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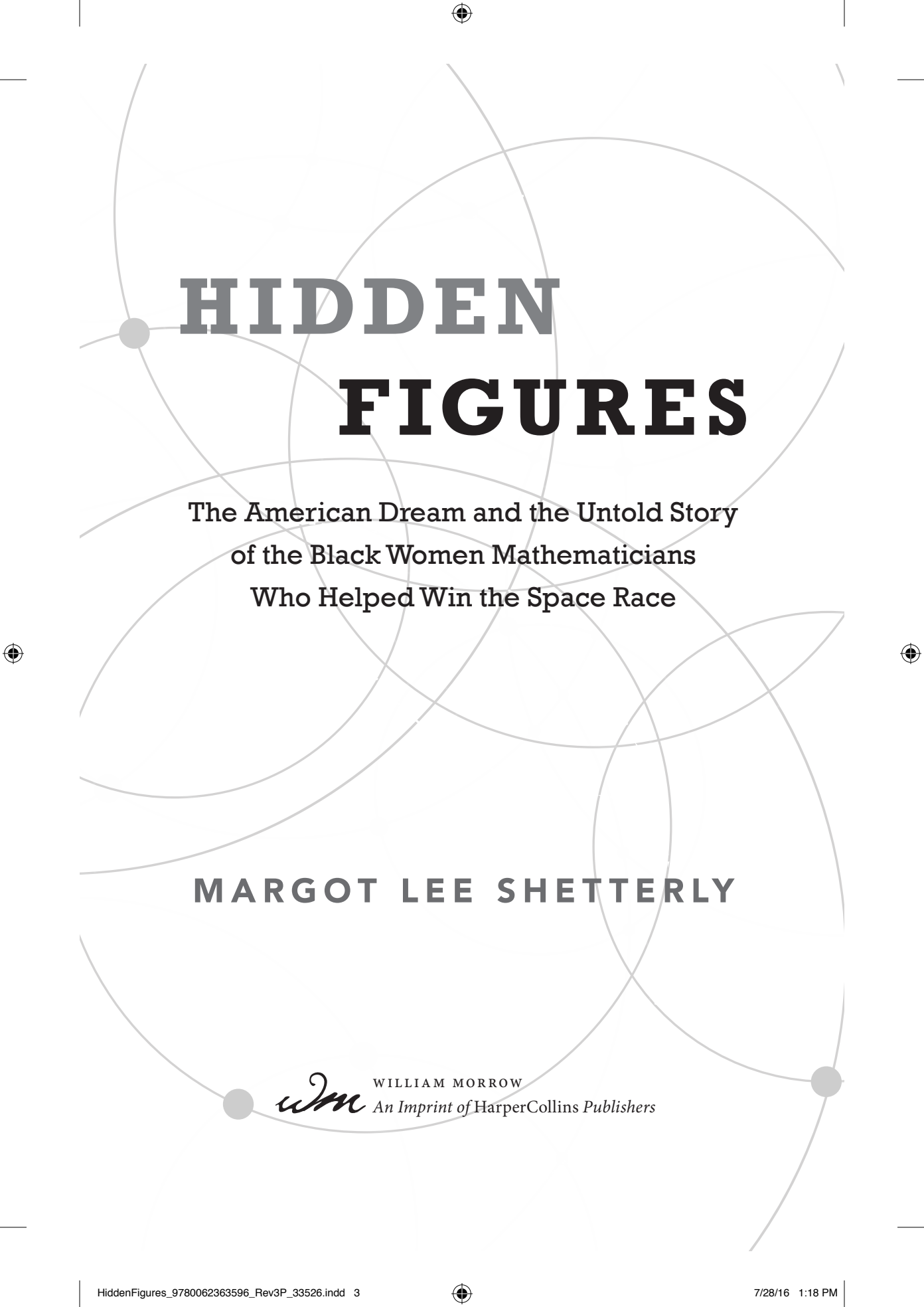
THE AMERICAN DREAM  
AND THE UNTOLD STORY OF  
THE BLACK WOMEN MATHEMATICIANS  
WHO HELPED WIN THE SPACE RACE

# HIDDEN FIGURES



MARGOT LEE SHETTERLY


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**The American Dream and the Untold Story  
of the Black Women Mathematicians  
Who Helped Win the Space Race**

**MARGOT LEE SHETTERLY**

 **WILLIAM MORROW**  
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## AUTHOR'S NOTE

“Negro.” “Colored.” “Indian.” “Girls.” Though some readers might find the language of *Hidden Figures* discordant to their modern ears, I’ve made every attempt to remain true to the time period, and to the voices of the individuals represented in this story.

## PROLOGUE

**M**rs. Land worked as a computer out at Langley,” my father said, taking a right turn out of the parking lot of First Baptist Church in Hampton, Virginia.

My husband and I visited my parents just after Christmas in 2010, enjoying a few days away from our full-time life and work in Mexico. They squired us around town in their twenty-year-old green minivan, my father driving, my mother in the front passenger seat, Aran and I buckled in behind like siblings. My father, gregarious as always, offered a stream of commentary that shifted fluidly from updates on the friends and neighbors we’d bumped into around town to the weather forecast to elaborate discourses on the physics underlying his latest research as a sixty-six-year-old doctoral student at Hampton University. He enjoyed touring my Maine-born-and-raised husband through our neck of the woods and refreshing my connection with local life and history in the process.

During our time home, I spent afternoons with my mother catching matinees at the local cinema, while Aran tagged along with my father and his friends to Norfolk State University football games. We gorged on fried-fish sandwiches at hole-in-the-wall joints near Buckroe Beach,

visited the Hampton University Museum's Native American art collection, and haunted local antiques shops.

As a callow eighteen-year-old leaving for college, I'd seen my hometown as a mere launching pad for a life in worldlier locales, a place to be from rather than a place to be. But years and miles away from home could never attenuate the city's hold on my identity, and the more I explored places and people far from Hampton, the more my status as one of its daughters came to mean to me.

That day after church, we spent a long while catching up with the formidable Mrs. Land, who had been one of my favorite Sunday school teachers. Kathaleen Land, a retired NASA mathematician, still lived on her own well into her nineties and never missed a Sunday at church. We said our good-byes to her and clambered into the minivan, off to a family brunch. "A lot of the women around here, black and white, worked as computers," my father said, glancing at Aran in the rearview mirror but addressing us both. "Kathryn Peddrew, Ophelia Taylor, Sue Wilder," he said, ticking off a few more names. "And Katherine Johnson, who calculated the launch windows for the first astronauts."

The narrative triggered memories decades old, of spending a much-treasured day off from school at my father's office at the National Aeronautics and Space Administration's Langley Research Center. I rode shotgun in our 1970s Pontiac, my brother, Ben, and sister Lauren in the back as our father drove the twenty minutes from our house, straight over the Virgil I. Grissom Bridge, down Mercury Boulevard, to the road that led to the NASA gate. Daddy flashed his badge, and we sailed through to a campus of perfectly straight parallel streets lined from one end to the other by unremarkable two-story redbrick buildings. Only the giant hypersonic wind tunnel complex—a one-hundred-foot ridged silver sphere presiding over four sixty-foot smooth silver globes—offered visual evidence of the remarkable work occurring on an otherwise ordinary-looking campus.

Building 1236, my father's daily destination, contained a byzantine complex of government-gray cubicles, perfumed with the grown-up smells of coffee and stale cigarette smoke. His engineering colleagues with their rumpled style and distracted manner seemed like exotic

birds in a sanctuary. They gave us kids stacks of discarded 11×14 continuous-form computer paper, printed on one side with cryptic arrays of numbers, the blank side a canvas for crayon masterpieces. Women occupied many of the cubicles; they answered phones and sat in front of typewriters, but they also made hieroglyphic marks on transparent slides and conferred with my father and other men in the office on the stacks of documents that littered their desks. That so many of them were African American, many of them my grandmother's age, struck me as simply a part of the natural order of things: growing up in Hampton, the face of science was brown like mine.

My dad joined Langley in 1964 as a coop student and retired in 2004 an internationally respected climate scientist. Five of my father's seven siblings made their bones as engineers or technologists, and some of his best buddies—David Woods, Elijah Kent, Weldon Staton—carved out successful engineering careers at Langley. Our next-door neighbor taught physics at Hampton University. Our church abounded with mathematicians. Supersonics experts held leadership positions in my mother's sorority, and electrical engineers sat on the board of my parents' college alumni associations. My aunt Julia's husband, Charles Foxx, was the son of Ruth Bates Harris, a career civil servant and fierce advocate for the advancement of women and minorities; in 1974, NASA appointed her deputy assistant administrator, the highest-ranking woman at the agency. The community certainly included black English professors, like my mother, as well as black doctors and dentists, black mechanics, janitors, and contractors, black cobblers, wedding planners, real estate agents, and undertakers, several black lawyers, and a handful of black Mary Kay salespeople. As a child, however, I knew so many African Americans working in science, math, and engineering that I thought that's just what black folks did.

My father, growing up during segregation, experienced a different reality. "Become a physical education teacher," my grandfather said in 1962 to his eighteen-year-old son, who was hell-bent on studying electrical engineering at historically black Norfolk State College.



In those days, college-educated African Americans with book smarts and common sense put their chips on teaching jobs or sought work at the post office. But my father, who built his first rocket in junior high metal shop class following the Sputnik launch in 1957, defied my grandfather and plunged full steam ahead into engineering. Of course, my grandfather's fears that it would be difficult for a black man to break into engineering weren't unfounded. As late as 1970, just 1 percent of all American engineers were black—a number that doubled to a whopping 2 percent by 1984. Still, the federal government was the most reliable employer of African Americans in the sciences and technology: in 1984, 8.4 percent of NASA's engineers were black.

NASA's African American employees learned to navigate their way through the space agency's engineering culture, and their successes in turn afforded their children previously unimaginable access to American society. Growing up with white friends and attending integrated schools, I took much of the groundwork they'd laid for granted.

Every day I watched my father put on a suit and back out of the driveway to make the twenty-minute drive to Building 1236, demanding the best from himself in order to give his best to the space program and to his family. Working at Langley, my father secured my family's place in the comfortable middle class, and Langley became one of the anchors of our social life. Every summer, my siblings and I saved our allowances to buy tickets to ride ponies at the annual NASA carnival. Year after year, I confided my Christmas wish list to the NASA Santa at the Langley children's Christmas party. For years, Ben, Lauren, and my youngest sister, Jocelyn, still a toddler, sat in the bleachers of the Langley Activities Building on Thursday nights, rooting for my dad and his "NBA" (NASA Basketball Association) team, the Stars. I was as much a product of NASA as the Moon landing.

The spark of curiosity soon became an all-consuming fire. I peppered my father with questions about his early days at Langley during the mid-1960s, questions I'd never asked before. The following Sunday I interviewed Mrs. Land about the early days of Langley's computing pool,

when part of her job responsibility was knowing which bathroom was marked for “colored” employees. And less than a week later I was sitting on the couch in Katherine Johnson’s living room, under a framed American flag that had been to the Moon, listening to a ninety-three-year-old with a memory sharper than mine recall segregated buses, years of teaching and raising a family, and working out the trajectory for John Glenn’s spaceflight. I listened to Christine Darden’s stories of long years spent as a data analyst, waiting for the chance to prove herself as an engineer.

Even as a professional in an integrated world, I had been the only black woman in enough drawing rooms and boardrooms to have an inkling of the chutzpah it took for an African American woman in a segregated southern workplace to tell her bosses she was sure her calculations would put a man on the Moon. These women’s paths set the stage for mine; immersing myself in their stories helped me understand my own.

Even if the tale had begun and ended with the first five black women who went to work at Langley’s segregated west side in May 1943—the women later known as the “West Computers”—I still would have committed myself to recording the facts and circumstances of their lives. Just as islands—isolated places with unique, rich biodiversity—have relevance for the ecosystems everywhere, so does studying seemingly isolated or overlooked people and events from the past turn up unexpected connections and insights to modern life. The idea that black women had been recruited to work as mathematicians at the NASA installation in the South during the days of segregation defies our expectations and challenges much of what we think we know about American history. It’s a great story, and that alone makes it worth telling.

In the early stages of researching this book, I shared details of what I had found with experts on the history of the space agency. To a person they encouraged what they viewed as a valuable addition to the body of knowledge, though some questioned the magnitude of the story.

“How many women are we talking about? Five or six?”

I had known more than that number just growing up in Hampton, but even I was surprised at how the numbers kept adding up. These women showed up in photos and phone books, in sources both expected and unusual. A mention of a Langley job in an engagement announcement in the *Norfolk Journal and Guide*. A handful of names from the daughter of one of the first West Computers. A 1951 memo from the Langley personnel officer reporting on the numbers and status of its black employees, which unexpectedly made reference to one black woman who was a “GS-9 Research Scientist.” I discovered one 1945 personnel document describing a beehive of mathematical activity in an office in a new building on Langley’s west side, staffed by twenty-five black women coaxing numbers out of calculators on a twenty-four-hour schedule, overseen by three black shift supervisors who reported to two white head computers. Even as I write the final words of this book, I’m still doing the numbers. I can put names to almost fifty black women who worked as computers, mathematicians, engineers, or scientists at the Langley Memorial Aeronautical Laboratory from 1943 through 1980, and my intuition is that twenty more names can be shaken loose from the archives with more research.

And while the black women are the most hidden of the mathematicians who worked at the NACA, the National Advisory Committee for Aeronautics, and later at NASA, they were not sitting alone in the shadows: the white women who made up the majority of Langley’s computing workforce over the years have hardly been recognized for their contributions to the agency’s long-term success. Virginia Biggins worked the Langley beat for the *Daily Press* newspaper, covering the space program starting in 1958. “Everyone said, ‘This is a scientist, this is an engineer,’ and it was always a man,” she said in a 1990 panel on Langley’s human computers. She never got to meet any of the women. “I just assumed they were all secretaries,” she said. Five white women joined Langley’s first computing pool in 1935, and by 1946, four hundred “girls” had already been trained as aeronautical foot soldiers. Historian Beverly Golemba, in a 1994 study, estimated that Langley had employed “several hundred” women as human computers. On the tail

end of the research for *Hidden Figures*, I can now see how that number might top one thousand.

To a first-time author with no background as a historian, the stakes involved in writing about a topic that was virtually absent from the history books felt high. I'm sensitive to the cognitive dissonance conjured by the phrase "black female mathematicians at NASA." From the beginning, I knew that I would have to apply the same kind of analytical reasoning to my research that these women applied to theirs. Because as exciting as it was to discover name after name, finding out who they were was just the first step. The real challenge was to document their work. Even more than the surprisingly large numbers of black and white women who had been hiding in a profession seen as universally white and male, the body of work they left behind was a revelation.

There was Dorothy Hoover, working for Robert T. Jones in 1946 and publishing theoretical research on his famed triangle-shaped delta wings in 1951. There was Dorothy Vaughan, working with the white "East Computers" to write a textbook on algebraic methods for the mechanical calculating machines that were their constant companions. There was Mary Jackson, defending her analysis against John Becker, one of the world's top aerodynamicists. There was Katherine Coleman Goble Johnson, describing the orbital trajectory of John Glenn's flight, the math in her trailblazing 1959 report as elegant and precise and grand as a symphony. There was Marge Hannah, the white computer who served as the black women's first boss, coauthoring a report with Sam Katzoff, who became the laboratory's chief scientist. There was Doris Cohen, setting the bar for them all with her first research report—the NACA's first female author—back in 1941.

My investigation became more like an obsession; I would walk any trail if it meant finding a trace of one of the computers at its end. I was determined to prove their existence and their talent in a way that meant they would never again be lost to history. As the photos and memos and equations and family stories became real people, as the women became my companions and returned to youth or returned to life, I started to want something more for them than just putting them on

the record. What I wanted was for them to have the grand, sweeping narrative that they deserved, the kind of American history that belongs to the Wright Brothers and the astronauts, to Alexander Hamilton and Martin Luther King Jr. Not told as a separate history, but as a part of the story we all know. Not at the margins, but at the very center, the protagonists of the drama. And not just because they are black, or because they are women, but because they are part of the American epic.

Today, my hometown—the hamlet that in 1962 dubbed itself “Spacetown USA”—looks like any suburban city in a modern and hyperconnected America. People of all races and nationalities mingle on Hampton’s beaches and in its bus stations, the WHITES ONLY signs of the past now relegated to the local history museum and the memories of survivors of the civil rights revolution. Mercury Boulevard no longer conjures images of the eponymous mission that shot the first Americans beyond the atmosphere, and each day the memory of Virgil Grissom fades away from the bridge that bears his name. A downsized space program and decades of government cutbacks have hit the region hard; today, an ambitious college grad with a knack for numbers might set her sights on a gig at a Silicon Valley startup or make for one of the many technology firms that are conquering the NASDAQ from the Virginia suburbs outside of Washington, DC.

But before a computer became an inanimate object, and before Mission Control landed in Houston; before Sputnik changed the course of history, and before the NACA became NASA; before the Supreme Court case *Brown v. Board of Education of Topeka* established that separate was in fact not equal, and before the poetry of Martin Luther King Jr.’s “I Have a Dream” speech rang out over the steps of the Lincoln Memorial, Langley’s West Computers were helping America dominate aeronautics, space research, and computer technology, carving out a place for themselves as female mathematicians who were also black, black mathematicians who were also female. For a group of bright and ambitious African American women, diligently prepared for a mathematical career and eager for a crack at the big leagues, Hampton, Virginia, must have felt like the center of the universe.