



Mothers of Science

Solo Exhibition of Portraits by Jo Napier

RACHEL CARSON

1907-1964

**Marine Biologist, Nature
Writer**

**Sparked Global Environmental
Movement**



Before Greta Thunberg, before David Suzuki, Rachel Carson tried to use her words, her beautiful writing, and her understanding of ecology, to save the planet. Perhaps the finest nature writer of the 20th century, Carson challenged the notion that humans could obtain mastery over nature by using chemicals, bombs and space travel. Her powerful and sensational book *Silent Spring* (1962) warned of the dangers to all natural systems from the misuse of chemical pesticides such as DDT, questioned the scope and direction of modern science, and initiated the contemporary environmental movement. Carson was, first and foremost, a student of Nature: born in Springdale, Pennsylvania - just upstream from the industrial behemoth of Pittsburgh - she became a marine scientist working for the U.S. Fish and Wildlife Service in Washington, DC, primarily as a writer and editor. She was a born ecologist, before that science was even defined; she was aware of the impact that humans had on the natural world. Rachel wrote of how islands were formed, how currents change and merge, how temperature affects sea life, how erosion impacts the marine world. Even in the 1950s, her ecological vision of the oceans shows her embrace of a larger environmental ethic; climate change, rising sea-levels, melting Arctic glaciers, collapsing bird and animal populations, crumbling geological faults - all were part of Carson's work. In *Silent Spring*, she asked whether and why humans had the right to control nature, to decide who lives or dies, to poison or to destroy non-human life. In showing that all biological systems were dynamic, and by urging the public to question authority, Rachel Carson became a social revolutionary - and created a sort of guide for the future of all life on Earth.

MARIE EQUI

1872-1952

Physician, Social Activist and LGBTQ+ Leader



Born of Italian-Irish parents in 1872, Marie Equi endured childhood labor in a gritty Massachusetts textile mill before fleeing to an Oregon homestead with her first long-time woman companion, who described Equi as impulsive, earnest, and kind-hearted. Equi self-studied her way into a San Francisco medical school and obtained her license, becoming one of the first practicing woman physicians in the Pacific Northwest. Then she leveraged that professional status: a fierce proponent of working-class women and children, she used her position of privilege to fight for labor rights. Equi was changed after witnessing a brutal police crackdown on Portland, Oregon's working-class women during a 1913 strike at a cannery. A believer in women's reproductive rights who provided access to contraceptives and performed abortions, she mounted soapboxes, fought with police, and simply refused to compromise her principles in the face of enormous opposition and adversity. The federal government noticed her radicalism, wiretapped her home and office, and arrested her in 1917 for opposing American entry into World War I. She served ten months in prison. (In her personal life, Equi lived openly in romantic relationships with women and adopted a daughter in 1915 with her partner, Harriet Speckart, heiress of the Olympia Brewing Company). Following her arrest and trial, Equi maintained that the true cause of her incarceration was official homophobia of her same-sex relationships. She was courageous, stubborn, determined – with a passion for justice; a fiercely independent and extraordinary woman who paved paths that, today, women and men are still fighting to protect.

ELISABETH BORGESE

1918-2002

‘Mother of the Oceans’

**Contributing Architect to UN
Law of the Sea**



Elisabeth Mann Borgese was never meant for an ordinary life. The family she was born into (her father, Thomas Mann, won the 1929 Nobel Prize for Literature), the circumstances history wrapped around her, the intellectual gifts and determined nature she inherited - all conspired to help her find her ‘work’ in this world: namely, to protect the oceans. Despite being suddenly widowed and left to raise her two daughters, Borgese had a ‘eureka moment’ while a fellow at the California Centre for the Study of Democratic Institutions: struck by the proposal of the Maltese ambassador to the United Nations - that the oceans should be considered the common heritage of mankind - she was inspired to act. And act she did, on a major, Mann-sized scale. She took the lead in initiating a project that culminated in a major 1970 conference examining issues around the peaceful use of the ocean. That conference grew into a series of 34 international gatherings held around the world. In tandem, Borgese founded the International Ocean Institute (IOI) which is now a global network of 35 centres and focal points, including a key one at Dalhousie University where Borgese taught from 1979 until her death in 2002. Through the IOI, she worked passionately as an advocate of the oceans, contributing to the UN Convention on the Law of the Sea and establishing oceans training for developing countries. The recipient of a multitude of awards and honorary degrees, including the Order of Canada, Borgese left as her legacy a road map that continues to inspire and guide others today - around the globe.

ANNIE JUMP CANNON

1863-1941

Astronomer, Star Classification Pioneer



As a girl, Annie Jump Cannon was given a book by her mother about star constellations. She was hooked: Cannon regularly climbed up on the roof of her family home and gazed for hours at the heavens above. She often brought a candle with her and once set fire to the roof. Despite the damaged roof, her parents didn't stop their daughter from returning to her celestial observations. Good decision: Cannon's fascination became a life-long pursuit that changed how stars came to be classified. After graduating with a degree in physics, Cannon studied astronomy. As a student, she didn't like the system being used to classify our stars so she decided to create her own: Cannon used simplified 'classes' - O, B, A, F, G, K, M - and created a catch phrase to help astronomers remember each class: "Oh, Be A Fine Girl - Kiss Me!" Over the course of her long life, Cannon catalogued thousands of stars, discovered a class of exploding stars, and created a star-classification system that astronomers still use today.

CECILIA PAYNE

1900-1979

Discovered The Composition of the Stars



Cecilia Payne knew she wanted to study a science but didn't know which one until she happened to hear the astronomer Arthur Eddington give a lecture at Cambridge University about his expedition to observe the 1919 solar eclipse - an observation that proved Einstein's theory of general relativity. Hearing Eddington's lecture completely transformed her "world picture," Payne once said, recalling that - when she returned to her dorm room - she found she could transcribe the lecture, word for word. Physics, obviously, was her new world. Payne wanted to be an astronomer. When she shared that ambition with Prof. Eddington, he suggested a number of books for her to read. Payne had already read them. So, he invited her to use the Cambridge Observatory library - which contained all the latest astronomical journals - an act that, effectively, opened the world of astronomical research to this wonder woman. What are the stars made of? Payne discovered the answer to this fundamental question of astrophysics in 1925 and explained it in her PhD thesis which she later turned into a book. (The work of Annie Jump Cannon - whose portrait is included in this collection - helped Payne show how to decode the complicated spectra of starlight, in order to learn the relative amounts of the chemical elements in the stars.) The distinguished astronomer Otto Struve deemed Payne's work "the most brilliant PhD thesis ever written in astronomy."

ELIZABETH MACGILL

1905-1980

World's First Female Aircraft Designer



An engineer, author and a women's rights advocate, Elsie MacGill was the first woman to receive an electrical engineering degree in Canada and the first woman aircraft designer in the world. Her father was a well-known lawyer; her mother, a suffragist, newspaper reporter, and the first woman judge in British Columbia. As a girl, MacGill saw her mother work to change legislation to improve the lives of women and children in Canada. In 1929, the same year MacGill became the first woman to earn her Master's degree in aeronautical engineering at the University of Michigan, she was afflicted with acute infantile myelitis - a form of polio - and told that she would never walk again. But she was determined. She eventually did walk again, with the aid of two metal canes, and went on to have an amazing career: MacGill helped design the first all-metal aircraft built in Canada and was perhaps best known for her work on the Hawker Hurricane fighter airplanes during World War II - the airplanes that were instrumental in the Battle of Britain. Called the "Queen of the Hurricanes," MacGill was in charge of all the engineering work adapting the Hawker Hurricane to fly in cold weather, and in charge of all the engineering work on the Curtis Helldiver fighter planes for the United States Navy. MacGill paved the way for a generation of young women; inspiring them; showing, by example, that despite great odds, goals in life are attainable through hard work and determination.

MARIE THARP

1920-2006

**American Oceanographic
Cartographer, Geologist**

Discovered the Mid-Atlantic Ridge



It was 1942; most men were away at war, leaving professional spots and laboratory jobs open to women. She got her master's degree in geology, found oil company work boring, and applied for work at Columbia University's geophysical lab where she was hired as an assistant to male graduate students to act as a human calculator and draft copies of simple maps and diagrams. In September 1952 women were not allowed to go to sea; Tharp was stuck in the lab, making calculations while her scientific partner geologist Bruce Heezen hit the waters. Heezen returned from his cruise on the Atlantic with cardboard boxes of echo soundings measuring ocean depths. No one had ever done a deep analysis of these soundings and Tharp and Heezen decided they wanted to see the entire pattern of the North Atlantic. Tharp made the dots marking depth; the dots needed to be interpreted in order to connect them, and Tharp's next step was revolutionary: using her geological training, she made educated guesses and sketched out hypothetical extensions of the rift and the ridge system. After eight months, she could sketch one nearly continuous rift valley all across the world, an underwater structure 40,000 miles long. Her discovery of a rift valley running down the centre of the Atlantic Ocean was truly revolutionary: it proved the theory of "continental drift" that said the Earth's surface is made of moving plates. Initially, no one believed her – not even her partner. ("Girl talk," Bruce Heezen said.). When Tharp and Heezen published their first physiographic map of the North Atlantic in 1957, her name did not appear on any of the major papers on plate tectonics published by Heezen and others between 1959 and 1963, and it was not until 1968 that she was finally allowed to join a data-collection expedition on a survey ship. After Heezen died suddenly in June 1977, The National Geographic published a fascinating painting which visually realized Tharp and Heezen's map of the world ocean floor; Tharp was finally recognized as having played a pivotal role in rewriting 20th century geophysics - and as one of the greatest cartographers of the 20th century.

INGE LEHMANN

1888-1993

Discovered Earth's Solid Inner Core



She started freshman courses in mathematics, chemistry, and physics at Copenhagen University in 1907 and then, after a year at Cambridge University - where she completely burned out - she returned to Copenhagen, only to abandon her studies to do actuarial work for an insurance company. When she finally returned to university, she graduated with a mathematics degree in 1920, at age 32. Five years later, she shifted to seismology work, and learned that the internal structure of our planet can be understood through the study of earthquake data. Captivated by her new academic field, Lehmann - at age 40 - obtained a Master of Science – and focused on the science of making measurements related to Earth. In 1929, there was an earthquake in New Zealand. Lehmann discovered that a few faint seismic waves from that quake had been recorded in places where they shouldn't have been. Without computers to help analyze the data, she kept track of information on slips of cardboard she stored in old oatmeal boxes. She theorized that these rogue waves could only register as they did if the Earth's core was solid – not liquid, as scientists then believed. Her idea was revolutionary. It was adopted by the scientific community, and only officially proven right with the advent of new, more sensitive seismographs in 1970. In 1971 this late-blooming, brilliant seismologist and geophysicist was awarded the Bowie Medal by the American Geophysical Union and acknowledged as “the master of a black art for which no amount of computerizing is likely to be a complete substitute.”



Jo Napier is a former technology journalist at the Ottawa Citizen and a former newspaper columnist at The Globe and Mail, who became a mom, started painting, and soon after was inspired to create work that would better enlighten some of the forgotten achievements of revolutionary women in STEM (Science, Technology, Engineering, Mathematics).

To learn more about Jo Napier's work visit www.jonapier.com