of differing longitudes, Walker noticed that the transit times recorded at each observatory compared with the time signals from one central clock differed depending on the distance of the observatory from the recording apparatus. In short, he stumbled onto the discovery that an electromagnetic signal was not instantaneous (the accepted view) but had a finite and measurable velocity through the circuit of about a tenth the speed of light in a vacuum.

In August 1851 Walker was afflicted by mild paralysis that deprived him of the use of one hand for several days. Despite pleas from friends and physician, he kept his usual schedule of working dawn to dusk. In 1852, showing symptoms of mental illness, he spent several months recuperating at two asylums, even there still working ceaselessly to refine the ephemeris of Neptune. During a visit to his brother Timothy, the never-married Walker died from fever.

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Wallace, Alfred Russel

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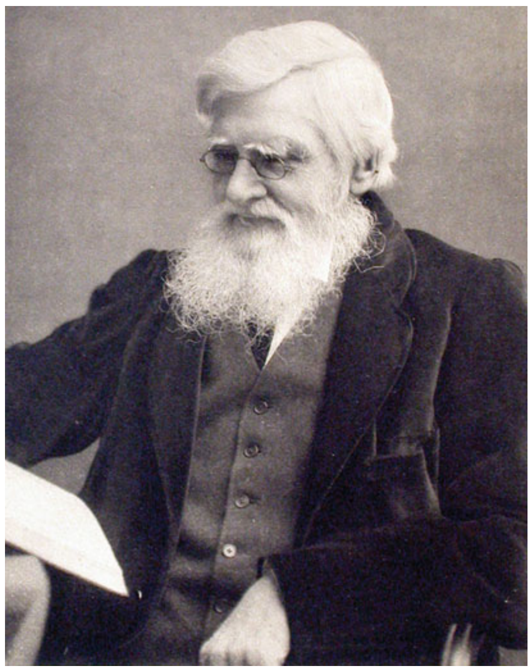
Born **Usk**, **Monmouthshire**, **Wales**, **8 January 1823**
Died **Wimborne near Bournemouth**, **Dorset**, **England**, **7 November 1913**



Wallace, Alfred Russel. Courtesy of History of Science Collections, University of Oklahoma Libraries

Although Alfred Russel Wallace made significant contributions to astronomy, he is best known as a central figure in the emergence of the fields of evolutionary biology and biogeography.

As the eighth of nine children of Thomas Vere and Mary Anne (*née* Greenell) Wallace, poor but middle-class English parents, Alfred Wallace led a rather ordinary life until his mid-teens. At that time, while working as a surveyor in western England and Wales, he began to take an amateur's interest in natural history. In the early and mid-1840s Wallace became involved in local mechanics' institutes as a lecturer, curator, and possibly librarian. In 1844 he took a position as a master at Leicester School, where he incidentally met another famous naturalist-to-be, Henry Walter Bates. The two would eventually decide to turn professional as natural history collectors. In 1848 they voyaged to the Amazon region, where in the following years they were quite successful in collecting specimens. Wallace returned to England in 1852 when his health deteriorated; on the way, he narrowly escaped death when his ship caught fire and sank, but he lost some 2 years of collections in the disaster. Undaunted, Wallace set off for the Far East 18 months later to reimmerse himself in collecting activities.

Wallace's name is now inextricably linked with the Malay Archipelago, where 8 years of fieldwork (1854–1862) secured for him a reputation among future generations as history's greatest tropical naturalist. While there, he thought out the theory of natural selection; the famous essay on the subject he sent to Charles Darwin is well known to have propelled the latter into finally committing his own ideas to paper in *On the Origin of Species* in 1859. Over the same period, Wallace made fundamental contributions to the study of biotic distribution patterns, and is now regarded as the father of the science of zoogeography. Wallace returned to England in 1862, thereafter settling down to a long career of study and writing.

Wallace's contributions to astronomy are overshadowed by his fame in other natural sciences, but his thoughts and writings on astronomical topics were and still are influential, and in some areas he may be regarded as an important pioneer. Although lacking even a secondary-school education, he developed a firm grasp of basic scientific principles, and later was particularly brilliant at marshaling evidence and drawing conclusions. Wallace's attention was drawn to astronomy during his early surveying days, when practical geodetical matters were of daily concern. He developed a talent for cartography, a skill he would exercise during his Amazon travels by producing one of the first reliable maps of the course of the Rio Negro.

In 1865, after his return from the Malay Archipelago, Wallace became embroiled in a public discussion on the shape of the Earth. While discussing this incident in his 1905 autobiography *My Life*, he produced a nontechnical explanation of the derivation of latitude that geographer Yi Fu Tuan would later describe as never having been surpassed in clarity. Wallace's fascination with geodesy culminated in 1870 when he devised the celebrated Bedford Canal experiment, an attempt to silence the claims of a particularly outspoken advocate of a flat Earth.

In the 1860s, Wallace also became interested in ► **James Croll**'s ideas concerning possible astronomical causes of the glacial epochs. Wallace adopted some of Croll's theory of climate change as related to eccentricity of the Earth's orbit and precessional movement of its axis, but added his own twist by examining possible synergistic interplays between astronomical and climato-geographical forces. His fully developed theory along these lines – the first of its kind – was presented as the opening sections of the book *Island Life* in 1880.

In 1896, Wallace was invited to Switzerland to give a lecture on scientific progress; the research he did for this lecture and in 1898 for a related book, *The Wonderful Century*, rekindled his interest in astronomy, and he soon took up the subject again. Adopting ► **William Whewell**'s position on the plurality of worlds and relying on his thorough review of the recent astronomical literature, Wallace attempted to make the argument that the Earth and Solar System are located at the very center of the Universe. Further, he argued that, on a consideration of the physical improbabilities involved, ours is probably the only existing world inhabited by advanced creatures. This position was first set out by Wallace in an essay published in early 1903, but later that year he produced a much expanded discussion in the book *Man's Place in the Universe*, which drew both much attention and much criticism.

A few years later, Wallace was drawn into the discussion surrounding ► **Percival Lowell**'s sensational view that the planet Mars is inhabited by advanced beings. In 1907, Wallace published a short book *Is Mars Habitable*? that devastatingly criticized the range of problems inherent in Lowell's position. The discussion remained close to principles of basic science with Wallace surmising that the Red Planet's surface must be desert-like and devoid of higher life forms. He was able to accurately deduce its likely surface temperatures and albedo, and to suggest that its polar caps are probably frozen carbon dioxide rather than frozen water.

The astronomical writings Wallace produced over the last decade of his life reflect an unusually flexible worldview: one scientific enough to address questions bearing on proximate causalities, yet philosophical enough to find a place for final causes. Although he has sometimes been accused of theistic leanings, he strictly rejected the notion of a reality operating on first causes and therefore, in spite of his spiritualist beliefs, was in no sense a creationist. Still, he did believe there was purpose exhibited by natural structure and its programs of change. In examining this matter scientifically in the context of astronomy, Wallace became perhaps the first significant purveyor of what has come to be known as the anthropic principle. With this philosophical perspective, it is all the more interesting that his most important contribution to the progress of astronomy was a methodological one: his analytical approach to the study of planetary atmospheres and surfaces toward the end of assessing their potential for life-sponsoring conditions. For this latter work, he may justly be regarded as a founding father of the science of astrobiology.

Wallace's career, especially after 1862, was characterized by frequent public controversy, for in addition to his natural science interests, he was also a vocal and demonstrative spiritualist, land nationalizer, antivaccinationist, and socialist. In April 1866, at the age of 43, he married Annie Mitten, the 20-year-old daughter of the English botanist William Mitten. They had three children, two of whom survived to adulthood. By the time of his death, Wallace was well honored: He was a fellow of the Royal Society and awarded the society's Royal Medal (1868), its Darwin Medal (1890), and its Copley Medal (1908). Among many other distinctions including two honorary doctorates, he received the Order of the British Empire in 1908, and that same year became the first recipient of the Darwin-Wallace Medal of the Linnean Society of London.

Wallace studies continue to produce surprises. In 2006, an 1843 letter from Wallace to Fox Talbot, one of the inventors of photography, was discovered. This contains Wallace's proposal for constructing reflecting mirrors by electroplating another metal onto a perfectly flat pool of mercury, an idea not far removed from liquid spinning mirror telescopy.

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Wallis, John

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Born **Ashford, Kent, England, 23 November 1616**
Died **Oxford, England, 28 October 1703**

Wallis, John. Courtesy of History of Science Collections, University of Oklahoma Libraries

► **Aristarchus** expert John Wallis was primarily a mathematician, and should be considered one of the inventors of analytic geometry. He lived during the English Revolution, and Oxford fell into the portion of England that sided with the Parliamentarians. Wallis decoded some messages from Royalists that came into the hands of the Parliamentarians. He was later accused of having decoded the personal letters of King Charles himself, a charge that Wallis adamantly denied. In his old age, Wallis taught what he knew of cryptography to his grandson, William Blencowe, though by then, Wallis admitted, the new French methods of encryption were too complicated to break by the means used by Wallis.

In 1649, Wallis became Savilian Professor of Geometry at Oxford, more likely because of his support for the Parliamentarians than for his mathematical ability. However, he soon proved that, political appointment or not, he well deserved the chair. In 1663, he was elected a fellow of the Royal Society.

Through the use of conjecture and interpolation, he was able to obtain an infinite product expansion for π, and had a considerable influence on ► **Isaac Newton**'s mathematical development. Wallis also played an important role in the development of analytic geometry and was among the first to consider curves defined purely by an algebraic equation.

Wallis's main contribution to astronomy was his publication and annotation of the Greek text *On the Sizes and Distances of the Sun and Moon* by Aristarchus. Aristarchus was the first to put forward a heliocentric model of the planetary system, and ► **Nicolaus Copernicus** used Aristarchus's work to support his own. Latin and Arabic translations of Aristarchus's writings were widely available, but Wallis's 1688 version was the first printed edition of the Greek text. Wallis based his work on two copies, one made by ► **Henry Savile** from a copy in the Vatican, and the second a Greek manuscript in the possession of Edward Bernard, the Savilian Professor of Astronomy at Oxford.