

## Wallace and Natural Selection, 1858

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In the nineteenth century, Alfred Russel Wallace was generally acknowledged as one of the founders of evolutionary theory. But, during the twentieth century, his contributions came to be neglected as Darwin worship often replaced cogent historical assessment. This is a story worth studying. It shows how scientific advances are often simultaneously made by many different individuals working independently; these advances are as much products of their intellectual context as they are of individual genius or inspiration. The story also shows the power of social background and privilege within science (how Darwin managed to avoid being pre-empted by Wallace), how scientists compete for priority, and how future generations co-opt history to suit their own purposes.

### 1. Introduction

Next year (2009), the world will be celebrating the 150th anniversary of the publication of Darwin's *Origin* [1], his comprehensive account of the theory of evolution by natural selection. Praise for the *Origin* is well-deserved: Newton's *Principia* (1687) is perhaps the only other book that has had a similar influence on the history of science. Nevertheless, what gets forgotten during the adulation of the *Origin* is that it was not the first complete published statement of the theory of natural selection. Rather, that honor belongs to a short 3,764-word paper, "On the Tendency of Varieties to Depart Indefinitely from the Original Type" [2], published almost a year earlier by Darwin's much younger contemporary, Alfred Russel Wallace. In 1858, Wallace's paper was published in the *Proceedings of the Linnaean Society* along with two extracts from older unpublished works by Darwin (see Classics section in this issue). These extracts establish that Darwin was indeed thinking of natural selection well before Wallace but they do not contain a full statement of the theory.

#### Keywords

Wallace, natural selection, Darwin.



## 2. Wallace's Travels and Travails

Unlike the independently wealthy Darwin, Wallace (born January 8, 1823) came from an impoverished background. The family's financial difficulties prevented any formal education beyond elementary schooling. From his early teens Wallace had to work for a living. Natural history started as a hobby to be pursued in spare time; gradually it became a vocation to the extent permitted by the exigencies of survival. Both Wallace and Darwin owed their intellectual breakthroughs to long periods of exploration of unfamiliar biological terrain. Whereas Darwin attributed many of his evolutionary insights to a five-year voyage on the *Beagle*, during which he was a scientific "companion" to its captain, Wallace's travels were financed through collecting specimens for sale. Between 1848 and 1852, initially accompanied by another aspiring young naturalist, Henry Walter Bates, Wallace explored the Rivers Amazon and Negro in South America collecting and shipping specimens for a living. Both Wallace and Bates had already begun to worry about the "species problem", how new species originated. (Bates would eventually make seminal contributions to the evolution of mimicry.) The years in the Amazon basin were intellectually exciting but, for Wallace, the expedition eventually ended in disaster: his ship caught fire during the return journey leading to a loss of all his personal specimens and the notes and journals from the trip. There was virtually nothing to show for five years of work.

After about a year back in London, in 1854, Wallace set off again, hoping to repair his fortunes. The destination, this time, was the Malay Archipelago (now Malaysia, Indonesia, East Timor, and Papua New Guinea), a region even less known to European biologists than the Amazon basin. After briefly exploring the Malayan peninsula, he wandered around the islands for seven long years, often accompanied only by a local assistant. Inter-island trips were by hazardous native boats; housing was as often improvised as not.

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Between 1854 and 1862 Wallace contributed over fifty papers and notes to scientific journals on various aspects of the natural history of the archipelago. The first major theoretical breakthrough came in early 1855 while he was residing at Santubong on the Sarawak coast (of Borneo). The paper, “On the Law which has Regulated the Introduction of New Species” [4], presented what came to be known as the Sarawak Law: “*Every species has come into existence coincident both in space and time with a pre-existing closely allied species.*” The paper was influential, impressing Darwin, and finally leading the prominent geologist, Charles Lyell, to waver in his faith in the fixity of species. What remained was to discover a mechanism for the introduction of such new species. It took Wallace almost three years and a debilitating bout of malarial fever.

### 3. Natural Selection

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On January 8, 1858, on the morning of his thirty-fifth birthday, Wallace arrived on a mail boat at Ternate, an island in the Maluku group (of what is now Indonesia). He made it the base for his collecting efforts for the next three years. The discovery of natural selection happened almost immediately. In spite of bouts of malaria, resistant even to large dose of quinine, Wallace voyaged to nearby Gilolo (present-day Halmahera) as usual in order to collect insects and other animals. There he suffered one of his worst bouts of fever to return exhausted to Ternate on March 1. By then the solution to the ‘species problem’ had begun to crystallize in his mind. At Ternate, fits of fever forced Wallace into physical inactivity accompanied by mental exertions. During one of these fits [5], he came to realize that Malthus’ principle of the geometric growth of populations provides a principle of natural selection that can explain the remarkable adaptation of organisms to their environments. If this principle is coupled to the pervasive heritable variation among organisms, natural selection can pull different sub-populations in different directions. This ‘principle of divergence’ solves the ‘species problem’ in the sense it shows how natural selection can lead to the formation of



new species. Darwin had envisioned natural selection as early as 1844 but, until 1858, had missed the principle of divergence.

By about March 6, Wallace had transformed his insight into the “Tendencies of Varieties” paper. He sent it to Darwin, presumably on March 9 when a Dutch cargo vessel left Ternate. When Darwin received the paper is a matter of historical controversy [6–8]. Darwin’s detractors, who suggest that he plagiarized Wallace’s work, argue that Darwin should have received the paper by June 3–4. (A letter from Wallace to Bates, sent on March 9 arrived in Leicester on June 3.) Darwin claimed to have only received Wallace’s paper on June 18, after already having independently formulated the principle of divergence on June 8. Strangely, Darwin did not preserve Wallace’s manuscript, the accompanying letter, or the envelop – the post-marks on the last would have established the date on which the paper reached his hands.

The rest of the story is well-known. Wallace’s manuscript was an expository masterpiece presenting the theory of evolution by natural selection with such clarity that it remains of pedagogic value even today. During the preceding two decades Darwin had been patiently collecting data for a major work on evolution. Wallace’s manuscript seemed to have pre-empted him completely, so much so that he considered abandoning his own work. Darwin was emotionally devastated. At this point, two of his closest friends, Lyell and the botanist, Joseph Dalton Hooker, both leading luminaries of English science, intervened to protect Darwin’s interests. They decided that Wallace’s paper was to be presented to the prestigious Linnaean Society and published in its *Proceedings*, but only along with something by Darwin, thus protecting the latter’s claim to priority. The trouble was that Darwin had nothing presentable. So Lyell and Hooker, with Darwin’s collaboration, salvaged extracts from an unpublished essay written in 1844 and from a letter written to the Harvard botanist Asa Gray. These were all presented to the Linnaean Society on 1 July, 1858 and published in August; Darwin’s contributions were placed ahead of Wallace’s on both occasions to suggest that Wallace had no claim to priority.

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In 1859, *On the Origin of Species by Means of Natural Selection* by Darwin was published.

There was little immediate reaction; that had to wait the publication of the *Origin*. The 1858 meeting had been presided over by the zoologist, Thomas Bell, who had described many of Darwin's reptile specimens from the voyage of the *Beagle* [9]. Bell, then President of the Linnaean Society, remained generally unsympathetic to evolution. Perhaps reflecting this hostility, in his Presidential Address to the Society in May, 1859 he observed: "The year which has passed . . . has not, indeed, been marked by any of those striking discoveries which at once revolutionize, so to speak, the department of science on which they bear" [10]. Rarely has a commentator shown less foresight.

Meanwhile Darwin rushed to prepare a 540-page abstract of the larger work on natural selection that he had envisioned. In 1859, it was published as *On the Origin of Species by Means of Natural Selection*. On the other side of the globe, Wallace had no say how his manuscript was handled though an 1860 letter to Hooker, shows no sign of rancor [11]. In 1860 he received his own copy of the *Origin* and his admiration for the book was genuine. He routinely claimed that he would never have been able to accumulate the evidence that Darwin had patiently brought in support of the theory. Later in life, when Wallace published his own version of the theory in 1889, he simply called it *Darwinism: An Exposition of the Theory of Natural Selection – with Some of Its Applications* [12]. This choice probably contributed to his own later neglect.

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By the 1880s, Wallace and Darwin had diverged significantly on their evolutionary views, particularly because Wallace did not believe that human mental and other 'higher' faculties could be explained by natural selection or, indeed, by the mere properties of matter. However, even in 1858, there were significant differences between Wallace and Darwin which are worth noting because they remain relevant today. For instance, Wallace emphasized the differences between artificial and natural selection while Darwin argued for a close analogy between the two mechanisms. It is widely surmised today that artificial selection often relies on epigenetic rather than genetic variation, unlike natural



selection. Wallace was far more insistent than Darwin that there is no inheritance of acquired characteristics. (Indeed, in later editions of the *Origin*, Darwin came increasingly to rely on such inheritance to speed up the process of evolution, much to the detriment of the original theory.) Perhaps most importantly, Wallace noted the importance of what has come to be called ‘reinforcement’ (sometimes also called the ‘Wallace effect’): natural selection may lead to speciation by contributing to the reproductive isolation of incipient species by encouraging varieties to develop barriers to hybridization. Contemporary accounts of speciation often rely on models of reinforcement. Finally, unlike Darwin, Wallace had no faith in sexual selection; here, at least, the subsequent development of evolutionary theory has largely validated Darwin.

#### 4. Wallace’s Later Career

Wallace finally returned to England in 1862. Though, by then, he was recognized as an accomplished naturalist, he was unable to obtain a suitable position that would guarantee his financial security: he was not a member of the well-heeled club of Darwin, Hooker and Lyell. For financial support, he relied on the sale of the specimens he had collected and, later, on the royalties from his writings. The most important of these was *The Malay Archipelago* [13], an impressive travelogue of his wanderings around Malaysia and Indonesia. The book abounds in brilliant natural history informed by the new theory of evolution. Wallace’s description of the patterns of cultural and social behavior of the various ethnic groups he encountered are also careful. In the Victorian context, and in sharp contrast to Darwin and even Marx, it was a book remarkably free of Eurocentric prejudices. Though he has little hesitation in calling some of them ‘savages’, he ends the book by praising their moral worth compared to the Englishmen of his time. Some commentators have argued that the beautiful illustrations in the book provided the inspiration for the creation of dioramas in modern natural history museums [14].

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theory. However, his most significant contributions were to biogeography. As early as 1859, in a paper in *Ibis*, he proposed what has come to be called the 'Wallace Line' which runs through the Malay archipelago and separates the 'Indo-Malayan' fauna in the west from the 'Austro-Malayan' fauna in the east. (For instance, placental mammals rule the western region while marsupials dominate the east.) Over the years Wallace modified the exact position of the line – in particular, Sulawesi in Indonesia (then called Celebes) was anomalous and was often moved between the two regions. Though the existence of the line was doubted in the early twentieth century, it is now well established and known to be a consequence of continental drift. Wallace's [15] *Geographical Distribution of Animals* divided the Earth into what are now the standard six biogeographic zones (besides Antarctica which was added later). Equally importantly, just as Darwin [16] had earlier brought evidence from domestication to support the theory of evolution, Wallace collated the supporting evidence from natural history and biogeography. Moving beyond biogeography and evolution, in much of this later work, Wallace began to argue for the importance of natural habitat conservation.

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Nevertheless, Wallace became an intellectually isolated figure in later life and was widely regarded as somewhat eccentric in the Victorian context. Though he lived till 1913, he failed to see the relevance of the new genetics to evolution. He also became an active spiritualist and argued that the origin of life, the emergence of consciousness, and the evolution of the higher human mental faculties were all incapable of materialist explanation and required intervention from a spiritual realm [12]. His longstanding faith in Owenite socialism led him to advocate land nationalization. He also emerged as a major critic of vaccination arguing that the evidence from smallpox showed no or marginal benefit compared to increased risk of developing the disease from the vaccine. Just as in 1858, and unlike Darwin who had been agonizing over his theory of evolution for two decades, Wallace had few qualms about challenging the orthodoxy of his day.



## 5. Final Remarks

Perhaps as a consequence of his heterodox views Wallace never managed to get a permanent position, even in a museum, that gave him financial security. However, thanks to the efforts of Darwin and some other friends, starting in 1881, he was awarded a Civil Service pension of £ 200 and finally freed him of the economic anxieties that had dominated his life for over two decades. Wallace's heresies may also have contributed to his neglect in the twentieth century, both by historians and by biologists unsympathetic to his spiritualism and, often enough, to his politics. That he judged Darwin, rather than himself, as the great innovator with respect to the theory of evolution was of no help. Moreover, beyond evolution, most of Wallace's contributions were in biogeography and, later, conservation and these were not fashionable topics in the early or mid-twentieth century.

However, starting in the 1990s, as attempts to conserve biodiversity emerged as a major movement in Europe and neo-Europe, Wallace's fortunes have revived [3]. Biogeography is central to conservation planning and Wallace receives due recognition as the founder of a theoretically informed biogeography. The last few years have seen the publication of four new books [11,18–20], the first book-length biographies since the 1960s. Luckily, the new work is leading to a welcome re-examination of all of Wallace's contributions. To the extent it records the complex origins and early development of the theory of natural selection, it is a welcome antidote to the simplistic view of the history of evolutionary biology received from the last century.

### Suggested Reading

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