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QUEST

THE HISTORY OF SPACEFLIGHT QUARTERLY


Mercury


Apollo VIII Launch Control Operations


Gemini

Space Shuttle

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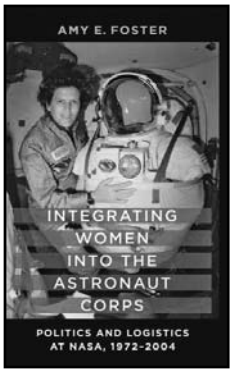
Mission control from the Mercury, Gemini, Apollo, and Space Shuttle programs. Credit: NASA

Book Review

Integrating Women into the Astronaut Corps:
Politics and Logistics at NASA, 1972-2004



By Amy E. Foster

Johns Hopkins University Press, 2011
ISBN 978-1-4214-0195-9
Pages: 224
Price: $55.00, hardcover

During the last two decades of the recently concluded Shuttle program, the appointment of women astronauts to Shuttle and Space Station crews became a non-event—unless a woman sat in the pilot or commander's seat on the orbiter. At the very end of this valuable and well-researched monograph, Amy Foster notes that, while the integration of women into the astronaut corps has to be considered "one of [NASA's] success stories[,] …women are nowhere nearing parity with the men" in the corps (158). That does not appear to be the agency's fault, but judging by Foster's narrative, this imbalance is rooted in continuing social barriers to the advancement of women in the pipeline careers of piloting and science, technology and medicine. Nonetheless, Foster's narrative is predominantly a positive one, a story of prejudices, barriers, and technological problems overcome, leading to progress in how the United States conducted its human spaceflight program.

The author comes to her narrative, as she explicitly states at the outset, from the standpoint of labor history and the history of technology. Her labor history is clearly not in the usual genre of studies of working-class occupations, but rather examines an elite, white-collar, science-and-technology job. She strains a bit justifying a case study of such an atypical occupation on that basis. Not that this rationale will matter deeply to space historians, who will welcome a scholarly history of how the idea and reality of women astronauts advanced after the hopes dashed in the first "Women in Space Program"—the medical examinations of 13 women at the Lovelace Clinic in 1959/60, a group later erroneously dubbed the "Mercury 13" by journalists. Margaret Weitekamp in *Right Stuff, Wrong Sex* (Baltimore: Johns Hopkins, 2005), has of course definitively researched that history; Foster's revised dissertation might well be considered a sequel.

Foster covers the Lovelace women's story again in Chapter 3, and it at first seems a little too familiar, but she quickly moves on to the lesser-known aftermath, episodic discussions of the possibility of women astronauts in the context of Valentina Tereshkova's flight in June 1963 and the selections of scientist-astronauts in 1964 and 1967. Nonetheless, choosing a woman astronaut was still a remote prospect as a result of entrenched gender attitudes and NASA's focus on the urgencies of the Moon race, followed by a long drought in the hiring of new astronauts caused by the sharp decline of NASA's budget and human spaceflight ambitions after Apollo.

Foster only reaches her core story—as expressed in the subtitle to the book—on page 67 (of only 159 pages of text), when she begins to work through the origins of the selection of the first class of Shuttle astronauts, Group VIII of 1978. Changes in federal civil rights law and NASA's promotion of Equal Employment Opportunity, often ahead of much of the civil service, meant that, instead of women and minority astronauts being a problem, suddenly they were de facto a requirement, otherwise NASA would have been embarrassed by the announcement of a new, all-white-male class. That, and the high qualifications of the applicants, led to the well-known result that six women and four minority male mission-specialist candidates were included in the "Thirty-Five New Guys" (as they titled themselves). The bulk of the narrative is then devoted to the selection process, the cultural problems of integrating women astronauts into a rather unenlightened white-male engineering world, and the practical engineering problems created by adapting equipment, spacesuits, toilets, etc., to differences in body size and biology. The latter sections are Foster's greatest strength, coming as she does from the history of technology. What she does not cover are the often sexist media images of the first women astronauts, focused as she is on the internal NASA story.

As I noted, the book earlier devotes 66 pages to subjects not nominally in the book, at least as defined by the subtitle. This is less a problem of the book's structure than simply of the choice of subtitle. (If I may be forgiven a nitpick, her use of the term "logistics" is also typical of current usage, in which a military technical term for supply to armed forces in the field has become vaguely applied to all kinds of things to which it is not related.) The first chapter discusses the restrictions on pipeline occupations prior to the sixties that led to the easy exclusion of women from the NASA astronaut corps, the second covers the cultural images of women as spacefarers from *Buck Rogers* to the multiple *Star Trek* television series, and the third, as mentioned, the thwarting of any chance of women astronauts being named in the 1960s. It is the second chapter that seems the most out of place in this narrative, at least when it is extended far beyond 1960.

Foster concludes the book with a chapter noting the unintended contradictions that the first women astronauts found themselves in. They each strove to be "one of the guys," minimizing confrontation while working to eliminate all vestiges of separate or special treatment. That was certainly the approach that worked best in NASA. Yet they found themselves often using their special status as pioneering women to

advance their causes or careers after they left the job. Sally Ride is the most notable example of this in her efforts to deploy her fame as the first American woman in space to encourage girls to take technical careers seriously. Almost no one would take issue with that now, but it is ironic when at the time of her first launch Ride strove, inevitably unsuccessfully, to be perceived not as a woman, but just another member of the crew.

In sum, Amy Foster's *Integrating Women into the Astronaut Corps* is a valuable monograph on an important topic. The small flaws do not detract from this fundamentally well-written, well-researched narrative. It will provide a foundation for much more scholarship to come on the astronaut corps and NASA after Apollo.

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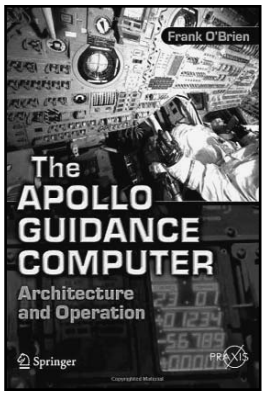
Book Review

The Apollo Guidance Computer: Architecture and Operation



By Frank O'Brien

Springer-Praxis, 2010
ISBN 978-1-4419-0876-6
Pages: 430
Price: $44.95, paperback

Frank O'Brien has written the most comprehensive and detailed analysis of the workings of the Apollo guidance computer that one could ever expect to have. It is not a book of history—for that I would recommend Eldon Hall's *Journey to the Moon: The History of the Apollo Guidance Computer* (Reston, Virginia: AIAA, 1996). Likewise, readers wishing to learn how the astronauts interacted with the machine during lunar missions can turn to David Mindell's *Digital Apollo: Human and Machine in Spaceflight* (Cambridge, MA: MIT Press, 2008). This is a look "inside the black box" of the computer: its hardware, memory, its interface with the crew, and above all, its software.

The book begins with a discussion of what computers looked like in the early 1960s, when the AGC was taking form. The author spends a lot of time on the decisions about the computer's "architecture." This is an interesting term as it is used in the computer world: it refers to the overall organization of hardware that directs the flow of data as the program instructions operate on it. It includes decisions how to handle negative numbers and perform subtraction, how to check for errors, and above all, "word length": how many bits does the processor handle at a time? Longer words mean greater numerical precision with each operation, but they also can slow down the machine and increase cost. The AGC used 14-bit words, plus one bit for the sign, and one for "parity" checking—to ensure that the data was not corrupt. Those of us who have followed the evolution of personal computers from the days of the Apple II know how word length has doubled, from the Apple's 8-bits, to the IBM PC's 16, to current 32- and 64-bit words. In the current computer world, the architecture is a commodity: it is decided by the chip manufacturer (e.g. Intel), designed into a chip called a microprocessor, then packaged and sold in a rugged, inexpensive, and compact chip. It is not something that many people worry about. That was not so in the 1960s, when every facet of the processor was a matter of debate.

After this discussion, the author moves on to what he calls the "heart of the AGC": the computer's "Executive" program. That is the program that allows the AGC to receive and execute the applications programs for a mission's guidance, navigation, and control. It is similar to a modern operating system, only much more tailored for a spaceflight with a lot more emphasis on real-time execution, recovery from errors, low memory requirements, and speed. Once again, most of us are familiar with operating systems such as Windows or the older MS-DOS, without which a computer could not do the work we want it to do, such as word processing or a spreadsheet. It is a necessary evil, and writing such a program can be one of the blackest of black arts. Like the previous chapters on hardware, this discussion reveals how much thought, hard work, and genius went into making the computer a success.

` These chapters are followed by a discussion of the basic guidance and navigation problems faced by a mission to the Moon, the applications programs that carried out these functions, and by a discussion of how the astronauts operated the computer through its Display and Keyboard—the "DSKY." The book is extensively illustrated, with a detailed glossary and several appendixes. Those without at least a basic familiarity with computer architecture and programming may find the book tough going, but it ought to remain the standard reference on this most remarkable machine.

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