When Henrietta lacks was diagnosed with cancer in 1951, doctors took her cells and grew them in test tubes. Those cells led to breakthroughs in everything from Parkinson's to polio. But today, Henrietta is all but forgotten. In an excerpt from her book, The Immortal Life of Henrietta Lacks, Rebecca Skloot tells her story.

In 1951, at the age of 30, Henrietta Lacks, the descendant of freed slaves, was diagnosed with cervical cancer – a strangely aggressive type, unlike any her doctor had ever seen. He took a small tissue sample without her knowledge or consent. A scientist put that sample into a test tube, and, though Henrietta died eight months later, her cells – known worldwide as HeLa – are still alive today. They became the first immortal human cell line ever grown in culture and one of the most important tools in medicine: Research on HeLa was vital to the development of the polio vaccine, as well as drugs for treating herpes, leukemia, influenza, hemophilia, and Parkinson's disease; it helped uncover the secrets of cancer and the effects of the atom bomb, and led to important advances like cloning, in vitro fertilization, and gene mapping. Since 2001 alone, five Nobel Prizes have been awarded for research involving HeLa cells.

There's no way of knowing exactly how many of Henrietta's cells are alive today. One scientist estimates that if you could pile all the HeLa cells ever grown onto a scale, they'd weigh more than 50 million metric tons – the equivalent of at least 100 Empire State Buildings.

Today, nearly 60 years after Henrietta's death, her body lies in an unmarked grave in Clover, Virginia. Gut her cells are still among the most widely used in labs worldwide – bought and sold by the billions. Though those cells have done wonders for science, Henrietta – whose legacy involves the birth of bioethics and the grim history of experimentation on African-Americans – is all but forgotten.

Start reading her story

3

Diagnosis and Treatment

After her visit to Hopkins, Henrietta went about life as usual, cleaning and cooking for Day, their children, and the many cousins who stopped by. Then, a few days later, Jones got her biopsy results from the pathology lab: "Epidermoid carcinoma of the cervix, Stage I."

All cancers originate from a single cell gone wrong and are categorized based on the type of cell they start from. Most cervical cancers are carcinomas, which grow from the epithelial cells that cover the cervix and protect its surface. By chance, when Henrietta showed up at Hopkins complaining of abnormal bleeding, Jones and his boss, Richard Wesley TeLinde, were involved in a heated nationwide debate over what qualified as cervical cancer, and how best to treat it.

TeLinde, one of the top cervical cancer experts in the country, was a dapper and serious fifty-six-year-old surgeon who walked with an extreme limp from an ice-skating accident more than a decade earlier. Everyone at Hopkins called him Uncle Dick. He'd pioneered the use of estrogen for treating symptoms of menopause and made important early discoveries about endometriosis. He'd also written one of the most famous clinical gynecology textbooks, which is still widely used sixty years and ten editions after he first wrote it. His reputation was international: when the king of Morocco's wife fell ill, he insisted only TeLinde could operate on her. By 1951, when Henrietta arrived at Hopkins, TeLinde had developed a theory about cervical cancer that, if correct, could save the lives of millions of women. But few in the field believed him.

Cervical carcinomas are divided into two types: invasive carcinomas, which have penetrated the surface of the cervix, and noninvasive carcinomas, which haven't. The noninvasive type is sometimes called "sugar-icing carcinoma," because it grows in a smooth layered sheet across the surface of the cervix, but its official name is *carcinoma in situ,* which derives from the Latin for "cancer in its original place."

In 1951, most doctors in the field believed that invasive carcinoma was deadly, and carcinoma in situ wasn't. So they treated the invasive type aggressively but generally didn't worry about carcinoma in situ because they thought it couldn't spread. TeLinde disagreed—he believed carcinoma in situ was simply an early stage of invasive carcinoma that, if left untreated, eventually became deadly. So he treated it aggressively, often removing the cervix, uterus, and most of the vagina. He argued that this would drastically reduce cervical cancer deaths, but his critics called it extreme and unnecessary.

Diagnosing carcinoma in situ had only been possible since 1941, when George Papanicolaou, a Greek researcher, published a paper describing a test he'd developed, now called the Pap smear. It involved scraping cells from the cervix with a curved glass pipette and examining them under a microscope for precancerous changes that TeLinde and a few others had identified years earlier. This was a tremendous advance, because those precancerous cells weren't detectable otherwise: they caused no physical symptoms and weren't palpable or visible to the naked eye. By the time a woman began showing symptoms, there was little hope of a cure. But with the Pap smear, doctors could detect precancerous cells and perform a hysterectomy, and cervical cancer would be almost entirely preventable.

At that point, more than 15,000 women were dying each year from cervical cancer. The Pap smear had the potential to decrease that death rate by 70 percent or more, but there were two things standing in its way: first, many women—like Henrietta—simply didn't get the test; and, second, even when they did, few doctors knew how to interpret the results accurately, because they didn't know what the various stages of cervical cancer looked like under a microscope. Some mistook cervical infections for cancer and removed a woman's entire reproductive tract when all she needed was antibiotics. Others mistook malignant changes for infection, sending women home with antibiotics only to have them return later, dying from metastasized cancer. And even when doctors correctly diagnosed precancerous changes, they often didn't know how those changes should be treated.

TeLinde set out to minimize what he called "unjustifiable hysterectomies" by documenting what *wasn't* cervical cancer and by urging surgeons to verify smear results with biopsies before operating. He also hoped to prove that women with carcinoma in situ needed aggressive treatment, so their cancer didn't become invasive.

Not long before Henrietta's first exam, TeLinde presented his argument about carcinoma in situ to a major meeting of pathologists in Washington, D.C., and the audience heckled him off the stage. So he went back to Hopkins and planned a study that would prove them wrong: he and his staff would review all medical records and biopsies from patients who'd been diagnosed with invasive cervical cancer at Hopkins in the past decade, to see how many initially had carcinoma in situ.

Like many doctors of his era, TeLinde often used patients from the public wards for research, usually without their knowledge. Many scientists believed that since patients were treated for free in the public wards, it was fair to use them as research subjects as a form of payment. And as Howard Jones once wrote, "Hopkins, with its large indigent black population, had no dearth of clinical material."

In this particular study—the largest ever done on the relationship between the two cervical cancers—Jones and TeLinde found that 62 percent of women with invasive cancer who'd had earlier biopsies first had carcinoma in situ. In addition to that study, TeLinde thought, if he could find a way to grow living samples from normal cervical tissue and both types of cancerous tissue—something never done before—he could compare all three. If he could prove that carcinoma in situ and invasive carcinoma looked and behaved similarly in the laboratory, he could end the debate, showing that he'd been right all along, and doctors who ignored him were killing their patients. So he called George Gey (pronounced *Guy*), head of tissue culture research at Hopkins.

Gey and his wife, Margaret, had spent the last three decades working to grow malignant cells outside the body, hoping to use them to find cancer's cause and cure. But most cells died quickly, and the few that survived hardly grew at all. The Geys were determined to grow the first *immortal* human cells: a continuously dividing line of cells all descended from one original sample, cells that would constantly replenish themselves and never die. Eight years earlier—in 1943—a group of researchers at the National Institutes of Health had proven such a thing was possible using mouse cells. The Geys wanted to grow the human equivalent—they didn't care what kind of tissue they used, as long as it came from a person.

Gey took any cells he could get his hands on—he called himself "the world's most famous vulture, feeding on human specimens almost constantly." So when TeLinde offered him a supply of cervical cancer tissue in exchange for trying to grow some cells, Gey didn't hesitate. And TeLinde began collecting samples from any woman who happened to walk into Hopkins with cervical cancer. Including Henrietta.

On February 5, 1951, after Jones got Henrietta's biopsy report back from the lab, he called and told her it was malignant. Henrietta didn't tell anyone what Jones said, and no one asked. She simply went on with her day as if nothing had happened, which was just like her—no sense upsetting anyone over something she could deal with herself.

That night Henrietta told her husband, "Day, I need to go back to the doctor tomorrow. He wants to do some tests, give me some medicine." The next morning she climbed from the Buick outside Hopkins again, telling Day and the children not to worry.

"Ain't nothin serious wrong," she said. "Doctor's gonna fix me right up."

Henrietta went straight to the admissions desk and told the receptionist she was there for her treatment. Then she signed a form with the words OPERATION PERMIT at the top of the page. It said:

> I hereby give consent to the staff of The Johns Hopkins Hospital to perform any operative procedures and under any anaesthetic either local or general that they may deem necessary in the proper surgical care and treatment of: ______________________________.

Henrietta printed her name in the blank space. A witness with illegible handwriting signed a line at the bottom of the form, and Henrietta signed another.

Then she followed a nurse down a long hallway into the ward for colored women, where Howard Jones and several other white physicians ran more tests than she'd had in her entire life. They checked her urine, her blood, her lungs. They stuck tubes in her bladder and nose.

On her second night at the hospital, the nurse on duty fed Henrietta an early dinner so her stomach would be empty the next morning, when a doctor put her under anesthetic for her first cancer treatment. Henrietta's tumor was the invasive type, and like hospitals nationwide, Hopkins treated all invasive cervical carcinomas with radium, a white radioactive metal that glows an eerie blue.

When radium was first discovered in the late 1800s, headlines nationwide hailed it as "a substitute for gas, electricity, and a positive cure for every disease." Watchmakers added it to paint to make watch dials glow, and doctors administered it in powdered form to treat everything from seasickness to ear infections. But radium destroys any cells it encounters, and patients who'd taken it for trivial problems began dying. Radium causes mutations that can turn into cancer, and at high doses it can burn the skin off a person's body. But it also kills cancer cells.

Hopkins had been using radium to treat cervical cancer since the early 1900s, when a surgeon named Howard Kelly visited Marie and Pierre Curie, the couple in France who'd discovered radium and its ability to destroy cancer cells. Without realizing the danger of contact with radium, Kelly brought some back to the United States in his pockets and regularly traveled the world collecting more. By the 1940s, several studies—one of them conducted by Howard Jones, Henrietta's physician—showed that radium was safer and more effective than surgery for treating invasive cervical cancer.

The morning of Henrietta's first treatment, a taxi driver picked up a doctor's bag filled with thin glass tubes of radium from a clinic across town. The tubes were tucked into individual slots inside small canvas pouches hand-sewn by a local Baltimore woman. The pouches were called Brack plaques, after the Hopkins doctor who invented them and oversaw Henrietta's radium treatment. He would later die of cancer, most likely caused by his regular exposure to radium, as would a resident who traveled with Kelly and also transported radium in his pockets.

One nurse placed the Brack plaques on a stainless-steel tray. Another wheeled Henrietta into the small colored-only operating room on the second floor, with stainless-steel tables, huge glaring lights, and an all-white medical staff dressed in white gowns, hats, masks, and gloves.

With Henrietta unconscious on the operating table in the center of the room, her feet in stirrups, the surgeon on duty, Dr. Lawrence Wharton Jr., sat on a stool between her legs. He peered inside Henrietta, dilated her cervix, and prepared to treat her tumor. But first—though no one had told Henrietta that TeLinde was collecting samples or asked if she wanted to be a donor—Wharton picked up a sharp knife and shaved two dime-sized pieces of tissue from Henrietta's cervix: one from her tumor, and one from the healthy cervical tissue nearby. Then he placed the samples in a glass dish.

Wharton slipped a tube filled with radium inside Henrietta's cervix, and sewed it in place. He sewed a plaque filled with radium to the outer surface of her cervix and packed another plaque against it. He slid several rolls of gauze inside her vagina to help keep the radium in place, then threaded a catheter into her bladder so she could urinate without disturbing the treatment.

When Wharton finished, a nurse wheeled Henrietta back into the ward, and Wharton wrote in her chart, "The patient tolerated the procedure well and left the operating room in good condition." On a separate page he wrote, "Henrietta Lacks . . . Biopsy of cervical tissue . . . Tissue given to Dr. George Gey."

A resident took the dish with the samples to Gey's lab, as he'd done many times before. Gey still got excited at moments like this, but everyone else in his lab saw Henrietta's sample as something tedious—the latest of what felt like countless samples that scientists and lab technicians had been trying and failing to grow for years. They were sure Henrietta's cells would die just like all the others.

1920s . 1930s . 1940s . 1950s . 1960s . 1970s . 1980s . 1990s . 2000s

1951

4 The Birth of HeLa

Gey's twenty-one-year-old assistant, Mary Kubicek, sat eating a tuna-salad sandwich at a long stone culture bench that doubled as a break table. She and Margaret and the other women in the Gey lab spent countless hours there, all in nearly identical cat-eye-glasses with fat dark frames and thick lenses, their hair pulled back in tight buns.

At first glance, the room could have been an industrial kitchen. There were gallon-sized tin coffee cans full of utensils and glassware; powdered creamer, sugar, spoons, and soda bottles on the table; huge metal freezers lining one wall; and deep sinks Gey made by hand using stones he collected from a nearby quarry. But the teapot sat next to a Bunsen burner, and the freezers were filled with blood, placentas, tumor samples, and dead mice (plus at least one duck Gey kept frozen in the lab for more than twenty years after a hunting trip, since it wouldn't fit in his freezer at home). Gey had lined one wall with cages full of squealing rabbits, rats, and guinea pigs; on one side of the table where Mary sat eating her lunch, he'd built shelves holding cages full of mice, their bodies filled with tumors. Mary always stared at them while she ate, just as she was doing when Gey walked into the lab carrying the pieces of Henrietta's cervix.

"I'm putting a new sample in your cubicle," he told her.

Mary pretended not to notice. *Not again,* she thought, and kept eating her sandwich. *It can wait till I'm done.*

Mary knew she shouldn't wait—every moment those cells sat in the dish made it more likely they'd die. But she was tired of cell culture, tired of meticulously cutting away dead tissue like gristle from a steak, tired of having cells die after hours of work.

Why bother? she thought.

Gey hired Mary for her hands. She was fresh out of college with a physiology degree when her adviser sent her for an interview. Gey asked Mary to pick up a pen from the table and write a few sentences. Now pick up that knife, he said. Cut this piece of paper. Twirl this pipette.

Mary didn't realize until months later that he'd been studying her hands, checking their dexterity and strength to see how they'd stand up to hours of delicate cutting, scraping, tweezing, and pipetting.

By the time Henrietta walked into Hopkins, Mary was handling most of the tissue samples that came through the door, and so far all samples from TeLinde's patients had died.

At that point, there were many obstacles to growing cells successfully. For starters, no one knew exactly what nutrients they needed to survive, or how best to supply them. Many researchers, including the Geys, had been trying for years to develop the perfect culture medium—the liquid used for feeding cells. The recipes for Gey Culture Medium evolved constantly as George and Margaret added and removed ingredients, searching for the perfect balance. But they all sounded like witches' brews: the plasma of chickens, purée of calf fetuses, special salts, and blood from human umbilical cords. George had rigged a bell and cable from the window of his lab across a courtyard to the Hopkins maternity ward, so nurses could ring anytime a baby was born, and Margaret or Mary would run over and collect umbilical cord blood.

The other ingredients weren't so easy to come by: George visited local slaughterhouses at least once a week to collect cow fetuses and chicken blood. He'd drive there in his rusted-out old Chevy, its left fender flapping against the pavement, shooting sparks. Well before dawn, in a rundown wooden building with a sawdust floor and wide gaps in the walls, Gey would grab a screaming chicken by the legs, yank it upside down from its cage, and wrestle it to its back on a butcher block. He'd hold its feet in one hand and pin its neck motionless to the wood with his elbow. With his free hand, he'd squirt the bird's chest with alcohol, and plunge a syringe needle into the chicken's heart to draw blood. Then he'd stand the bird upright, saying, "Sorry, old fella," and put it back in its cage. Every once in a while, when a chicken dropped dead from the stress, George took it home so Margaret could fry it for dinner.

Like many procedures in their lab, the Gey Chicken Bleeding Technique was Margaret's creation. She worked out the method step-by-step, taught it to George, and wrote detailed instructions for the many other researchers who wanted to learn it.

Finding the perfect medium was an ongoing experiment, but the biggest problem facing cell culture was contamination. Bacteria and a host of other microorganisms could find their way into cultures from people's unwashed hands, their breath, and dust particles floating through the air, and destroy them. But Margaret had been trained as a surgical nurse, which meant sterility was her specialty—it was key to preventing deadly infections in patients in the operating room. Many would later say that Margaret's surgical training was the only reason the Gey lab was able to grow cells at all. Most culturists, like George, were biologists; they knew nothing about preventing contamination.

Margaret taught George everything he knew about keeping cultures sterile, and she did the same with every technician, grad student, and scientist who came to work or study in the lab. She hired a local woman named Minnie whose sole job was washing the laboratory glassware using the only product Margaret would allow: Gold Dust Twins soap. Margaret was so serious about that soap, when she heard a rumor that the company might go out of business, she bought an entire boxcar full of it.

Margaret patrolled the lab, arms crossed, and leaned over Minnie's shoulder as she worked, towering nearly a foot above her. If Margaret ever smiled, no one could have seen it through her ever-present surgical mask. She inspected all the glassware for spots or smudges, and when she found them—which was often—she'd scream, "MINNIE!" so loud that Mary cringed.

Mary followed Margaret's sterilizing rules meticulously to avoid her wrath. After finishing her lunch, and before touching Henrietta's sample, Mary covered herself with a clean white gown, surgical cap, and mask, and then walked to her cubicle, one of four airtight rooms George had built by hand in the center of the lab. The cubicles were small, only five feet in any direction, with doors that sealed like a freezer's to prevent contaminated air from getting inside. Mary turned on the sterilizing system and watched from outside as her cubicle filled with hot steam to kill anything that might damage the cells. When the steam cleared, she stepped inside and sealed the door behind her, then hosed the cubicle's cement floor with water and scoured her workbench with alcohol. The air inside was filtered and piped in through a vent on the ceiling. Once she'd sterilized the cubicle, she lit a Bunsen burner and used its flame to sterilize test tubes and a used scalpel blade, since the Gey lab couldn't afford new ones for each sample.

Only then did she pick up the pieces of Henrietta's cervix—forceps in one hand, scalpel in the other—and carefully slice them into one-millimeter squares. She sucked each square into a pipette, and dropped them one at a time onto chicken-blood clots she'd placed at the bottom of dozens of test tubes. She covered each clot with several drops of culture medium, plugged the tubes with rubber stoppers, and labeled each one as she'd labeled most cultures they grew: using the first two letters of the patient's first and last names.

After writing "HeLa," for *Henrietta* and *Lacks*, in big black letters on the side of each tube, Mary carried them to the incubator room that Gey had built just like he'd built everything else in the lab: by hand and mostly from junkyard scraps, a skill he'd learned from a lifetime of making do with nothing.

George Gey was born in 1899 and raised on a Pittsburgh hillside overlooking a steel mill. Soot from the smokestacks made his parents' small white house look like it had been permanently charred by fire and left the afternoon sky dark. His mother worked the garden and fed her family from nothing but the food she raised. As a child, George dug a small coal mine in the hill behind his parents' house. He'd crawl through the damp tunnel each morning with a pick, filling buckets for his family and neighbors so they could keep their houses warm and stoves burning.

Gey paid his way through a biology degree at the University of Pittsburgh by working as a carpenter and mason, and he could make nearly anything for cheap or free. During his second year in medical school, he rigged a microscope with a time-lapse motion picture camera to capture live cells on film. It was a Frankensteinish mishmash of microscope parts, glass, and 16-millimeter camera equipment from who knows where, plus metal scraps, and old motors from Shapiro's junkyard. He built it in a hole he'd blasted in the foundation of Hopkins, right below the morgue, its base entirely underground and surrounded by a thick wall of cork to keep it from jiggling when streetcars passed. At night, a Lithuanian lab assistant slept next to the camera on a cot, listening to its constant tick, making sure it stayed stable through the night, waking every hour to refocus it. With that camera, Gey and his mentor, Warren Lewis, filmed the growth of cells, a process so slow—like the growth of a flower—the naked eye couldn't see it. They played the film at high speed so they could watch cell division on the screen in one smooth motion, like a story unfolding in a flip book.

It took Gey eight years to get through medical school because he kept dropping out to work construction and save for another year's tuition. After he graduated, he and Margaret built their first lab in a janitor's quarters at Hopkins—they spent weeks wiring, painting, plumbing, building counters and cabinets, paying for much of it with their own money.

Margaret was cautious and stable, the backbone of the lab. George was an enormous, mischievous, grown-up kid. At work he was dapper, but at home he lived in flannels, khakis, and suspenders. He moved boulders around his yard on weekends, ate twelve ears of corn in one sitting, and kept barrels full of oysters in his garage so he could shuck and eat them anytime he wanted. He had the body of a retired linebacker, six feet four inches tall and 215 pounds, his back unnaturally stiff and upright from having his spine fused so he'd stop throwing it out. When his basement wine-making factory exploded on a Sunday, sending a flood of sparkling burgundy through his garage and into the street, Gey just washed the wine into a storm drain, waving at his neighbors as they walked to church.

Gey was a reckless visionary—spontaneous, quick to start dozens of projects at once, filling the lab and his basement at home with half-built machines, partial discoveries, and piles of junkyard scraps only he could imagine using in a lab. Whenever an idea hit him, he sat wherever he was—at his desk, kitchen table, a bar, or behind the wheel of his car—gnawing on his ever-present cigar and scribbling diagrams on napkins or the backs of torn-off bottle labels. That's how he came up with the roller-tube culturing technique, his most important invention.

It involved a large wooden roller drum, a cylinder with holes for special test tubes called roller tubes. The drum, which Gey called the "whirligig," turned like a cement mixer twenty-four hours a day, rotating so slowly it made only two full turns an hour, sometimes less. For Gey, the rotation was crucial: he believed that culture medium needed to be in constant motion, like blood and fluids in the body, which flow around cells, transporting waste and nutrients.

When Mary finally finished cutting the samples of Henrietta's cervix and dropping them in dozens of roller tubes, she walked into the incubator room, slid the tubes one at a time into the drum, and turned it on. Then she watched as Gey's machine began churning slowly.

Henrietta spent the next two days in the hospital, recovering from her first radium treatment. Doctors examined her inside and out, pressing on her stomach, inserting new catheters into her bladder, fingers into her vagina and anus, needles into her veins. They wrote notes in her chart saying, "30 year-old colored female lying quietly in no evident distress," and "Patient feels quite well tonight. Morale is good and she is ready to go home."

Before Henrietta left the hospital, a doctor put her feet in the stirrups again and removed the radium. He sent her home with instructions to call the clinic if she had problems, and to come back for a second dose of radium in two and a half weeks.

Meanwhile, each morning after putting Henrietta's cells in culture, Mary started her days with the usual sterilization drill. She peered into the tubes, laughing to herself and thinking, *Nothing's happening. Big surprise.* Then, two days after Henrietta went home from the hospital, Mary saw what looked like little rings of fried egg white around the clots at the bottoms of each tube. The cells were growing, but Mary didn't think much of it—other cells had survived for a while in the lab.

But Henrietta's cells weren't merely surviving, they were growing with mythological intensity. By the next morning they'd doubled. Mary divided the contents of each tube into two, giving them room to grow, and within twenty-four hours, they'd doubled again. Soon she was dividing them into four tubes, then six. Henrietta's cells grew to fill as much space as Mary gave them.

Still, Gey wasn't ready to celebrate. "The cells could die any minute," he told Mary.

But they didn't. They kept growing like nothing anyone had seen, doubling their numbers every twenty-four hours, stacking hundreds on top of hundreds, accumulating by the millions. "Spreading like crabgrass!" Margaret said. They grew twenty times faster than Henrietta's normal cells, which died only a few days after Mary put them in culture. As long as they had food and warmth, Henrietta's cancer cells seemed unstoppable.

Soon, George told a few of his closest colleagues that he thought his lab might have grown the first immortal human cells.

To which they replied, Can I have some? And George said yes.