PIONEROS DE LAS GEOCIENCIAS

Marie Tharp: 1920 - 2006

Marie Tharp was well-suited to the task of interpreting the texture and rhythm of the Earth's surface, including the ocean floor — a space almost entirely unknown to humans, even after they began sailing the seas. A scientist, she had a background in mathematics, music, petroleum geology and cartography.

But she was a professional woman in the American mid-century in a field overwhelmingly dominated by men. She played a major role in one of cartography's greatest achievements, mapping the sea floor for the first time in history, documenting a vast mountain range in the Atlantic Ocean. The maps she and her longtime collaborator, Bruce Heezen created then verified the theory of continental drift — the idea that the Earth's continents shifted across the ocean bed due to the movement of tectonic plates. Continental drift is now fundamental to understanding how our planet came to be.

"It was a once-in-a-lifetime—a once-in-the-history-of-the-world—opportunity for anyone, but especially for a woman in the 1940s," she wrote in a 1999 essay.

Tharp donated the papers of their research to the Library in 1995, then helped Library staff arrange the tens of thousands of items for future researchers. It is by far the largest manuscript/research collection in the Geography and Map Division, comprising maps, journals, research papers, letters, correspondence and geologic and cartographic data. It culminates in the depiction of the map in the painting above, the Heezen-Tharp "World Ocean Floor" map. It is still in use today and documents the 40,000-mile undersea mountain ranges that are critical to understanding how and why the Earth's continents came to be where they are.

This collection is part of a larger archival project that documents some of the pioneering geographers of the 20th century, include Roger Tomlinson, one of the primary developers of the Geographical Information System (GIS), and John P. Snyder, who worked on the mathematics that enables mapping from space.

"Tharp's work certainly provided evidence and weight to the theory of plate tectonics, but her work is really about seafloor spreading, which occurs at the mid-ocean ridges that she was the first to map," says Paulette Hasier, chief of the division.

Tharp's role as a top-tier female scientist who largely worked behind the scenes might prompt comparisons to the women at NASA's space program in the 1960s, as featured in the book and film, "Hidden Figures." But Hasier says the better comparison would be to the "Harvard

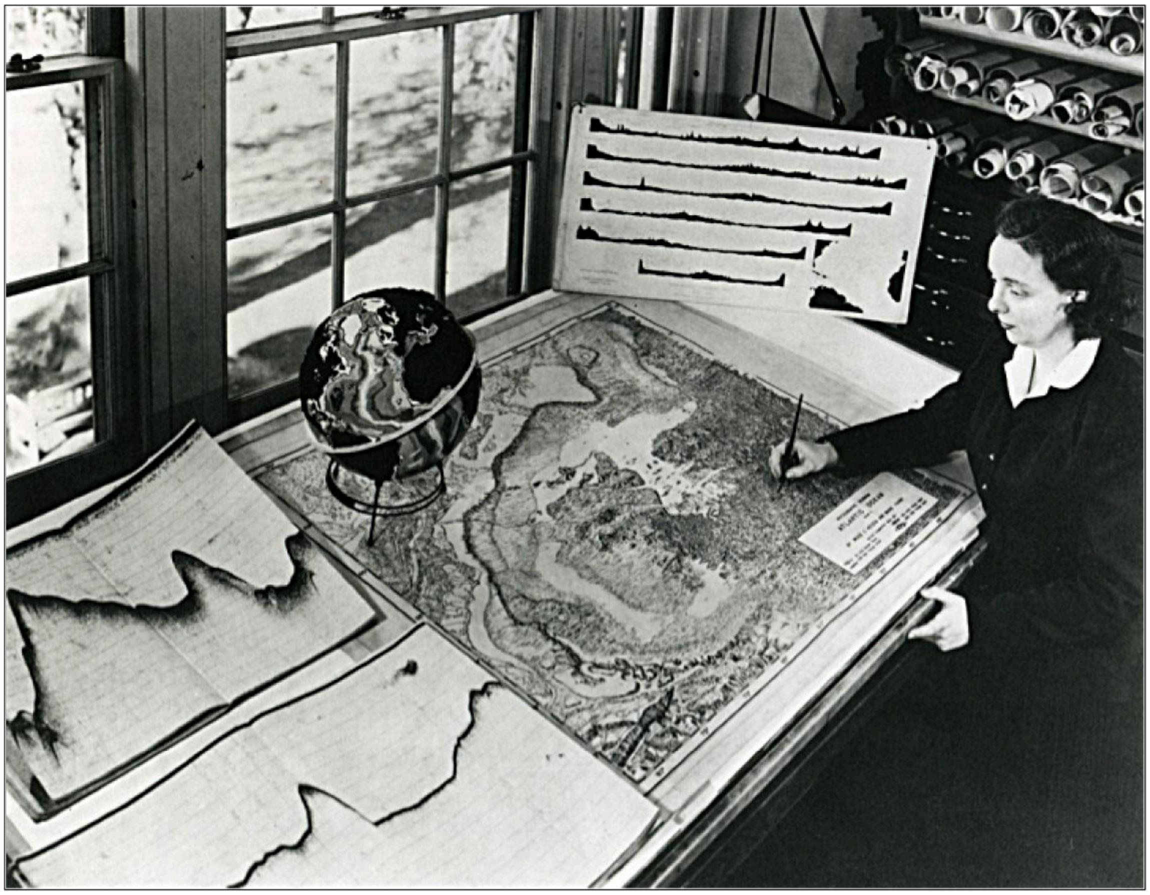
Computers," female scientists who worked at the Harvard Observatory in the early 20th century. Astronomers such as Annie Jump Cannon, Williamina Fleming and Florence Cushman helped develop and codify a classification system for some 300,000 stars, thus rendering the universe more of a known entity.

"Tharp, like these women, had a talent for visualizing data, something we take for granted today but required real geometric intuition before the widespread use of computers," Hasier said.

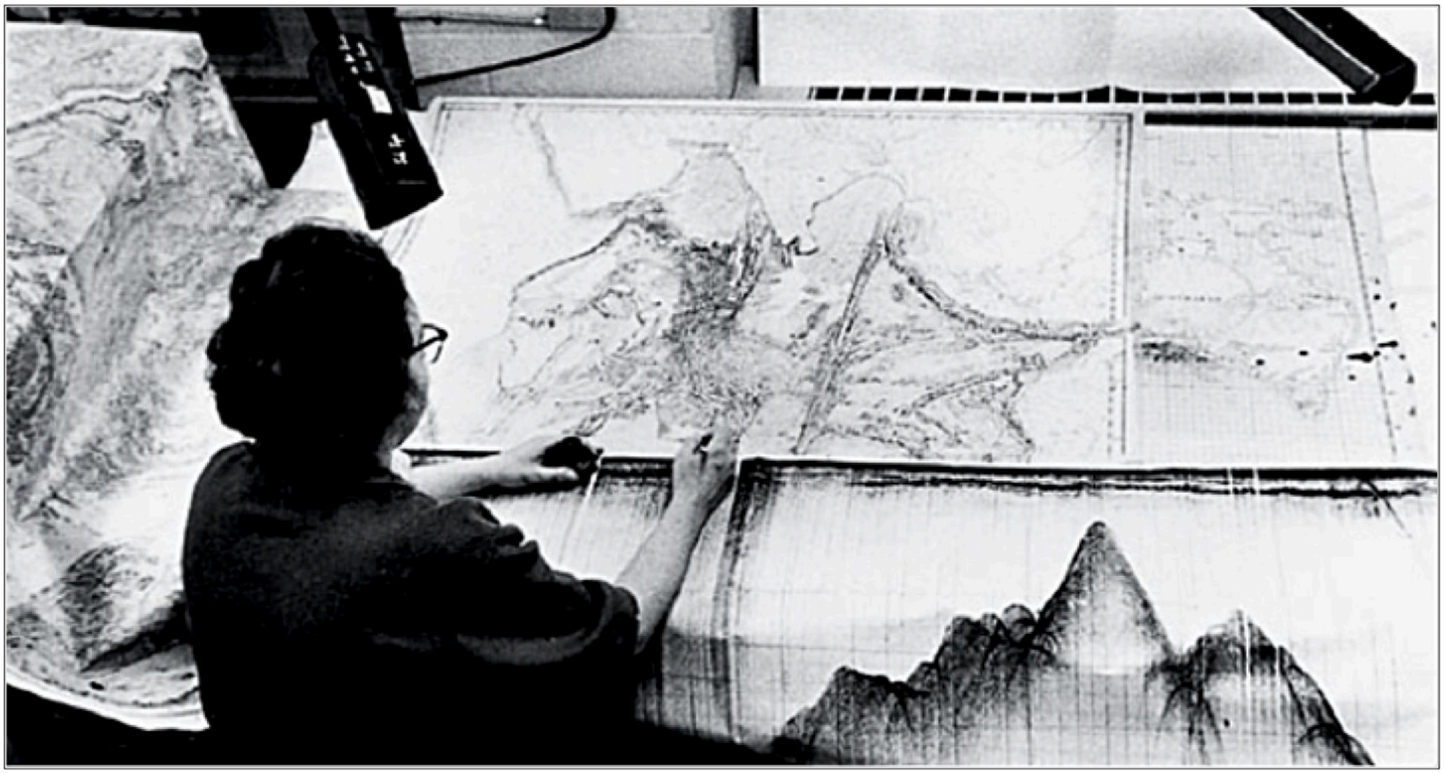
Before Heezen and Tharp's work, maps of the world showed three-fourths of it — the oceans — to be a flat blue surface. Sailors knew of reefs, channels and sand bars, of course, but not much else of what lay further below. Geologists had only a vague idea of the depths, but it was largely presumed to be flat and featureless.

"I think our maps contributed to a revolution in geological thinking, which in some ways compares to the Copernican revolution," she wrote in an essay included in "Lamont-Doherty Earth Observatory of Columbia University: Twelve Perspectives on the First Fifty Years 1949 – 1999." "Scientists and the general public got their first relatively realistic image of a vast part of the planet that they could never see."In many ways, she had been working her entire life to make such discoveries.

Born in Ypsilanti, Michigan, in 1920, Tharp grew up moving to place to place, as her father was a soil surveyor for the U.S. Department of Agriculture. The family moved seasonally to follow his work, a peripatetic life in which she attended more than two dozen schools by the time she graduated high school. It left her, she later said, with a residual awareness of land, soil and the way the Earth is shaped.



Marie Tharp at work on her maps of the Atlantic Ocean floor, in the early 1950s. Photograph: Alamy



A young Marie Tharp at work, using hundreds of echo sounding profiles to map the topography of the ocean floor. Photo: Lamont-Doherty Earth Observatory.

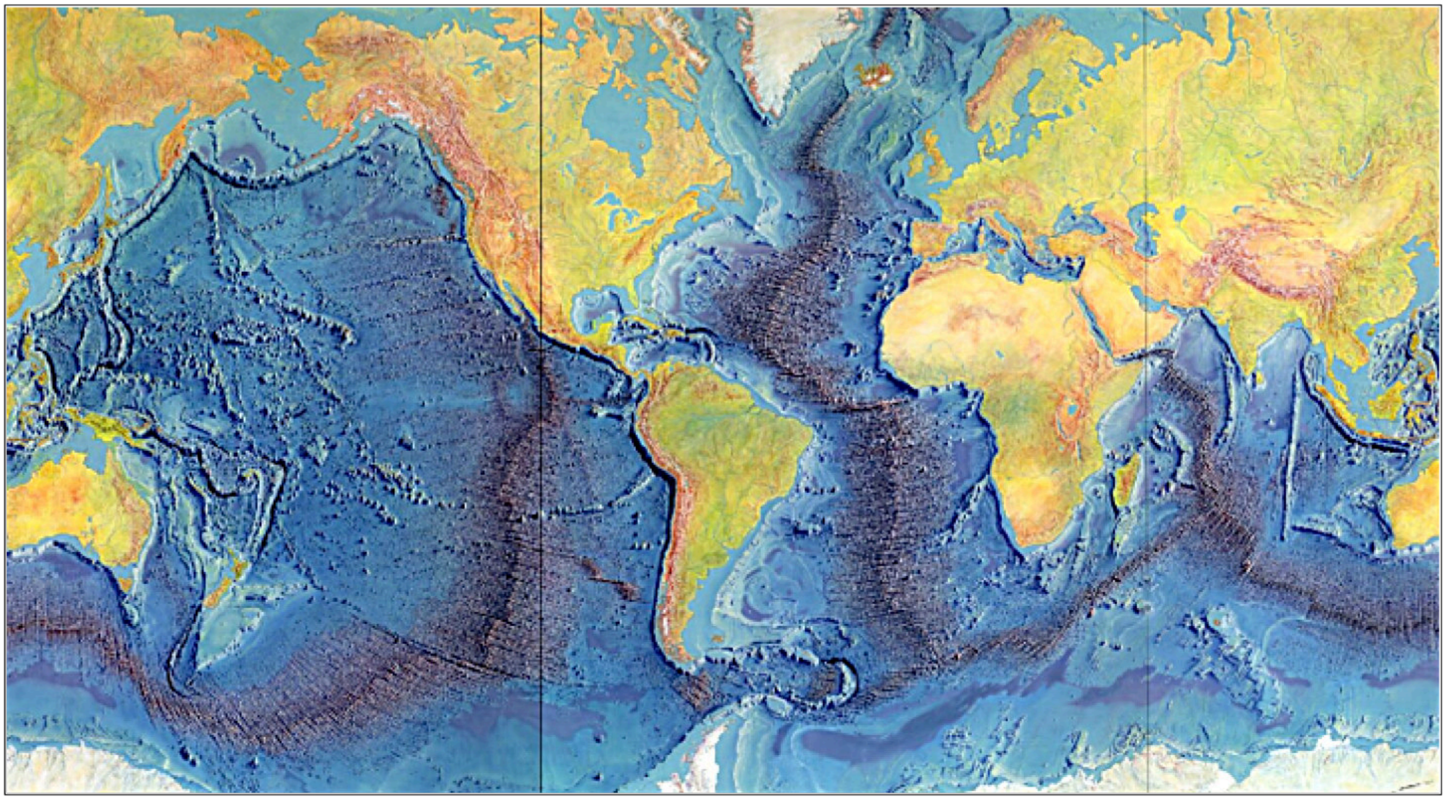
Her father's mantra: "When you find your life's work, make sure it is something you can do, and most important, something you like to do." At Ohio University, she didn't find much she liked that women were allowed to do. The outbreak of World War II provided a break in the patriarchal system, as men were called away to war. In their absence, women took on many roles in the workplace they had not before. At the University of Michigan's geology department, the staff began to allow female students. In 1943, Tharp was one of 10 young women who enrolled.

This led to unfulfilling work in the petroleum industry, which led to an unfulfilling math degree from the University of Tulsa, which led to an unfulfilling proposed job the American Museum of Natural History in New York, which, finally, led to a job at Columbia University's Lamont Geological Observatory (now the Lamont-Doherty Earth Observatory). There, she soon met Bruce Heezen, another bright young star, with whom she would work for the next quarter century. The partnership was necessary, as women were not allowed on sea-faring research ships at the time. For years, while he gathered data at sea, she developed the data on maps back at the lab.

They began compiling thousands of files of data about the ocean floor (mostly sonar readings from U.S. Navy ships). The sonar soundings were rough, incomplete, and taken at different international measuring standards. Still, she began to map out data that showed a huge north-to-south mountain range underneath the Atlantic Ocean, bordered by a rift valley.

When she showed it to Heezen, he dismissed it as "girl talk" and scoffed that it looked "too much like continental drift," then considered an outlandish theory.

"But I thought the rift valley was real and kept looking for it in all the data I could get," she wrote. "If there were such a thing as continental drift, it seemed logical that something like a mid-ocean rift valley might be involved. The valley would form where new material came up from deep inside the Earth, splitting the mid-ocean ridge in two and pushing the sides apart."



Heezen-Tharp “World Ocean Floor” map, a landmark in cartography. Geography and Map Division.

By the 1970s, as their work progressed, after they had charted the locations of tens of thousands of undersea earthquakes, and as their findings were collaborated by other scientists from around the world, the Mid-Atlantic Ridge became an obvious part of an undersea mountain range that stretched around the world.

The pair produced maps of individual oceans in partnership with National Geographic that culminated in the iconic worldwide panorama above in 1977, painted by Austrian artist Heinrich Berann. Ironically, Heezen died of a heart attack on a research cruise just a few months before the map’s publication.

She summed it all up this way: “I worked in the background for most of my career as a scientist, but I have absolutely no resentments. I thought I was lucky to have a job that was so interesting. Establishing the rift valley and the mid-ocean ridge that went all the way around the world for 40,000 miles—that was something important. You could only do that once. You can’t find anything bigger than that, at least on this planet.”

Source: https://blogs.loc.gov/loc/2021/08/marie-tharp-mapping-the-ocean-floor/

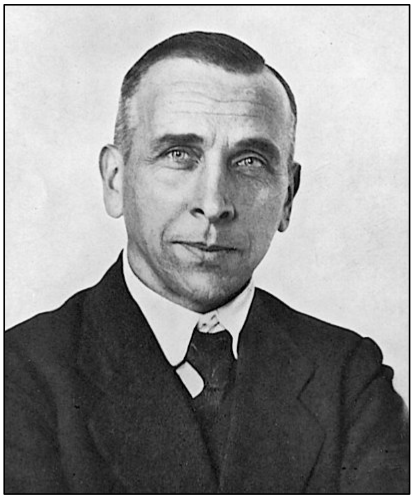
After processing the echo sounding data, **Marie Tharp** drew her maps with pencil and ink manually.

Alfred Wegener: 1880 - 1930

Alfred Wegener, in full Alfred Lothar Wegener, (**born November 1, 1880, Berlin, Germany—died November 1930, Greenland**), German meteorologist and geophysicist who formulated the first complete statement of the continental drift hypothesis.

The son of an orphanage director, Wegener earned a Ph.D. degree in astronomy from the University of Berlin in 1905. He had meanwhile become interested in paleoclimatology, and in 1906–08 he took part in an expedition to Greenland to study polar air circulation. On this trip he befriended German climatologist Wladimir Köppen, who became his mentor, and later married Köppen's daughter, Elsa, in 1913. He made three more expeditions to Greenland, in 1912–13, 1929, and 1930. He taught meteorology at Marburg and Hamburg and was a professor of meteorology and geophysics at the University of Graz from 1924 to 1930. He died during his last expedition to Greenland in 1930.

Like certain other scientists before him, Wegener became impressed with the similarity in the coastlines of eastern South America and western Africa and speculated that those lands had once been joined together. About 1910 he began toying with the idea that in the late Paleozoic Era (which ended about 252 million years ago) all the present-day continents had formed a single large mass, or supercontinent, which had subsequently broken apart. Wegener called this ancient continent Pangaea. Other scientists had proposed such a continent but had explained the separation of the modern world's continents as having resulted from the subsidence, or sinking, of large portions of the supercontinent to form the Atlantic and Indian oceans. Wegener, by contrast, proposed that Pangaea's constituent portions had slowly moved thousands of miles apart over long periods of geologic time. His term for this movement was die Verschiebung der Kontinente ("continental displacement"), which gave rise to the term continental drift.

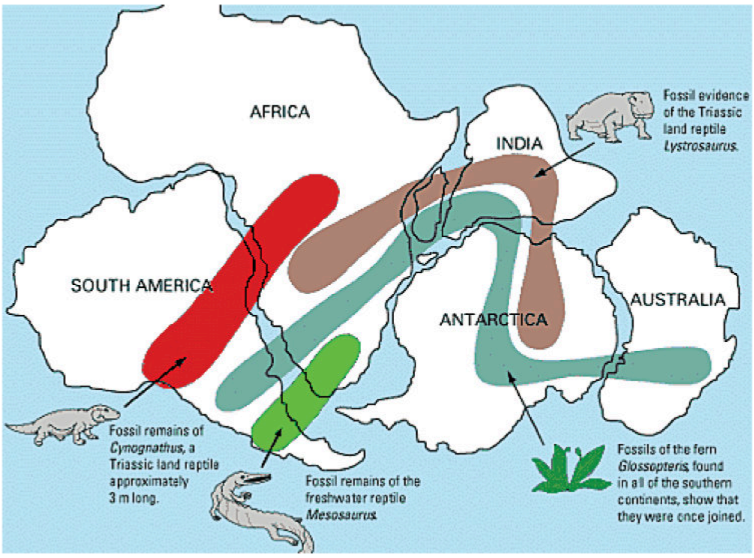


Wegener first presented his theory in lectures in 1912 and published it in full in 1915 in his most important work, Die Entstehung der Kontinente und Ozeane (The Origin of Continents and Oceans). He searched the scientific literature for geological and paleontological evidence that would buttress his theory, and he was able to point to many closely related fossil organisms and similar rock strata that occurred on widely separated continents, particularly those found in both the Americas and in Africa. Wegener's theory of continental drift won some adherents in the ensuing decade, but his postulations of the driving forces behind the continents' movement seemed implausible. By 1930 his theory had been rejected by most geologists, and it sank into obscurity for the next few decades, only to be resurrected as part of the theory of plate tectonics during the 1960s.

Well after his death, and after World War II, Wegener's theories were vindicated by the work of Harry Hess and others. In 1960 Hess proposed the mechanism of sea-floor spreading, which would explain how the continents moved. Newly discovered exporation techniques were employed to prove this theory and ultimately, the correctness of Wegener's chief idea as well.

Wegener during J.P. Koch's Expedition 1912–1913 in the winter base "Borg".

Wegener (*left*) and Villumsen (*right*) in Greenland; 1 November 1930.



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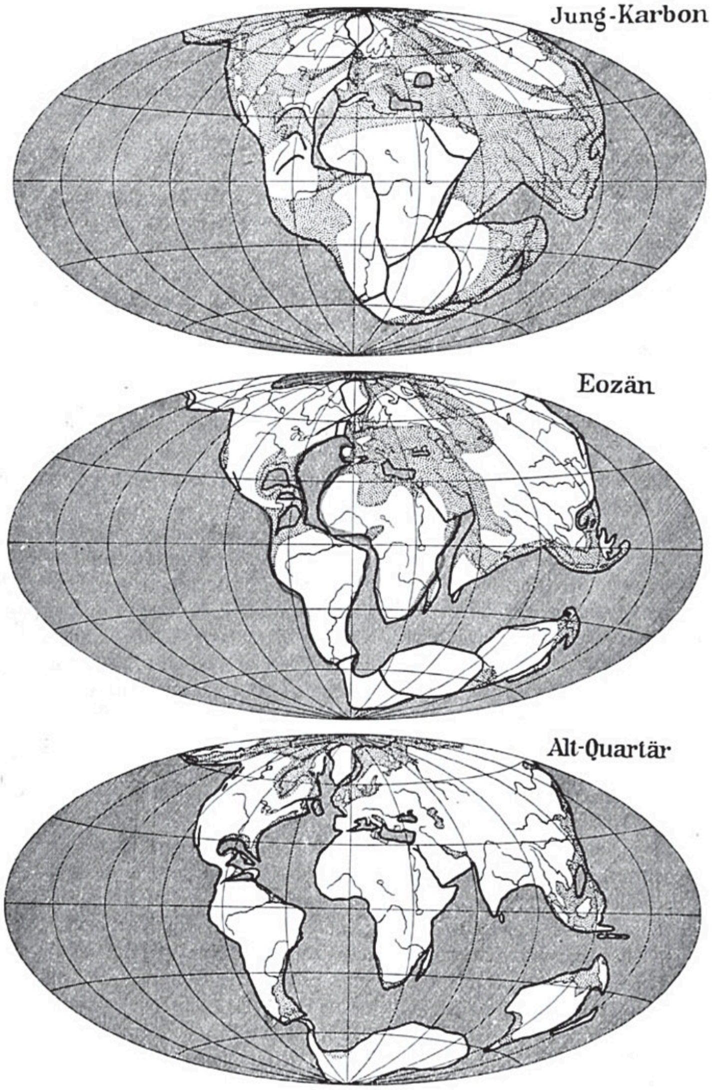
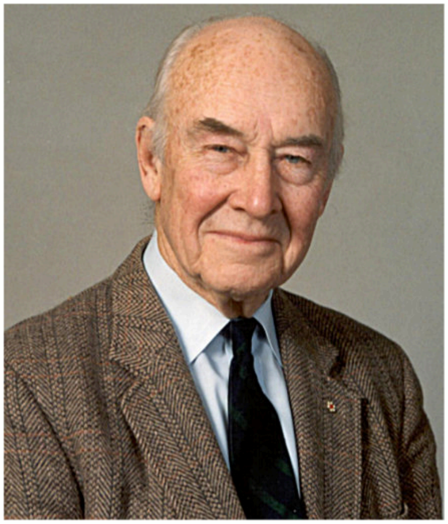


Original world maps created by Alfred Wegener showing Pangaea and the continents drifting apart. Its spatial and temporal classification corresponds to his conception at that time, not to the later proven positions and geological epochs.

J. Tuzo Wilson: 1908 - 1993

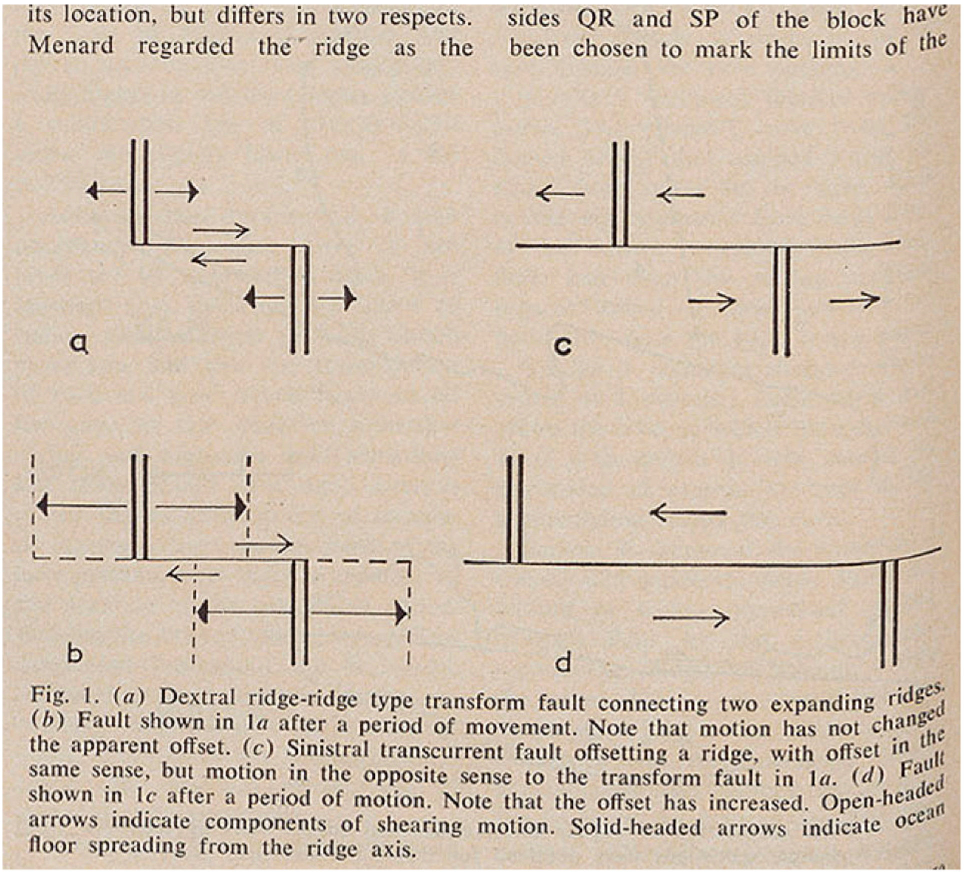
J. Tuzo Wilson, a Canadian geophysicist, was born in Ottawa, Canada, Oct. 24, 1908. His mother Henrietta, famous in her own right, was the first to climb the 7tth peak in the Valley of Ten Peaks in the Canadian Rockies, a summit later named Tuzo Mountain. His father, fascinated with airplanes, was charged with developing civil aviation in Canada. Tuzo got his love of the outdoors and hiking from his mother, both requirements for extensive geological surveying. Influenced by his father, he was one of the first to use airplanes to conduct efficiently huge geological surveys – some of his contemporaries thought it was cheating. Graduating from the University of Toronto in 1930, he obtained a second undergraduate degree in geophysics at the University of Cambridge, where he took a class from the mathematical geophysicist Sir Harold Jeffreys, a leading opponent of continental drift. Leaving Cambridge, he secured his PhD in geology at Princeton University. He then took a position with the Geological Survey of Canada in 1926, and remained there for a decade before becoming a professor of geophysics in the physics department at the University of Toronto.

Throughout much of his career Wilson championed the gradual contraction of a cooling Earth as the working mechanism for mountain building, and he rejected the idea of continental drift as proposed by Alfred Wegener in 1915. Mapping much of the Canadian Shield and surrounding mountain belts, Wilson argued that the shield itself had existed since North America had formed, and that mountain belts had subsequently formed through the squeezing and upward movement of sediments that had collected in geosynclines along the periphery of the ancient shield. This process of mountain building continued, with ever younger mountain belts forming along the periphery of the growing continent. He argued that continental drift was not only unneeded to explain the geology of North America, but was unable to explain the stability of the Canadian Shield and the distribution of its surrounding mountains. A strict uniformitarian, Wilson also objected to the idea that continental drift had occurred only once, as Wegener had proposed.



Wilson was not unfamiliar with the strong support for mobilism (drift) found in the Southern Hemisphere. On a trip to South Africa in 1950, he saw evidence in support of continental drift, but Wilson remained completely unconvinced. Wilson also rejected the paleomagnetic support for continental drift developed during the 1950s based on the divergence of apparent polar wander paths, and the fact that paleomagnetically determined ancient latitudes of the continents more or less agreed with those determined paleoclimatically by Wegener and Köppen.

Wilson's views began to change in 1960, when he briefly adopted Earth expansion, and combined it with his geosynclinal account of mountain-building. A year later, he jettisoned Earth expansion for seafloor spreading. In 1960, Harry Hess had first proposed seafloor spreading, which required continental drift. Wilson began to take seafloor spreading seriously after reading Robert Dietz's 1961 paper in which he presented his own version of seafloor spreading. Why did Wilson change his mind? Partly because he realized that he could not explain the origin of the worldwide system of mid-ocean ridges with fixed continents. He also realized that the paleomagnetic support for mobilism was correct.

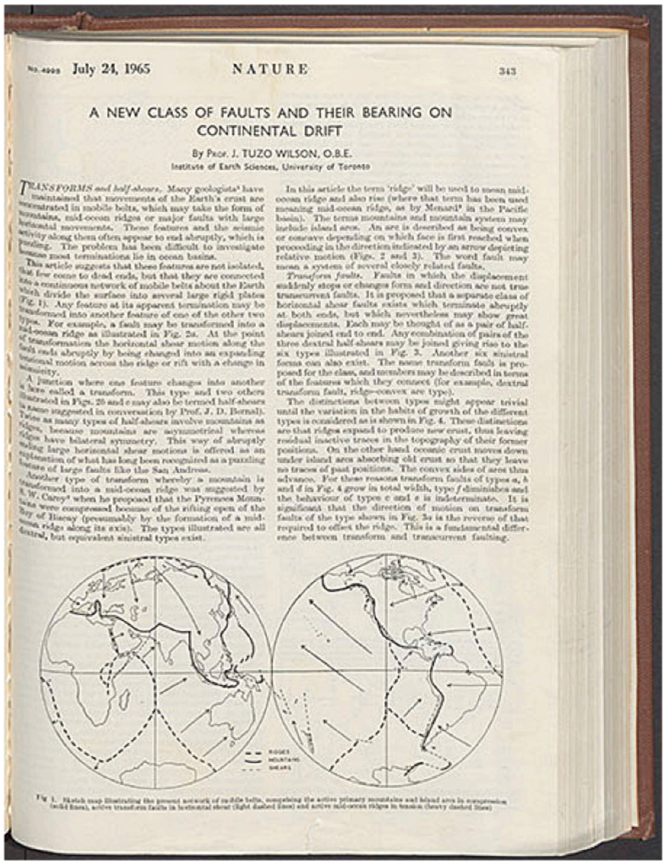


its location, but differs in two respects. Menard regarded the ridge as the

sides QR and SP of the block have been chosen to mark the limits of the

Fig. 1. (*a*) Dextral ridge-ridge type transform fault connecting two expanding ridges. (*b*) Fault shown in 1*a* after a period of movement. Note that motion has not changed the apparent offset. (*c*) Sinistral transcurrent fault offsetting a ridge, with offset in the same sense, but motion in the opposite sense to the transform fault in 1*a*. (*d*) Fault shown in 1*c* after a period of motion. Note that the offset has increased. Open-headed arrows indicate components of shearing motion. Solid-headed arrows indicate ocean floor spreading from the ridge axis.

Source: Henry Frankel is Professor Emeritus of Philosophy at the University of Missouri-Kansas City, and author of The Continental Drift Controversy (Cambridge University Press, 2012).



July 24, 1965 NATURE 343

A NEW CLASS OF FAULTS AND THEIR BEARING ON CONTINENTAL DRIFT

By Prof. J. TUZO WILSON, O.B.E.

Institute of Earth Sciences, University of Toronto

Diagram of transform faults (single horizontal lines) connecting oceanic ridges (vertical double lines), from Tuzo Wilson’s paper in *Science*, 1965 (Linda Hall Library)

Wilson then thought about what should be expected if seafloor spreading occurs. For instance, he reasoned that several Pacific island chains, the Hawaiian Islands being his best example, whose individual islands increase in age as their distance from the East Pacific Rise increases, could have formed by upwelling basalt arising from hypothesized fixed hot spots as seafloor moved over them. But his most important deduction from seafloor spreading was his hypothesis (1965) of a new class of faults, which he called transform faults. He also proposed an empirical test for their existence. He used the figure (first image) to introduce the idea of ridge-ridge transform faults, and how their existence can be tested.

Mid-ocean ridges are made up of small segments offset from one another. They are represented as double vertical lines. The horizontal line in each figure represents the fault between ridge offsets. Arrows show the predicted movement with seafloor spreading (a and b) and without seafloor spreading (c and d). In addition, if seafloor spreading occurs, the seafloor moves in opposite directions along the fault only between ridge offsets; if seafloor spreading does not occur, opposing movements occur along the entire fault beyond ridge segments. Both differences were testable. In 1967, Lynn Sykes, a seismologist at the then Lamont Doherty Geological Observatory at Columbia University, found that earthquakes along faults occur only between ridge offsets, and that the direction of motion is what should be expected, if ridge-ridge transform faults exist.

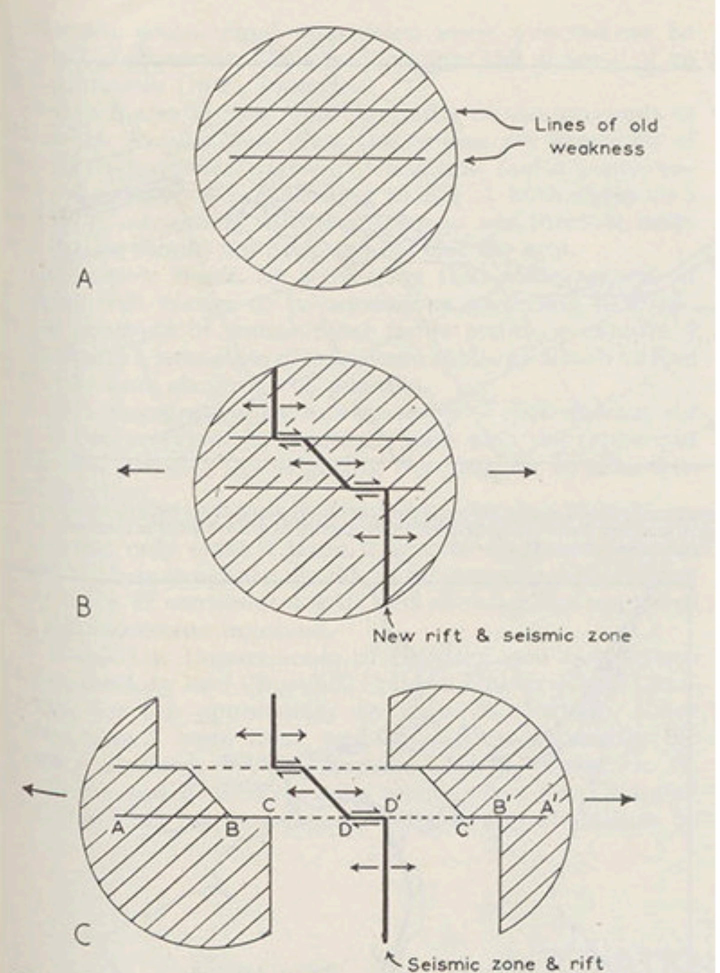


Fig. 6. Diagram illustrating three stages in the rifting of a continent into two parts (for example, South America and Africa). There will be seismic activity along the heavy lines only

Diagram illustrating three stages in the rifting of a continent, from Wilson's paper in *Nature* 1965 (Linda Hall Library)

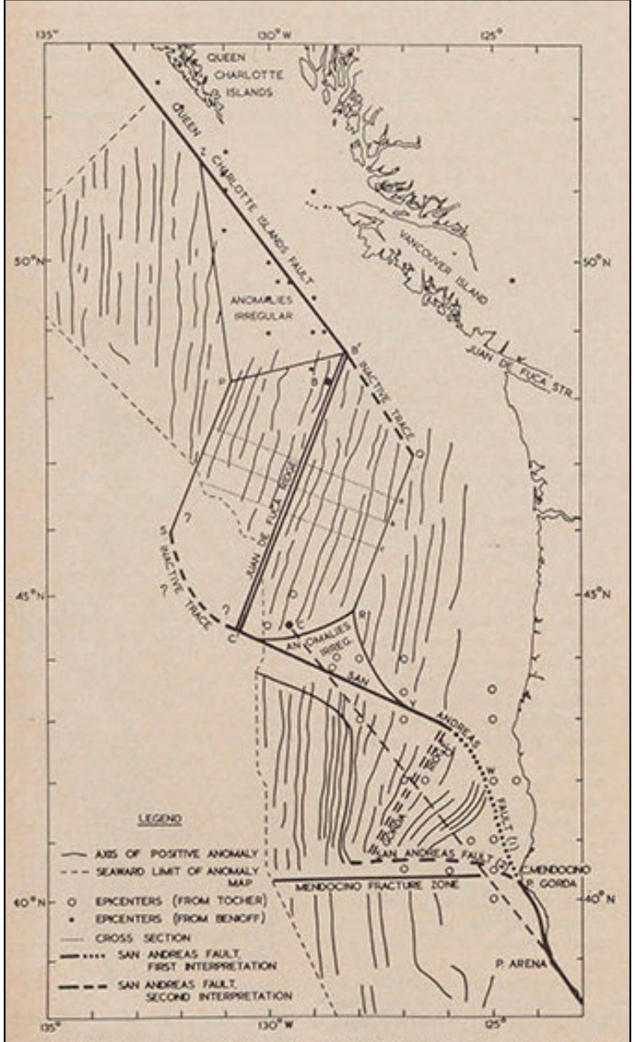
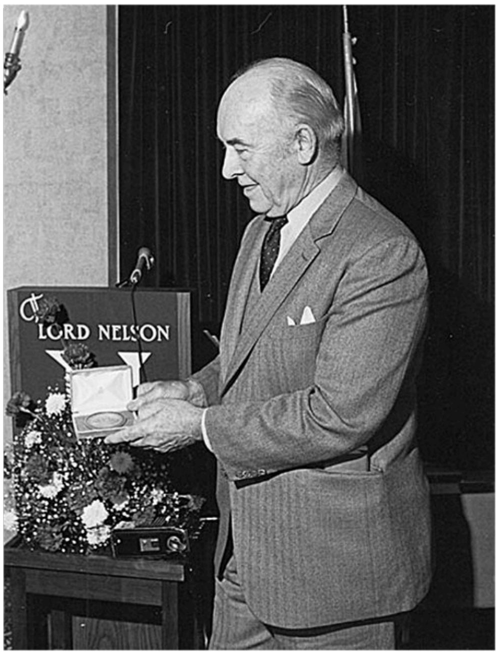


Fig. 3. Sketch map showing the proposed interpretation of the Juan de Fuca Ridge with its relation to other faults and the magnetic anomalies. It should be compared with the map of anomalies in Raff and Mason (7).

Map of the Juan de Fuca ridge off the coast of Washington state, showing the ridge as a double line and the transform faults at an angle; the fault running southeast from the ridge, shown twice as a dashed or dotted line, is the San Andreas fault. From Wilson's paper in *Science*, 1965 (Linda Hall Library)

Tuzo Wilson also claimed that Earth's surface was made up of rigid plates, Indeed, he was close to proposing what became known as plate tectonics. However, he did not quite get there. Wilson did not apply his ideas to a spherical surface, and therefore, did not connect the idea of plate movements to Euler's Point Theorem, which forms the mathematical basis of plate tectonics. According to Euler's point theorem, the movement of a point (or ridge block) can be analyzed as the rotation of the point (rigid block) around a fixed pole, called an Euler pole. Perhaps Wilson was unfamiliar Euler's theorem or failed to appreciate its importance. By own admission, mathematics was not one of his strengths.

Wilson's proposal of transform faults was presented in two papers in 1965, one in *Nature*, one in *Science*. Our images come from both of those papers. The photograph shows Wilson receiving the A.G. Huntsman Award for excellence in the marine sciences in 1981.



Tuzo Wilson accepting the A.G. Huntsman Award for Excellence in Marine Science in 1981 (Bedford Institute of Oceanography).

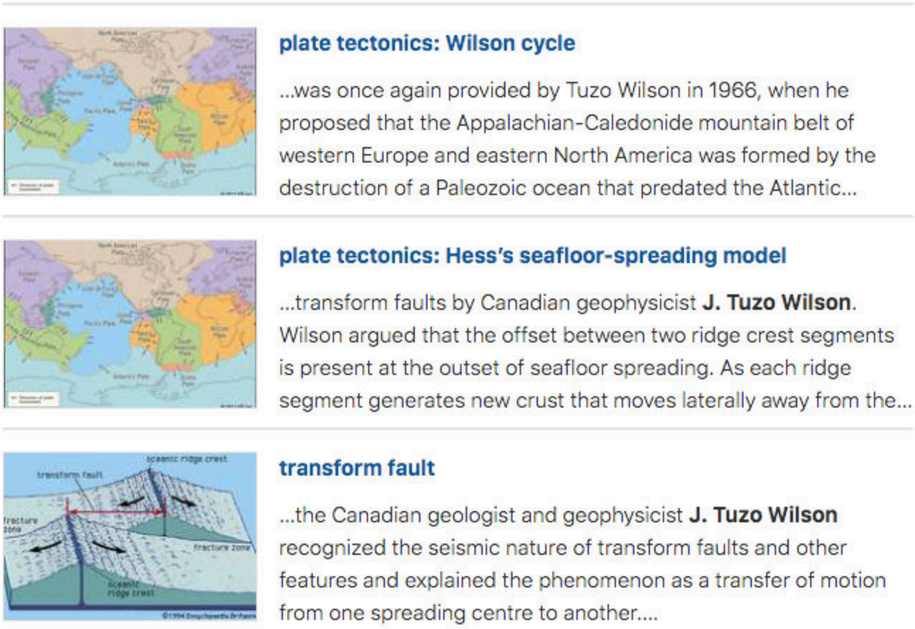


plate tectonics: Wilson cycle

...was once again provided by Tuzo Wilson in 1966, when he proposed that the Appalachian-Caledonide mountain belt of western Europe and eastern North America was formed by the destruction of a Paleozoic ocean that predated the Atlantic...

plate tectonics: Hess's seafloor-spreading model

...transform faults by Canadian geophysicist **J. Tuzo Wilson**. Wilson argued that the offset between two ridge crest segments is present at the outset of seafloor spreading. As each ridge segment generates new crust that moves laterally away from the...

transform fault

...the Canadian geologist and geophysicist **J. Tuzo Wilson** recognized the seismic nature of transform faults and other features and explained the phenomenon as a transfer of motion from one spreading centre to another....

William R. Dickinson: 1931 - 2015

William R. Dickinson, the University of Arizona geoscientist who integrated the fields of plate tectonics and sedimentology and also helped trace the migration of humans through the Pacific, died in his sleep on July 21 while on an archaeological field trip in Nuku'alofa, Tonga. He was 83.

A member of the National Academy of Sciences, Dickinson made key contributions to several subdisciplines of geosciences and also to the archaeology of the South Pacific. Not only was he a significant contributor to the "plate tectonics revolution" in the 1960s, he later studied ancient sedimentary rocks to reconstruct past movements of the Earth's plates and envision ancient landscapes.

"Bill Dickinson left few areas of geology untouched. He used the mineralogy of sand grains to give great insight into how tectonic provinces on Earth differ from each other. His work provided a unifying theme that could be applied across the entire globe and in very different geological settings," Thure Cerling, chair of the Geology Section of the National Academy of Sciences, wrote in an email.

"He applied his extensive knowledge of mineralogy not only to the distant geological past, but also to the understanding of trade routes across the Pacific Islands through the examination of the temper of pottery sherds. He bridged the disciplines of geology and archaeology," added Cerling, a Distinguished Professor of geology and geophysics and of biology at the University of Utah in Salt Lake City.

Dickinson was an expert on the formation of the North American part of the Cordillera, the mountain system that runs from Alaska to Chile. In addition, he and colleagues figured out that the sand that forms the scenic red rocks and canyons of the American West, including Bryce, Grand Canyon and Zion National Parks, originated in the Appalachian Mountains.

"Bill Dickinson was a bigger-than-life guy in a bigger-than-life place," said his close colleague **George Davis**, UA Regents Professor Emeritus of geosciences and former head of the UA Department of Geosciences.

"Bill helped in the whole discovery and introduction of plate tectonics — and then proceeded to so tightly integrate tectonics and sedimentology that he created a new field of endeavor. ... I've never known anyone who had such focus when he was going after the solution of the problem — I mean never. This guy was able to put all of his intellectual and field work faculties into just assaulting a geological problem and bringing it to its knees."

He also knew what problems to tackle, said his stepson Jon Spencer, senior geologist at the Arizona Geological Survey in Tucson. "He had a really good vision for what problems we needed to understand if we really wanted to understand how the Earth works." Dickinson, Davis and several colleagues established the Laboratory of Geotectonics within the UA Department of Geosciences. The lab developed partnerships with petroleum and mining companies. Davis said the UA-industry relationships provided no-strings-attached money to help fund research and provided a way for UA faculty and students to connect with research geologists in industry.

Dickinson's former doctoral student Timothy Lawton, professor emeritus of geological sciences at New Mexico State University in Las Cruces, said, "Bill had this insatiable appetite for knowledge." Dickinson told Lawton that upon arriving at a South Pacific island to do research: "When you're walking down the stairs from the airplane you can just flip open your field notebook and start taking notes."

Dickinson had been conducting research in the South Pacific since the 1960s. He realized he could help archaeologists trace the migration path of people from island to island and find sites of past human habitation, said his colleague **David Killick**, a UA professor of anthropology.

"Archaeologists track these migrations in the Pacific by the pottery that people carried along with them," Killick said. The pots were made with clay combined with sand from where the pot was made.

By collecting sand from various islands and comparing it to the sand in a particular pot, Dickinson could figure out on what island or island group a pot had been made. To do so, he examined thin sections of the pot fragments under a microscope. Although Killick has now taken up doing those analyses for parts of the Pacific, he said for about 40 years Dickinson did almost all of that work. "He was revered by the Pacific archaeologists. Earlier this year they had a symposium in his honor at the Society for American Archaeology in San Francisco."

"I really enjoyed associating with him. He was intellectually rigorous, he was insightful, he was modest and self-deprecating, he was funny. I will miss him — he really was a great man," Killick said.

Dickinson was renowned for his ability to make key observations in the field and to synthesize enormous amounts of data. Those abilities, combined with his disciplined approach to science and his enormous energy and enthusiasm, fueled his tremendous productivity. Although he formally retired in 1991, Dickinson continued his research unabated. More than half of his 298 articles, chapters, field guides and comments were published since he retired, including 15 publications from 2013 and 2014. Dickinson was in the midst of writing at least one publication when he died, Spencer said. Not only was he a prodigious researcher, Dickinson was dedicated to educating both undergraduate and graduate students. He was the principal adviser for 42 master's students and 43 doctoral students.

He championed the importance of undergraduate teaching because a geology professor whose course Dickinson took while a junior in college changed his career path from engineering to geology, Davis said. Dickinson wrote in an email to Davis, "Every single student is worth whatever it takes. Think back to Aristotle. He tutored Alexander the Great, and who could have imagined his future when he was a dumb teenager? Not even Aristotle was that wise, but I suspect he gave his charge full effort nonetheless."

Spencer, Dickinson's stepson, was one of the young people Dickinson influenced. "When I was in high school, the plate tectonics revolution was just getting rolling. Bill made it clear that there was a revolution going on. When I went to college I decided I wanted to be part of the revolution," Spencer said, adding that he has spent all of his adult life talking with Dickinson about rocks.

"Bill was a fascinating guy," Spencer said. "He had an ear for rural people — he'd go up and ask a rancher could we go through his property and then talk to him for half an hour. He really knew horses well, he was a wonderful story teller, he had huge experience in all kinds of places in the West — and he was an absolutely first-class scientist."

Born in Nashville, Tennessee in 1931, Dickinson moved to California as a teenager. His parents raised Arabian horses near Santa Barbara. He earned a bachelor's degree in petroleum engineering from Stanford University in 1952. He earned his master's degree and doctorate in geology from Stanford University in 1956 and 1958, respectively. He was an officer in the U.S. Air Force from 1952 to 1954, and in 1958 he became a faculty member at Stanford University, where he advanced through the ranks to full professor.

He joined the UA faculty as a professor of geosciences in 1979, was head of the UA Department of Geosciences from 1986 to 1991 and retired in 1991 as a UA professor emeritus of geosciences. His service to his profession includes being president of the Geological Society of America, initial chair of the Geological Sciences Board on Earth Sciences of the National Research Council, chair of the U. S. Geodynamics Committee and chair of the Geology Section of the National Academy of Sciences.

His numerous honors and awards include a Guggenheim Fellowship in 1965 to live in and study the geology of Fiji, the Penrose Medal of the Geological Society of America in 1991, election to the National Academy of Sciences in 1992, the Sloss Award of the Geological Society of America in 1999, the SEPM (Society for Sedimentary Geology) Twenhofel Medal in 2000, and the Geological Society of America's Rip Rapp Award for Archaeological Geology in 2014. He was also a Geological Society of America Fellow and an American Association for the Advancement of Science Fellow.

Dickinson's second wife and constant companion, Jacqueline (Jackie), pre-deceased him. He is survived by his first wife, Margaret (Peggy) Palmer Dickinson; his brother, Rufus Dickinson, and sisters, Edith Tipple and Maxi Decker; his sons, Edward and Ben; stepsons, Jon and Brian Spencer; nine nieces and nephews; three grandchildren and four step-grandchildren; and one great-grandchild.

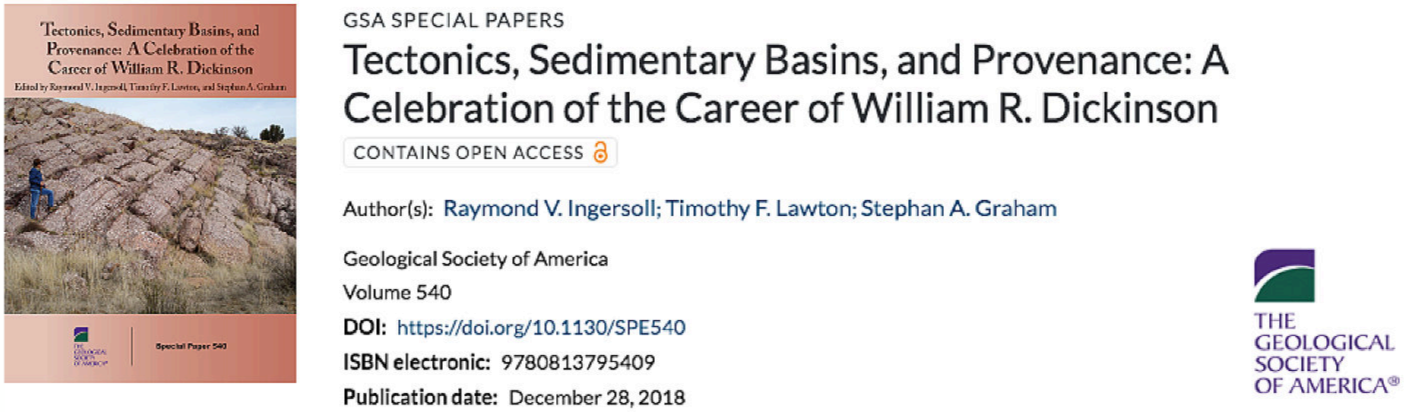
Donations can be made to the William R. Dickinson Field Trip Support Fund, which provides funding for field trips for geosciences students. Mail donations to William R. Dickinson Field Trip Support, Department of Geosciences, Gould-Simpson Building, University of Arizona, Tucson, Arizona 85721. Checks should be made out to "University of Arizona/Geosciences." Please put "WRD Field Trip Support" in the memo line.

https://news.arizona.edu/story/william-r-dickinson-major-figure-in-plate-tectonics-and-pacific-archaeology-dies

https://www.researchgate.net/scientific-contributions/William-R-Dickinson-72413760

https://www.geo.arizona.edu/sites/www.geo.arizona.edu/files/WR%20Dickinson%20-%20Nat%20Acad%20Sci%20biography%20-%202016.pdf

https://www.youtube.com/watch?v=XRwxwCp65OM



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Tectonics, Sedimentary Basins, and Provenance: A Celebration of the Career of William R. Dickinson

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Tanya Atwater

Tanya Atwater (Born 1942) is an American geophysicist and marine geologist, who specializes in plate tectonics. She is particularly renowned for her early research on the plate tectonic history of western North America.

EARLY LIFE AND EDUCATION

Atwater was born in Los Angeles, California on August 27, 1942. Her father was an engineer and her mother was a botanist. She is one of four siblings. Atwater was one of the first women to research the ocean floor in terms of its Geology.

Atwater began her education in 1960 at the Massachusetts Institute of Technology, then received her B.A. in Geophysics from the University of California, Berkeley in 1965. She earned a Ph.D. (1972) in marine geophysics from Scripps Institution of Oceanography, University of California, San Diego. She is director of the University of California, Santa Barbara Educational Multimedia Visualization Center where she is an emerita professor of geological sciences. She was a professor at the Massachusetts Institute of Technology before joining the faculty at UCSB in 1980. Atwater retired from UCSB in 2007.

CAREER

Atwater was a professor of tectonics, in the Department of Geological Sciences at the University of California, Santa Barbara before retiring. She authored and co-authored 50 articles in international journals, professional volumes, and major reports. Seven of these papers were published in the journals Nature or Science. In 1975, she became a fellow of the American Geophysical Union for her work in tectonophysics. From 1975 to 1977, Atwater was a Sloan Postdoctoral Fellowship Recipient in Physics. In 1984, she won the Encouragement Award from the Association for Women Geoscientists. Atwater is a member of the National Academy of Sciences for her contributions to marine geophysics and tectonics. In 2019 she received the highest award of the Geological Society of America, the Penrose Medal.

Scientific discoveries

Atwater was involved in oceanographic expeditions using deep towed instruments to explore the ocean floor. To date, she has participated in 12 deep water dives in the deep-ocean submersible Alvin. She researched the volcano-tectonic processes responsible for creating new oceanic crust at seafloor spreading centers. In 1968, she co-authored a research paper featuring groundbreaking work into the faulted nature of spreading centers. With Jack Corliss, Fred Spiess, and Kenneth Macdonald, she played key roles in expeditions that uncovered the distinct biology of ocean floor warm springs, which led to the discovery during the RISE project of the high temperature black smokers, undersea hydrothermal vents.

In Atwater's research on Propagating Rifts near the Galapagos Islands, she discovered that propagating rifts were created when spreading centers along the seafloor were disturbed by tectonic movement or magma and therefore had to change direction to realign. This helped to explain the complex pattern of the seafloor.

Atwater is perhaps best known for her work on the plate tectonic history of western North America. She wrote two major research papers outlining the history of plate tectonic evolution of North America and tectonic problems of the San Andreas Fault, which assisted in documenting the history of the San Andreas Fault Line.

She also studied geometric evolution, integrating and comparing the global plate motion records with the regional continental geologic records. She found emerging relationships that revealed the origins of many large-scale geologic features (e.g. Rocky Mountains, Yellowstone, Death Valley, Cascade volcanoes, California Coast Ranges).

Atwater published a research paper, Implications of Plate Tectonics for the Cenozoic Tectonic Evolution of Western North America. In her work, she explains that approximately 40 million years ago, the Farallon Plate was subducting underneath the North American Plate and the Pacific Plate. The lower half of the Farallon plate was entirely subducted under Southern California and the upper half did not sink, which eventually became known as the Juan de Fuca Plate.Since the southern section of Farallon completely disappeared, the boundary of southern California was now between the Pacific Plate and the North American Plate. The San Andreas Fault is unique because it acts as a major fault line as well as a border between the Pacific Plate and the North American Plate. She updated this work in 1989.

Atwater is interested in communication and education at all levels. She has developed electronic multi-media to enhance geologic visualization and understanding, particularly related to the histories of tectonic plates.

https://atwater.faculty.geol.ucsb.edu/

AWARDS AND HONORS

1975, Fellow, American Geophysical Union

1980, AAAS Newcomb Cleveland Prize for top research article in the journal Science

1997, elected to the National Academy of Sciences

2002, National Science Foundation Director's Award for Distinguished Teaching Scholars. This award, of $300,000 over four years, is given to help and honor distinguished scientists who are working out ways to translate research into education. The money is meant to provide teaching scholars the opportunity to expand their work beyond their home institutions.

Leopold von Buch Medal, German Geosciences Society

2005 Gold Medal, Society of Woman Geographers

2019 Penrose Medal of the Geological Society of America. https://www.geosociety.org/GSA/About/awards/GSA/Awards/2019/penrose.aspx

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Source: Wikipedia, April 1, 2020.

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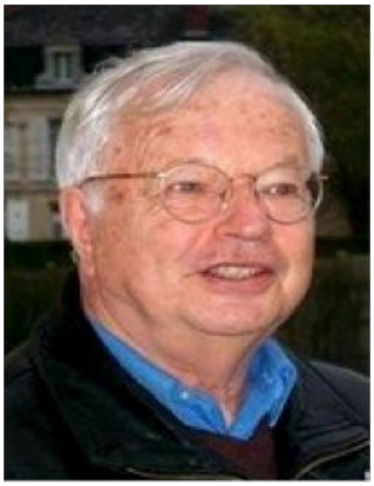
Xavier Le Pichon

Crónica del nacimiento de un nuevo paradigma en Ciencias de la Tierra, protagonizado por Xavier Le Pichon

Xavier Le Pichon nació en Quinhon, Indochina Francesa (hoy Vietnam) el 18 de junio de 1937. Es reconocido por ser uno de los pioneros de la tectónica de placas. Se desempeñó como oceanógrafo físico del Centro Oceanográfico del departamento de Bretaña en la ciudad de Brest, Francia; y posteriormente trabajó en los Estados Unidos a fines de la década de 1960, enfocándose al estudio de los mecanismos de expansión del fondo oceánico. Cuantificó la cinemática y geometría de los desplazamientos de las placas en una esfera y fue el primero en reconocer la existencia de seis placas tectónicas principales.

Durante su niñez, debido a la guerra de Vietnam en el año de 1946, se vio obligado a dejar el país a la edad de 9 años, donde no recibió ningún tipo de educación formal, sólo la que recibió de su madre. Posteriormente tuvo que trasladarse con su familia a la ciudad de Cherburgo, Normandía, lugar donde asistió a la escuela secundaria y a la escuela preparatoria, en la cual enfocó sus estudios en las matemáticas y la física.

La mayor parte su vida ha estado ligada al océano por haber vivido en zonas costeras, tanto en Vietnam como en Francia, preguntándose, ante la inmensidad del océano, qué había debajo de éste. Por este motivo, en un inicio, deseaba ser oficial naval. Empero, su sueño fue truncado debido a problemas de la vista, los cuales no le permitieron aprobar el examen de ingreso por esta condición. Esta situación lo condujo a tomar la decisión de estudiar dos años de ingeniería geofísica, graduándose de la Universidad de Estrasburgo en 1956. Posteriormente realizó su maestría en física en la Universidad de Caen, donde obtuvo un puesto como investigador, mientras que, al mismo tiempo, realizaba gestiones para obtener la beca Fullbright, asesorado por su mentor el profesor Jean Pierre Rother, que a su vez lo dirigió al sismólogo Maurice Ewing, gracias al cual, finalmente, fue acreedor a la beca deseada y a ser admitido como estudiante en la Universidad de Columbia. Una vez inscrito en esta universidad, Maurice Ewing invitó a Le Pichon a estudiar el mundo, la tierra y los océanos en un barco oceanográfico, delegándole el cargo de los estudios de oceanografía física, a pesar de no haber realizado nunca tales trabajos.



Debido a su falta de experiencia, Le Pichon comenzó a estudiar en los libros de oceanografía física que había disponibles en el barco. A partir de sus primeras investigaciones y mediciones, comenzó a escribir un artículo sobre las mediciones que realizó durante sus misiones en el Océano Atlántico e Índico. Describió la circulación profunda del suroeste del Océano Índico, y al regresar de esta labor cuatro meses y medio después, envió su artículo al *"Journal of Geophysical Research"*, realizando así, su primer artículo, el cual fue publicado en 1960.

Posteriormente, comenzó a trabajar con Manik Talwani e hicieron el primer bloque tridimensional con inversión gravimétrica, inventando un nuevo método de estudio numérico tridimensional en su tipo. En febrero de 1963, Le Pichon comenzó a trabajar con John Ewing en geofísica, iniciándose así en sismología, particularmente con el método de refracción sísmica y a estudiar con ello los rifts; los cuales proporcionaron perfiles de refracción sísmica que no podían comprender e interpretar adecuadamente. En estos perfiles se notaba que la corteza manifestaba un engrosamiento particular, y su composición parecía ser influenciada por el manto. Al continuar colaborando con Manik, comenzaron el estudio de una cresta marina utilizando, por primera vez, el método de cavidad 3D que Manik había diseñado para Le Pichon y gracias al cual, comenzaron ambos a comprender el estado de las dorsales oceánicas. En este estudio fueron elaborados cinco artículos publicados en 1965 sobre refracción sísmica. E inmediatamente después publicaron la interpretación de la gravimetría del mismo estudio, y a partir de este punto, Le Pichon abordó el tema del magnetismo, mancomunadamente con Jim Heirtzler. Tal colaboración condujo a la publicación de un artículo sobre la interpretación de las anomalías magnéticas y sobre el patrón magnético en el "*East Pacific Rise*". Este artículo creó un gran debate sobre la veracidad de la teoría de la expansión del rift oceánico y si era correcta o no. Le Pichon, estaba a favor de la expansión del piso oceánico, y a sabiendas que era algo poco realista, analizó la distribución de sedimentos usando refracción sísmica en el rift; esto lo llevó, en 1966, a elaborar un modelo de flujo de calor que fluyera a través del subsuelo del Océano Atlántico, creando, de este modo, el primer modelo de las corrientes de convección. Con ello demostraron que se podía explicar el flujo de calor debido a las corrientes de convección y que éstas no llegan a la superficie. Para inicios de 1966, en Inglaterra, ya comenzaba a extenderse la teoría de la expansión del fondo oceánico, pero permanecía la incógnita de cómo ésta funcionaba en la corteza de la Tierra. Fue entonces cuando comenzaron a generar eco las ideas de John Tuzo Wilson sobre las fallas transformantes, pero continuaba existiendo el problema de cómo ajustar este concepto a una escala global y cómo este mecanismo se relacionaba con la distribución de los sismos.

En la primavera de 1967, durante una sesión llevada a cabo para analizar el modelo de la expansión del fondo oceánico, durante una reunión de la "*American Geophysical Union*" en Washintong, Jason Morgan presentó un controvertido artículo sobre la trinchera de Puerto Rico. Este artículo fue el parteaguas en la compresión del funcionamiento del mecanismo de expansión del piso oceánico, y de la manera cómo éste concordaba con la geometría de la corteza de la Tierra. Esto propició que Le Pichon utilizara estos conceptos para probar tal geometría también en el Océano Atlántico, en el Océano Índico y en el Océano Pacifico. Demostrándose, así, que debe existir un movimiento global coherente, e incitando a la idea que debía haber un desplazamiento concordante en la trinchera de todas las placas. Con la información que luego tuvo disponible, propuso un modelo consistente en seis placas tectónicas, lo cual le permitió publicar un artículo en 1968 sobre la primera reconstrucción global en la cual se utilizaron rotaciones finitas desde el inicio del Cretácico. Ello tuvo un gran impacto debido, en gran parte, a que ahora cualquier persona podía tener un modelo que podría ser confrontado con los hechos observados para entender los sismos y su ubicación genética. Este modelo fue aprobado inmediatamente, por su utilidad, por los especialistas dedicados al modelado. Comenzaron, entonces, a proliferar una gran cantidad de artículos publicados sobre sismología y tectónica globales. Siendo Le Pichon el autor más abundantemente multicitado en referencias bibliográficas de las Ciencias de la Tierra en el mundo científico.

Tiempo después, Le Pichon publicó el primer libro sobre tectónica de placas en la editorial Elsevier en 1973, el cual tuvo un impacto impresionante. Posteriormente, en el mismo año, Le Pichon se convirtió en una figura destacada de la Oceanografía y la exploración en aguas profundas, utilizando sumergibles, al dirigir el "*French American Mid-ocean Ridge Study*" (FAMOUS) junto con Jim Heirtzler y Bob Ballard, marcando un nuevo inicio en el estudio de alta resolución del rift oceánico con mecanismos de fuentes hidrotermales. De 1979 a 1981 utilizó su método de exploración en trincheras de aguas profundas en la zona oriente del mediterráneo y en las trincheras del Océano Pacifico frente a las costas de Japón descubriendo los límites de las placas convergentes y divergentes. Tal fue el resultado espectacular de los estudios de los procesos geofísicos, geológicos y geoquímicos en esos diferentes entornos oceánicos. Conocer el papel de los fluidos en estos contextos de la corteza terrestre, no sólo fue fundamental para entender la distribución de los sismos, sino también para estudiar el equilibrio geoquímico de los océanos.

Las contribuciones de Xavier Le Pichon al concepto de "Ciencias de los sistemas terrestres" han sido importantes, y muy significativas, tanto para los geólogos como para el público en general. Su papel de liderazgo en el desarrollo de la Geología marina en Francia y en innumerables programas internacionales, junto con su virtud de combinar conocimientos de las matemáticas, geofísica y geología, fueron la base de su excelente trabajo en equipo, y lo cual ha constituido una guía portentosa, y muy prometedora hacia las nuevas generaciones de jóvenes investigadores en las Ciencias de la Tierra. Estas hazañas protagonizadas por Xavier Le Pichon y sus equipos de investigación, cumplieron el reto de inaugurar la nueva Revolución de las Ciencias de la Tierra del siglo XX: ¡La Tectónica Global!

Actividad profesional y de investigación

La actividad profesional y de investigación del Dr. Le Pichon, fue condecorada con las siguientes responsabilidades científicas a lo largo de más de 40 años de intensa actividad científica:

1963-1966, Asistente Junior de Investigación en la Université de Columbia, New York, USA.

1966-1968, Asistente de Investigación en la Université de Columbia, New York, USA.

1968-1969, Consejero Científico en el Centre National pour l'Exploitation des Océans. (CNEXO), Francia.
1969-1973, Jefe del Departamento Científico, y enseguida Jefe de Medio Sólido, del Centre Océanologique de Bretagne, en Brest, Francia.
1970, Visitante Científico en el Lamont Geological Observatory, en New-York, USA.
1971, Profesor Asociado en la l'Université Paris 7, Paris, Francia.
1972, Visitante Científico, Primer Titular de la Bourse Cecil et Ida Green, Institute of Geophysics & Planetary Physics, Université de California, en San Diego, USA.
1973-1978, Consejero Científico del Presidente de CNEXO, en Paris, Francia.
1978-1984, Profesor Titular en la Université Pierre et Marie Curie, en Paris, Francia
1978-1984, Director del Laboratoire de Géodynamique; Consejero del Presidente del Centre National pour l'Exploitation des Océans, Paris, Francia.
1984-2000, Director del Laboratoire de Géologie de l'Ecole Normale Supérieure, Paris, Francia.
1995, Premier Profesor Visitante del International Communication Center, Ocean Research Institute, Tokyo University, Japan.
2002 Wiess visiting professor à Rice University, Houston.

Además, el Dr. Le Pichon, es Profesor Honorario en la Chaire de Géodynamique del *Collège de France*, con 303 publicaciones científicas internacionales. Asimismo, el Dr. Le Pichon, ha sido partícipe de numerosos comités y consejos científicos nacionales e internacionales. Es además miembro de la *National Academy of Sciences* de los Estados Unidos. Asimismo, ha sido condecorado con numerosos premios nacionales e internacionales, destacándose la condecoración del Premio de Japón en 1990 y la *Medalla Wollaston* en 1991.

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Conociendo a Xavier Le Pichon: https://blogs.egu.eu/divisions/ts/2018/11/06/meeting-plate-tectonics-xavier-le-pichon/

Researchgate: https://www.researchgate.net/profile/Xavier-Le-Pichon

Youtube: https://www.youtube.com/watch?v=yPzwm5OhRz4

https://books.google.com/books/about/Plate_Tectonics.html?id=lxTgBAAAQBAJ

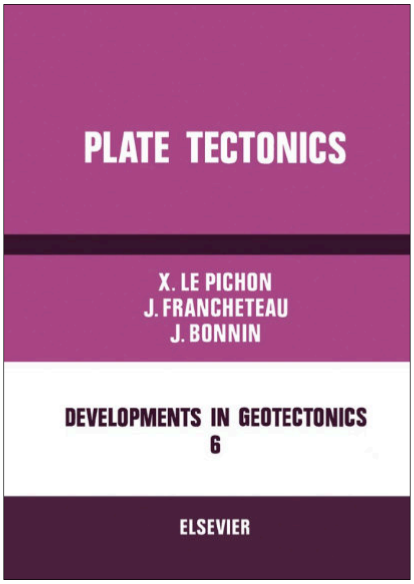

PLATE TECTONICS

X. LE PICHON
J. FRANCHETEAU
J. BONNIN

DEVELOPMENTS IN GEOTECTONICS
6

ELSEVIER

John F. Dewey

The continents stay on top like a scum.... It stays on top and squashes and scrunches and makes a mountain belt.”

Geologists must often think in staggeringly long time spans and jump mentally between spatial scales, both microscopic and macroscopic. So, for fun, some do as geologist John F. Dewey has for the past three decades: shrink time and space to a more human scale by building model railways. Dewey has been tooling with an extensive model of a spiraling Swiss Alpine railway, housed now in the garage of his California home. Here, boxcars are about 6 inches long, but for Dewey the focus is on rocks, not rails. “I try to get the scenery to look like the geology of Switzerland,” Dewey says. “You can see the rocks tilting in the correct direction up in the mountainside. The scenery is very serious, actually. The geology is correct.”

Dewey brings the same attention to detail in his research on orogeny, the geological process of mountain building. “The earth generates enormous complexity on a small scale,” he says. “The great trick is taking that complexity, analyzing and synthesizing it, and then pulling it through into the larger scale.” This perspective—seeing the mountain for the rocks, one might say—is one of the hallmarks of Dewey's research. It led first to his pursuit of a unifying theory for the formation of mountain belts in Ireland and the eastern United States, and then to his groundbreaking proposals in 1968 of how plate tectonics could explain orogeny. Like the mountain belts he studies, Dewey's career has straddled the Atlantic Ocean, with academic posts in both his native England and the United States, where he is now Distinguished Professor of Geology at the University of California, Davis (Davis, CA). In his Inaugural Article, published in this issue of PNAS, Dewey presents the results of research underway since his election to the National Academy of Sciences in 1997 (1). In the paper, he reports on processes that can build mountains in surprisingly short geologic times, which he illustrates with detailed evidence from the Irish mountains that he has been studying since his doctoral work 47 years ago.

Simultaneous Obsessions

As a child in London during World War II and its aftermath, Dewey excelled at sports—boxing, rugby, cricket, gymnastics, even the high jump and javelin. “I was obsessed with sport; I really was,” he says, “but it was clear that I was not good enough to get to the top in any of them. And I was really ambitious. I wanted to be the top of something.” Learn about what happens after your research publishes at PNAS. At age 16, he found a field in which he would lead. During a holiday in Devon, England, he learned a bit of field geology with his great uncle, Henry Dewey, a geologist with the British government. Intrigued, the young Dewey considered studying geology for a career and found that his plan met with the approval of his housemaster at Bancroft's School (Essex, U.K.), an amateur geologist named John Hayward. Immediately, academic studies became a “simultaneous obsession,” along with sports, Dewey says. He attended Queen Mary, University of London, where he graduated with a first-class geology degree in 1958.

Dewey was less interested in the booming fields of mining and petroleum applications and more attracted to academic geology, where he could pursue the sort of teaching he enjoyed during his frequent lectures to schoolchildren. He performed graduate work at Imperial College London, where he studied the Irish Caledonian mountain belt, which would come to dominate his subsequent research career. After earning his doctorate in 1960, Dewey worked as a lecturer at the University of Manchester (Manchester, U.K.) and the University of Cambridge (Cambridge, U.K.).

Linking Oceans and Mountains

The late 1960s marked a turning point both in Dewey's career and in the field of geology. In 1967, Dewey took a 3-month sabbatical to work at the Lamont Geological Observatory (now the Lamont–Doherty Earth Observatory) in New York. He studied the Appalachian/Caledonian belt, which comprised the other tails of the Irish Caledonides that he had investigated during his doctoral work. These mountains are part of a range that curves from the eastern United States around to Greenland, Norway, and Scotland. With the help of a large map and extensive research in the Columbia University (New York) library, Dewey plotted the geologic details of the entire Caledonian system, struggling to make sense of it. As Dewey worked toward a unifying explanation for orogeny, the then-new theory of plate tectonics was beginning to take hold in the geology world. Researchers had been trying to solve the puzzle of why rocks from the ocean were so young, roughly 160 million years and younger, versus the 4-billion-year-old rocks from the continents. Geologists at Lamont and elsewhere began to realize that deep ridges in the ocean were constantly being pulled apart by strong geological forces, with new oceanic crust forming at the axial crack and carried outward as if on a conveyer belt, a phenomenon called seafloor spreading. The old oceanic crust is then pulled back down into the earth's interior and destroyed at oceanic trenches, or subduction zones.

Gradually, plate tectonics began to explain the puzzling observations from the oceans. Dewey, however, brought the theory ashore and used it to solve the puzzles of mountain belts. Through his research, he began to realize that there existed mountain belts of different rock types that could be explained only by the opening and closing of an ocean between them. Plate tectonics could address this question directly. Researchers saw that continental plates sat on top of the ocean's rocks because they are much lighter and weaker. “The continents stay on top like a scum. So when one continent collides with another, it won't go down the tubes” and into the earth, as an oceanic plate would, Dewey says. “It stays on top and squashes and scrunches and makes a mountain belt.” While at Lamont, Dewey filled in the details of seafloor spreading, colliding continents, and mountain building. “They just exploded,” he says of the papers he wrote during this time (2, 3). “That was what got me going in plate tectonics. I was always interested not just in the details of geology but how all the details put together to give you the bigger picture.”

From Ink to Computers

Dewey feels lucky to have been at Lamont during that time, when renowned scientists such as Walter C. Pitman III and Lynn R. Sykes were there. Plus, he says, “I got to love America. It was a cultural delight. America was open and lively and a freewheeling place. It was a free and exciting period,” he says. In 1970, Dewey took a position at State University of New York at Albany. The next 12 years were fabulous, Dewey says. “I had superb students, great colleagues, and we just did a huge amount of research. We changed the way people thought about the world.” Until the early 1970s, he studied old mountain belts, such as the 400-million-year-old Appalachian system. After a while, he began extending his research to younger mountain belts such as the Alps, Himalayas, and Andes, where signs of the ongoing mountain building were still evident (4–6).

When it comes to choosing research topics, Dewey says, “I just follow my nose. If something really interests me much more than what I'm doing now, I just drop what I'm doing now and start on something else.” He cites as a major influence in this philosophy the late Sir Edward “Teddy” Bullard, who told him not to follow the advice of “older people” and instead just pursue interests without fear of failure. His thinking has always been quite visual, he says—another bonus in geology. He believes strongly in the value of drawing maps, which necessitates going into the field, looking at the rocks in immense detail, and then being able to see the larger picture. Early in his career, Dewey drew maps by hand, with stencils and inks, but by the late 1990s he was happily using illustrator (Adobe Systems, San Jose, CA) to create his maps on the computer. “I was a bit late coming to computers, really,” he says.

The American West

After a decade of research in New York, Dewey began to feel “a bit foot-loose again” and entertained thoughts of moving elsewhere. Courted for years by various English universities, he finally accepted a position as chair of the Department of Geological Sciences at the University of Durham (Durham, U.K.) in 1982. In 1986, he moved again to serve as chair of the Department of Earth Sciences at the University of Oxford. In his first 5–6 years at Oxford, Dewey was happy as he carried out more research on the British and Irish Caledonides (7–9). Yet dissatisfaction with British academic culture caught up with him before long. “I got tired of a closed, class-based society,” he says. At the age of 63, he examined the career choices in front of him. “I thought I was going downhill a bit intellectually, and so, come 2001, I thought, `Well, do I really want to retire and become an old emeritus in Oxford, or do I want to break out again?”' he says. “So I broke out again.” “Just how long does it really take to make a mountain?”

This time, he headed to California, accepting a Professor of Geology position at the University of California, Davis, in 2001. It was “an immense intellectual rejuvenation,” he says, as he began new research projects in the Sierra Nevada and Rocky mountain ranges (10). He skied the slopes surrounding Lake Tahoe, but, most importantly, he was back in an academic environment that challenged him.

Quick-Cooking Mountains

Dewey's PNAS Inaugural Article (1), which exemplifies his research style, involves massive data synthesis and springs from his line of detailed work on the Irish Caledonides, which he has studied for 47 years (7–11). The research “is something I'm known for, and, although it sounds immodest, nobody else is really capable of writing this paper,” he says. The research concerns the formation and destruction of mountain belts and looks to resolve the question, “Just how long does it really take to make a mountain?”

The answer may be surprising, Dewey says. “People think of mountain building as a long, slow process,” on the order of 50 million years, he says. Yet when he synthesized the sedimentologic, mineral, and geochronologic data for the Irish Caledonides, the model pointed to something more rapid. “These mountains were made and destroyed in 10–12 million years,” Dewey says, “and that's really a new concept.”

In the case of the Irish Caledonides, this arc of islands on the edge of a dense oceanic plate began colliding with a continental plate roughly 475 million years ago. The islands essentially climbed on top of the continent, Dewey says, forming the mountain range. The mountain-building process was cut short, however, because the oceanic plate was heavy enough to sink beneath the continent, which formed a new subduction zone and relieved the collision pressures rather quickly. In contrast, two colliding continents have no avenue of escape, and so they build in pressure and continue to form mountains over many more millions of years.

According to Dewey, this work might spur a revisitation of other mountain belts. In particular, one aspect of orogeny may need to be reexamined: the metamorphism and heat transfer in rocks. In traditional models, the rocks in developing mountains heat up gradually by conduction under the forces of collision. “It is now quite clear that all those models are completely wrong,” he says. “These rocks heated up very, very quickly. The only way you can do that is shove into them something very hot, or intrude some very hot liquid,” like magma. “Basically, I'm now convinced, and I think I can prove it in many orogenic belts of all ages around the world, that metamorphism takes place very, very fast, and all these conductive models cannot be right.”

Importance of Sweat

In October of this year, Dewey plans to give a talk at the annual meeting of the Geological Society of America in Salt Lake City on one of his favorite topics: balancing detail and the big picture in geology and geophysics. On the one hand, geologists have always tended to “get rather obsessed with a very small scale, the particular, the minutiae, the details,” Dewey says, “and geophysicists tend to think on whole-earth scales, because they can't deal with the immense complexity that we have on a small scale. So there's a terrible spatial and temporal gap, and I think we need to get over that.” Dewey believes the answer lies in more intensely focused field work and in “getting sweaty. The truth resides in the rocks,” he says. “The rocks don't lie.” He says studies of the rocks “are difficult, and it's hard work if you're really getting at the maps. But if you have intelligent maps about rocks, you can do a lot.” He points to another role model in this respect, geologist Robert Shackleton. Abstract models “can run away with us,” Dewey says. “They're mathematically great fun to do, but you mustn't ever believe them.” Although Dewey plans to retire in the not-too-distant future, he says he will never be able to leave geology entirely. He and his wife, Molly, plan to split their time among California, Ireland, England, South Africa, and New Zealand. Dewey says he hopes to stay fit through his wide-ranging athletic regimen of fishing, swimming, cycling, playing cricket and tennis, and walking the hills of his beloved mountains. And, even if he does not leave his house, he can still immerse himself in Alpine geology. “I normally do a tiny bit here and there on the model,” he says, “but, when I retire next year, I'll spend a tremendous 6 months and just have a real bash of the railway.”

Source: https://www.pnas.org/doi/10.1073/pnas.0506419102

John F. Dewey: Earth Science H-index & Awards - Academic Profile.

https://research.com/u/john-f-dewey

https://royalsociety.org/people/john-dewey-11330/

Publications: https://www.researchgate.net/profile/John-Dewey

John Dewey: Thoughts from one of the founding fathers of the theory of plate tectonics on geology, education and his own illustrious career | Jackson School of Geosciences | The University of Texas at Austin.

https://www.jsg.utexas.edu/news/2017/11/john-dewey-thoughts-from-one-of-the-founding-fathers-of-the-theory-of-plate-tectonics-on-geology-education-and-his-own-illustrious-career/

Albert W. Bally: 1925 - 2019

Born in The Hague, Netherlands, he spent his early years in Indonesia, Italy, and Switzerland. He began as a paleontologist at the University of Zurich and mapped in the Central Apennines for his Ph.D.

Prior to his tenure at Rice, he worked for Shell Oil where he rose through the ranks to become chief geologist. He would spend many summers mapping the Canadian Rocky Mountains and foothills of Alberta. Because of this, Bert recognized the importance of combining seismic reflection records with geologic maps to reconstruct the history of mountains and basins. One of his greatest and longest lasting contributions is his two three-volume sets of seismic atlases (1983) that popularized the use of industrial reflection techniques for scientific purposes. Until his death, he was considered the world's leading expert in using seismic records to interpret regional geology, particularly in fold and thrust belts.

Bert had an amazing ability to synthesize regional geologic and geophysical data into a continental-scale framework. He made enduring contributions to the structure and orogenic evolution of the North American Cordillera by demonstrating how regional seismic data could be used to understand fold belts. This included outlining many of the principles for making balanced cross sections, and showing that the fold belts are underlain large decollements, and revealing the intimate relationship between foredeep subsidence with tectonic activity in the fold belt.

In 1990, along with two other Rice structural geologists, John Oldow and the late Hans Ave Lallemant, Bert recognized that there was a severe deep lithosphere mass balance problem in Cordilleran type orogens and was one of the first to suggest the importance of large-scale delamination before it became popularized in the early 2000s. With T. Cook he published the Stratigraphic Atlas for North and Central America (1975), complete with more than 250 maps showing the entire Phanerozoic stratigraphy of North America.

As a counselor with the Geological Society of America, it was Bert who proposed the Decade of North American Geology (DNAG) project, a large multivolume encyclopedia on the geology of North America. To this day, the DNAG volumes represent the most comprehensive geologic study of a continent ever done.

More impressive than his scholastic achievements were the life-changing impacts he had on his students and anyone who had the fortune of interacting with him. His former students remember him as not just a scientific mentor but a mentor in life. His curiosity was never satiated. It was so contagious that when anyone was around him, everything seemed interesting. He was an encyclopedia of geology, having seen and read so much during his long and productive life. Faculty and students, whenever they wanted to explore a new area (of research or geography), did well to pick Bert's brain. Going on a ride with Bert, however, meant that sometimes discussions would digress into stories of his life, such as being forced to watch Mussolini march by when he was a boy, or visiting Tibet as one of the first western geologists to enter China. Then it would turn back to some of his favorite unsolved science problems, one of them being the unconformity.

In recognition of his contributions, Bert received many honors, including the William Smith medal (Geological Society of London), the Gustav Steinmann Medal (Geologische Vereinigung), the Sidney Powers Medal from the AAPG, the OTC Career Contribution Award for Structural Geology and many others.

After retirement, Bert continued at full speed ahead. He engaged with the department, showing students how to look at geologic maps. He gave generously, among many things recently helping us secure a Neoproterozoic mylonitized diamictite slab that now graces an entire wall in the foyer of our department. At the time of his death he was in the final stages of preparing and converting his global geologic maps, with accompanying text, for digital publication with the American Association of Petroleum Geologists. Bert never stopped.

Source: https://eeps.rice.edu/news/2019/passing-albert-bally

https://scholar.google.com/citations?user=8m9RxuEAAAAJ&hl=en&oi=ao

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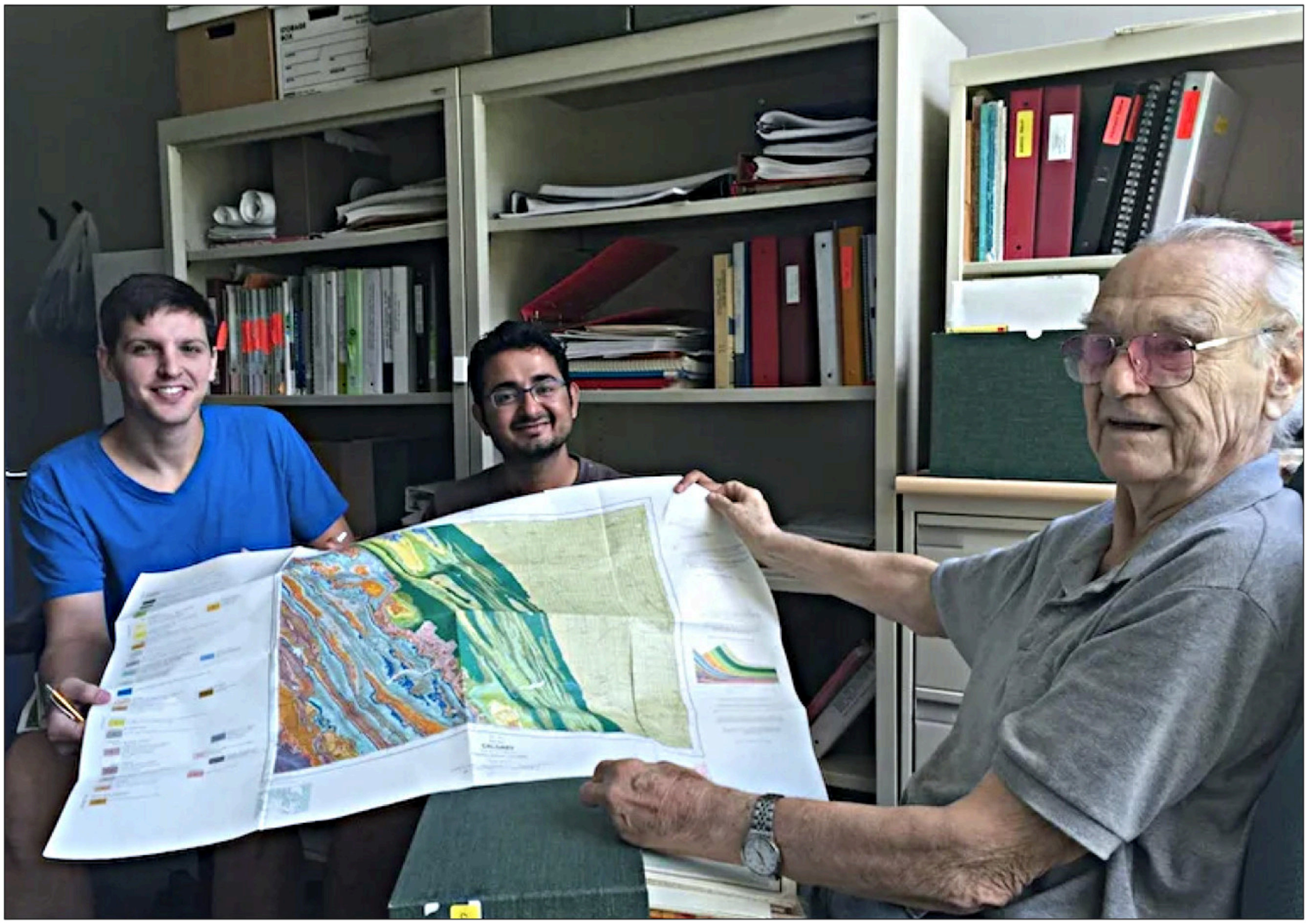


Dan McKenzie

Dan McKenzie published his first article on plate tectonics, providing a mathematical model for convection in the mantle explaining the movement of the earth's crust, “The viscosity of the lower mantle” (McKenzie, 1966). He and colleague, Bob Parker, went on to publish another article which described the principles of plate tectonics, “The north pacific: An example of tectonics on a sphere” (McKenzie and Parker, 1967), although there was a bit of controversy over it. McKenzie is currently Royal Society Professor of Earth Sciences at Cambridge University in England.

Biographical Information

McKenzie was born in Cheltenham, UK, in 1942 to brilliant parents. Cheltenham is in western England, closer to Cardiff, Wales, than London. His father was an ear, nose and throat physician, as was his paternal grandfather. His mother won a national scholarship for college. She became interested in landscaping and geology, which influenced McKenzie.

McKenzie’s undergraduate work was in math and physics. His graduate work was in physics, and graduated with 2:1 honors, which he attributed to losing interest in physics toward the end of college. McKenzie earned a research fellowship at Cambridge under Edward “Teddy” Bullard, who suggested that McKenzie pursue thermodynamic variables. This led to McKenzie’s interest in convection in the earth’s interior. He taught himself fluid mechanics, and joined the Scripps Institution at the invitation of Freeman Gilbert and Walter Munk.

After several months, he returned to Cambridge and submitted his PhD in 1966. Shortly after this, Bullard brought McKenzie to a conference in New York entitled, “The History of the Earth’s Crust.” McKenzie heard Fred Vine and Lynn Sykes speak about sea floor spreading, magnetic anomalies, and earthquakes. He heard his calling in life.

Specific contributions to the theory of plate tectonics

Following his attendance at the conference on the Earth’s Crust, McKenzie applied his knowledge of math, physics, and thermodynamics to the problem of the mechanism for the earth’s crust moving. The result was his first paper on plate tectonics – “The viscosity of the lower mantle” (McKenzie, 1966). Using more math than I can comprehend, he concluded that the there are two layers in the mantle, each of them in motion, which contribute to continental drift. He refuted two other models of the earth that were apparently prevalent at the time; one posited that the earth was homgeneous sphere, and the other that the core is inviscid and that the mantle is homogeneous. McKenzie's work showed that the earth is far more dynamic than previously thought and added to the growing awareness that convection in the mantle was driving continental drift. Wegener's idea was rejected in part because he could not provide a mechanism for continent's moving. McKenzie provided that mechanism.

Euler Theorem applied to the paving stone theory of world tectonics(from McKenze & Parker, 1967, page 1277)

One year later, McKenzie and Bob Parker published “The north pacific: An example of tectonics on a sphere” (McKenzie & Parker, 1967). McKenzie had read a paper by

Bullard on using a theorem by Euler. He and Parker combined that math with the magnetic anomalies and earthquake data he had picked up from Vine and Sykes to produce their paper. McKenzie and Parker postulated that rotational vectors, as described by Euler's theorem, explain the behavior of plates and explains the formation of ridges, trenches and transform faults. Interestingly, they refer to their idea as "the paving stone theory of world tectonics" (McKenze & Parker, 1967, page 1276).

This paper was received with some controversy. Jason Morgan published a paper using the same math principles in 1968. However, Morgan had presented his ideas a year earlier at a conference which McKenzie had attended. However, McKenzie stated that he had not attended Morgan's lecture, and that Morgan's actual lecture at the conference was not the one indicated in the abstract (MacFarlane, 2007).

After this, McKenzie turned his attention to convection currents in the mantle. He and others determined that convection is the dynamo that leads to the movement of the plates.

Other important scientific contributions

McKenzie investigated the phenomenon of earthquakes in Iran.

McKenzie became interested in the formation of sedimentary basins caused by stretching of the crust. Many of these basins filled in with organic material, which over time became fossil fuels. Oil companies refer to this process as the McKenzie Model of Sedimentary Basins.

McKenzie has recently conducted research in Iceland to delve into the issue of how magma flows and comes to the surface. Finally, McKenzie is analyzing data from the magnetometers on board the Mars Global Surveyor spacecraft and other satellite data to explore whether there is plate tectonics on Mars or Venus.

Other cool stuff you should know

McKenzie's mother initially applied to Cambridge, but was rejected due to her Yorkshire accent. She enrolled at Royal Holloway of the University of London instead. She was a little disappointed that in later years her son would attend and become a professor at Cambridge.

McKenzie's mother enrolled in a degree program in landscaping. After 1 year, she became dissatisfied with the curriculum, dropped out, did her own research, and published "New Lives, New Landscapes," which became a standard textbook at the very program from which she dropped out. That school gave her an honorary degree.

When McKenzie came to the Scripps Institution, he came on an immigration visa. He didn't realize it, but that made him liable for the draft. When he was mailed draft registration papers six months later to complete, he hopped on a plane and returned to Cambridge.

Awards

- Fellow of the Royal Society (FRS), 1976
- Wollaston Medal, Geological Society of London, 1983
- Rutherford Memorial Lecture, 1988
- Awarded a Royal Society Research Professorship, 1996
- William Bowie Medal, 2001
- Crafoord Prize Royal Swedish Academy of Sciences,2002
- Order of the Companions of Honour by Queen Elizabeth II, 2003

SOURCE: https://www.e-education.psu.edu/earth520/content/l2_p21.html

https://www.mckenziearchive.org/

https://www.esc.cam.ac.uk/directory/dan-mckenzie

University of Cambridge Newsletter. (2002). Photo retrieved on February 1, 2011, from http://www.admin.cam.ac.uk/univ/newsletter/2002/june-july/newsinbrief.html

Harry H. Hess: 1906 - 1969

In February 1945, the assault transport ship USS Cape Johnson was engaged in supporting the American troop landings at Iwo Jima, one of the key actions in the Pacific Ocean theatre of World War II. This was one of many operations in which the ship was involved, as it transported troops between bases in the Pacific, and to various battlefronts. Its military missions also helped serve a scientific purpose. The ship was equipped with sonar that allowed bathymetric surveys of the ocean to be undertaken.

The significance of this opportunity was not lost on the ship's executive officer (subsequently, its commander), Harry Hess. Hess was an academic geologist based at Princeton University, who as a U.S. Navy reservist had reported for active duty the day after the Pearl Harbour attack by the Japanese air force. Hess already had a particular interest in the geology of the oceans and understood that these new data could throw light on how the oceans formed. In fact they proved inspirational him in developing one of the most important strands of the plate tectonics paradigm — sea-floor spreading.

Harry Hess was born in New York in 1906 and attended Ashbury Park High School in New Jersey. He entered Yale University in 1923, with the intention to study electrical engineering. However, he found this subject boring and, looking for something that would give freer rein to his imagination, decided to study geology. Since he was one of only two undergraduates at the time, he took graduate as well as undergraduate courses. This was hard work, but he graduated in 1927, with the first B.Sc. in Geology at Yale.

After graduation, Hess spent eighteen months as a mineral exploration geologist in Northern Rhodesia (now, Zambia). He remarked, "At seventeen miles a day, I developed leg muscles, a philosophical attitude toward life, and a profound respect for fieldwork.". However, he was not destined to be an industrial geologist. He returned to the U.S. and was accepted for a PhD program at Princeton, studying the serpentinisation of a large peridotite intrusion at Schuyler in Virginia. He received his PhD degree in 1932.

Hess taught at Rutgers University between 1932 and 1933 and spent time at the Geophysical Laboratory of the Carnegie Institute in Washington, D.C. before accepting a position in the Geology department at Princeton in 1934. This would continue to be his academic base for the rest of his career.

Whilst undertaking his PhD research, Hess had the opportunity to participate in gravity and bathymetric surveys in the Caribbean Sea aboard the submarine USS S-48. This experience and a subsequent survey aboard the USS Barracuda in 1937 would be the catalysts sparking his interest in marine geology. The S-48 surveys were carried out along with the Dutch geophysicist, Vening Meinesz, who became a mentor to Hess as they discussed the origin of the oceanic and gravimetric features they had observed.

Of particular interest was the coincidence of negative gravity anomalies and ocean deeps adjacent to island arcs, in features Hess and Meinesz described as "tectogenes," which were ascribed to down-buckling of the crust. No explanation for the warping of the crust was given, although the concept would subsequently be adapted thirty years later as part of the process of subduction. Hess speculated that sediment infilling the basin above a tectogene would eventually be deformed as tectogenesis continued, forming mountain belts, such as the Alps. The ultramafic serpentines of his PhD research had their place in this theory, too. They were intruded from the mantle in an early stage of tectogenesis and subsequently uplifted and deformed. Hence, serpentine belts, which Hess knew from the Alps and many other ancient mountain belts, were evidence for deformed and uplifted tectogenes. These ideas now seem far from plate tectonics but, nonetheless, were stepping stones towards that understanding.

Hess's research activities were put on hold in 1941, with the entry of the U.S. into World War II; although, as already mentioned, the sonar aboard the USS Cape Johnson allowed him to gather valuable bathymetric data from the Pacific Ocean. After the war, he was able to evaluate the implications of these data. A surprising discovery was the presence of twenty deeply submerged, reefless, flat-topped seamounts that he named "guyots" after Arnold Guyot, the Swiss oceanographer, who founded Earth Sciences at Princeton. A further 140 guyots were identified through examination of bathymetric charts from the U.S. Navy's Hydrographic Office. They were circular or oval in shape and ranged from two to sixty miles in diameter. Their origin presented Hess with a puzzle. The flat tops suggested erosion by wave action, but if this were so, why were reefs not present?

Hess's first solution was to suggest that these guyots were Precambrian oceanic islands formed before the advent of reefal organisms. During the time since their formation, the sea level had risen because of constant sedimentation on the ocean floor, along with isostatic adjustments. His observations and ideas on guyots were published in 1946, in a paper that firmly established Hess's already considerable scientific reputation, even though the erroneous theory on the origin of guyots would subsequently be rejected, not least by Hess, himself.

After the war, increasing amounts of data on the ocean crust, ocean floor topography and sedimentation were gathered by the international scientific community at large. Hess saw his role as the synthesiser of these data, providing explanations of what they implied, and his ideas began to evolve very rapidly. A strong believer that science moves forward in an iterative process, he was not afraid to advance a hypothesis and then overturn it as new data emerged. This constant development and refining of hypotheses were important steps towards the concept of sea-floor spreading, which he first put forth in 1960. One might say that Hess carried out his thinking in public.

Building on ideas first introduced by Arthur Holmes and others, Hess believed that mantle convection might provide an explanation for deformation of oceanic crust. By 1953, he had turned his attention to the mid-ocean ridge known to be in the Atlantic. Having previously considered this to be an old, folded mountain belt, he now related its origin to upward convection in the mantle driving intrusion and uplift. When this convection ceased, the ridge subsided. However, he was soon forced to reverse the notion once he realized that rising convection causes deserpentinisation (serpentine is transformed into olivine at temperatures above 500°C and water is released) and, hence, sinking of the ocean floor. This concept also provided him with a mechanism to sink guyots deep below sea level. (The fact that some guyots had Late Cretaceous fossils at their crests challenged Hess's original idea of them being Precambrian islands.)

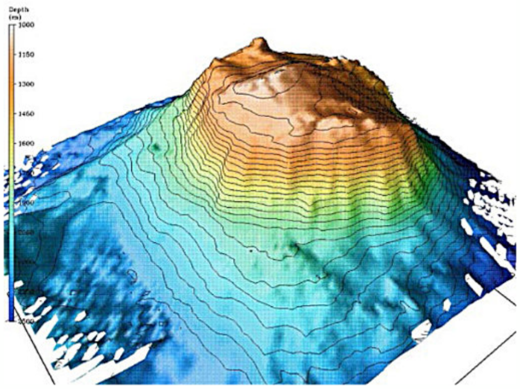
The late 1950s saw Hess constantly updating his models for the origin of oceanic features, such as mid-ocean ridges, guyots and island arcs. The tectogene hypothesis became increasingly challenged. As the debate for and against continental drift grew, Hess was initially a "fixist," arguing in 1955 that Early Palaeozoic folded mountain belts in North America and north-western Europe might continue beneath the Atlantic and be hidden by younger sediments. However, by 1959, he was happy to switch to "mobilism" as the first palaeomagnetic studies demonstrating polar wander paths were published. Interaction with the Australian geologist, Warren Carey, who favoured an expanding Earth, but in doing so, promoted mobilist ideas, may also have been an influence.

By 1960, Hess was ready to assess all the oceanic features, which he had spent much of his career discussing, in terms of mobilsm. The result was a manuscript entitled Evolution of the Ocean Basins, a report to the Office of Naval Research widely circulated in 1960, but not formally published until 1962 as History of the Ocean Basins in a Geological Society of America publication. Hess envisaged that oceans grew from their centers, with molten material (basalt) rising up from the Earth's mantle along the mid-ocean ridges, driven by mantle convection. The presence of a rift valley at the center of ocean ridges, as detected from bathymetric surveys by Mary Tharp and Bruce Heezen, was a crucial observation that helped Hess to develop his ideas.

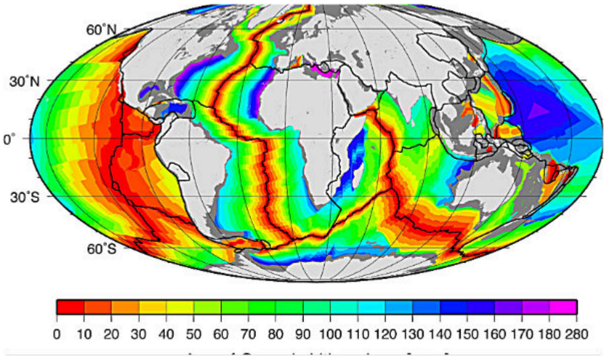
The extrusion of basaltic lava created new sea floor, which spread away from the ridge in both directions. The ocean ridge was thermally expanded and, consequently, higher than the ocean floor further away. As spreading continued, the older ocean floor cooled and subsided to the level of the abyssal plain, which is approximately 4 km deep. Ocean trenches were areas where ocean floor was destroyed and recycled — a point that Hess expanded upon in a joint paper with Robert Fischer, of the Scripps Institute of Oceanography, in 1963. His long-standing conundrum of the origin of guyots could also be explained by this theory; i.e., they evolved from wave-eroded volcanic peaks that formed at ridge crests and then, as spreading moved them away from the ridge, they subsided with the cooling oceanic crust they were resting upon.

Hess did not initially call this theory "sea-floor spreading" — that term was introduced by Robert Dietz in a 1961 Nature paper, which contained many similar ideas to those that had been circulated by Hess in 1960. Once introduced, the term became widely accepted.

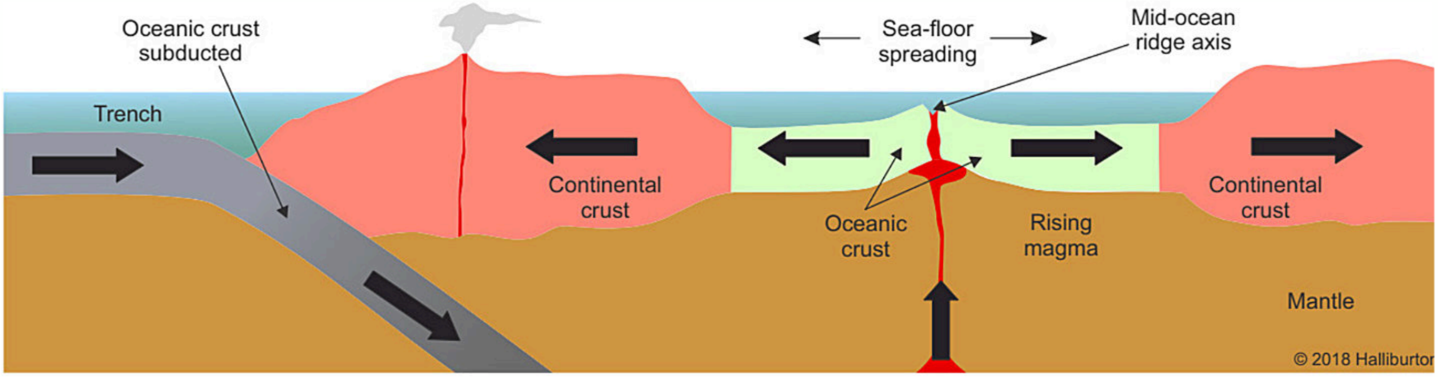
Hess was well aware that his ideas were both provisional and controversial. His History of the Ocean Basins paper contained the line, "I shall consider this paper an essay in geopoetry;" thereby, emphasising its speculative nature. If it were poetry, it scanned well. The paper explained many observations in an integrated way and offered the solution that proponents of



The Bear Seamount, a guyot from the North Atlantic.



The age of the ocean crust demonstrates sea-floor spreading.



Simplification of the sea-floor spreading hypothesis advanced by Harry Hess.

continental drift had long sought — a mechanism for continental movement along the conveyor belt of sea-floor spreading.

Support for Hess's ideas was soon to appear when, in 1963, the British geologists, Fred Vine and Drummond Mathews, published a paper in the journal Nature, noting that there was a symmetrical pattern of magnetic stripes (positive and negative magnetic anomalies relating to magnetic pole reversals) on either side of the mid-ocean ridges. In addition, when the basalts of the sea floor were dated, they were found to be the same age at similar distances away from the ridge on each side. This suggested that the ocean floor was created at the mid-ocean ridges, and then progressively moved away from the ridge, just as Hess had speculated.

Outside of his work on marine geology, Hess was also involved in many other scientific endeavours, including the Mohole project (1957–1966), an investigation into the feasibility and techniques of deep sea drilling that eventually gave rise to the Deep Sea Drilling Programme and its successors. He continued to be involved in the U.S. Naval Reserve, rising to the rank of Rear Admiral. He was also an active adviser to U.S. governmental science programmes, including the Lunar Exploration Missions. Hess died from a heart attack in Woods Hole, Massachusetts, on August 25, 1969, while chairing a meeting of the Space Science Board of the National Academy of Sciences.

Hess was one of the truly great American geologists, who took full advantage of being at the center of the explosion of data gathering from the marine realm in the mid-20th century. He had the rare ability to overturn his ideas when new data demanded it and did not hesitate to say publically that he had been wrong. His greatest contribution to geology was the notion of sea-floor spreading, without which the development of the paradigm of plate tectonics would have been delayed. Hess said of himself in his speech accepting the Geological Society of America's Penrose Medal in 1966, "As a geologist who has often guessed wrong, I deeply appreciate the generosity of the society in balancing my errors against deductions of mine not yet proven incorrect. I am pleased to come out with a positive balance."

During his career at Princeton University, Hess chose the Caribbean area as an ideal subject for testing the plate tectonic paradigm. To implement this, he led a project for Ph.D. students to do field work in northern South America, the Caribbean islands and Central America. These students included Gabriel Dengo, J.C. Maxwell, Thomas (Nick) Donnelly, Bill MacDonald, Fred Nagle, and many others who went on to important careers in geology. They, in turn, supervised many more doctoral studies which advanced the understanding of this key area.

<u>Some of Harry Hess' publications</u>

Hess, H.H., 1938, Gravity anomalies and island arc structure with particular reference to the West Indies: Amer. Phil. Soc., Proc, v. 79, p. 71-96.

Hess, 1939, Island arcs, gravity anomalies and serpentinite inclusions: A contribution to the ophiolite problem: Int. Geol. Congr., 17th, Rep., v. 2, p. 263-283.

Hess, H.H., 1946, Drowned ancient islands of the Pacific basin: Amer. J. Sci., v. 244, p. 772-791

Hess, H.H., 1948, Major structural features of the western North Pacific: an interpretation of H.O. 5485, Bathymetric Chart, Korea to New Guinea, G. S. A. Bull.v. 59, p. 417-446.

Kevin C.A. Burke: 1929 - 2018

Kevin C. A. Burke (Kevin Charles Anthony Burke, November 13, 1929 - March 21, 2018) was a geologist known for his contributions in the theory of plate tectonics. During his life, Burke held multiple professorships, most recent of which (1983-2018) was the position of professor of geology and tectonics at the Department of Earth and Atmospheric Science, University of Houston. His studies on plate tectonics, deep mantle processes, sedimentology, erosion, soil formation and other topics extended over several decades and influenced multiple generations of geologists and geophysicists around the world

Burke was born in 1929 and grew up in London, England, where he received both his B.S. and Ph.D. degrees in geology from the University of London in 1951 and 1953, respectively. His Ph.D. study was a mapping and dating study of Barrovian metamorphic rocks and granites in the Connemara area of western Ireland.

From 1953 to 1972, he held a series of geology positions in teaching and research that included postings in Gold Coast, Ghana, the United Kingdom, Korea, Jamaica, and Nigeria. A critical junction in his career occurred in 1972-73 when he became a visiting professor at the University of Toronto. There, he became a close associate and mentee of Dr. J. Tuzo Wilson, who was one of the most prominent proponents of plate tectonics and hotspot studies at that time.

During his time in Toronto with Wilson, Burke began a lifelong study of hotspots, rifting, and mantle processes which was enhanced by his previous field experiences in Africa and the Caribbean.

In 1973, he was invited by Dr. John Dewey to join a faculty at the State University of New York at Albany which had assembled a distinguished group of geoscientists interested in the fledgling areas of plate tectonics, hotspot studies, rifting, and field-based ophiolite studies. During his 10-year residence in Albany, Burke produced many seminal papers on continental rifting, hotspots, Caribbean tectonics, and the effects of continental collision in Asia and other continental interiors.

In 1983, he joined the faculty of the University of Houston and also worked as director and associate director of the Lunar and Planetary Institute at NASA in Houston until 1988.

In the 1990s and 2000s, in addition to mentoring graduate students and teaching at UH, he held many visiting professorships at NASA, JPL, UCLA, Carnegie Institute, Oslo, and South Africa. He also served on many national committees, including the National Research Council, NASA, and the National Academy of Sciences.

From 2003 and until his death in 2018, Kevin Burke worked in close collaboration with Trond H. Torsvik, who was then the head of the Geodynamics research group at the Geological Survey of Norway and later became a professor of geology at the University of Oslo, Norway. This collaboration resulted in several seminal contributions, describing the causal links between the two large-scale structures in the lowermost part of the Earth mantle (Large Low Shear-wave Velocity Provinces, or LLSVPs), the large-scale geometry of mantle convection, mantle plumes and surface hotspot volcanism.

Burke was the first who recognized that the most prominent mantle plumes feeding active hotspots rose from the margins of LLSVPs, which he termed the "Plume Generation Zones" (PGZs). Evidence for long-term stability of LLSVPs (over time scales of hundreds of millions of years) from paleogeographic reconstructions of large igneous provinces and kimberlites, led Burke and Torsvik to develop a new approach to absolute plate reconstructions (PGZ method), in which the geological records of hotspot volcanism are used to constrain the longitudinal positions of lithospheric plates in the originally unconstrained reconstructions based on paleomagnetism. This work stimulated renewed interest to the LLSVPs in the geosciences community, resulting in a growing number of studies aimed to address the origin and evolution of the LLSVP structures in the lowermost mantle. The long-term temporal stability of LLSVPs has not yet been fully accepted by the scientific community and remains a field of on-going debate and active research.

His lifetime achievement awards include the Geological Society of America (GSA) Structure and Tectonics Career Award (2004); the Penrose Medal, the highest award of GSA (2007); and the Arthur Holmes Medal & Membership, one of the most prestigious awards of the European Geosciences Union (2013).

https://www.uh.edu/nsm/news-events/stories/2018/0328-burke-memoriam.php

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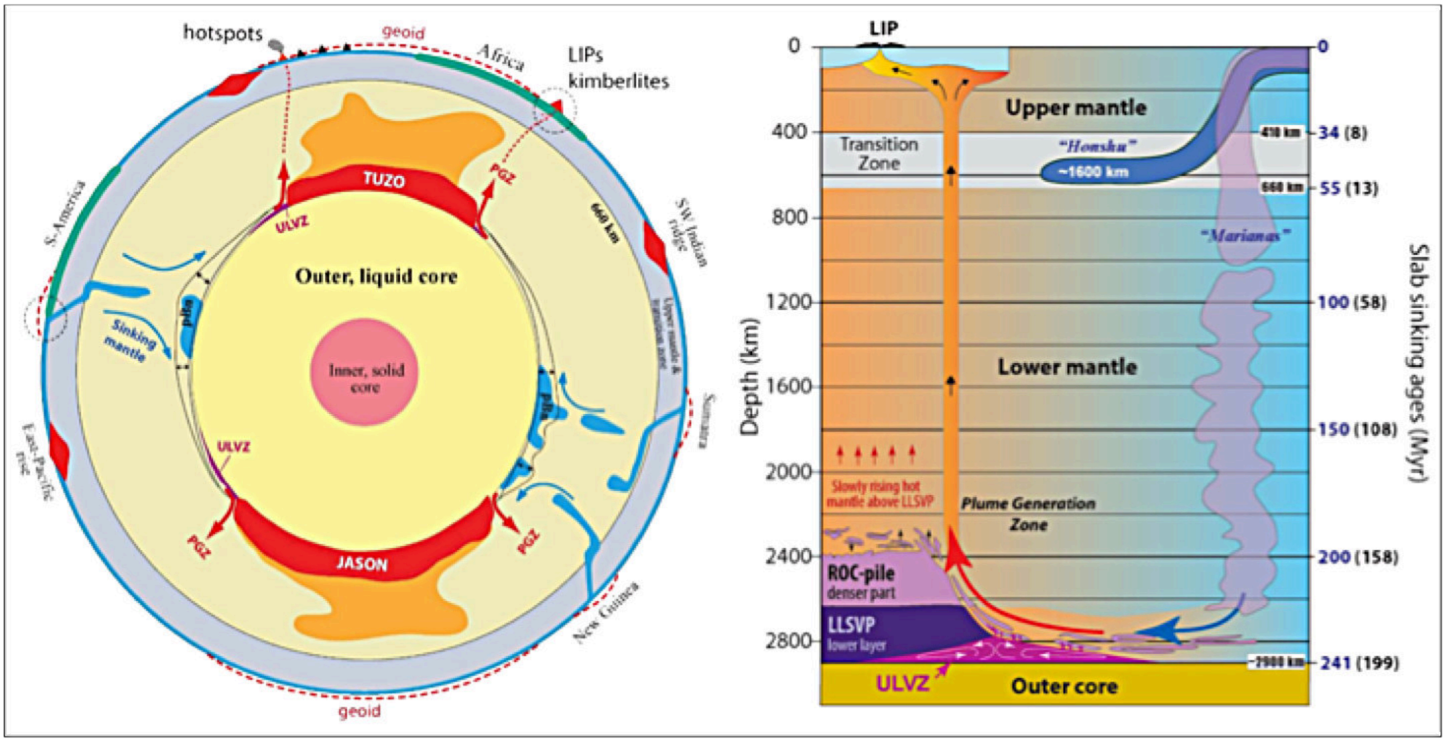
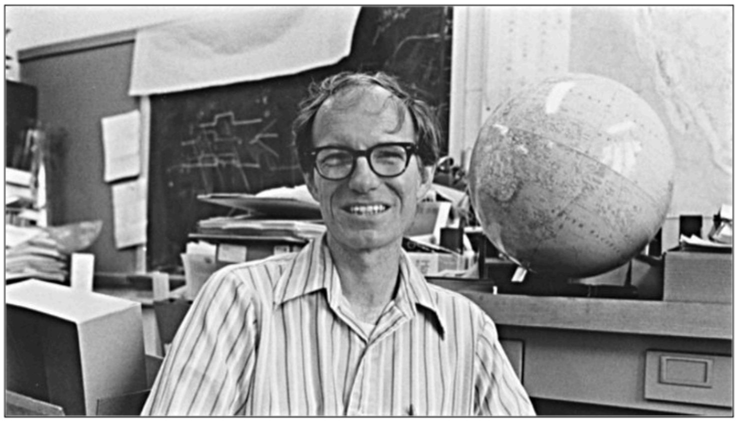


The Burkian Earth is a simple conceptual model of a degree-2 planet with two stable antipodal thermochemical piles at the core-mantle boundary (LLSVPs, TUZO and JASON). Large Igneous Provinces (LIPs), kimberlites, and active hotspots are sourced by deep mantle plumes rising from the Plume Generation Zones (PGZs) at the margins of TUZO and JASON. Convection in the lower mantle is limited to vertically sinking slabs and ascending plumes. Left panel: Schematic cross-section of the Earth in the equatorial plane. Right panel: Schematic vertical cross-section of the Earth's mantle through the Plume Generation Zone (PGZ). Redrawn from Torsvik et al. (2016).

William J. Morgan: 1935 - 2023



William Jason Morgan (October 10, 1935 – July 31, 2023) was an American geophysicist who made seminal contributions to the theory of plate tectonics and geodynamics.

Morgan, Princeton University's Knox Taylor Professor of Geology, Emeritus, and a professor of geophysics, emeritus, was a pioneer of the theory of plate tectonics, which explains that mountains, earthquakes, volcanoes and more are caused by the movement of rigid plates floating on Earth's mantle. This theory represented a huge step forward when Morgan, known universally as Jason, proposed it during a conference in 1967. At that time, scientists struggled to explain the origins of mountains or the movement of the continents.

Other scientists, including Princeton's Harry Hess and Frederick Vine, had played key roles in laying out vital pieces of evidence for how the continents might move, but Morgan was the first to identify that our planet's surface is broken into about 20 plates underlying both continents and oceans, and that these plates can separate, collide, or slide side-by-side, thus linking together the San Andreas Fault, the Pacific Ocean's volcanic "ring of fire," mid-oceanic ridges, and many other geological phenomena into a cohesive model.

For his fundamental scientific contributions, Morgan received the National Medal of Science, the nation's highest scientific honor. Among his many other awards are the Japan Prize; the Maurice Ewing Medal, jointly sponsored by the American Geophysical Union and the U.S. Navy; the Leon Lutaud Prize of the French Academy of Sciences; and the Alfred Wegener Medal of the European Geosciences Union. He was elected to the National Academy of Sciences in 1982.

Born Oct. 10, 1935, in Savannah, Morgan graduated from Savannah High School in 1953, the Georgia Institute of Technology in 1957, then spent two years in the U.S. Navy, after which he came to Princeton as a graduate student in physics. He studied under renowned physicist Robert Dicke, received his Ph.D. in physics in 1964 and immediately moved to the geosciences department for postdoctoral research. He joined the faculty as an assistant professor in 1966, was promoted to associate professor in 1971 and became a full professor in 1975. In 1988, he was named the Knox Taylor Professor of Geography. ("Geography" was replaced with "Geology" in 2004.) He was the director of Princeton's program in geological engineering from 1996 to 2003, and he transferred to emeritus status in February 2004.

After publishing his seminal plate tectonics paper, Morgan began studying volcanic regions called "hot spots," in which a column of hot mantle rises from the core-mantle boundary and melts to produce magma just beneath a tectonic plate. This mantle plume hypothesis, published in the journal Nature in 1971, remains a leading explanation for still-unsettled questions about the formation of undersea mountains and landmasses like Hawaii and Iceland.

Morgan received many honors and awards for his work, among them the Bucher Medal (1972), the Alfred Wegener Medal of the European Geosciences Union (1983), the Maurice Ewing Medal of the American Geophysical Union (1987), the Japan Prize (1990), the Wollaston Medal of the Geological Society of London (1994) and the National Medal of Science of the USA, award year 2002. In 1959, Morgan married Cary Goldschmidt. Together they had two children. She died in 1991. He died in Natick, Massachusetts on July 31, 2023, at the age of 87.

https://www.princeton.edu/news/2023/08/14/w-jason-morgan-pioneer-plate-tectonics-dies-87

https://nationalmedals.org/laureate/w-jason-morgan/

https://geosciences.princeton.edu/sites/g/files/toruqf2391/files/about/publications/morganfest.pdf

Rob Van der Voo: 1940 - 2024

Rob Van der Voo was a prominent geoscientist known for his pioneering work in paleomagnetism and tectonics. Born in the Netherlands, he completed his B.Sc. in Geology in 1961, followed by M.Sc. degrees in Geology and Geophysics, and a Ph.D. in Geology and Geophysics from the University of Utrecht in 19691.

Van der Voo's research significantly advanced our understanding of the Earth's magnetic field and its historical changes. His work on paleomagnetism provided crucial insights into the processes of mountain building and the movements of tectonic plates before the Mesozoic era. He was particularly noted for his studies on the rotation of the Iberian Peninsula, which formed the basis of his Ph.D. dissertation.

Throughout his career, Van der Voo held various academic positions, most notably at the University of Michigan, where he served as a professor and later as the Frank H. T. Rhodes Collegiate Professor Emeritus of Geological Sciences. His contributions to geophysics and tectonics earned him numerous accolades, including the Benjamin Franklin Medal in Earth Science and election to prestigious scientific

societies such as the American Geophysical Union and the Royal Academy of Sciences in the Netherlands.

Van der Voo was also a dedicated educator and mentor, influencing many students and colleagues with his deep knowledge and passion for geology. His legacy continues to impact the field of geoscience, with his research remaining a cornerstone for studies in paleomagnetism and tectonics

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Don Lynn Anderson: 1933 - 2014

Don Lynn Anderson was a distinguished American geophysicist whose groundbreaking work significantly advanced our understanding of the Earth's interior. Born on March 5, 1933, in Frederick, Maryland, Anderson pursued his undergraduate studies in geology and geophysics at Rensselaer Polytechnic Institute, graduating in 1955. He continued his education at the California Institute of Technology (Caltech), where he earned his M.S. in 1958 and Ph.D. in 1962.

Anderson's career was marked by his innovative research in seismology, geophysics, and geochemistry. He was a pioneer in the use of seismic anisotropy to study the Earth's interior, which led to significant discoveries about the boundaries of the planet's mantle. One of his most notable contributions was the co-development of the Preliminary Reference Earth Model (PREM) in 1981, alongside Adam Dziewonski. This model remains a fundamental tool in geophysics for understanding the Earth's average properties.

Throughout his career, Anderson received numerous prestigious awards, including the Crafoord Prize in 1998 and the National Medal of Science the same year1. He was also honored with the William Bowie Medal from the American Geophysical Union and the Gold Medal of the Royal Astronomical Society. His academic tenure at Caltech was distinguished, serving as a professor and later as the Eleanor and John R. McMillan Professor of Geophysics, Emeritus.

Anderson's legacy extends beyond his research. He was a dedicated educator and mentor, influencing many students and colleagues with his profound knowledge and passion for geophysics. His seminal works, including the textbooks "Theory of the Earth" (1989) and "New Theory of the Earth" (2007), continue to be essential references in the field.

Don L. Anderson passed away on December 2, 2014, but his contributions to geophysics and our understanding of the Earth's interior endure, cementing his place as a seminal figure in the history of geoscience

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