ROCK STARS

Marie Tharp—Plate Tectonics Pioneer

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Marie Tharp during her college days. Image courtesy Hali Felt.

YOUTH

Marie Tharp was born in 1920 in Ypsilanti, Michigan, USA, to William Edgar Tharp and Bertha Louise Newton. William worked in a plant nursery until the U.S. Department of Agriculture's Bureau of Soils hired him in 1904. Bertha had been a high school German teacher before, as Tharp says her father always used to remark, she "traded one job for another." She died when Tharp was 15. As parents, William and Bertha seem to have been past an age (50 and 40, respectively, when Tharp was born) where coddling their only child was an option. They were devoted, but they trusted her to find her own way and let her explore the unknown so she'd gain confidence. This proved handy, as William's job required them to move nearly every season, following soft soil: winters spent in the south, summers spent in the north. They spent every four years in Washington, D.C., so William could go to the Soil Bureau's main office to oversee the printing of the maps he had worked on since his last visit.

For most of her early life, Marie Tharp did not display much interest in science as a formal pursuit, but she loved going into the field with her father. As a small child, she would sit in the back of her father's truck "making mudpies and generally being a nuisance." She loved to tell one particular story about trekking out into the Midwestern countryside with her father, who on this occasion had his camera and took a photograph of Tharp pointing to a tumor on a tree. Her father's itinerant job meant that Marie attended more than a dozen schools before graduating from high school, of which her full school year in Florence, Alabama, USA, was influential. In Florence, she took school field trips on weekends to study trees and rocks, and collected a big bag of snake skeletons and skins and took them home, terrifying her mother. Florence was also where she had a class called Current Science, in which she and her classmates learned all about what contemporary scientists were working on, which she loved, but it had an optimistic tone that discouraged her from thinking that there was anything left to discover.

EDUCATION

Science as a discipline to be studied eluded Tharp until college. She entered Ohio University in the fall of 1939, started out an art major, then took music, German, zoology, paleobotany, philosophy, and English classes before discovering her love of geology. A semester after her introduction to geology she took physical geology and met the "nearest to a mentor I ever saw." His name was Dr. Dow, and his office door was always open; he must have recognized a blossoming talent when he saw it. He was the one who suggested that Tharp take drafting, a skill not usually necessary to become a geologist, but one which he knew would improve her chances of getting a job in a discipline dominated by men and old traditions: If she could draft, she might be able to work in an office. She got a C in the class (of 73 students, only three were women), but said that she learned a lot. "It was very important to learn the tools, and it was a beginning of learning to see things in three dimensions."

As a senior, Tharp saw a flyer hanging on the bulletin board outside of Dow's office. The University of Michigan, it said, was offering an accelerated geology degree with the guarantee of a job in the petroleum industry upon graduation. Because most of the men were off fighting in WWII, it was understood that most of the students would be women. When Tharp asked Dow, he told her to try it: "It only takes two years," she remembered him telling her, "you don't like it, you can do something else." By the beginning of 1943, she was enrolled in the University of Michigan's petroleum geology program, one of a group of women called the "PG [Petroleum Geology] Girls."

It was a confusing time to be training as a geologist. Alfred Wegener had published *The Origins of the Continents and Oceans* 28 years prior, but his ideas had been largely dismissed, and there was still no definitive theory that explained how Earth's crust formed. Mountains, oceans, continents, islands, valleys—even Earth's simplest features were still a source of contention. One

textbook from the time "admitted" that "the cause of crustal deformation is one of the great mysteries of science and can be discussed only in a speculative way" (Longwell et al., p. 18). Tharp recalled being taught in grad school what continental drift was—but not in a way that suggested it was a realistic possibility.

In one of the few stories she related about her time at Michigan, Tharp recalled a talk and visit from the state geologist. At a post-presentation tea, the PG Girls were given the chance to ask him questions. What was it like to be in this field? What would a job in the real world be like? Just what, their questions implied, were they getting themselves into? "And lo and behold what did this geologist say?" Tharp remembered, "He said the geologist is the best one on the spot to make an educated guess." The geologist's best tool, in other words, was the ability to look at an incomplete picture and make a hypothesis about what that picture meant.

DISCOVERIES AND IMPACT

Tharp's unconventional educational history made possible her 1952 discovery of the worldwide mid-oceanic rift valley. In addition to her eclectic undergraduate coursework, she rounded out her scientific training while at Michigan, taking extra classes in physics, math, and chemistry. Before landing a job at Maurice Ewing's newly formed geophysical lab at Columbia University in 1948, she worked for a time at Standard Oil in Tulsa, Oklahoma, USA, during which time she earned a degree in math to combat the boredom of being stuck in an office. Despite her extensive education, she was hired at Lamont to draft and compute—a research assistant to younger male graduate students. Boredom became a problem for Tharp there, too. Only after she quit did Ewing realize that she needed more stimulating work; he asked her to come back and assigned her to work with Bruce Heezen.

Tharp and Heezen began their 25-year-long partnership in 1952 by processing thousands of unexamined sounding records of the North Atlantic Ocean floor. While Heezen spent much of his time at sea and working on other projects, Tharp used the sounding records to compile six profiles that stretched across the North Atlantic; even if she had wanted to go to sea, women at that time were not permitted on Lamont's or most ships. The northernmost profile began at Martha's Vineyard, the southernmost one at Recife, Brazil. But the picture was incomplete. What was happening in the hundreds of miles separating each profile? To fill in the blanks, Tharp used temperature readings, salinity measurements, and cores to reveal, for the first time, a rift valley trending down the center of the Mid-Atlantic Ridge. The (American) scientific establishment was still hostile to any implication that Wegener's continent drift hypothesis might be true—and the rift valley was a 10,000-mile-long piece of evidence. Afraid of possible repercussions, Heezen called Tharp's work "girl talk" the first time he saw it. Only after she re-drew the profiles twice and showed him that the valley's pattern correlated with newly mapped earthquake epicenters in the North Atlantic did he accept the valley's existence—a correlation that also allowed Tharp to extend the rift valley out of the Atlantic and across the entire world.

The discovery of a 40,000-mile-long, worldwide mid-oceanic rift valley shocked scientists and the public, both groups worrying that their worlds might be shattered. For the public it was quite literal; in a letter to one concerned woman, Heezen wrote, "I do not believe that you have any immediate worry. The earth seems to have been 'ripping at the seams' for a long time now (millions of years)." For the scientific community it was figurative; Tharp recalled that her first depiction of the ocean floor was called "a bunch of lies," and Bill Menard remarked in a letter to Heezen that he was "increasingly distressed to read one account after another in the press and magazines of this fabulous rift valley."

The first detailed physiographic diagram of the ocean floor was published by the Geological Society of America in 1957; diagrams of the other oceans followed in quick succession, each one revealing a newly discovered feature that helped scientists develop the interlocking hypotheses that together revolutionized Earth history. With the hope that the public might become as fascinated with inner space as they were with outer space, Tharp and Heezen collaborated with *National Geographic* on a series of accessible artistic renderings of the ocean floors, the first of which appeared in 1967. By the late 1960s, the plate tectonics revolution was complete; a few years later, grade-schoolers were learning why South America and Africa looked like they'd fit together if an ocean wasn't dividing them. And by 1977, Tharp and Heezen published their *World Ocean Floor Panorama*, a map that's still ubiquitous in the textbooks and halls of geology departments today.

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Marie Tharp and her globe of the seafloor. Image courtesy Lamont-Doherty Earth Observatory.