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ALFRED RUSSEL WALLACE AND NATURAL SELECTION: THE REAL STORY

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Abstract
Alfred Russel Wallace (1823–1913) was a largely self-educated British naturalist, who co-published the theory of evolution by natural selection with Charles Darwin in 1858, fifteen months before Darwin's book *Origin of species* was released. Some have suggested that Wallace's independent discovery of natural selection in Indonesia in February of that year was merely fortuitous, but in fact it was the culmination of a concerted 10 year personal quest to understand how evolutionary change takes place. Although Wallace was showered with prestigious honours and awards for his great discovery, and in spite of the fact that he became one of the most famous people in the world towards the end of his life, his intellectual legacy was rapidly overshadowed by Charles Darwin's after his death.

***Key words*:** Charles Lyell, Joseph Hooker, Linnean Society, Malay Archipelago

Evolution of an evolutionist

Alfred Russel Wallace OM, LLD, DCL, FRS, FLS was born in Llanbadoc near Usk, Monmouthshire, England (now part of Wales) on January 8th, 1823 to a middle class English couple, Thomas Vere and Mary Ann. He was the eighth of nine children, three of whom did not survive to adulthood. The family had moved to Llanbadoc from London a few years earlier in order to reduce their living costs. Although Alfred's father had trained as a solicitor, he had never worked, thanks to inherited wealth, but his finances became increasingly strained as his family grew. In 1828 when Wallace was five, he and his family left Monmouthshire and moved to Hertford, England, and it was there, at Hale's Grammar School, that he received his only formal education.

Serious family financial problems forced Wallace to leave school aged only fourteen and a few months later he took a job as a trainee land surveyor with his elder brother William. This work involved extensive travel in the English and Welsh countryside and it was at this time that his interest in natural history developed.

Whilst living in Neath, Wales, in 1845 Wallace read Robert Chambers' anonymously published book *Vestiges of the natural history of creation* (Chambers, 1844) and became fascinated by the controversial idea that living things had evolved from earlier forms. So interested in the subject did he become that he suggested to his close friend Henry Walter Bates, that they travel to Amazonia to collect and study animals with the aim of investigating how evolution (then called species transmutation) operates (see preface of Bates, 1863). Duplicate specimens of the animals they collected would fund the trip. They left for Brazil in April 1848, but although Wallace made many important discoveries during his four years in the Amazon Basin, he did not manage to solve the great 'mystery of mysteries' of how life evolves.

The Malay Archipelago (1854–1862)

Wallace returned to England in October 1852, after surviving a disastrous shipwreck in the mid-Atlantic which destroyed all the thousands of natural history specimens he had painstakingly collected during the last two and most interesting years of his trip. Undaunted, in 1854 he set off on another expedition, this time to the Malay Archipelago (Singapore, Malaysia, Indonesia and East Timor), where he would spend eight years travelling, collecting, writing, and thinking deeply about evolution (Costa, 2013b, 2014). He visited every important island in the archipelago and sent back 109700 insects, 7500 shells, 8050 bird skins, and 410 mammal and reptile specimens (Wallace, 1869a), including probably more than five thousand species new to science (Beccaloni, 2013).

In Sarawak, Borneo, in February 1855, Wallace produced one of the most important papers written about evolution up until that time (Costa, 2014; Wallace, 1855). In it he proposed a 'law' which stated that "Every species has come into existence coincident both in time and space with a pre-existing closely allied species". He described the affinities (relationships) between species as being "…as intricate as the twigs of a gnarled oak or the vascular system of the human body" with "...the stem and main branches being represented by extinct species..." and the "...vast mass of limbs and boughs and minute twigs and scattered leaves..." living species (Wallace, 1855). The eminent geologist Charles Lyell (who was an anti-transmutationist at that time) was so struck by Wallace's paper that in November 1855, soon after reading it, he was moved to initiate what grew into a series of seven notebooks on the species question (Wilson, 1970). Notes on Wallace's paper fill the first pages of Lyell's first notebook.

In April 1856 Lyell visited Charles Darwin at his home, Down House in Kent, and Darwin confided that for the past twenty years he had been secretly working on a theory (natural selection) which explained how evolutionary change takes place. Not long afterwards, Lyell sent Darwin a letter urging him to publish before someone beat him to it (he probably had Wallace in mind), so in May 1856, Darwin, heeding this advice, began to write a 'sketch' of his ideas for publication. Finding this unsatisfactory, Darwin abandoned it in about October 1856 and instead began working on an extensive book on the subject.

Wallace's greatest discovery

The idea of natural selection came to Wallace during an attack of fever (probably malaria) whilst he was on a remote

Indonesian island in February 1858 (it is unresolved whether this epiphany happened on Ternate or neighbouring Halmahera, but probably the latter). As soon as he had sufficient strength, he wrote a detailed essay explaining his theory and sent it together with a covering letter to Darwin, who he knew from earlier correspondence, was deeply interested in the subject of evolution.

Wallace asked Darwin to pass the essay on to Lyell (who Wallace did not know), if Darwin thought it sufficiently novel and interesting. Darwin had mentioned in an earlier letter to Wallace that Lyell had found his 1855 paper noteworthy and Wallace must have thought that Lyell would be interested to learn about his new theory, since it neatly explained the evolutionary 'law' which Wallace had proposed in that paper[1].

Darwin, having formulated natural selection about 20 years earlier, was horrified when he received Wallace's essay and immediately wrote an anguished letter to Lyell asking for advice on what he should do. "I never saw a more striking coincidence. If Wallace had my M.S. sketch written out in 1842 he could not have made a better short abstract! ... So all my originality, whatever it may amount to, will be smashed." he exclaimed (Darwin, 1858a). Lyell teamed up with another of Darwin's close friends, botanist Joseph Hooker, and rather than attempting to seek Wallace's permission, they decided instead to present his essay plus two excerpts from Darwin's writings on the subject (which had not been written with publication in mind[2]) to a meeting of the Linnean Society of London on July 1st 1858. The public presentation of Wallace's essay took place only 14 days after its arrival in England.

Darwin and Wallace's musings on natural selection were published in the Linnean Society's journal in August that year under the title "On the Tendency of Species to Form Varieties; And on the Perpetuation of Varieties and Species by Natural Means of Selection" (Darwin & Wallace, 1858). Darwin's contributions were placed before Wallace's essay, thus emphasising his priority to the idea[3]. Hooker had sent Darwin the proofs to correct and had told him to make any alterations he wanted[4], and although he made a large number of changes to his part of the text (Burkhardt & Smith, 1991), he chose not to alter Lyell and Hooker's arrangement of his and Wallace's contributions.

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[1] Wallace greatly admired Lyell's 1835 book *Principles of geology*, but strongly disagreed with Lyell's creationist views. He had been systematically dismantling Lyell's arguments in both his unpublished and published writings since the beginning of his expedition to the Malay Archipelago (Costa, 2013a,b, 2014).

[2] These were an extract from Darwin's unpublished essay on evolution of 1844, plus the enclosure to a letter dated 5th September [1857], which Darwin had written to the American botanist Asa Gray (Darwin, 1857).

[3] Publishing another person's work without their agreement was as unacceptable then as it is today. Publishing someone's novel theory without their consent, prefixed by material designed to give priority of the idea to someone else is ethically highly questionable: Wallace should have been consulted first! Fortunately for Darwin and his supporters, Wallace appeared to be pleased by what has been called the 'delicate arrangement'.

[4] In a letter from Joseph Hooker to Darwin dated 13th and 15th July 1858 (Hooker, 1858), Hooker stated "I send the proofs from Linnæan Socy— Make any alterations you please..."

Lyell and Hooker stated in their introduction to the Darwin-Wallace paper that "…both authors… [have]… unreservedly placed their papers in our hands…" (Darwin & Wallace, 1858), but this is patently untrue since Wallace had said nothing about publication in the covering letter he had sent to Darwin [5]. Wallace later grumbled that his essay "…was printed without my knowledge and of course without any correction of proofs…" [6] (Wallace, 1869b).

As a result of this ethically questionable episode (Rachels, 1986), Darwin stopped work on his big book on evolution and instead rushed to produce an 'abstract' of what he had written so far. This was published fifteen months later in November 1859 as *On the origin of species by means of natural selection*: a book which Wallace later magnanimously remarked would "…live as long as the 'Principia' of Newton" (Wallace, 1860).

Fame and awards

In spite of the theory's traumatic birth, Darwin and Wallace developed a genuine admiration and respect for one another. Wallace frequently stressed that Darwin had a stronger claim to the idea of natural selection than himself, and he even named one of his most important books on the subject *Darwinism* (1889)! Wallace spent the rest of his long life explaining, developing and defending natural selection, as well as working on a very wide variety of other (sometimes controversial) subjects. He wrote more than 1000 articles and 22 books, including *The Malay Archipelago* (1869a) and *The Geographical Distribution of Animals* (1876). By the time of his death in 1913, he was one of the world's most famous people (Smith, 2014).

During Wallace's lifetime the theory of natural selection was often referred to as the Darwin-Wallace theory and the highest possible honours were bestowed on him for his role as its co-discoverer. These include the Darwin–Wallace and Linnean Gold Medals of the Linnean Society of London; the Copley, Darwin and Royal Medals of the Royal Society (Britain's premier scientific body); and the Order of Merit (awarded by the ruling Monarch as the highest civilian honour of Great Britain). It was only in the 20th Century that Wallace's star dimmed while Darwin's burned ever more brightly. So why did this happen?

Overshadowed by Darwin

Beccaloni (2009) proposed the following explanation for why Wallace's fame decreased markedly after his death: in the late 19th and early 20th centuries, natural selection as an explanation for evolutionary change became unpopular, with most biologists adopting alternative theories such as neo-Lamarckism, orthogenesis, or the mutation theory. It was only with the modern evolutionary synthesis of the 1930s and '40s that it became widely accepted that natural selection is indeed the primary driving force of evolution. By then, however, the history of its discovery had largely been forgotten and many wrongly assumed that the idea had first been published in Darwin's *On the origin of species*. Thanks to the so-called 'Darwin Industry' of recent decades, Darwin's fame has increased exponentially, eclipsing the important contributions of his contemporaries, like Wallace.

[5] In a letter from Darwin to Charles Lyell dated 18th [June 1858], Darwin (1858a), who was referring to Wallace's essay, says "Please return me the M.S. [manuscript] which he does not say he wishes me to publish..." and in a letter from Darwin to Lyell dated [25th June 1858], Darwin (1858b) states that "Wallace says nothing about publication..."

[6] That Wallace would have appreciated the opportunity to correct the proofs is evident from the corrections he made to his personal copy of the published paper (Beccaloni, 2008).

A more balanced, accurate and detailed history of the discovery of what has been referred to as "…arguably the most momentous idea ever to occur to a human mind" (Dawkins, 2007) is surely long overdue.

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