Seddon she had corrected him saying "...Rhea, just to let you

⁴⁵ Laura Helmuth, "Happy 30th, Sally Ride's First Space Flight. You Came Too Late," *Slate*, http://www.slate.com/blogs/xx_factor/2012/07/23/sally_ride_in_space_not_exactly_a_great_moment_for_feminism_.html.

⁴⁶ Ryan, "A Ride in Space".

⁴⁷ *Ibid.*

⁴⁸ US House of Representatives, *Hearings before the Special Subcommittee*, 48, 73.

know we're looking out for you down here, when he called you a seamstress...we corrected him and told him that was the work of a *surgeon*."⁴⁹

V. First American Female Spacecraft Pilot

"We all knew Eileen and just kind of felt like we were there going up with her saying, 'Go, go, go.' It was a feeling as if we had finally made it." Mercury 13 member Sarah Ratley to the Kansas City Star⁵⁰

Although Eileen Collins loved flying and paid for her own lessons at the age of nineteen, she had planned to be a math teacher. Her plans took a different turn when, within two years of her high school graduation, both the Navy and Air Force lifted their restrictions on female pilots. In 1978, Collins applied to the Air Force Undergraduate Pilot Training program and out of 120 total applicants, she was one of four women accepted. That same year, NASA began accepting women into the space program, giving Collins the idea that maybe she, too, could be an astronaut. She eventually attended the Air Force Test Pilot School and, although she was originally accepted into the space program as Orbiter systems support, she was ultimately designated to pilot the Space Shuttle for the 1995 mission that included the historic rendezvous with the Mir space station. The women of Mercury 13 had been an inspiration to her and all of the surviving members were invited to attend this first American space launch piloted by a female. Collins carried a memento from each on the flight. She would later become the first female Space Shuttle commander.⁵¹

⁴⁹ "Female Astronauts Rebel at Stereotypes: Sexism Receives Rebuke from on High," *Los Angeles Times* April 18, 1985, (Emphasis added).

⁵⁰ *Your Dictionary Online*, s.v. "Eileen Collins Facts," <http://biography.yourdictionary.com/eileen-collins>.

⁵¹ *Ibid*.

Since Sally Ride made her momentous flight in 1983, forty-three American women have flown in space. In all, fifty-five women⁵² from a handful of countries have flown, forty-eight of them with NASA. Besides Ride and Collins, several other American women have made historic flights. Kathryn Sullivan was the first American female to make a spacewalk, in 1984. Anna Lee Fisher was the first mother in space, also in 1984. Judith Resnick died in the Challenger disaster in 1986. (Christa McAuliffe also died on the Challenger mission, however, the Shuttle had not reached the line considered to demarcate "outer space.") Shannon Lucid made many firsts, including being the first to fly on a space station (Mir) in 1996. The first African-American woman in space, Mae Jemison, flew in 1992. Peggy Whitson was the first female International Space Station (ISS) commander in 2007 and has also spent the most time in space (376+ days). Sunita Williams made the longest single spaceflight in 2007. Laurel Clark was killed in the Columbia disaster in 2003. Wendy Lawrence was also on the mission commanded by Collins that was the first Space Shuttle flight after the Columbia disaster. Tracy Dyson has the distinction of being the first female astronaut born after men first walked on the moon (August 14, 1969, just a few weeks after the lunar walk).⁵³

⁵² According to a 2013 statistic, the number is fifty-seven: Miriam Kramer, "The Whole World Celebrates 50 Years of Women in Spaceflight," NBC News: Science, <http://www.nbcnews.com/science/whole-world-celebrates-50-years-women-spaceflight-6C10319422>.

⁵³ Steve Garber, "Women in Space," NASA History Program Office, <http://history.nasa.gov/women.html>. and Clara Moskowitz, "Women in Space: A Gallery of Firsts," Space.com, <http://www.space.com/16143-women-space-firsts-gallery.html>.

VI. Astronaut Group 21

"On the plus side, the medical screenings sure are easier than for the first astronauts back in the late 1950s and early 1960s in the Mercury program." Bill Tarver, NASA Medical Director in a 2013 interview⁵⁴

History was made again recently when, for the first time, NASA's astronaut class of 2013 included an equal number of men and women, at four each.⁵⁵ In an interview, Duane Ross, manager of NASA's Astronaut Selection Office, said that they were "shocked but happy" that there were over 6,000 applicants, the second highest number to date.⁵⁶ During the same interview, Bill Tarver, medical director at Johnson Space Center confirmed that this new class of astronauts will be training for the prospect of long-duration missions, such as going to Mars. Applicants were expected to pass a new long-duration flight physical in order to be considered and applicants may be ruled out due to such medical conditions as kidney stones or arteriovenous malformation. Tarver also admits that the tests are nothing compared to what the men and women of the Mercury days went through. The new requirements also allowed for candidates who'd had corrective surgery for vision, something that hadn't been allowed before. Ross admitted that poor vision had been a disqualifying factor for many people in the past.⁵⁷

The media around the world applauded the inclusion of equal numbers of men and women in the new astronaut class and *National Geographic* noted that another big difference was that although, "the media touted the gender of our newest astronauts; the astronauts

⁵⁴ Adam Hadhazy, "Popular Science Q&A: How NASA Selected the 2013 Class of Astronauts: What Is 'the Right Stuff' for a Trip to Mars?," Popular Science, <http://www.popsci.com/technology/article/2013-01/popsci-qampa-choosing-2013-class-nasa-astronauts>.

⁵⁵ "New Astronaut Candidates Take Center Stage at the Johnson Space Center," NASA, <http://www.nasa.gov/content/new-astronaut-candidates-take-center-stage-at-the-johnson-space-center/>.

⁵⁶ Hadhazy, "Popular Science Q&A: How NASA Selected the 2013 Class".

⁵⁷ Ibid.

themselves did not."⁵⁸ This suggests that perhaps, finally, the inclusion of women in the astronaut corps is commonplace. The problem that now lies before NASA and independent space travel companies is "long-duration". These flights come with some big differences from past space missions, especially in the psychological arena. Besides being fit, intelligent, and trained, astronauts will need to be able to work well with other people, in close quarters, for long periods of time and have significant social-problem solving skills. (One might wonder how the egos that made men choose to be jet test pilots in the 1950s would have dealt with a long-duration mission.) As far back as 1991, the Canadian Space Agency was thinking about this problem and felt that it would signify many changes to the astronaut selection process.⁵⁹ As Jerrie Cobb pointed out in her 1962 testimony to Congress, research shows that females have better coping skills.⁶⁰ For women, then, there are other considerations that may, once again, disqualify them from space flight of long-duration. The potential complications of pregnancy in space are an obvious area of concern, but there is one single thing that may be the barrier for women: lifetime radiation exposure limits. Unless the limit is changed, women may, once again be disqualified from space flight by an arbitrary rule.

⁵⁸ Melody Kramer, "New Female Astronauts Show Evolution of Women in Space," National Geographic, <http://news.nationalgeographic.com/news/2013/06/130618-space-female-astronauts-sally-ride-nasa-science/>.

⁵⁹ Stephen Strauss, "Calling Would-Be Astronauts: Crew Selection to Start Next Year," *Globe and Mail (Canada)*, June 27 1991.

⁶⁰ US House of Representatives, *Hearings before the Special Subcommittee*, 5.

VII. Women at Risk Again

"In my case, if I had a Y chromosome, I would be qualified. Because I have two X's, I'm not." astronaut Peggy Whitson at an Institute of Medicine Workshop, 2013⁶¹

Once a human leaves the protection of Earth's atmosphere and magnetic field, ionizing radiation exposure becomes significant. Aside from the added exposure during the long voyage to the planet, since Mars has no magnetic field, orbiting astronauts or those that have landed on the surface remain unprotected. During a 253-day Mars rover mission, the dose of radiation measured by the unmanned craft was dangerously high, a level that would significantly increase the risk of cancer later in an astronaut's life. Thus, radiation exposure is one of the few risks of space travel identified as having lasting effects after landing.⁶² According to Space.com, the amount would be like, "receiving a whole-body CT scan every five or six days"⁶³ or "between 100 to 1,000 times higher dose rate than on Earth."⁶⁴ This radiation hazard is the biggest obstacle to a manned Mars mission and research seeks ways to diminish the risk, including shortening travel times and figuring out ways to shield the astronauts from radiation both inside and outside the craft. Another way to protect space travelers is to make the best selection of astronauts, choosing those with lowest risk for cancer and limiting lifetime radiation exposure limits.

⁶¹ Miriam Kramer, "Female Astronauts Face Discrimination from Space Radiation Concerns, Astronauts Say," Space.com, <http://www.space.com/22252-women-astronauts-radiation-risk.html>.

⁶² Space Radiation Analysis Group (SRAG), Johnson Space Center (JSC), "Why Is Space Radiation an Important Concern for Human Spaceflight?," NASA, <http://srag.jsc.nasa.gov/SpaceRadiation/Why/Why.cfm>.

⁶³ Karl Tate, "Space Radiation Threat to Astronauts Explained (Infographic)," Space.com, <http://www.space.com/21353-space-radiation-mars-mission-threat.html>.

⁶⁴ Miriam Kramer, "Mars-Bound Astronauts Could Face Higher Risk of Cancer," Space.com, <http://www.space.com/21359-mars-radiation-manned-mission.html>.

According to a 1994 MIT newsletter article, the occupational limit per year for an adult is 5 rems⁶⁵ above the average 0.3 rem of background radiation inherent on Earth.⁶⁶ The article also states that the allowable occupational dose during World War II was 25 rems for soldiers and other workers with high likelihood of radiation exposure. Those limits were lowered to 15 rems in 1950 for the same group and lowered again to 5 rems in 1957.⁶⁷ The highest recommended dosage per Space Shuttle mission was also 25 rems. Generally, radiation exposure limits for American workers are set by the Occupational Safety and Health Administration (OSHA),⁶⁸ which NASA, as any government agency, would be expected to follow. However, according to a NASA document, there is no OSHA requirement for space flight so, NASA's Space Radiation Analysis Group (SRAG) works on this topic.⁶⁹

SRAG lifetime radiation exposure limits differ depending on age, gender and specific organs (e.g. skin, eyes and blood-forming organs). Age is a factor because it is presumed that radiation exposure to younger astronauts early in their careers could present greater health risks during old age.⁷⁰ Certain organs, such as those that produce blood are especially at risk because of the high cellular turnover rate, which means more chances for a damaged cell to be created.

⁶⁵ The unit *rem* is abbreviated from "roentgen equivalent *in man*", a unit of radiation dosage applied to humans.

⁶⁶ "Radiation, How Much Is Considered Safe for Humans?," Massachusetts Institute of Technology (MIT), <http://web.mit.edu/newsoffice/1994/safe-0105.html>.

⁶⁷ *Ibid.*

⁶⁸ View the standard online: Occupational Safety and Health Administration (OSHA), "Ionizing Radiation No. 1910-1096," in *Occupational Safety and Health Standards: Toxic and Hazardous Substances*, 1096.

⁶⁹ Space Radiation Analysis Group (SRAG), Johnson Space Center (JSC), "Spaceflight Radiation Health Program at JSC," NASA, <http://srag-nt.jsc.nasa.gov/Publications/TM104782/techmemo.htm>.

⁷⁰ Jon Rask et al., "Introduction and Module 1: Radiation," *Space Faring: the Radiation Challenge* (Huntsville, AL: NASA, George C. Marshall Space Flight Center), under "checked." http://www.nasa.gov/pdf/284273main_Radiation_HS_Mod1.pdf. 7.

Gender is a factor because NASA models show that women have a lower threshold for radiation exposure.

NASA has, somewhat arbitrarily, accepted the idea that the lifetime exposure should not be more than that which would increase the chance of cancer mortality more than 3%.⁷¹ This number is based on studies performed on victims of the nuclear bombing of Japan in 1945,⁷² which may not be perfectly applicable since the bombings represent an acute exposure as opposed to the chronic low-dose exposure of space travel. It should be noted that NASA has no authority to create its own program regarding occupational health.⁷³ There is currently no system to provide long-term surveillance of astronaut health although the authorization went before Congress in July 2013. The bill, S.1317,⁷⁴ which includes requests for funding has not yet been approved. According to GovTrack.us, it has a 20% chance of being passed as is.⁷⁵

This 3% exposure limit is the same for both men and women, however, due to the lower tolerance of women, this means that the lifetime dosage of a thirty-five year old female is limited to 175 rems compared to 250 rems for a thirty-five year old male. This is because women have the added risk of developing breast, ovarian, and uterine cancers. Herein lies the problem.

⁷¹ The full report could not be found, but a summary of it is available here: Francis Cucinotta and Kay Nute, "Release of the New NCRP Report No. 132: Radiation Protection Guidance for Activities in Low-Earth Orbit," *Space Radiation Health Newsletter* 1, no. 2 (2001), http://www.nasa.gov/centers/johnson/pdf/513049main_V1-2.pdf.

⁷² Ibid.

⁷³ Robert Behnken et al., "Presentation to the Institute of Medicine Ethics Principles and Guidelines for Health Standards for Long Duration and Exploration Spaceflights," (July 25, 2013), http://www.iom.edu/~media/Files/Activity%20Files/Research/HealthStandardsSpaceflight/2013-JUL-25/Panel%20%20Astronaut%20Corp%20Final%20IOM_presentationfinal2.pdf. Slide 12.

⁷⁴ 113th Congress (2013-2014), "H.R. 2687 - National Aeronautics and Space Administration Authorization Act of 2013," <http://beta.congress.gov/bill/113th-congress/house-bill/2687/all-actions-with-amendments/>.

⁷⁵ "H.R. 2687: National Aeronautics and Space Administration Authorization Act of 2013," GovTrack.com, <https://www.govtrack.us/congress/bills/113/hr2687>.

Former astronaut and former chief of the Astronaut Corps, Peggy Whitson, claims that, "depending on when you fly a space mission, a female will fly only 45 to 50 percent of the missions that a male can fly."⁷⁶ Whitson believes that the standard, which could also prevent travel to Mars, is lower than necessary.⁷⁷ The 3% mortality limit, which was already in place, was recommended again in a 2000 National Council on Radiation Protection and Measurement (NCRP) report on *low-earth orbits* (emphasis added), such as Space Shuttle missions.⁷⁸ Space mission objectives have changed dramatically since 2000 and this nearly fourteen-year-old standard must be revisited. It has, in fact, already had a detrimental effect on astronaut selection for a one-year ISS mission: out of a pool of fifty astronauts, forty-seven of them were eliminated due in part to the lifetime limit.⁷⁹ In his presentation to the Institute of Medicine (IOM), Astronaut Office Chief Robert Behnken stated that the limit would also mean that no astronaut could participate in more than one 12-month ISS mission.⁸⁰ Another interesting point he made is that in post-flight surveillance, it would be impossible to positively attribute a cancer to spaceflight radiation exposure.⁸¹ He concludes that the "overly conservative lifetime medical standards could limit worthwhile exploration."⁸²

⁷⁶ Kramer, "Female Astronauts Face Discrimination from Space Radiation".

⁷⁷ Ibid.

⁷⁸ Behnken et al., "Presentation to the Institute of Medicine Ethics Principles and Guidelines for Health Standards for Long Duration and Exploration Spaceflights". Slide 15.

⁷⁹ Kramer, "Female Astronauts Face Discrimination from Space Radiation".

⁸⁰ Behnken et al., "Presentation to the Institute of Medicine Ethics Principles and Guidelines for Health Standards for Long Duration and Exploration Spaceflights". Slide 15.

⁸¹ Ibid.

⁸² Ibid., Slide 17.

VIII. Discussion

"I'm the most unconsulted consultant in any Government agency." Jerrie Cobb, when asked about Tereshkova's spaceflight, one week before she was fired from NASA, 1963⁸³

Since the beginning, NASA's astronaut selection process has been discriminatory to women. In the early days it was based on social constructs and prejudice, but the current medical standards place women at a severe disadvantage nevertheless. James Oberg, writing for the *Space Review* online, feels that in retrospect the test pilot requirement was necessary given the problems faced by the Mercury, Gemini and Apollo crews.⁸⁴ Jerrie Cobb and the other women may argue that Oberg makes an unfair statement with the assumption that the females of Mercury 13, who had logged thousands and thousands of flight hours involving their own life and death decisions, could not have handled the challenges equally well or better. Oberg attempts to support his argument by adding that, "astronauts on several occasions were able to safely complete missions that, on autopilot, would have led to failure and death."⁸⁵ It is too bad that he did not qualify this statement as it could be misleading if not entirely untrue: *Computer Weekly* stated in an article about Apollo 11, "While the astronauts would probably have preferred to fly the spacecraft manually, only the AGC (Apollo Guidance Computer) could provide the accuracy in navigation and control required to send them to the Moon and return them safely home again."⁸⁶

⁸³ "At 16 Boy Scouts Become Girl Scouts," *Florence (AL) Times*, July 16, 1963, 4.

⁸⁴ James Oberg, "The Mercury 13: Setting the Story Straight," *Space Review*, <http://www.thespacereview.com/article/869/1>.

⁸⁵ *Ibid.*

⁸⁶ Cliff Saran, "Apollo 11: The Computers That Put Man on the Moon," *Computer Weekly*, <http://www.computerweekly.com/feature/Apollo-11-The-computers-that-put-man-on-the-moon>.

For her 2003 book *Mercury 13*, Martha Ackmann interviewed both John Glenn and Scott Carpenter, asking them about their testimony in the 1962 hearing. Glenn restated, as he did at the hearing, that the disadvantages the women faced were just a sign of the times, however, Carpenter admitted that he regretted his testimony against the women.⁸⁷ It is interesting that Glenn's statement is a commentary on the *actual* discrimination against women that was socially prevalent in the US at the time as opposed to using his statement to support the *requirements* regarding jet test pilots which eliminated women that NASA used to defend their position at the 1962 hearings. One wonders if Glenn, who would have undoubtedly been an "insider" at NASA in 1962, is actually admitting that the social discrimination at the agency was real.

Although the Russians did launch the first women into space, their record since has not been so impressive: only six Soviet/Russian women have flown compared with the United States' forty-three.⁸⁸ It is unlikely Cobb will get her chance. In 1998, when John Glenn, at the age of seventy-seven, was to make another space flight, becoming the oldest person in space, NASA was "deluged" with requests petitioning the agency to assign Cobb to a spaceflight, including support from the National Women's History Project; the American Association of University Women of California; the senators from Cobb's home state of Oklahoma; Sens. Barbara Boxer and Dianne Feinstein of California; and the National Organization of Women (NOW.)⁸⁹ According to NOW, Hilary Rodham Clinton was willing to lobby Congress on Cobb's behalf.⁹⁰

⁸⁷ Joanna Carver, "Before Sally Ride, Mercury 13 Pioneered the Way for Women Astronauts," Medill (Northwestern University) Reports, <http://news.medill.northwestern.edu/chicago/news.aspx?id=208295>.

⁸⁸ Garber, "Women in Space".

⁸⁹ Marcia Dunn, "11 Years Later, Jerrie Cobb Wants Her Chance to Be an Astronaut," Seattle Times, <http://community.seattletimes.nwsourc.com/archive/?date=19980713&slug=2760916>.

⁹⁰ "Action Alert: Support Jerrie Cobb," National Organization of Women (NOW), <http://www.now.org/actions/cobb.html>.

Cobb, temporarily leaving her work in the Amazon,⁹¹ wrote Glenn asking for his support, as well. NASA was apparently not interested and Cobb never heard from Glenn. NASA spokesman Dwayne Brown dismissed the notion by saying, “at this time, there are no plans to fly her.”⁹² Glenn’s spokesman claimed that Glenn was “too busy” to reply.⁹³ Glenn had petitioned to be accepted for the spaceflight with the justification that it would be useful to study the effects of weightlessness on the elderly. NOW points out that Cobb, who was, at the age of sixty-seven in 1998 and still the picture of health and fitness, would, as a female, represent the majority of the American population and was therefore an “imperative” choice.⁹⁴

The actions, or rather inactions, of NASA and Glenn continue to reek of discrimination against women, or at the very least, a prejudice against Cobb herself. Sadly, this is an injustice to Cobb and the other Mercury 13 women, most of whom are unlikely to fulfill their dream of space flight. Commercial space efforts are likely to offer more women, including Mercury 13-er Wally Funk a chance to go into space. Funk, one of the most fascinating of the Mercury 13, has applied to make a trip with Virgin Galactic in 2014 and paid \$200,000 for her ticket. Now in her seventies with over 18,000 flight hours under her belt, it is about time.⁹⁵

Presumably, women no longer face discrimination at NASA due to social prejudices, but more efforts need to be made to assure that they are not excluded for other reasons. Wendy

⁹¹ For which she received many honors, including a 1981 Nobel Peace Prize nomination. See: "Jerrie Cobb - Fact Sheet," Jerrie Cobb Foundation, http://www.jerrie-cobb-foundation.org/jerrie_cobb_facts.html.

⁹² Dunn, "11 Years Later, Jerrie Cobb".

⁹³ Ibid.

⁹⁴ "NOW Launches Campaign to Send Jerrie Cobb into Space," National Organization of Women (NOW), <http://www.now.org/press/10-98/10-28b98.html>.

⁹⁵ Richard B. Stolley, "Woman in Space: The Long-Delayed Flight of Wally Funk," Time, <http://content.time.com/time/nation/article/0,8599,2112251,00.html>.

Lawrence, U.S. Naval Academy graduate and Naval Aviator, was Mission Specialist for NASA on four Shuttle missions and has over 1,225 hours logged in space.⁹⁶ She served as Director of Operations for NASA at the Gagarin Cosmonaut Training Center in Star City, Russia, coordinating and implementing Shuttle/Mir operations and trained for a four-month mission on the Mir space station. Even with all her qualifications and experience, she didn't get to go: she was too small for the spacewalking suits, both Russian and American.⁹⁷ According to a 2000 SAE Technical Paper, a smaller version of the shuttle-era Extravehicular Mobility Unit (EMU) for women was under development.⁹⁸ Thirteen years later, that suit is still not ready and a completely redesigned suit was revealed at a TEDWomen conference in December 2013 by an MIT researcher. The suit, designed by Dava Newman, is form-fitting and was designed specifically for women under five feet, five inches (which includes Newman,) because they cannot fit into the current NASA suit.⁹⁹ Another benefit of the new design is that its added mobility would help prevent astronaut training injuries: 25 astronauts have had to undergo shoulder surgeries as a result of training in the heavy EMU suit. The EMU has also been blamed for the most common astronaut injury, fingernail loss, as reported by MIT researchers, including Newman, in 2010.¹⁰⁰ Clearly, the poor design of the current NASA suit needs to be corrected.

⁹⁶ "Biographical Data: Wendy B. Lawrence (Captain, USN), NASA Astronaut (Former)," NASA, <http://www.jsc.nasa.gov/Bios/htmlbios/lawrence.html>.

⁹⁷ Wendy Lawrence, e-mail message to author, January 26, 2014.

⁹⁸ David Graziosi, James Stein, and Lara Kearney, "Space Shuttle Small EMU Development," (SAE Technical Paper 2000-01-2256, 2000).

⁹⁹ Harrison Jacobs, "This New Form-Fitting Spacesuit Could Revolutionize How Astronauts Move in Space," Business Insider, <http://www.businessinsider.com/dava-newmans-skintight-spacesuit-could-be-nasas-future-2013-12>.

¹⁰⁰ Roedolph A. Opperman et al., "Probability of Spacesuit-Induced Fingernail Trauma Is Associated with Hand Circumference," *Aviation, Space, and Environmental Medicine* 81, no. 10 (2010).

VIII. Conclusion

One can't help but wonder why NASA is so slow to correct such simple problems as a spacesuit that is too small for women, while admittedly, the radiation lifetime dosage factor is a far more complex one. A National Research Council report evaluating the NASA Model for astronaut cancer risk due to radiation exposure has some suggestions.¹⁰¹ Studies simulating *actual* astronaut radiation exposure, such as one published in the 2013 *Journal of Radiation Research* using a Chinese female astronaut phantom, should be conducted in order to replace the reliance on 1945 atomic bomb data with more relevant information.¹⁰²

There is another factor that should be explored, as controversial as it may be: choice. In the Institute of Medicine presentation, Behnken included this idea in two of his slides. First, he stated "each crewmember must also decide if the job/mission risks are acceptable for them" and the follow-up slide stated that "crewmembers...make their own judgment relative to risk and mission value."¹⁰³ It is far beyond the scope of this paper to discuss the technical aspects of research into the radiation effects on astronauts and the associated cancer risk or to debate the ethics behind astronaut exposure, it is simply a statement that something needs to be done.

Of over 500 space travelers, only slightly over 11% have been female. Presumably, much of this is due to the fact that woman have historically faced a great amount of discrimination simply based on gender, but today the problem is due to medical and physical requirements. The singular radiation dosage factor will exclude women from our most important next step, a

¹⁰¹ National Research Council, *Technical Evaluation of the NASA Model for Cancer Risk to Astronauts Due to Space Radiation* (Washington, DC: National Academies Press, 2012).

¹⁰² Wenjuan Sun et al., "Construction of Boundary-Surface-Based Chinese Female Astronaut Computational Phantom and Proton Dose Estimation," *Journal of Radiation Research* 54, no. 2 (2013).

¹⁰³ Behnken et al., "Presentation to the Institute of Medicine Ethics Principles and Guidelines for Health Standards for Long Duration and Exploration Spaceflights". Slide 19.

mission to Mars, and that requirement is wholly unnecessary. Throughout their history, NASA has made too many wrong choices. Their complacency has unfairly excluded women from entering the space program or being chosen for certain missions for illogical, unreasonable and inappropriate reasons. It is a tragedy and national embarrassment that women like Jerrie Cobb, Janey Hart, and Wally Funk did not receive the respect and consideration that was their due *as Americans* in the early space program. NASA must take measures now not to repeat that history.

Final Note: This paper is dedicated to three women, who have all been a huge inspiration to me. Jerrie Cobb, who I did not know of until I started research on this paper, showed incredible spirit and, when she couldn't win the fight for an opportunity at spaceflight, applied herself to philanthropic causes that were possibly more challenging than the battle with NASA. Wendy Lawrence has, on a personal level, shown me what a woman can do, and suggested the idea for my research. Having Professor Lawrence as the instructor for three graduate classes has been the highlight of my college career. More than any biography could, her personal attention has pushed me to be my better self. My mother, who always believed I had more potential to become an astronaut than I believed, never let anything stand in her way to being and doing what she wanted. And if anything ever disappointed her, she never showed it, always finding the silver lining. Throughout the research and writing of this paper these three women inspired me to dig deeper, find the story, and present it with respect. I hope I have succeeded.

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