

500 years after the first circumnavigation of the world: the efforts, rewards and drawbacks of exploration

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500 years ago, Ferdinand Magellan set out to find a passage through America. The resulting first circumnavigation of the world was a dramatic journey towards a new world of knowledge. Remarkably, today, it can symbolize many aspects of hypothesis-driven scientific exploration.

On 20 September 1519, five ships under the command of the Portuguese captain Ferdinand Magellan set sail from Sanlúcar in Spain. Three years later, one of the ships reached home again. Only 18 of the 265 men who originally embarked on this enterprise managed to circle the world. Antonio Pigafetta was one of them. With his logbook, he brought home fundamental knowledge. The limits of the world were finally known. The modern age was dawning.

The first circumnavigation of the world can also symbolize how new knowledge is generated. The gaining of new insights often requires the formulation of a remarkable idea (hypothesis) by a visionary. However, the hypothesis can only be tested through the performance of a group of people. This process involves frustration and requires perseverance, as well as the willingness to adjust the course if a hypothesis does not hold.

Magellan did not want to circumnavigate the earth. Rather, his goal was to secure the 'Spice Islands' (the Maluku Islands in today's Indonesia) for Spain. For this, he had to sail westward, because the Treaty of Tordesillas (1494) assigned newly discovered territories in the West to Spain, while lands in the East went to the rival Portugal. Portugal had already found the eastern sea route around the Cape of Good Hope, gaining access to the highly precious cloves and nutmegs.

Captain Magellan was seeking fame and fortune, but what the journey brought above all was new knowledge to humanity. The spherical shape of the Earth, which was suspected since the time of Aristotle, was finally proven. The rotation of the Earth and the need for a date line became apparent. Despite all the hardships of the journey, nature was being observed. The crew sighted new distant galaxies in the night sky, the Magellanic Clouds.

Magellan's initial idea was the existence of a passage through America at the height of today's Buenos

Aires. He bravely set out to explore the area with his crew. However, when his fleet arrived there on 10 January 1520, the hoped-for sea route turned out to be the mouth of the huge La Plata River. Magellan, therefore, steered further and further south. He survived a mutiny and a harsh winter before he found a sea route between Patagonia and Tierra del Fuego at 52 degrees latitude, a passage which was later named the Strait of Magellan (Fig. 1).

The journey through the strait was dramatic: one ship was wrecked due to severe weather conditions, another deserted. As the three remaining ships completed the passage on 28 November 1520, the storms finally subsided. As a result, Magellan called the sea stretching out before him 'the Pacific Ocean'. During the long voyage across the Pacific, the supplies continued to dwindle. Deceased sailors were quickly thrown overboard—probably out of fear of cannibalism, as Pigafetta suspected. Finally, Magellan sighted land and discovered the Philippines. There he was killed in battle with locals and thus never arrived at the long-sought Spice Islands. The crew was so decimated at that point, that they had to leave a ship behind. But they carried on to complete Magellan's mission.

The Spaniard Juan Elcano took command and landed on 6 November 1521 on the Spice Islands. Elcano bought valuable spices and birds of paradise from the Sultan of Tidore. On the way back to Europe, the Portuguese captured one of the two remaining ships. Only the three-master Victoria reached the Cape of Good Hope, where it was severely damaged. Later, many sailors were captured at Cape Verde, but part of the crew managed to escape and, finally, reached Sanlúcar again on 6 September 1522.

Magellan's dramatic journey also marks the beginning of a time of immense suffering brought by European explorers to the indigenous inhabitants of South America and Oceania. Magellan himself burned down a village in the Philippines, as it resisted Christianization. This was followed by centuries of colonialism and violence. In Tierra del Fuego, for instance, the Selk'nam people were exterminated and became extinct in the 20th century. In this respect, Magellan's case



Fig. 1. Map of the southern portion of South America from 1672, showing the mouth of the Rio de la Plata river (top, right) and the Strait of Magellan (bottom, left) between Patagonia and Tierra del Fuego. Map reproduction courtesy of the Norman B. Leventhal Map & Education Center at the Boston Public Library.

also shows how new knowledge can, very unfortunately, also bring disaster to humanity. A disheartening example of this from the last century is the development of nuclear weapons, which was based on new knowledge of nuclear fission.

Magellan's and Elcano's success of circumnavigating the world for the first time came about by pursuing an initial hypothesis that proved to be wrong. The erroneous assumption of a passage at the mouth of the Rio de la Plata led to the discovery of an actual sea route through America at a different location. It also brought with it serendipitous findings that expanded the boundaries of knowledge.

Scientists often use working hypotheses that turn out to be wrong in the course of their research. However, that is how, in many cases, new knowledge breaks through. Hypotheses help researchers and explorers to get started, but they only last until they are refuted by new evidence. For example, it was assumed for a long time that Tierra del Fuego was the legendary southern continent, Terra Australis (also called 'Magellanica'). Two and a half centuries later James Cook showed that this continent does not exist.

James Cook already had scientists on board during his travels, notably the botanist Daniel Solander, who joined his first voyage, and the naturalists Johann and Georg Forster, who participated in his second voyage around the world. But it took decades before such journeys had primarily scientific aims. In 1799, Alexander von Humboldt set out to explore Central America and the Orinoco River. About three decades later, Charles Darwin reached the Strait of Magellan. The Englishman sailed around the Earth with Captain Fitz Roy and developed his theory of the origin of species. Humboldt and Darwin could only embark on these journeys because others before them had sailed the globe and mapped it in large parts. Thus, research enterprises are always based on prior knowledge acquired by others. We stand on the shoulders of giants.

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