**Harry Hess**

One of the Discoverers of Seafloor Spreading

Nothing could feel more solid than the ground under our feet. Yet the surface of the Earth is not fixed, but rather broken up like a jigsaw puzzle into enormous plates that move. This process is called plate tectonics, and it transformed the thinking of geologists. One of them, Harry Hess, was an instrumental figure in figuring out how plate tectonics worked.

Hess possessed two valuable skills: careful attention to detail and the ability to form sweeping hypotheses. This unusual combination produced groundbreaking work on a number of subjects, including the origin of ocean basins and island arcs, mountain building, and the movement of continents. The idea that the continents might have moved, or “drifted” over time can be traced back to the sixteenth century, when European cartographers compiled world maps based on the seagoing expeditions of that time. This idea was transformed into the theory of “continental drift” by German meteorologist Alfred Wegener in 1912, when he published a treatise with several lines of supporting evidence that went beyond simply matching the continents like puzzle pieces. These lines of evidence included, for example, matching geological formations and paleontological distributions from South America and Africa. Wegener’s critics correctly pointed out, however, that the continents could not simply “plow” though the ocean floor as Wegener had vaguely theorized. It was Hess who determined how oceanic mountain ranges, called mid-ocean ridges, are fundamental to the tectonic movement that results in the drift of continents.

According to his own account, Hess flunked his first course in mineralogy at Yale and was told he had no future in the field. Nevertheless he stuck with it, and was teaching geology at Princeton when World War II was declared. Already a lieutenant junior grade in the Naval Reserve, Hess was called to active duty after Pearl Harbor and was eventually to rise to the rank of Rear Admiral. He soon developed a system for estimating the daily positions of German U-boats in the North Atlantic, and requested duty aboard a decoy vessel in order to test the program. It worked.

He then served as commander of the attack transport U.S. Cape Johnson in the Pacific Ocean, taking part in major landings at Marianas, Leyte, Lingayen Gulf, and Iwo Jima. Ever the scientist, while cruising from one battle to the next, Hess kept the transport’s sounding gear (which bounced sound waves off the sea-floor in order to determine the underwater relief or topography) running day and night. This led to his discovery of submerged and curiously flat-topped mountains that he named “guyots” in honor of the Swiss founder of the Princeton geology department. It also produced thousands of miles of echo-sounding surveys of the ocean floor.

The postwar period was a revolutionary one for the earth sciences. Efforts to map the ocean floor intensified, thanks in large part to the newly-created U.S. Office of Naval Research. Within a few years, a curious terrain had emerged: vast, flat plains interrupted by ridges, or more precisely, vast mountain ranges. In the Atlantic Ocean, the “ridge” is about midway between the continents on either side, and thus it became known as a mid-ocean ridge. We now know that the ocean ridge system snakes around the entire globe in a continuous chain some 80,000 kilometers long. In 1953, scientists discovered that a prominent valley, called the Great Global Rift, ran down the center of these ridges. Intrigued, Hess reexamined the data from a completely fresh, unorthodox perspective. In 1962, he proposed a groundbreaking hypothesis that proved vitally important in the development of plate tectonic theory. It addressed several geologic puzzles: If the oceans have existed for at least 4 billion years, why has so little sediment accumulated on the ocean floor? Why are fossils found in ocean sediments no more than 180 million years old? And how do the continents move?

Hess theorized that the ocean floor is at most only a few hundred million years old, significantly younger than the continents. This is how long it takes for molten rock to ooze up from volcanically active mid-ocean ridges, spread sideways to create new seafloor, and disappear back into the Earth’s deep interior at the ocean trenches. This “recycling” process, later named “seafloor spreading,” carries off older sediment and fossils, and moves the continents as new ocean crust spreads away from the ridges.

Supporting Wegener’s theory of continental drift, Hess explained how the once-joined continents had separated into the seven that exist today. The continents don’t change dramatically or move independently, but are transported by the shifting tectonic plates on which they rest. The theory also explained Hess’s puzzling guyots. They are believed to be once-active volcanoes that rose above the surface like modern-day island arcs and then were eroded to sea level. As the ocean crust spread away from the higher ocean ridges, the guyots sank below sea level, becoming completely submerged. Hess also theorized that because the continental crust was lighter, it didn’t sink back into the deep earth at trenches as did the oceanic crust. Instead, it scraped rock off the descending ocean crust and piled it into mountain rages at the trenches’ edge. Hess also incorporated the idea proposed by Swiss geologist Emile Argand in the 1920s that mountain belts are also created when two continents collide.

Hess’s bold intuition was subsequently corroborated. Later studies showed that the age of the ocean floor increases with distance from the ridge crests, and seismic studies confirmed that the oceanic crust was indeed sinking into the trenches. His report, *History of Ocean Basins*, was formally published in 1962 and for some time was the single most referenced work in solid-earth geophysics.

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