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GREAT GEOGRAPHERS

Charles Darwin and Thomas Henry Huxley

by
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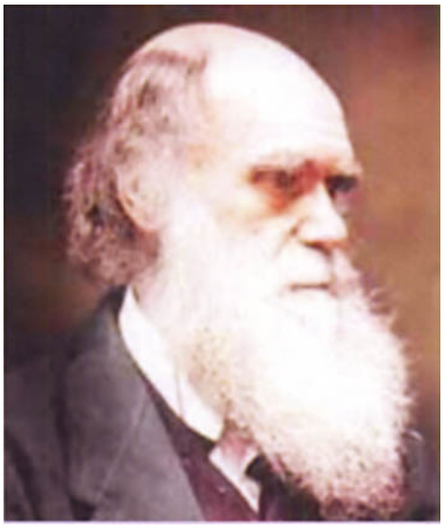
In this series for Focus on Geography, I am providing short biographies of "Great Geographers," scholars of the past who have made important contributions to our understanding of the world in which we live. I take a loose definition of geographer, because I think it is silly to establish sharp disciplinary boundaries and even sillier to refuse to cross them. As geographer Halford Mackinder wrote in 1887, "The truth of the matter is that the bounds of all the sciences must naturally be compromises. Knowledge...is one. It's division into subjects is a concession to human weakness."[1] In this contribution to the series, I introduce two eminent and closely connected scientists of the Nineteenth Century, Charles Darwin and Thomas Henry Huxley, who are best known as biologists but also qualify as geographers. Geography today, and not just biogeography, rests strongly on the foundations Darwin and Huxley helped lay.

Charles Darwin



Charles Darwin (1809-1882) is a towering figure in the history of science. He was born into a rather wealthy English family his grandfather Josiah Wedgwood founded the pottery and fine china line that still bears his name. Charles was not a great student as a child; instead of school, he preferred hunting, collecting things, and playing with a chemistry set. He went to the University of Edinburgh to become a medical doctor, like his father. Although he hated studying medicine, Darwin began interacting with the natural history scholars there. After a couple of years, Darwin switched to Cambridge University, intending to become a clergyman in the Church of England. He continued with natural history, collecting beetles, mostly, and thought that becoming a country priest would give him enough spare time to devote to his nature studies.

Darwin sailed on a five-year voyage of the *H.M.S. Beagle* (1831-1836), mostly to South America, although the voyage did go around the world. Darwin was invited to be an intellectual companion for the captain, who was not supposed to mingle with the crew, and to contribute to the scientific mission of the voyage. Darwin was seasick almost the entire time they were at sea. On land, though, he felt better and mainly collected plants, animals and fossils, and observed the geology. While on the Galapagos Islands (a group of volcanic islands in the Pacific Ocean, 1,200 km [745 miles] west of Ecuador), he was told that locals could determine the difference between tortoises from each island, a fact he didn't think much about at the time. While collecting on each island, Darwin did notice differences in some of the bird species, although he didn't always keep good records of which island each bird came from. Examining his specimens while crossing the Pacific, it appeared that many of the birds that he thought were of different species were actually finches with significantly different features. Tortoises were caught on the islands, too, but for food, not science, and their shells were dumped overboard after they were eaten; he unwittingly lost what would have been useful information for his theory.

Back in England after his voyage, Darwin made a name for himself as an explorer and geologist, writing books about his travels, South American geology, and coral reefs. He married his cousin Emma Wedgwood, a common practice at the time. He also began studying evolution. There was plenty of talk of evolution of species by scientists trying to understand living things and by non-scientists wishing to disagree with the Church of England. The Church of England was the established Church and it dominated intellectual life, education and government. Some felt that Church influence on public affairs was too strong and sought to 'disestablish' it. (As an aside, this is the main reason for the separation of church and state in the United States Constitution. Going further aside, one of the longest words in the English language, antidisestablishmentarianism, is the belief of those opposed to disestablishing the Church.) The Church was opposed to evolution, as its official position was that God created species as separate entities as stated in Genesis. Darwin thought that his observations on the Galapagos Islands might shed light on the problem.

Darwin's records for the Galapagos were not in the best order, so he borrowed the collections of several others on the *Beagle* and analyzed them. With the help of bird specialist John Gould, better known for his bird paintings, Darwin determined that there were twelve distinct species of finch. Darwin concluded that at some time in the past, one type of finch arrived on the islands and slowly changed into different species. That evolution occurs was not a new idea to science, although it was quite controversial. Darwin's biggest contribution to science was his explanation for how evolution happens. He spent a lot of time studying domesticated animals (dogs, pigeons, chickens, etc.) and how breeders develop new features. If people artificially select for certain traits, then maybe the environment changes species by "natural selection." He also was strongly influenced by Thomas Malthus's well known essay on human population, predicting that population growth is faster than growth in the food supply and so in the future people will starve to death in large numbers. When

applied to natural life forms trying to survive with limited resources, this became the concept later called "survival of the fittest." (Actually, "survival of the fittest" is a tautology: the fittest are those who survive and those who survive are the fittest, but we appear to be stuck with the phrase.)

Darwin concluded that the different species of finch on the Galapagos became distinct because each island had a different food source. If the food is bugs found in holes in trees, then those birds with longer and thinner beaks are more likely to survive, and since offspring generally resemble their parents, they too will have long and thin beaks. The overall change in beaks may be very small in a single generation, but over many generations the beaks take on a new shape. On another island the food source may be nuts, which have to be cracked open with the beak. Here, short and fat beaks are selected for and over many generations all the finches on that island will have stubby beaks. In this way, new species develop.

Over time Darwin gave up the idea of being a priest and devoted himself to science, supporting his family and research on investments. He developed his theory of evolution by natural selection in the 1830s, but did not publish it. It was too controversial and as a young scientist he did not want to make too many enemies. He therefore put it aside and worked on other projects for twenty years, all the time strengthening his theory with better evidence. Among other pursuits, he spent ten years working on the physiology and classification of barnacles from around the world and he continued his studies on domesticated animals.

Darwin was sickly most of his adult life, with stomach and other problems. It was common for him to be unable to work more than a couple hours per day and sometimes he was unable to work at all for months at a time. In spite of this, he became one of the best known and most respected scientists in England.

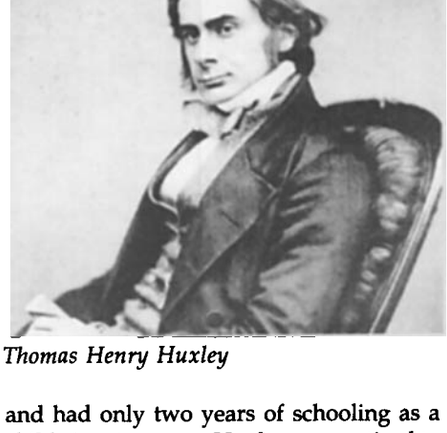
In the late 1850s, Darwin was sent a paper outlining the theory of natural selection written by Alfred Russel Wallace, a naturalist working mostly in Asia. Independently, the two had come up with essentially the same theory. In science, the first to publish generally gets credit for a new idea. Darwin could have used his influence to prevent publication of Wallace's paper until Darwin's was published (he was well known, Wallace was not, and Wallace was in Asia), but he didn't. Darwin explained the situation to Wallace and they agreed to publish simultaneously. Darwin wrote a summary of his theory and the two papers appeared together. (Not all problems in science are settled this amiably.) While evolution was still a highly controversial idea and opposed by both the hierarchy of the Church of England and by many scientists, public opinion had changed to the point that many supported the idea of evolution. In addition, by that time Darwin was an influential scientist who could not be dismissed easily. He then put the theory into book form and *On the Origin of Species by Means of Natural Selection* was published in 1859.

The *Origin of Species* was a popular book and stirred quite a controversy. For reasons of both personality and health, Darwin did not defend it in debates, but he had friends who did, most notably Thomas Henry Huxley. Some eminent scientists were convinced right away that the theory was correct, some came to believe it over time, and some went to their graves adamant that it was wrong. The Church of England and the Catholic Church also declared the theory wrong, although over time both religions have rejected a literal interpretation of the Bible and support the idea of evolution of new species by natural means. Virtually all scientists now accept the basic premise of natural selection bringing about new species: the details are debated, but not the general theory. Opposition now comes mostly from fundamentalist religious groups who insist that the Bible be interpreted literally.

Darwin spent much of his research time after 1859 more fully developing the ideas in *The Origin of Species*, investigating topics such as seed transport across oceans, why orchids look the way they do, and the biology of human facial expressions. When he died in 1882, Darwin was buried in Westminster Abbey, one of the highest honors his country could bestow. In terms of influence on scientific thinking, Darwin ranks with such greats as Galileo, Newton, and Einstein. And like Galileo, Darwin's theory not only advanced a scientific discipline, but also contributed to changed attitudes about the separation of science and religion.

Thomas Henry Huxley

Thomas Henry Huxley (1825-1895) was highly influential in convincing both the public and the scientific community that Charles Darwin's theory of evolution by natural selection was correct. Unlike Darwin, Huxley was born to a poor family



Thomas Henry Huxley

and had only two years of schooling as a child. As a teenager, Huxley apprenticed to a druggist and spent much of his time delivering medicines in the slums of London, seeing disease, malnutrition, and suffering on a daily basis. Educating himself, he won a scholarship to a medical school in London, where he began his studies in animal physiology. While Darwin was invited to be the gentlemanly ship's naturalist on the *Beagle*, Huxley joined the Navy to pay off debts and voyaged on the *H.M.S. Rattlesnake* as assistant surgeon. The four-year voyage (1846-1850), mostly to Australia and New Guinea, gave him plenty of time to continue his work on anatomy, studying jellyfish and other species of sea life. During the voyage, he prepared several papers, which he mailed to scientific societies for publication. While on leave in the young city of Sydney, he met and was soon engaged to Nettie Heathhorn, a brewer's daughter. They agreed that he should be financially secure back in England before they wed.

Upon returning to England, Huxley found that his papers were well received and the Navy allowed him time to complete his research and prepare more papers. Most scientists at the time, like Darwin, were wealthy and needed no pay for their work, but Huxley did not have that luxury. After several years of scrambling for an income, he was employed to give lectures at several institutions in London. Five years after the *Rattlesnake* returned to England and eight years after he and Nettie became engaged, he wrote her that he could support them above a poverty lifestyle and she sailed to England for their wedding. Thus began a long and happy marriage.

Huxley's studies of comparative anatomy continued and he earned respect as a superb scientist. In 1859, Darwin's *Origin of Species* was published and Huxley was a leader in the ensuing debate,

both public and scientific, over whether nature is controlled by natural laws or by the whims of a divine being. Also upsetting to many was the idea that humans are part of nature, rather than above it. Where Darwin avoided public debate, Huxley reveled in it and he is often referred to as "Darwin's Bulldog." Although it would be years before Huxley agreed with the details of Darwin's theory, he knew that it was an important contribution to science and to how people viewed their place in nature. Huxley took his skills in animal physiology and turned to the young field of paleontology to see what he could learn about evolution from the fossil record. He was the first to see the evolutionary connection between reptiles and birds, for example, and was an early investigator of the evolution of humans and apes.

Tom Huxley not only had exceptional abilities as a scientist, he also was a brilliant communicator, both in print and on the lecture stage. His writing, whether for scientific journals or popular magazines, remains a prime example of clear, forceful prose. He gave lectures to scientific societies, college students, and the public. Huxley's "Workingman's Lectures," introducing science to the working class, typically were standing room only events.

Many facets of science in England changed during Huxley's career and he spearheaded many of the changes. Science became a profession where a salary could be earned, rather than a gentlemanly pursuit. Science became an integral part of education, which beforehand was dominated by studies of the Greek and Roman Classics. Huxley helped introduce laboratory experimentation as part of science education. Huxley also sought to make a university education more available to the poor and to women.

Huxley was a leading force in the changing religious ideas of the time. His early debates in favor of Darwin's *Origin of Species* were often religiously based, revolving around the controversy of whether or not the Bible is to be interpreted as literally true or as metaphor. Later, Huxley argued the position of agnosticism, stating that there was not enough evidence to prove anything about the Bible, so a skeptical attitude was appropriate. In fact, Huxley invented the word 'agnostic' - while the Second Century Gnostics claimed to have received their knowledge divinely, people who must rely on second hand evidence, hence a-gnostic, can never be sure of their convictions. While atheists often used the *Origin of Species* to attack the Church, Huxley felt that their position was just as untenable as that of the Biblical purists. By the end of Huxley's life near the end of the Nineteenth Century, this position was much less radical than it had been several decades earlier.

Darwin and Huxley were friends who changed both science and the way people comprehend their place in nature. Darwin was a wealthy naturalist who could spend years on a study, but Huxley was always scrambling to make enough money to pay the bills and trying to accomplish five things at once. Darwin avoided the public eye, but Huxley loved it. Darwin introduced the dominating theory of biology and Huxley made sure that both scientists and lay people could understand it and accept it. Both were revered by the scientific community and by much of the public.

Darwin, Huxley, and Geography

Darwin and Huxley are best known for their contributions to biology, but they both improved geography as well. Perhaps most importantly, biogeography only makes sense in light of natural selection. Plant and animal distributions are primarily determined by selection pressure from both the physical environment and other living organisms, including people. Darwin also influenced the field of geomorphology; in his 1842 book on coral reefs, he suggested that coral reefs form only on subsiding coasts, a theory that has stood the test of time, even though it was proposed before much of anything was known about subsidence and sea level changes. More importantly, the publication of *Origin of Species* and the debates that followed it marked the beginning of the end of Christian religious domination of the study of people and the natural world. Geographers and other scientists could study both humanity and nature without a biblical filter.

In addition, Huxley greatly benefited geography in the realm of education reform. In an 1868 lecture delivered to the South London Working Men's College, he proposed a liberal education in British schools. The common schooling at the time in England emphasized learning to "read, write, and cipher," understanding theology and morality, and learning some history and geography, but mostly of Biblical lands and times. The way these topics were taught, he felt, they had no relevance to student's lives. Huxley argued that educated people will lead more fulfilling lives if they learn history, literature, 'moral and social science' and the workings of the natural world. On this last topic, Huxley said:

> *...we need what, for want of a better name, I must call* ***Physical Geography****. What I mean is that which the Germans call "Erdkunde." It is a description of the earth, of its place and relation to other bodies; of its general structure, and of its great features, winds, tides, mountains, plains: of the chief forms of the vegetable and animal worlds, of the varieties of man. It is the peg upon which the greatest quantity of useful and entertaining scientific information can be suspended.*[2]

To facilitate this teaching of physical geography, Huxley wrote ***Physiography: An Introduction to the Study of Nature*** in 1877. This revolutionary book, at least in terms of teaching geography, introduced the study of the natural world by showing how it relates to people's lives, rather than the descriptions of the Holy Land that commonly passed for geography instruction at the time. Teachers of physical geography today can learn much on how to organize a course and present the subject matter by reading this book.

One of the beauties of geography is its breadth. We learn much from biologists, economists, archeologists, geologists, and most every other scholarly discipline - and they learn much from us. As I mentioned at the beginning, Halford Mackinder said that the boundaries of the sciences are compromises and concessions to human weakness; we also can think of disciplines as the many colors that get mixed to create the great painting of knowledge. What a boring world it would be if paintings had only isolated, primary colors.

Further Reading:

Desmond, Adrian and Moore, James, 1991, *Darwin*. Warner Books, 808 p.

Desmond, Adrian, 1994, *Huxley: From Devil's Disciple to Evolution's High Priest*. Reading, Massachusetts: Addison Wesley, 820 p.

Sources of Quotes:

1. Mackinder, H.J. 1887. On the Scope and Methods of Geography. *Proceedings of the Royal Geographical Society and Monthly Record of Geography* 9:141-160, quote on p. 154.

2. Huxley, Thomas Henry. 1868. A Liberal Education; and Where to Find It. In *The Major Prose of Thomas Henry Huxley*, ed. Alan P. Barr (1997), 206-223. Athens, GA: University of Georgia Press. Quote on p. 223.