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JOY IN THE ENDEAVOR

by
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A vivid image in our culture is that of the writer, artist, or scientist who persistently pursues a private vision, unrewarded. When at last the individual's genius is recognized, early hardships are recast as merely "paying one's dues." But this is hindsight, and shortsighted hindsight at that.

Persistence does not guarantee eventual success, in the form of either fame or financial reward. Even the highest quality of work does not guarantee success. So what compels an individual to persist when success is not forthcoming—and may never come at all? Why persist in the face of anonymity? Of derision or criticism? Of hardship and poverty?

A close look at the life and work of one persistent scholar may give us some clues. Her name was Barbara McClintock.

Barbara McClintock was born in 1902 in Hartford, Connecticut, the third of four children. Her parents named her Eleanor, but they soon realized that the name they had chosen simply didn't suit the child with whom they had been blessed. The baby's strength of character was so un-Eleanor-like, they felt they had no choice but to rename her Barbara. Babs, for short.

When Barbara McClintock was young, her parents didn't emphasize formal schooling. She would often cut classes to spend the afternoon ice-skating or attending local events. When Barbara did go to school, she had a wonderful time. She later recalled, "I loved information. I loved to know things. I would solve some of the problems in ways that weren't the answers the instructors

expected...It was a tremendous joy, the whole process of finding that answer, just pure joy."

Through high school, Barbara McClintock continued to be a voracious reader, an avid nature-lover, and an independent thinker. But young women of her era were not encouraged to continue their education. Rather, they were expected to turn their attention towards marriage and children.

When McClintock insisted on continuing her studies, her mother worried that she would become "a strange person, a person that didn't belong to society"—or worse, "a college professor." Despite her parents' opposition, McClintock signed up for courses at a local junior college, and finally enrolled as a freshman at Cornell University in 1919.

As an undergraduate, McClintock studied botany and conducted research with maize (corn plants). She perfected a method for staining genetic material so that individual chromosomes could be identified under a microscope. For the first time, the observable characteristics of a chromosome could be shown to correspond to the observable traits of the organism itself—a major development in the new field of cytogenetics. Most biologists at the time, however, were working with fast-breeding fruit flies, not with slow-growing maize. The work of the young McClintock was outside the mainstream of the field.

McClintock continued her experiments as a graduate student and in 1927 she was awarded her doctorate in botany. Cornell then invited her to

stay on in the position of Instructor. McClintock took the job. A professorship was out of the question, despite her groundbreaking research. It would be another twenty years before Cornell would hire its first female professor in any field other than home economics.

McClintock continued her research thanks to a series of fellowships and grants. Working with one of her students, Harriet Creighton, she demonstrated that a single chromosome may contain genetic material from both parents. McClintock and Creighton presented their work at the Sixth International Congress of Genetics in 1931. Their findings were immediately controversial and elicited both excitement and criticism from the Congress participants. Although McClintock and Creighton's arguments provided an elegant explanation for some otherwise inexplicable data, the very existence of "crossover" genes, as they called them, was incompatible with the prevailing doctrine.

Quite by chance, the Congress led to a positive development in McClintock's strained relationship with her parents. One of the participants was a Scottish geneticist named Dr. Crew, who returned to Scotland after the Congress via steamship. During the voyage, he struck up a conversation with a pleasant American couple on vacation. Dr. Crew raved to his new friends about the leaps of scientific understanding taking place in his field, citing in particular the provocative work of a young woman from Cornell. His listeners turned out to be Barbara McClintock's parents. After years of concern about the folly of their daughter's life path, they at last caught a glimpse of the depth of her commitment and the significance of her work.

In 1942, McClintock joined the staff of the Carnegie Institute at Cold Spring Harbor. There she found an intellectual home where she could grow her maize and conduct her research with some degree of security. She pursued her investigations into the properties and functions of genes, hypothesizing the existence of what she called transposable genetic elements. Genes could actually change their location in a chromosomal lineup, she argued, and depending on where they

landed would activate or inhibit the operation of neighboring genes.

This argument was heretical indeed. It ran counter to the most basic laws of the reigning Mendelian model, in which genes were defined as static entities locked in place on the chromosomal string like pearls on a strand. The idea that genes are not locked in stable order, and are active or inactive depending on the presence of nearby genes, was simply inconceivable.

McClintock presented her work at a 1951 conference. She backed up her argument with detailed and complex analyses that few of her colleagues could follow. Her work was not well received. "They called me crazy; absolutely mad," she later recalled.

McClintock retreated to Cold Spring Harbor. For the next thirty years, working mostly alone, she continued her research. She divided her time between raising her maize and conducting experiments. And while she went about her work, the rest of the scientific community went about its own.

In the 1960s and 1970s the central importance of the work that McClintock had been doing for decades began to be recognized. As the fields of molecular biology and genetics developed, more and more evidence accumulated that supported McClintock's earlier research. By the 1980s, the leading bioscientists of the world began to understand what McClintock had been talking about for forty years.

In 1983, the 81-year-old Barbara McClintock was awarded the Nobel Prize in Medicine for the work she had done in the 1940s. One of many scientists who noted the importance of this particular award was James Watson (the same Watson who, with Francis Crick, discovered the molecular structure of DNA). He stated categorically, "It is not a controversial award. No one thinks of genetics now without the implications of her work."

This brings us back to our original question: What leads an individual to persist in a private vision which brings only hardship? McClintock labored for over half a century, pursuing a line of research that flew in the face of established

orthodoxy and that brought her nothing but financial hardships and the derision of her peers. What allowed her, even compelled her, to persist?

The question ceases to be so puzzling the moment we recognize that the answer has nothing to do with the usual extrinsic rewards of fame and fortune. McClintock's descriptions of her life and work make clear that she wasn't strongly motivated by the need for acclaim, nor by the desire for money or career advancement. She must have known from very early on that her possibilities for conventional rewards were constricted by the sexist attitudes of her times and by the scientifically radical nature of her work. But she hardly thought in these terms.

Instead, McClintock was motivated by the intrinsic rewards that she experienced from the work itself. She was rewarded every day by the joy she felt in the endeavor. She loved posing questions, finding answers, solving problems. She loved working in her garden and in her laboratory. She recalled later, "I was doing what I wanted to

do, and there was absolutely no thought of a career. I was just having a marvelous time."

Upon hearing that she had been named for the Nobel Prize, McClintock told reporters, "The prize is such an extraordinary honor. It might seem unfair, however, to reward a person for having so much pleasure, over the years, asking the maize to solve specific problems and then watching its response." When asked if she was bitter about the lateness of the recognition, she said simply, "If you know you're right, you don't care. You know that sooner or later, it will come out in the wash."

Countless persistent scholars, artists, writers, and scientists express similar sentiments. They are motivated by the intrinsic rewards of the work itself; by a conviction in the validity of their own experiences and insights; by an internally rather than externally calibrated sense of "success." Some have eventually achieved financial reward and professional renown. Most have not. Many are now, with uncertain futures, struggling to persist in their work. Not for fame and not for fortune—for the joy in the endeavor.

SOURCES

Paragraphs 4-17, 19-21: Biographical information is drawn from E. Fox Keller, *A Feeling for the Organism: The Life and Work of Barbara McClintock*, San Francisco: W. H. Freeman and Company, 1983; C. Moritz, (Ed.), *Current Biography Yearbook: 1984*, New York: H. W. Wilson Company, 1984; T. Wasson, (Ed.), *Nobel Prize Winners: An H. W. Wilson Biographical Dictionary*, New York: H. W. Wilson Company, 1987. **Paragraph 5:** "I loved information..." quoted in Keller, p. 26. **Paragraph 7:** "a strange person..." quoted in Moritz, p. 263. **Paragraph 14:** "They called me crazy..." quoted in Moritz, p. 264. **Paragraph 17:** "It is not a controversial award..." quoted in Moritz, p. 262. **Paragraph 20:** "I was doing what I wanted..." quoted in Keller, p. 34. **Paragraph 21:** "The prize is such ..." quoted in Moritz, p. 262. **Paragraph 21:** "If you know you're right..." Moritz, p. 265 quoting *Newsday*, October 11, 1983.