



Hidden Figures: The Untold Story of the African American Women Who Helped Win the Space Race

Margot Lee Shetterly

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Hidden Figures by Margot Lee Shetterly is a well-researched non-fiction work that sheds light on the untold story of the African-American women mathematicians and engineers who played pivotal roles at NASA during the space race. Providing thorough historical detail, in particular with the description of the long history of NASA Langley's avionics and aeronautics research the author presents an all embracing story.

Shetterly brings to life the stories of women like Katherine Johnson, Dorothy Vaughan, and Mary Jackson, whose brilliance, perseverance, and contributions were overlooked for decades due to both their race and gender.

The book chronicles the journey of these Afro-American mathematicians starting from World War II, through the Civil Rights era, and into the Space Age. It focuses on the professional and personal lives of these women who, despite the challenges of segregation and discrimination, rose to break barriers in science and technology. Being black 'you had to be twice as good to get half as far', this rule also applied to the Afro-American mathematicians in Langley's West Computing Office.

But Shetterly also highlights their contributions to key projects, such as the calculations for John Glenn's orbital flight and the Apollo missions using the technological state of the art tools available at the time.

In addition, the detailed descriptions of the workplace dynamics at NASA's Langley Research Center, particularly the challenges posed by systemic racism, offer a compelling look into how these women navigated an environment that was often hostile to them.

The merits of the book are pointing out the challenges of segregation and discrimination of African American women, have been praised by many reviewers already – I was more interested about the details of their contributions to NASA's early human spaceflight projects and, in particular to the calculation of John Glenn's flight trajectory.

Calculating John Glenn's orbit was a complex technical challenge that required precise mathematical and computational skills. This was a pioneering effort in the early 1960s as NASA prepared for the orbital flight of Glenn, the first American astronaut to orbit the Earth in 1962. Glenn's mission, known as *Friendship 7*, demanded reliable calculations of his orbital trajectory to ensure he would safely orbit Earth and re-enter the atmosphere at the correct angle and speed.

To calculate his orbit, NASA's engineers and "human computers" from Langley's West Computing Office had to account for several technical factors:

1. **Orbital Mechanics:** Glenn's orbit required detailed calculations based on Kepler's laws of planetary motion and Newtonian physics. The trajectory team needed to determine Glenn's

precise path around Earth, using gravitational force equations to define how the spacecraft would maintain a stable orbit.

2. **Re-entry Calculations:** Calculating re-entry was one of the most critical tasks. Glenn's capsule had to enter the atmosphere at a precise angle. A slight deviation could mean missing the recovery area in the ocean or, worse, burning up upon re-entry. Engineers needed to determine his capsule's speed, angle, and descent trajectory in real-time, requiring an understanding of changing atmospheric drag, spacecraft speed, and heat resistance.
3. **Coordinate Transformation and Data Processing:** Because Earth is round, calculations needed to use spherical coordinates rather than simple Cartesian (x, y) coordinates. Transforming data in real-time as the spacecraft moved over different points on Earth required significant computational power, especially since the capsule's position was dynamic and constantly changing relative to Earth's rotation.
4. **Using the IBM 7090 Computer and Human Verification:** IBM's 7090 computer was a new major technical asset, processing thousands of complex equations to determine Glenn's trajectory. However, given the early stage of computer technology, NASA was cautious about relying solely on machine calculations. This is where Katherine Johnson played a pivotal role. Johnson, one of the "hidden figures" who was a mathematician and aerospace technologist, manually verified the computer's calculations by hand. She worked with complex differential equations and iterative calculations to ensure the computer's results were accurate. Her rigorous supervisor John Gilruth, leader of the newly created Space Task Force appreciated Katherine's work by acknowledging her talent 'think beyond the numbers' not even the brand-new IBM computer could do.
5. **Time Synchronization and Tracking Stations:** Ground-based tracking stations communicated with Friendship 7 to provide updates on Glenn's position and velocity. NASA needed a real-time tracking system to monitor the spacecraft's location and maintain an up-to-date model of its orbit, so technicians synchronized time between the spacecraft and the ground systems. Data from these stations helped in recalibrating trajectory predictions and ensuring that Glenn remained on a safe path.

John Glenn's first orbital flight demonstrated a blend of traditional mathematics, human ingenuity, and cutting-edge technology. The contributions of Katherine Johnson and her peers highlighted the crucial role of meticulous calculation in space missions and underscored the importance of rigorous manual verification in the early days of computer science culminating in John Glenn's request before his historic flight '*get the girl check the numbers*' because he didn't trust the IBM 7090 computation completely either.

Conclusion

Overall, Hidden Figures is an essential read that fills a significant gap in both American history and the history of NASA from an Afro-American point of view. Shetterly's work not only honors the legacy of these remarkable women but also challenges the reader to think about who gets remembered in history—and why. Their contributions were instrumental in shaping modern space exploration, yet their recognition was delayed for too long.