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# The Secret of Immortality

More than thirty years after Henrietta's death, research on HeLa cells finally helped uncover how her cancer started and why her cells never died. In 1984 a German virologist named Harald zur Hausen discovered a new strain of a sexually transmitted virus called Human Papilloma Virus 18 (HPV-18). He believed it and HPV-16, which he'd discovered a year earlier, caused cervical cancer. HeLa cells in his lab tested positive for the HPV-18 strain, but zur Hausen requested a sample of Henrietta's original biopsy from Hopkins, so he could be sure her cells hadn't been contaminated with the virus in culture. The sample didn't just test positive; it showed that Henrietta had been infected with multiple copies of HPV-18, which turned out to be one of the most virulent strains of the virus.

There are more than one hundred strains of HPV in existence, thirteen of which cause cervical, anal, oral, and penile cancer—today, around 90 percent of all sexually active adults become infected with at least one strain during their lifetimes. Throughout the eighties, using HeLa and other cells, scientists studied HPV infection and how it causes cancer. They learned that HPV inserts its DNA into the DNA



of the host cell, where it produces proteins that lead to cancer. They also found that when they blocked the HPV DNA, cervical cancer cells stopped being cancerous. These discoveries would help lead to an HPV vaccine, and eventually earn zur Hausen a Nobel Prize.

Research into HPV eventually uncovered how Henrietta's cancer started: HPV inserted its DNA into the long arm of her eleventh chromosome and essentially turned off her p53 tumor suppressor gene. What scientists still haven't figured out is why this produced such monstrously virulent cells both in and out of Henrietta's body, especially since cervical cancer cells are some of the hardest of all cells to culture.

When I talked to Howard Jones fifty years after he found the tumor on Henrietta's cervix, he was in his early nineties and had seen thousands of cervical cancer cases. But when I asked if he remembered Henrietta, he laughed. "I could never forget that tumor," he said, "because it was unlike anything I've ever seen."

I talked to many scientists about HeLa, and none could explain why Henrietta's cells grew so powerfully when many others didn't even survive. Today it's possible for scientists to immortalize cells by exposing them to certain viruses or chemicals, but very few cells have become immortal on their own as Henrietta's did.

Members of Henrietta's family have their own theories about why her cells grew so powerfully: Henrietta's sister Gladys never forgave her for moving to Baltimore and leaving their father behind for Gladys to care for as he aged. The way Gladys saw it, that cancer was the Lord's way of punishing Henrietta for leaving home. Gladys's son Gary believed all disease was the wrath of the Lord—punishment for Adam eating the apple from Eve. Cootie said it was the disease-causing spirits. And Henrietta's cousin Sadie never knew what to think.

"Oh Lord," she told me once. "When I heard about them cells I thought, Could it'a been somethin live got up in her, you know? It scared me, cause we used to go around together all the time. Hennie and I ain't never been in that nasty water down there in Turners Station like the other peoples, we didn't go to no beach or nothing like

that, and we didn't never go without no panties or anything, so I don't know how something got up inside Hennie. But it did. Somethin came alive up in her. She died, and it just keep on living. Made me start thinkin things, you know, like maybe something come out of space, dropped down, and she walked over it."

Sadie laughed when she said this because she knew it sounded crazy. "But that did went through my mind," she said. "I ain't lying. Everything just go through your mind, you know? How else you gonna explain them cells growin like they do?"

Every decade has had its landmark moments in HeLa research, and the connection between HPV and cervical cancer was only one of several in the eighties. At the beginning of the AIDS epidemic, a group of researchers—including a molecular biologist named Richard Axel, who would go on to win a Nobel Prize—infected HeLa cells with HIV. Normally, HIV can infect only blood cells, but Axel had inserted a specific DNA sequence from a blood cell into HeLa cells, which made it possible for HIV to infect them as well. This allowed scientists to determine what was required for HIV to infect a cell—an important step toward understanding the virus, and potentially stopping it.

Axel's research caught the attention of Jeremy Rifkin, an author and activist who was deeply involved in a growing public debate over whether scientists should alter DNA. Rifkin and many others believed that any manipulation of DNA, even in a controlled laboratory setting, was dangerous because it might lead to genetic mutations and make it possible to engineer "designer babies." Since there were no laws limiting genetic engineering, Rifkin regularly sued to stop it using any existing laws that might apply.

In 1987 he filed a lawsuit in federal court to halt Axel's research on the grounds that it violated the 1975 National Environmental Policy Act, because it had never been proven environmentally safe. It was widely known, Rifkin pointed out, that HeLa was "an extraordinarily virulent and infectious line of cells" that could contaminate other cultures. Once Axel infected HeLa cells with HIV, Rifkin said, they could infect other cells and expose lab researchers around the world to HIV, "thus increasing the virus' host range and potentially leading to the further hazardous dissemination of the AIDS virus genome."



Axel responded to the suit by explaining that cells couldn't grow outside of tissue culture and that there was a world of difference between culture contamination and HIV infection. *Science* reported on the lawsuit, writing, "Even Rifkin admits that taken together these events sound more like the plot of a grade-B horror movie than the normal run of affairs in the country's biomedical research laboratories." Eventually the suit was dismissed, Axel went on using HeLa for HIV research, and Rifkin's horror-film scenario didn't come true.

But in the meantime two scientists had developed a theory about HeLa that sounded far more like science fiction than anything Rifkin had come up with: HeLa, they said, was no longer human.

Cells change while growing in culture, just as they change in a human body. They're exposed to chemicals, sunlight, and different environments, all of which can cause DNA changes. Then they pass those changes on to each new generation of cells through cell division, a random process that produces even more changes. Like humans, they evolve.

All of this happened to Henrietta's cells once they were placed in culture. And they passed those changes on to their daughter cells, creating new families of HeLa cells that differed from one another in the same way that second, third, and fourth cousins differ, though they share a common ancestor.

By the early nineties, the little sample of Henrietta's cervix that Mary had put into culture in the Gey lab had given rise to many tons of other cells—all still known as HeLa, but all slightly different from one another, and from Henrietta. Because of this, Leigh Van Valen, an evolutionary biologist at the University of Chicago, wrote, "We here propose, in all seriousness, that [HeLa cells] have become a separate species."

Van Valen explained this idea years later, saying, "HeLa cells are evolving separately from humans, and having a separate evolution is really what a species is all about." Since the species name *Hela* was already taken by a type of crab, the researchers proposed that the new HeLa cell species should be called *Helacyton gartleri,* which combined *HeLa* with *cyton,* which is Greek for "cell," and *gartleri,* in honor of Stanley Gartler, who'd dropped the "HeLa Bomb" twenty-five years earlier.

No one challenged this idea, but no one acted on it either, so Henrietta's cells remained classified as human. But even today some scientists argue that it's factually incorrect to say that HeLa cells are related to Henrietta, since their DNA is no longer genetically identical to hers.

Robert Stevenson, one of the researchers who devoted much of his career to straightening out the HeLa contamination mess, laughed when he heard that argument. "It's just ridiculous," he told me. "Scientists don't like to think of HeLa cells as being little bits of Henrietta because it's much easier to do science when you disassociate your materials from the people they come from. But if you could get a sample from Henrietta's body today and do DNA fingerprinting on it, her DNA would match the DNA in HeLa cells."

Around the time Van Valen suggested HeLa was no longer human, researchers began exploring whether Henrietta's cells might hold the key to human life extension—perhaps even immortality—and headlines once again claimed that scientists had found the fountain of youth.

In the early 1900s, Carrel's chicken-heart cells supposedly proved that all cells had the potential for immortality. But *normal* human cells—either in culture or in the human body—can't grow indefinitely like cancer cells. They divide only a finite number of times, then stop growing and begin to die. The number of times they can divide is a specific number called the Hayflick Limit, after Leonard Hayflick,



who'd published a paper in 1961 showing that normal cells reach their limit when they've doubled about fifty times.

After years of disbelief and argument from other scientists, Hayflick's paper on cell limits became one of the most widely cited in his field. It was an epiphany: scientists had been trying for decades to grow immortal cell lines using normal cells instead of malignant ones, but it had never worked. They thought their technique was the problem, when in fact it was simply that the lifespan of normal cells was preprogrammed. Only cells that had been transformed by a virus or a genetic mutation had the potential to become immortal.

Scientists knew from studying HeLa that cancer cells could divide indefinitely, and they'd speculated for years about whether cancer was caused by an error in the mechanism that made cells die when they reached their Hayflick Limit. They also knew that there was a string of DNA at the end of each chromosome called a *telomere,* which shortened a tiny bit each time a cell divided, like time ticking off a clock. As normal cells go through life, their telomeres shorten with each division until they're almost gone. Then they stop dividing and begin to die. This process correlates with the age of a person: the older we are, the shorter our telomeres, and the fewer times our cells have left to divide before they die.

By the early nineties, a scientist at Yale had used HeLa to discover that human cancer cells contain an enzyme called *telomerase* that rebuilds their telomeres. The presence of telomerase meant cells could keep regenerating their telomeres indefinitely. This explained the mechanics of HeLa's immortality: telomerase constantly rewound the ticking clock at the end of Henrietta's chromosomes so they never grew old and never died. It was this immortality, and the strength with which Henrietta's cells grew, that made it possible for HeLa to take over so many other cultures—they simply outlived and outgrew any other cells they encountered.