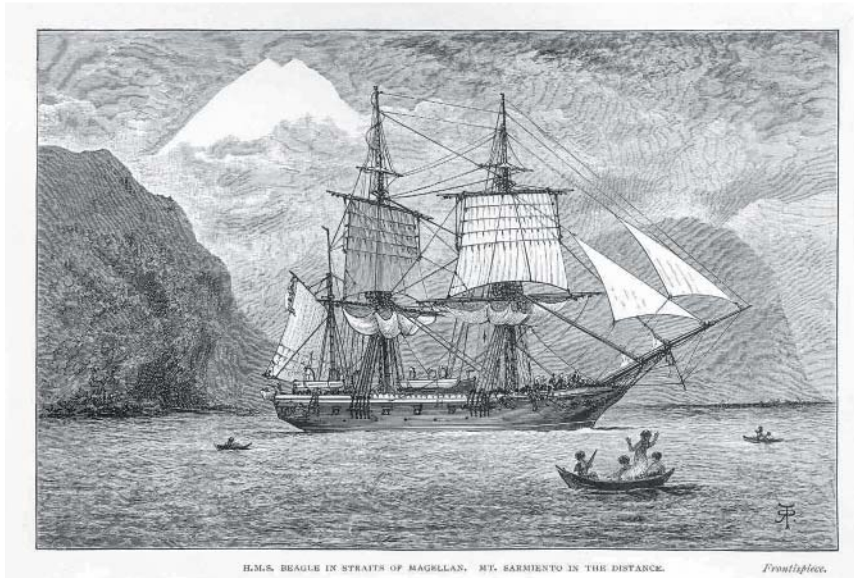
Commentary

Science and colonialism



THE HMS *BEAGLE* in the Strait of Magellan, a reproduction of the frontispiece by Robert Taylor Pritchett from the 1890 illustrated edition of Charles Darwin's *Journal of Researches* [...] (later republished as *The Voyage of the Beagle*). (Courtesy of Freshwater and Marine Image Bank, University of Washington, public domain.)

It is hard to imagine what much of modern science would have looked like without colonialism. It is equally hard to imagine what 19th- and 20th-century colonialism would have looked like minus developments in science.

To grasp the first point, one only has to think of Charles Darwin on board the *Beagle* on a five-year voyage that would take him around the world and that would provide much of the data that would drive his theory of natural selection. The young man was brought on as a naturalist and gentleman companion for the captain, Robert Fitzroy, who was tasked with a survey of the southern waters. The survey mattered for economic reasons because it could extend trade with a number of Latin American states. Fitzroy was also tasked with taking measurements that would aid imperial security and hopefully ward off French and North American interests in the same region.

Darwin himself carried an imperial sensibility with him, lauding British efforts when he arrived in Sydney, Australia, in January 1836. After walking through the town, he noted that it was "a most magnificent testimony to the power of the British nation," in the book we now know as *The Voyage of the Beagle*. "Here, in a less promising country, scores of years have done many more times more than an equal number of centuries have effected in South America," he wrote. "My first feeling was to congratulate myself that I was born an Englishman."

Imperial connections aided the physical sciences as much as the biological. Solar eclipse expeditions often involved travel to regions well outside Europe. There they relied on imperial infrastructures to help with transportation and communication, to supply skilled assistants and those able to repair complex machinery, and to access official protection when necessary. While Victorian astronomers often wrote adventurous accounts of their journeys, complete with perilous jungles and dangerous "natives", the reality was often far more staid. As the historian Alex Soojung-Kim Pang notes, eclipse expeditions were, in fact, "less like James Cook's voyages than Thomas Cook's tours."[1]

Nor, to provide a final example, were colonial structures only useful as a support for collection or observation. Imperial problems could produce quite remarkable theoretical solutions. The value of the telegraph for facilitating trade, communication, and control at vast distances was noted by a myriad of 19th-century observers. Karl Marx wrote in 1853 that India's political unity was "imposed by the British sword" and would "now be strengthened and perpetuated by the electric telegraph."[2] The attempt to lay and use transatlantic cables also led to fundamental developments in physics, not the least of which was the spread and broad acceptance of Michael Faraday's field theory in Britain in the 1850s and 1860s.

Action-at-a-distance theories struggled to explain, in simple ways that were not ad hoc, why signals traveled so much more slowly, were less crisp, and were more smeared out through undersea cables than through overhead ones. For Faraday, the answer was simple as long as one paid more attention to the material around the wire than the wire itself. Before electricity was conducted through a wire, he argued, a state of strain was induced in the surrounding dielectric, which also stored a certain amount of charge. The inductive capacity of a long cable was large, so it took some time for the charge to be stored, unlike the case of the overhead wires, where induction was close to immediate.

Faraday's explanation would soon inspire further work by William Thomson (later Lord Kelvin) and James Clerk Maxwell. According to the historian of physics Bruce Hunt, one major reason that field theory was broadly adopted in Britain by the 1860s and largely ignored in Germany until the late 1880s had to do with the difference in "technological environments."[3] Cable telegraphy was a virtual British monopoly, and cable telegraphy made field theory make sense.

As Marx's words suggest, the telegraph offers an easy example of the ways that science and technology facilitated the colonial enterprise. Communication was slow in the early 19th century, and armies require information. A story told about the sepoys who rose up against British officers in the Indian Mutiny of 1857–59 is probably apocryphal, but it is nonetheless revealing of the power that the Crown ascribed to its technology. As one rebel was led to his death, he was supposed to have noted a telegraph wire and muttered, "The accursed string that strangles us!"

Certainly, the so-called lightning wire allowed communication at speeds hitherto unimaginable. Before the age of steam, sending a letter from Britain to India and then receiving a reply could take considerably more than a year, depending on the prevailing winds. With steamships and trains, that time had been cut to two or three months by the 1850s. In the 1870s, however, a telegraph message could get from Britain to India in a number of hours, and in 1924 King George V could send himself a message that traveled the globe on all-British lines in 80 seconds.

What telegraphy made easier, medicine made possible. One set of data may serve to illustrate a larger point. According to statistics published in 1840, out of 1685 white British troops that arrived in western Africa between 1822 and 1825, 77% died between 1823 and 1827; the remaining 23% were "invalided" (that is, removed from service due to infirmity). Of the latter group, 4% died on their journey home; only 9% of the survivors were found fit for service again.[4] Quinine prophylaxis against malaria was one of the main reasons that the "scramble for Africa" became thinkable. Where death rates for Europeans in West Africa had once been on the order of 25–75% per year, by the end of the century,[5] they were closer to 5–10%.

The history of science and colonialism is, relatively speaking, a fairly new area of research. Its most fundamental claim is, however, well established: Modern colonialism and modern science could not have been what they were—and what they are—without one another.

References

1. A. S.-K. Pang, *Empire and the Sun: Victorian Solar Eclipse Expeditions*, Stanford U. Press (2002), p. 81.
2. K. Marx, *New-York Daily Tribune*, 8 August 1853, p. 5.
3. B. J. Hunt, in *History of Technology*, vol. 13, G. Hollister-Short, F. A. J. L. James, eds., Bloomsbury Academic (1991), p. 1.
4. "Statistical Society," *Athenæum* **653**, 353 (1840).
5. D. R. Headrick, *The Tools of Empire: Technology and European Imperialism in the Nineteenth Century*, Oxford U. Press (1981), p. 70.

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LETTERS

Heliocentrism before Copernicus

In his interesting review of P. C. Deshmukh's *Foundations of Classical Mechanics* (Physics Today, December 2021, page 54), Robert Scott notes "that the 14th- to 16th-century Kerala school of astronomy and mathematics developed a heliocentric model of the solar system well before the Copernican revolution." But I believe that for historical completeness, that statement should be supplemented by a note that about 1600 years earlier, in the third century BCE, Aristarchus of Samos proposed a heliocentric model in which Earth revolved about the Sun in a circular orbit with the Sun at the center. However, the writings in which he proposed that idea have been lost, and the only reference to his work from that century is by Archimedes in a letter to King Gelon of Syracuse.[1]

Aristarchus of Samos is regrettably skipped over in many popular accounts of early astronomy—for example, in Stephen Hawking's well-known book *A*