Alfred Russel Wallace

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Comment

Shipwrecked science

Andrew Berry

Alfred Russel Wallace is most often celebrated for his travels in southeast Asia, but it was on an earlier trip to Amazonia that he first experienced the highs and lows of doing science.

Best known for formulating the theory of evolution by natural selection, independently of Charles Darwin, Alfred Russel Wallace is an appealing if enigmatic figure. The appeal stems in part from his underdog status: poor and self-educated, Wallace had none of Darwin's social and financial advantages. The enigma comes from his keen embrace of a range of eccentric non-scientific causes, including spiritualism, phrenology and anti-vaccination (for smallpox).

Scientists do not like their scientific heroes to bear the taint of irrational thinking. Wallace's enthusiasms have therefore contributed to him becoming marginalized in the history of evolutionary thought. Most people know about Darwin and the HMS *Beagle*. But what about Wallace and the *Helen*?

The *Helen* story is worth revisiting because it shows Wallace at his resolute best. Despite numerous disastrous career setbacks — of which the *Helen* episode was the most severe — he persevered and eventually succeeded as a scientist.

More than 150 years after Wallace's experience on the *Helen*, doing science continues to be hard and can be disappointing. Wallace's misadventure provides both perspective and an object lesson in how to navigate setbacks. His response to problems showcases his most inspiring traits: his commitment to science, his almost superhuman resilience and his refusal to mire himself in self-pity.

NATURAL HISTORY MUSEUM/ALAMY

Some of Alfred Russel Wallace's sketches were salvaged from the fire aboard the *Helen* on his return journey from South America in 1852.

Tropical explorations

In his first job as a land surveyor, Wallace developed an interest in the plants he encountered as he tramped across the countryside. Then, in 1844 at the age of 21, he met Henry Walter Bates, who would later discover 'Batesian mimicry' (whereby members of a palatable prey species gain protection by mimicking an unpalatable one).

Bates, two years Wallace's junior, had a fixation with beetles, and he catalysed Wallace's transformation from hobbyist naturalist to serious collector. Wallace's new-found focus on beetles transcended mere entomological stamp-collecting; he developed an interest in some of the great scientific questions of the time. He was particularly inspired by the anonymously published *Vestiges of the Natural History of Creation* (1844) by Robert Chambers, which put forward a vision of a transmutational process, with life progressing from simple to complex.

Without money or connections, Wallace and Bates aspired to careers in science at a time when the field was the preserve of the moneyed elite. They would have to fund their scientific explorations by collecting and selling specimens. After a hasty choice of destination — tropical South America — and a crash course in collecting methods, Wallace, aged 25, and Bates, aged 23, arrived in Belém, Brazil, in May 1848 (see 'Doggedly determined').

The two split up early on, with Wallace concentrating on the Amazon River's northern tributary, the Rio Negro (see page 24), and Bates on the southern fork, the Solimões.

Collecting was challenging. The Amazon's ubiquitous ants often deprived science of hard-won specimens. Crucial collecting materials also disappeared: Wallace once recovered from a bout of fever to discover that local people had drunk the cachaça (a Brazilian rum) he'd been using to pickle specimens. Transport was a constant headache, with travel upstream past rapids requiring unwieldy portages of canoes and cargo. And thanks to his collecting, the cargo became ever more

MONDADORI PORTFOLIO VIA GETTY

Naturalist Alfred Russel Wallace went on an expedition to Amazonas state in Brazil in 1848–52.

voluminous and unwieldy.

Wallace and Bates sporadically sent back shipments of material to their agent in London, Samuel Stevens, who publicized their adventures in scientific journals and sold their specimens, taking a 20% commission.

Wallace's journeys on the Rio Negro and its tributaries took him into areas that had not yet been visited by Europeans. He saw (and collected) an extraordinary array of species,

> **"Almost all the reward of my four years of privation & danger was lost."**

many of them new to science. He had a chance to observe and collect artefacts from several Indigenous groups with little or no previous contact with Europeans. As he travelled, Wallace capitalized on his surveying skills to map the terrain. But the remoteness took its toll. He made an "inward vow never to travel again in such wild, unpeopled districts without some civilised companion or attendant"[1].

Wallace was frequently ill, on one occasion nearly lethally so. His younger brother came out to join him as an assistant in 1849 but died of yellow fever two years later in Belém, on his way back to England. Wallace learnt that his brother was sick but had to wait many anxious months before news of his death made it upriver.

In 1852, after four years of exploring and collecting, it was time for Wallace himself to head home. He envisaged a triumphant return. He would complement his collections of preserved organisms with a menagerie of living ones. Mr Wallace's biological wonders would surely be the toast of scientific London.

On 12 July in Belém, Wallace boarded the *Helen*, a freighter ship bound for London. The trip across the continent to Belém had not gone smoothly. The authorities in Manaus, Brazil, had had to be persuaded to release some of his earlier shipments meant for London, which they had impounded, making the final haul aboard the *Helen* even larger. But now all that remained was the long voyage back across the Atlantic. Wallace, who shared Captain Turner's cabin, was the only passenger.

Disaster strikes

Three weeks into the voyage, Captain Turner interrupted Wallace's morning routine to tell him that the ship was on fire.

Friction caused by the rocking of the ship

Doggedly determined

Alfred Russel Wallace tends to be unjustly relegated to a footnote in the Charles Darwin story. He was, in fact, a pioneering biologist who refused to let disadvantage or disaster prevent him from pursuing his scientific dreams.

January 1823: Alfred Russel Wallace is born in Usk in Wales.

May 1848: Wallace and Henry Walter Bates arrive in Belém, Brazil.

July 1852: Wallace boards the *Helen*, which catches fire three weeks later while at sea.

October 1852: Wallace reaches Deal, England, aboard the *Jordeson*.

March 1854: Wallace leaves Southampton for southeast Asia.

September 1855: Wallace's first evolutionary paper describing his 'Sarawak Law' is published.

May 1856: Citing the Sarawak Law paper, geologist Charles Lyell alerts Darwin to the possibility that Wallace is developing ideas similar to Darwin's.

February 1858: Wallace sends his paper on natural selection to Darwin from Ternate in the Maluku islands (Moluccas), Indonesia.

July 1858: The joint Darwin–Wallace paper is presented at the Linnean Society in London.

November 1859: Darwin's *On the Origin of Species* is published.

March 1862: Wallace returns from southeast Asia.

November 1913: Wallace dies in Broadstone, England.

had ignited poorly stowed cargo. Attempts to intervene were counterproductive — removing the hold covers merely oxygenated the fire — and soon the ship became what Wallace later called "a most magnificent conflagration"[1].

Captain Turner gave the order to abandon ship, and the scramble to prepare two small wooden boats began. Having been stored on deck in the tropical sunshine, both boats leaked badly. The cook had to find corks to plug their hulls.

Before he left the ship, Wallace "went down into the cabin, now suffocatingly hot and full of smoke, to see what was worth saving"[1]. He retrieved his "watch and a small tin box containing some shirts and a couple of old note-books, with some drawings of plants and animals, and scrambled up with them on deck"[1]. He tried to lower himself on a rope into one of the small boats, but fever-weakened, he ended up sliding down the rope, stripping the skin off his hands.

With fine weather, the best hope of rescue lay in other ships seeing the fire. The two boats duly circled the burning wreck for the next 24 hours, meaning that Wallace got to witness every moment of the tragedy. The animals he had brought with him on the long river journey across the continent, now free from their cages, sought refuge on the one part of the ship still untouched by the flames, the bowsprit. Wallace watched as the monkeys, parrots and more — his pets as well as his best hope of impressing London's scientific elite — were incinerated.

The hoped-for rescue did not immediately materialize, and Captain Turner turned the two open boats towards Bermuda, 1,100 kilometres away to the northwest.

As the days ticked by, the situation became increasingly desperate. Water ran low and the tropical sun left Wallace's "hands and face very much blistered"[1]. Wallace nevertheless remained upbeat, later recalling that during one night, he "saw several meteors, and in fact could not be in a better position for observing them, than lying on [his] back in a small boat in the middle of the Atlantic"[1].

Finally, ten days into the ordeal, salvation appeared on the horizon in the form of the *Jordeson*, a creaking and already overladen cargo ship bound for London.

With the immediate crisis past, the magnitude of what had happened started to sink in. In a letter[2] written aboard the *Jordeson* to botanist Richard Spruce (see go.nature.com/3prhbdk), Wallace tallied his catastrophic losses — "almost all the reward of my four years of privation & danger was lost" — and concluded with characteristic understatement, "I have some need of philosophic resignation to bear my fate with patience and equanimity."

The *Jordeson* finally limped into Deal, England, on 1 October 1852. Wallace had been at sea for 80 days. His outward voyage with Bates had taken only 29 days.

Wallace added a PS to his letter to Spruce. First there was immediate exhilaration about the return — "Such a dinner! Oh! beef steaks & damson tart". But then came thoughts about the future: "Fifty times since I left Pará [Belém] have I vowed if I once reached England never to trust myself more on the ocean." Even then, he noted that "good resolutions soon fade".

Stevens had thoughtfully taken out insurance. So Wallace had £200 (US$980 at the time) — a fraction of his collections' actual value — to cover his costs for a year in London while he tried to salvage what he could from the disaster and make future plans.

He rushed out two books, one a travelogue, the other a more technical account of the palm trees of the Amazon. Neither did well — 250 copies remained unsold a decade later from the travel book's print run of 750. But he was getting his name out there. Stevens, too, had a done a good job of publicizing Wallace's discoveries while Wallace had been away.

Perhaps most crucially, the positive response of the UK Royal Geographical Society to his mapping work of the Rio Negro yielded a free steamship ticket to Singapore.

In March 1854, less than 18 months since the *Jordeson*'s bedraggled arrival at Deal, Wallace departed from Southampton in England for what he would call the "central and controlling incident"[2] of his life.

Eight more years of perilous travel awaited. So, too, did the discoveries of what came to be known as Wallace's Line (a boundary between the Asian and Australasian biogeographic regions) and of the theory of evolution by natural selection[3,4].

The scientific acclaim that greeted Wallace's return from southeast Asia in 1862 was a just reward both for his contributions and for that phenomenal doggedness — his determination, despite everything, to be a scientist.

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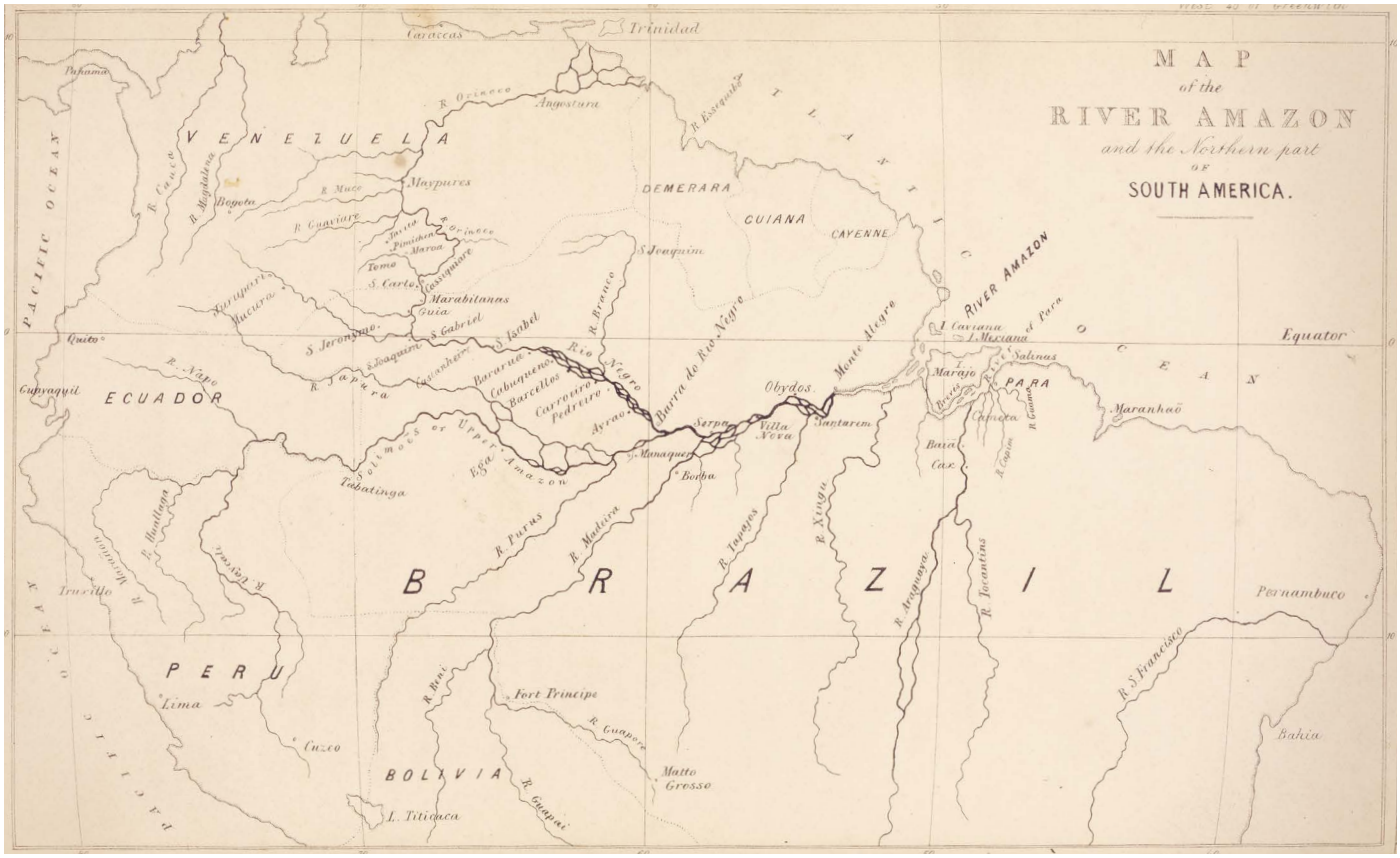
Wallace knew Indigenous knowledge was key

Camila C. Ribas

Alfred Russel Wallace's seminal work on species ranges in the Amazon happened only because he paid close attention to local people. That work inspires Indigenous researchers today.

Dzoodzo Baniwa, a member of an Indigenous community in Brazil's Amazonas state, has been collecting data on the region's biodiversity for around 15 years. He lives in a remote village called Canadá on the Ayari River, a tributary of the Içana, which in turn feeds the Rio Negro, one of the main branches of the Amazon. The nearest city, São Gabriel da Cachoeira, is a three-day trip by motor boat.

Dzoodzo (who goes by his Indigenous name but is also known as Juvêncio Cardoso) takes inspiration for his work from many cross-cultural sources. A perhaps unexpected one is a 170-year-old book by the British naturalist Alfred Russel Wallace, who visited the Amazon and Negro rivers on his expeditions in 1848–52. *A Narrative of Travels on the Amazon and Rio Negro* gives detailed accounts of the wildlife and people Wallace encountered near Dzoodzo's home, including the



MARY EVANS/NATURAL HISTORY MUSEUM

A map of the Amazon River and its tributaries, as published in Alfred Russel Wallace's 1853 book.

Guianan cock-of-the-rock (*Rupicola rupicola*), a bright orange bird that Wallace describes as "magnificent … sitting amidst the gloom, shining out like a mass of brilliant flame"[1].

Dzoodzo's passion for local biodiversity is reflected in his work at Baniwa Eeno Hiepole School, an internationally praised education centre for Indigenous people. He dreams of one day turning it into a research institute and university that might increase scientific understanding of the region's species, including *R. rupicola*.

Wallace, who was born 200 years ago, on 8 January 1823, is best known for spurring Charles Darwin into finally publishing *On the Origin of Species*, after Wallace sent Darwin his own independent discovery of evolution by natural selection in 1858. Most of Wallace's subsequent work drew on observations from his 1854–62 expeditions in southeast Asia; his earlier work in Amazonia is much less well known.

Yet there are lessons from Wallace's time in Brazil that are especially relevant for conservationists and other scientists today — notably, what can come from paying attention to what local people say about their own territory.

Barriers and boundaries

Wallace made two key contributions that still shape thinking about Amazonia, the world's most biodiverse region, which covers parts of Bolivia, Brazil, Colombia, Ecuador, Peru, Venezuela, Guyana, Suriname and French Guiana.

On 14 December 1852, Wallace read out his manuscript 'On the monkeys of the Amazon' at a meeting of the Zoological Society of London. In this study, which was later published[2], Wallace relays observations that form the basis of the most debated hypothesis for how Amazonian organisms diversified: the riverine barrier hypothesis.

"Wallace did better than many of his contemporaries when it came to respecting local knowledge."

His paper refers to the large Amazonian rivers as spatial boundaries to the ranges of several primate species. "I soon found that the Amazon, the Rio Negro and the Madeira formed the limits beyond which certain species never passed," he writes. Since 1852, Wallace's observations that large rivers could act as geographical barriers that shape the distribution of species have been corroborated, criticized and debated by many. The phenomenon he described clearly holds for some groups, such as monkeys and birds[3,4], but not for other groups, such as plants and insects[5].

Subsequent researchers have explored whether the distribution patterns of species, such as those observed by Wallace, indicate that the evolution of the Amazonian drainage system has itself driven the diversification of species[6]. Work in the past few years by geologists and biologists show that this drainage system, which includes some of the largest rivers in the world, is dynamic[7], and that its rearrangements lead to changes in the distribution ranges of species[8]. Current species ranges thus hold information about how the Amazonian landscape has changed over time.

The second crucial observation made by Wallace, also in his 1852 paper, was that the composition of species varies in different regions. He describes how "several Guiana species come up to the Rio Negro and Amazon, but do not pass them; Brazilian species on the contrary reach but do not pass the Amazon to the north. Several Ecuador species from the east of the Andes reach down into the tongue of land between the Rio Negro and Upper Amazon, but pass neither of those rivers, and others from Peru are bounded on the north by the Upper Amazon, and on the east by the Madeira." From these observations, he concluded that "there are four districts, the Guiana, the Ecuador, the Peru and the Brazil districts, whose boundaries on one side are determined by the rivers I have mentioned."

Even though Amazonia is presented as a single, large, green ellipse in most world maps, it is actually a heterogeneous place, with each region and habitat type holding a distinct set

of species[9,10]. The four districts proposed by Wallace are bounded by the region's largest rivers: the Amazon, Negro and Madeira. But further studies of species ranges since then have revealed more districts, now called areas of endemism, some of which are also bounded by these and other large Amazonian rivers, such as the Tapajós, Xingu and Tocantins[9,11].

This recognition of spatial heterogeneity in Amazonian species distributions — first accomplished by Wallace — is essential for today's research, conservation and planning[10]. Each area of endemism includes species that occur only in that area. And different areas of endemism are affected differently by anthropogenic impacts, such as deforestation, fires and development[10]. More than half of Amazonia is now within federal or state reserves or Indigenous lands — territories that are recognized by current governments as belonging to Indigenous people. But nearly half of the region's areas of endemism are located in the south of the region, close to the agricultural frontier, and the species they contain are severely threatened by habitat loss[10] (see also www.raisg.org/en).

Local knowledge

Although Wallace's writings indicate that in many ways he admired most of the Indigenous people he met, especially those from the upper Rio Negro basin, he still viewed Indigenous people through the European colonial lens of his time. In *A Narrative of Travels on the Amazon and Rio Negro*[1], Wallace describes the Indigenous communities he encountered as "in an equally low state of civilization" — albeit seemingly "capable of being formed, by education and good government, into a peaceable and civilized community".

Yet he did better than many of his contemporaries when it came to respecting local knowledge. In his 1852 paper, for example, Wallace notes that his fellow European naturalists often give vague information about the locality of their collected specimens, and fail to specify such localities in relation to river margins. By contrast, he writes, the "native hunters are perfectly acquainted" with the impact of rivers on the distribution of species, "and always cross over the river when they want to procure particular animals, which are found even on the river's bank on one side, but never by any chance on the other." Likewise, in his 1853 book[1], Wallace frequently corroborates his findings with information he has obtained from Indigenous people — for example, about the habitat preferences of umbrellabirds (*Cephalopterus ornatus*) or of "cow-fish" (manatees; *Trichechus inunguis*).

Considering the vastness and complexity of Amazonia, it is hard to see how Wallace could have gained the insights he did after working in the region for only four years, had he not paid close attention to local knowledge.

HEIN NOUWENS/GETTY

The Guianan cock-of-the-rock (*Rupicola rupicola*), which Wallace likened to a "brilliant flame".

Amazonian Indigenous peoples have had to endure invasion of their lands, enslavement, violence from invaders and the imposition of other languages and cultures. Despite this, numerous Indigenous researchers wish to expand their knowledge about Amazonia by combining Indigenous and European world views. Meanwhile, a better understanding of how the Amazonian socio-ecological system is organized, and how it is being affected by climate change and local and regional impacts[12], hinges on the ability of researchers worldwide to learn from and to be led by Indigenous scientists.

"Indigenous people in the Rio Negro basin have taken charge of their own research using tools from different cultures."

The 98 Indigenous lands in the Rio Negro basin cover more than 33 million hectares (see go.nature.com/3wkkftu). If the hopes of Dzoodzo and others to build a research institute and university for the region are met, school students will no longer have to leave their homeland to pursue higher education. The community would have a way to document its own knowledge and that of its ancestors in a more systematic way. And the legitimization of Indigenous people's research efforts in the legal and academic frameworks recognized by non-Indigenous scientists — such as through the awarding of degrees — would make it easier for Indigenous researchers to partner with other organizations, both nationally and internationally.

Indigenous people in the Rio Negro basin today are no longer objects of observation — they have taken charge of their own research using tools from different cultures. Indeed, Dzoodzo is turning to Wallace's writings, in part, to learn more about how his own ancestors lived.

Perhaps the thread between Wallace and Dzoodzo, spanning so many years and such disparate cultures, could seed new kinds of partnership in which learning is reciprocal and for the benefit of all.

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ENGLISH HERITAGE

Evolution's red-hot radical

Sidekick status does Alfred Russel Wallace an injustice. He was a visionary scientist in his own right, a daring explorer and a passionate socialist, argues **Andrew Berry**.

Alfred Russel Wallace is too often remembered as little more than Charles Darwin's goad. Darwin's procrastination in publishing his ideas on evolution by natural selection was ended by the arrival from Indonesia of a manuscript from Wallace that outlined the very same idea. Papers by both men were read at the Linnean Society on 1 July 1858 (ref. 1). *On the Origin of Species*, published by Darwin the following year, brought the theory into the public eye.

Wallace's finest moment has condemned him to be forever Watson to Darwin's Holmes. Characteristically, Wallace actively promoted this perception. He entitled his major 1889 book on evolution *Darwinism* and, at the 1908 event to mark the 50th anniversary of the joint reading, played down his contribution: "I was then (as often since) the "young man in a hurry": he [Darwin] the painstaking and patient student, seeking ever the full demonstration of the truth that he had discovered, rather than to achieve immediate personal fame."

Sidekick status does Wallace an injustice. He was a visionary scientist in his own right, a daring explorer and a passionate socialist. This year's conferences and exhibitions marking a century since his death in 1913 (see go.nature.com/icpkp8) provide an excellent opportunity to reappraise his huge scientific legacy, which ranged from discovering natural selection to defining the term species, and from founding the field of evolutionary biogeography to pioneering the study of comparative natural history.

AMAZON APPRENTICESHIP

Born in 1823 into genteel poverty, Wallace left school at 13 years old to assist his brother, a land surveyor. Tramping the English countryside introduced Wallace to his first scientific interest: plants. He became a serious student of natural history in 1844, when another young, self-educated naturalist, Henry Walter Bates (of future Batesian mimicry fame), introduced him to beetle collecting. In 1847, dissatisfied with "a mere local collection", Wallace wrote to Bates, "I should like to take some one family, to study thoroughly — principally with a view to the theory of the origin of species."

So, with extraordinary daring, the two neophytes headed to the Brazilian Amazon in 1848. Wallace stayed for 4 years, Bates 11. They funded their scientific expedition by selling specimens.

Wallace headed home in 1852. Because of a customs issue, he found many of the specimens he had been sending to London held up in Manaus in Brazil, at the confluence of the Amazon and Rio Negro. Reunited with the fruits of years of perilous labour and accompanied by a small menagerie of living animals he had ferried across the continent

to Belém at the mouth of the Amazon, Wallace must have fantasized about the impact of his arrival on London society: imagine walking into Victorian scientific salon with a toucan on your arm.

It was not to be. In the middle of the Atlantic, Wallace's ship caught fire and went up like a tinderbox. He had time to grab only a small box of drawings before being a part of what is surely one of the most poignant scenes in the history of science. Hopeful that the burning wreck would attract other shipping, Wallace and the crew stayed close. He watched as the living animals he had brought such a distance — his pets and his passport to the scientific big time in London — perished on the stricken vessel. "Many of the parrots, monkeys, and other animals we had on board, were already burnt or suffocated; but several had retreated to the bowsprit out of reach of the flames … quite unconscious of the fate that awaited them."

Wallace spent ten days adrift in an open boat before being rescued. His Victorian stiff upper lip never quivered: "During the night I saw several meteors, and in fact could not be in a better position for observing them, than lying on my back in a small boat in the middle of the Atlantic."

Having lost almost everything but determined to make his name as a naturalist–scientist, Wallace took to sea once more in 1854, en route to Singapore, from where launched his second set of extraordinary explorations. The Amazon was his scientific apprenticeship; his eight-year journey through southeast Asia was, Wallace wrote, "the central and controlling incident of my life".

Wallace ranged from peninsula Malaysia to Western New Guinea (see page 165). This time, despite his many dangerous adventures in small boats in remote archipelagoes, Wallace's extensive collections made it safely back to England, complete with some 1,000 species new to science. By his return in 1862, he was a member of the scientific elite. He had impressed hungry collectors and institutions such as the British Museum with his constant stream of specimens. And, thanks to the Linnean Society reading and a stream of innovative papers from the field, he had made a name for himself as biological theorizer.

SCIENTIFIC DEBUT

In forcing him to undertake a second expedition, Wallace's mid-Atlantic catastrophe inadvertently completed his biogeographical education. As a collector, he was interested in the distribution of animals: he needed information on where he could find particular species, and he was sensitive to geographical transitions from one species to another. In one of his early Amazon papers, he complains about the lack of precision of previous naturalists in designating the ranges of monkey species.

Wallace had a prodigious ability to spot patterns in the apparently chaotic (and largely uncatalogued) world of tropical diversity. This is the skill of the true naturalist: to generate a mental database of observed plants and animals that can be referenced when similar forms are encountered elsewhere. It led to his first attempt at biological generalization, a paper he wrote in 1855 while in Sarawak, Borneo: 'On the Law which has Regulated the Introduction of New Species' (often called the Sarawak Law)[2].

It was a stunning scientific debut. He italicized the paper's take-home message, "*Every species has come into existence coincident both in space and time with a pre-existing closely allied species*". In other words, related species tend to be found in the same geographical area (all kangaroos are in Australasia, for instance) and, as fossils, in contiguous strata (all ceratopsid dinosaurs appear in the late Cretaceous). The origin of species was, Wallace recognized, a genealogical process.

"The origin of species was, Wallace recognized, a genealogical process."

A remarkable feature of the Sarawak law is Wallace's synthetic use of published information. In Borneo, Wallace had little or no access to fossil material: wet tropical environments are famously fossil-poor because vegetation and soil conceal underlying rock formations. In the absence of academic libraries, he relied on his phenomenal memory and whatever published accounts of the fossil record he could carry. Charles Lyell's *Principles of Geology* (1830–33) was his bible. Whereas Darwin's appreciation of the fossil record was acquired in the field in South America, Wallace's palaeontological insights were book-learnt. This makes his magisterial two-volume overview of the global distribution of life — *The Geographical Distribution of Animals* (1876) — all the more extraordinary in its synthesis of living and fossil data.

Wallace's pattern-spotting led him to another concept fundamental to evolution. In his brilliant 1865 paper on the papilionid butterflies of southeast Asia[3], he parses variations within and among populations, among subspecies and species, and arrives at this definition: "Species are merely those strongly marked races or local forms which, when in contact, do not intermix, and when inhabiting distinct areas are generally believed to have had a separate origin, and to be incapable of producing a fertile hybrid offspring."

It is emblematic of history's neglect of Wallace that most undergraduates today are taught that the biological species concept was introduced in 1942 by Ernst Mayr[4].

Becoming familiar with the wet tropics of both the New and Old Worlds put Wallace in a position to ask questions on a larger scale. Given climatic similarities, why do two regions have markedly different fauna? Wallace had laid the groundwork for this field — historical biogeography — in his 1857 paper about the Aru Islands off western New Guinea[5], and eventually made it his own. He wrote "how totally the productions of New Guinea differ from those of the Western Islands of the Archipelago, say Borneo", despite the likeness of their "climate and physical features". He also pointed out that, despite the contrast between the physical conditions of Australia and New Guinea, "the faunas of the two, though mostly distinct in species, are strikingly similar in character." Had Borneo and New Guinea been geologically connected, Wallace hinted, their faunas would have been similar.

The Sarawak law built on this, in noting that the distributions of species are dictated partly by environmental considerations (some trees, for example, are tropical specialists) but mostly by the quirks of history. It is this line of thinking that culminated in *The Geographical Distribution of Animals*. If only Wallace had lived to see the unveiling of the theory of continental drift in the 1960s that clinched it: Australia and New Guinea are on one tectonic plate, Borneo on another.

LUCKY BREAK

It is tempting to see echoes between Wallace's serendipitous path through life and his contingent interpretation of natural systems: his most famous biogeographical discovery also had a dose of luck. In 1856, having missed a connection as he tried to make his way to Sulawesi, he spent a couple of months on the islands of Bali and Lombok, and noted drastic differences in the wildlife even though the islands are only some 35 kilometres apart. To the south and east, the Australian fauna dominated; to the north and west, the Asian one. He had identified an ancient biogeographic split across southeast Asia that biologist Thomas Henry Huxley later dubbed 'Wallace's Line'.

Wallace's 1858 discovery of natural selection pulled these strands together. While in a fever on the Maluku islands (Moluccas), he was pondering another biogeographic discontinuity: that between the Austronesian people of southeast Asia and the Melanesians of New Guinea. Drawing, like Darwin, on the work of economist Thomas Malthus, he focused on competition for limited resources. Combining this with his appreciation of variation within species that came from being a collector, natural selection was, for him, a logical step.

Wallace was disappointed that his heretical Sarawak law paper had barely made a ripple. His agent in London complained that "theorizing" was not useful and that Wallace ▶

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One of the few Amazon drawings rescued by Alfred Russel Wallace from his burning ship in 1852.

should "collect more facts". To save his natural-selection paper from the same fate, Wallace sent the manuscript to a senior colleague in the hope that his endorsement would give it prominence. That colleague was Darwin. How different things may have turned out had Wallace instead sent the manuscript directly to a journal.

BEYOND EVOLUTION

Standard histories of Wallace sometimes refer to the "other Wallace", giving the impression of a flake who used his newfound scientific celebrity to plunge into dubious causes, from suffrage and socialism to spiritualism and phrenology. But Wallace's world view was far more coherent[6] than is often claimed. Take, for example, his perspective on human evolution.

Of the several disagreements between Wallace and Darwin, the most significant was on human evolution: Wallace came to believe that natural selection alone could not account for our species. Darwin was horrified, writing to his friend in 1869: "I hope you have not murdered too completely your own and my child." Two factors are behind Wallace's defection on this issue.

First, he had become a convinced spiritualist. Seances by fraudulent mediums keen to fleece fashionable Victorians were especially popular among free-thinkers such as Wallace. They had disavowed established religion but hankered for something to fill the void. Wallace even attempted to convince his scientific colleagues that spiritual forces were undetectable by scientific means because the technology had not yet been devised. In the days before microscopes, he wrote, who would have believed that a drop of water from the Thames was swarming with tiny creatures? As a spiritualist, he had to assert the existence of some kind of non-material intervention in the genesis of humans.

His other reason for rejecting natural selection as sufficient for human evolution is more scientific. Having spent some 12 years living among and being dependent on people deemed by Victorians to be savages, Wallace, unlike even the most liberal abolitionists, was no racist. "The more I see of uncivilized people, the better I think of human nature on the whole, and the essential differences between so-called civilized and savage man seem to disappear."

For Wallace, this enlightened social perspective posed an evolutionary problem. He appreciated that an Aru islander living in a mud hut has the same mental attributes as a member of London's scholarly Athenaeum club. Given the necessary training, he felt, the islander would be able to play Chopin and to declaim Ovid; yet this potential would never be realized on the Aru Islands. Thus, many humans have abilities that they never have the opportunity to use.

Such a situation, Wallace reasoned, cannot evolve through natural selection alone, which promotes only those traits that are useful. Wallace concluded that human evolution required some divine intervention. This argument shows an excellent appreciation of the mechanics of natural selection, even if we are now comfortable with the idea of the brain having evolved under natural selection for specific adaptive purposes, with many of its attributes — including Chopin-playing and Ovid-declaiming — being simply by-products of the resulting organ.

Whatever one's qualms about some of Wallace's non-scientific causes, one cannot fail to be impressed by the passion and intensity he brought to them. He was in many ways the prototype of a socially engaged scientist. A constant theme of his 20 books and almost 800 articles is sympathy for the underdog: whether that be the poor ("To allow one child to be born a millionaire and another a pauper is a crime"); disenfranchised women ("women are human beings; therefore they should have votes as well as men."); or the threatened redwoods of California ("Let us hope that … care will be taken, before it is too late, to preserve … some more extensive tracts of forest.").

Meanwhile, Wallace remained engaged and productive as a scientist throughout his life. One of his last books, *Is Mars Habitable?* (Macmillan, 1907), arguably established the field of astrobiology (see U. Kutschera *Nature* **489,** 208; 2012). He wrote extensively on the evolution of animal colouration, especially crypsis (camouflage), aposematism (warning colouration) and mimicry. And he suggested that natural selection may actually facilitate speciation by promoting the evolution of inviability or infertility of hybrids between incipient species (sometimes called the Wallace effect[7]). The most significant of Wallace's contributions, however, were his synthetic works on evolutionary biogeography: *The Geographical Distribution of Animals* and *Island Life* (1880), which established the field and set the bar high for future contributions.

As we remember Wallace 100 years after his death, let us celebrate his remarkable scientific achievements and his willingness to take risks and to advocate passionately for what he believed in. He was, after all, both a scientist, and, in his own assessment, a "Red-hot Radical, Land Nationaliser, Socialist, Anti-Militarist, etc., etc., etc." In short, a whole lot more than Darwin's goad. ■

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ESSAY

The other beetle-hunter

Thanks to a fateful letter, the theory of evolution by natural selection was unveiled 150 years ago this week. **Andrew Berry** and **Janet Browne** celebrate the letter's writer, Alfred Russel Wallace.

One hundred years ago, to mark the 50th anniversary of the reading of the original papers by Charles Darwin and Alfred Russel Wallace on evolution by natural selection, the Linnean Society of London issued its first Darwin–Wallace awards to honour contributors to the study of evolution. Six of the seven 1908 recipients, including Francis Galton, Ernst Haeckel and Joseph Dalton Hooker, received silver medals. The only gold medal ever awarded went to Alfred Russel Wallace. At 85, he had five years to live and three books still to publish.

Wallace, who usually avoided academic ceremony, came to London from his home in Dorset for the occasion. His speech on "Why did so many of the greatest intellects fail, while Darwin and myself hit upon the solution of this problem" is vintage Wallace, a mixture of self-deprecation and insight. His conclusion? "In early life both Darwin and myself became ardent beetle-hunters."

Wallace went on to play down his role in the announcement of evolutionary theory. Indeed, in one account of the 1908 celebrations, his presence — and his speech — was entirely overlooked. The botanist Joseph Hooker was instead fêted as the "sole survivor of those immediately concerned".

It is too easy to see Wallace as the 'other man' of evolutionary theory, the one who served merely as a stimulus to Darwin. Worse, he is often remembered as a crank whose later embrace of spiritualism and socialism muddied his biological thinking.

In fact, he was a superb scientist, whose contributions to many aspects of evolutionary biology and biogeography remain influential. His conduct in the evolution business is exemplary. Despite rumblings from conspiracy theorists that Darwin cheated him, Wallace got exactly what he wanted: scientific recognition. Darwin too got what he wanted: precedence. And the book that reinforced that precedence will justly be celebrated next year as the foundation of modern biology.

Neither man expected the joint announcement of evolution by natural selection at the Linnean Society in 1858. Indeed it was not as self-sacrificing an arrangement as is often portrayed. And it exemplifies what scientists have always known — that the making of a new theory rarely occurs in isolation. Rather, it depends on the support of colleagues, social networks and interactions within the scientific community, as well as the power of the theory itself.

Humble beginnings

Wallace was born in 1823 into a middle-class family in decline. After a minimal education he became an assistant to his brother, a railway surveyor. Trekking around the English countryside, surveying-pole in hand, he became interested in natural history. After a downturn in surveying, Wallace spent a year as a schoolteacher in Leicester. Here, in 1844, he met Henry Walter Bates, a 19-year-old with great expertise in natural history, especially beetles. Wallace duly became an "ardent beetle-hunter". That same year, Robert Chambers anonymously published his controversial, flawed and widely read theory of evolution, *The Vestiges of the Natural History of Creation*, in which he proposed a universal "law of development". Wallace regarded this an "ingenious hypothesis".

Inspired by Darwin's and Alexander von Humboldt's published accounts of their journeys, Wallace and Bates headed to the Amazon in 1848. They funded their travels by selling exotic specimens to museums and collectors. The contrast with Darwin's voyage is striking. Being of considerable independent means, Darwin travelled in some style on the *Beagle* as the captain's paying guest. Wallace and Bates had to work for a living, depended on the hospitality and assistance of locals, and needed an agent in London to market their wares.

Wallace returned from Brazil in 1852 after four years of exploration, collection and privation. The trip ended in disaster: he lost nearly all his specimens, and almost his life, when his ship caught fire in the mid-Atlantic. With nothing to show for all his efforts, his hope of joining the scientific élite was cruelly derailed. In 1854, he set off for Southeast Asia to do it all over again.

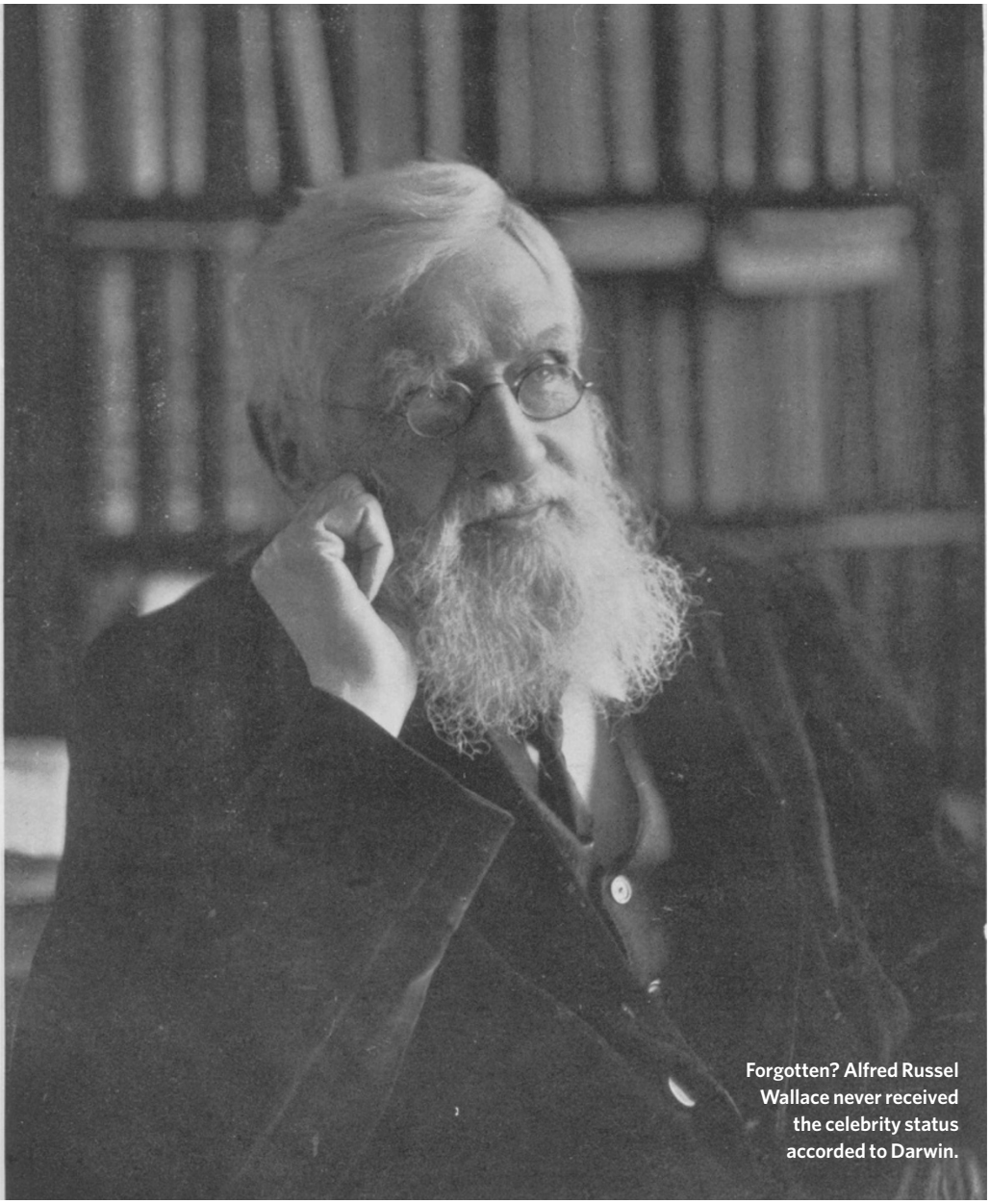
A year or so into these eastern travels, he was confident enough to write what he regarded as an evolutionary manifesto. "On the law which has regulated the introduction of new species" was published in 1855 in the *Annals and Magazine of Natural History*, a respected periodical read by both amateurs and professionals. Wallace pointed out that related species tend to occur together in both space and time — in the same geographical regions and in the same geological strata. The implication was clear to him: life consisted of a diversifying genealogical process. The paper was a major step towards the scientific status that Wallace craved, but it failed to create the stir he had hoped.

Around the start of 1856, geologist Charles Lyell told Darwin about Wallace's paper, warning Darwin that he might be scooped. Edward Blyth, an English naturalist in Calcutta, also wrote to Darwin: "Wallace has, I think, put the matter well; and according to his theory the various domestic races of animals have been fairly developed into species." In May 1856, not especially worried about Wallace, Darwin began to write the long-planned tome he expected to call 'Natural Selection'. He opened a correspondence with Wallace, noting that Lyell and Blyth had drawn his attention to the paper and sympathizing over the apparent lack of scientific reaction: "very few naturalists care for anything beyond the mere description of species". Better still, Darwin wrote that he agreed with Wallace's conclusions. Wallace was thrilled. Here was a direct connection to a major star of the scientific firmament.

Wallace's 'law' was still only half a theory of evolution. In February 1858, during a bout of malaria, he glimpsed the other half: the missing mechanism. Recalling the writings of the economist Thomas Malthus, Wallace suddenly recognized that better-adapted groups would gradually replace less well-adapted ones. He waited anxiously for his fever to end so he "might at once make notes for a paper on the subject", which he entitled "On the tendency of varieties to depart indefinitely from the original type". He then did a surprising thing. Rather than submitting the paper directly to a journal, he sent it to Darwin. No one else had shown such interest in his work.

A striking coincidence

In June 1858 (the exact date is unknown), Darwin opened and read a brilliantly incisive handwritten essay that repeated most of his own account of evolution by natural selection. Late in the evening of 18 June 1858, he wrote to Lyell: "I never saw a more striking coincidence… if Wallace had my MS sketch written out in 1842 he could not have made a better short abstract!" Some Wallace scholars suggest that Darwin may have received this letter several weeks earlier and used the intervening period to polish his own ideas in the light of Wallace's. But the documentary record attests to the gradual formulation of



R. HAINES/MARY EVANS PICTURE LIBRARY

Forgotten? Alfred Russel Wallace never received the celebrity status accorded to Darwin.

Darwin's theory over the previous 20 years. In particular, Darwin already had a clear understanding of evolutionary divergence, the main principle that some accuse him of taking from Wallace. Wallace was not telling Darwin anything he did not already know.

Publication was just as important to nineteenth-century science as it is now. Struggles over priority were fiery affairs that could make or break careers. Wallace's article was ready to be published — and as far as Darwin knew, it might already have been sent elsewhere for publication. As Lyell had predicted, he was forestalled. Gentlemanly honour required him to let Wallace take the credit. But Lyell and Hooker urged Darwin not to lose his claim as the originator of the theory. They suggested that there was room for manoeuvre.

These manoeuvrings have exercised historians ever since. Hooker and Lyell proposed a double announcement, so that priority would be shared. Despite his misgivings, Darwin agreed and sent them selections from his writings that explained his views and established chronological priority. Lyell and Hooker rushed these and Wallace's essay onto the programme of an extra meeting of the Linnean Society at the end of the season that was rescheduled because of the death of botanist Robert Brown, a former president of the society. Often described as a joint paper, it was rather two independent statements of the same idea. One hundred and fifty years ago this week, at a meeting on 1 July 1858, Lyell and Hooker communicated "On the tendency of species to form varieties; and on the perpetuation of varieties and species by natural means of selection" to the Linnean Society.

Neither author was present. Darwin was wretched with grief over the death of his youngest child from scarlet fever two days earlier, and Wallace was seriously ill at Dorey (now named Manokwari) in New Guinea.

When Wallace heard about the fate of his essay, he immediately wrote to Darwin and the others to say that he thought the arrangements were completely satisfactory. To his mother he wrote: "I have received letters from Mr. Darwin and Dr. Hooker, two of the most eminent naturalists in England, which has highly gratified me. I sent Mr. Darwin an essay on a subject on which he is now writing a great work. He showed it to Dr. Hooker and Sir C. Lyell, who thought so highly of it that they immediately read it before the Linnean Society. This assures me the acquaintance and assistance of these eminent men on my return home…."

Wallace had made it. Like Darwin, although by a more arduous route, Wallace had gone from 'ardent beetle-hunter' to scientific luminary. This shared collecting spirit provided a link that lasted even when their intellectual paths began to diverge.

The papers were published in the Linnean Society's journal in August 1858, while Wallace was travelling to Ternate in the Moluccas. Darwin was by then working on what would become *Origin of Species*. Contrary to the usual story, several people recognized the likely impact of the Linnean Society papers: the American botanist Asa Gray, a close friend of Hooker and Darwin, immediately mentioned in print the value of evolutionary theory for explaining patterns of plant distribution; and a young ornithologist at the University of Cambridge, Alfred Newton, sat up all night to master their proposals. That said, Thomas Bell, president of the Linnean Society, guaranteed himself an unfortunate footnote in the history books by writing in his annual review of 1858: "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."

A new science

It took the *Origin of Species* to effect that revolution. One year later, with Darwin's book in his hands, Wallace was enthralled: "Mr. Darwin has given the world a new science," he wrote to his friend George Silk, adding that "his name should stand above that of every philosopher of ancient or modern times. The

force of admiration can no further go!!!"

So why has the name of one so prescient, and so generous, faded from popular view, while it still inspires those who find the modern infatuation with Darwin stultifying?

Exploring Wallace's role in the evolutionary story reveals a host of other figures who also deserve to be heard. Over the past twenty years, the Darwinian revolution has been shown to be neither a revolution as commonly understood nor solely due to Darwin. Many people proposed developmental schemes, some as famous as Jean-Baptiste Lamarck and Herbert Spencer, others relatively unknown but just as interesting. To remember Wallace is therefore to recognize that "evolution was in the air", and prompts one to wonder how Darwin's name rose so smoothly to the top.

The structure of science plays a part. First, the scientific community and the public tend to see science as a succession of advancing steps, each achieved by a named individual. In this view, precedence is everything: posterity ignores the second placed. Second, major changes in scientific theory are not just about the formulation of new ideas, but also depend on circulation and discussion. Shortly after Darwin's book was published, the word 'darwinism' began appearing in reviews and articles, and quickly came to denote an intellectual movement that also drew on the work of other figures, including Spencer, Chambers, Thomas Henry Huxley and Haeckel, as well as Wallace. Darwin's *Origin of Species*, and Darwin himself, became the flag to which many radical ideas rallied.

Perhaps Wallace contributed to his own eclipse too. For instance, he called one of his finest books *Darwinism*. Darwin's publishing strategy after *Origin of Species* was to consolidate, producing ever more evidence in support of the theory. Wallace, meanwhile, published on myriad topics, from the true identity of Shakespeare to the advisability of railway labour strikes. Darwin's politics, although strongly felt, had few public airings. Wallace, in contrast, was an outspoken socialist, the campaigning president of the Land Nationalisation Society, which insisted that private ownership of land was the root of all social iniquity. Attracted to radical issues, he became a spiritualist, believed in phrenology as "the true science of mind", and was a leading opponent of smallpox vaccination. This undermined his credibility with many scientists. Some defenders of Wallace consider him a victim of the Victorian class system, but his problems stem from more than a humble background. After all, Huxley, Darwin's most prominent advocate, was born above a butcher's shop yet became the leading spokesman for British science.

"Wallace compared Darwin to a great military general and likened himself to a guerrilla, useful for a skirmish."

Step by step, Darwin's star brightened as Wallace's faded. By the time Darwin died, he was held to be "first among the scientific men of England", as the socialist writer Edward Aveling put it. Darwin's name was inextricably linked with the idea of evolution and with broader shifts in public opinion that swept through the nineteenth century. Wallace never acquired Darwin's celebrity status. Unlike Darwin, he was not buried in Westminster Abbey, although a wall medallion was unveiled there in 1915, two years after his death. None of his houses became a museum. Images of Wallace did not appear in any of the satires or cartoons of evolution. Nor did Wallace have the evocative connection that Darwin did to the Galapagos Islands. His manuscripts were not published, and his library was not preserved.

At the start of the twenty-first century, Darwin could hardly be more prominent. His name is invoked in every modern discussion of evolution. He stares out from websites both for and against evolutionary theory. Books, stamps, exhibitions, conferences, festivals and artistic works abound. A portrait of Darwin was commissioned in 1881 by the Linnean Society from the artist John Collier, and copied for the National Portrait Gallery, the Royal Society and the Darwin Museum at Down House. By contrast, the portrait of Wallace that hangs in the Linnean Society was not painted until 1998.

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Two of Wallace's notebooks.

Wallace modestly endorsed these differences. In a letter in 1869, he compared Darwin to a great military general who kept sight of every campaign detail, and likened himself to a guerrilla, useful for a skirmish. "I feel truly thankful that Darwin had been studying the subject so many years before me, and that I was not left to attempt and to fail, in the great work he has so admirably performed."

As for the events of 150 years ago, Erasmus Darwin, Charles's older brother, encapsulated Wallace's magnanimity when he wrote in 1871 to Charles's daughter Henrietta: "in future histories of science the Wallace–Darwin episode will form one of the few bright points among rival claimants." ■

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See http://tinyurl.com/5beghd for further reading.

Alfred Russel Wallace

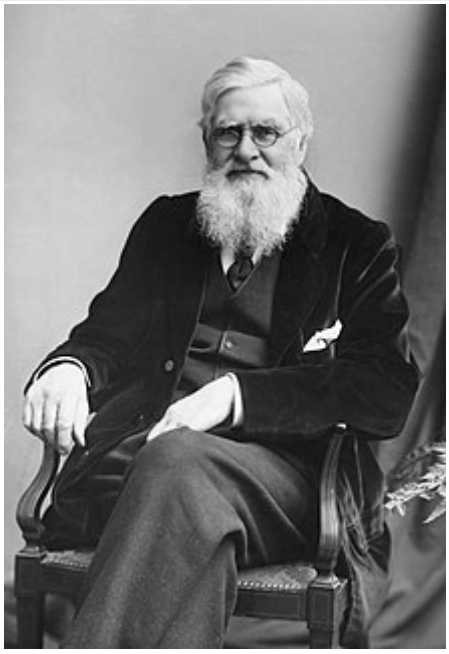
Alfred Russel Wallace OM FRS (8 January 1823 – 7 November 1913) was a British[1] naturalist, explorer, geographer, anthropologist, biologist and illustrator.[2] He is best known for independently conceiving the theory of evolution through natural selection. His 1858 paper on the subject was published that year alongside extracts from Charles Darwin's earlier writings on the topic.[3][4] It spurred Darwin to set aside the "big species book" he was drafting, and quickly write an abstract of it, published in 1859 as *On the Origin of Species*.

Wallace did extensive fieldwork, starting in the Amazon River basin. He then did fieldwork in the Malay Archipelago, where he identified the faunal divide now termed the Wallace Line, which separates the Indonesian archipelago into two distinct parts: a western portion in which the animals are largely of Asian origin, and an eastern portion where the fauna reflect Australasia. He was considered the 19th century's leading expert on the geographical distribution of animal species, and is sometimes called the "father of biogeography", or more specifically of zoogeography.[5]

Wallace was one of the leading evolutionary thinkers of the 19th century, working on warning coloration in animals and reinforcement (sometimes known as the Wallace effect), a way that natural selection could contribute to speciation by encouraging the development of barriers against hybridisation. Wallace's 1904 book *Man's Place in the Universe* was the first serious attempt by a biologist to evaluate the likelihood of life on other planets. He was one of the first scientists to write a serious exploration of whether there was life on Mars.[6]

Aside from scientific work, he was a social activist, critical of what he considered to be an unjust social and economic system in 19th-century Britain. His advocacy of spiritualism and his belief in a non-material origin for the higher mental faculties of humans strained his relationship with other scientists. He was one of the first prominent scientists to raise concerns over the environmental impact of human activity. He wrote prolifically on both scientific and social issues; his account of his adventures and observations during his explorations in Southeast Asia, *The Malay Archipelago*, was first published in 1869. It continues to be both popular and highly regarded.

Alfred Russel Wallace
OM FRS



Wallace in 1895

Born	8 January 1823 Llanbadoc, Monmouthshire, Wales
Died	7 November 1913 (aged 90) Broadstone, Dorset, England
Known for	Co-discovery of natural selection Pioneering work on biogeography Wallace Line Wallace effect
Awards	Royal Medal (1868) Gold Medal of the *Société de Géographie* (1870)

Contents

	Darwin Medal (1890) Founder's Medal (1892) Linnean Medal (1892) Copley Medal (1908) Darwin–Wallace Medal (Gold, 1908) Order of Merit (1908)
Scientific career	
Fields	Exploration, evolutionary biology, zoology, biogeography, and social reform
Author abbrev. (botany)	Wallace

Biography

Early life

Alfred Russel Wallace was born on 8 January 1823 in Llanbadoc, Monmouthshire.[a][7] He was the eighth of nine children born to Mary Anne Wallace (née Greenell) and Thomas Vere Wallace. His mother was English, while his father was of Scottish ancestry. His family claimed a connection to William Wallace, a leader of Scottish forces during the Wars of Scottish Independence in the 13th century.[8]

Thomas Wallace graduated in law but never practised it. He owned some income-generating property, but bad investments and failed business ventures resulted in a steady deterioration of the family's financial position. His mother was from a middle-class Hertford-based family.[8] When Wallace was five years old, his family moved to Hertford. There he attended Hertford Grammar School until 1837, when he was aged 14. The family had financial difficulties, but this was the normal leaving age for a pupil not going on to university.[9][10]

A photograph from Wallace's autobiography shows the building Wallace and his brother John designed and built for the Neath Mechanics' Institute.

Wallace then moved to London to board with his older brother John, a 19-year-old apprentice builder. This was a stopgap measure until William, his oldest brother, was ready to take him on as an apprentice surveyor. While in London, Alfred attended lectures and read books at the London Mechanics Institute. Here he was exposed to the radical political ideas of the Welsh social reformer Robert Owen and of the English-born political theorist Thomas Paine. He left London in 1837 to live with William and work as his apprentice for six years. They moved repeatedly to different places in Mid-Wales. Then at the end of 1839, they moved to Kington, Herefordshire, near the Welsh border, before eventually settling at Neath in Wales. Between 1840 and 1843, Wallace worked as a land surveyor in the countryside of the west of England and Wales.[11][12] The natural history of his surroundings aroused his interest; from 1841 he collected flowers and plants as an amateur botanist.[9]

One result of Wallace's early travels is a modern controversy about his nationality. Since he was born in Monmouthshire, some sources have considered him to be Welsh.[13] Other historians have questioned this because neither of his parents was Welsh, his family only briefly lived in Monmouthshire, the Welsh people Wallace knew in his childhood considered him to be English, and because he consistently referred to himself as English rather than Welsh. One Wallace scholar has stated that the most reasonable interpretation is therefore that he was an Englishman born in Wales.[2]

In 1843 Wallace's father died, and a decline in demand for surveying meant William's business no longer had work available.[9] For a short time Wallace was unemployed, then early in 1844 he was engaged by the Collegiate School in Leicester to teach drawing, mapmaking, and surveying.[14][15] He had already read George Combe's *The Constitution of Man*, and after Spencer Hall lectured on mesmerism, Wallace as well as some of the older pupils tried it out. Wallace spent many hours at the town library in Leicester; he read *An Essay on the Principle of Population* by Thomas Robert Malthus, Alexander von Humboldt's *Personal Narrative*, Darwin's *Journal* (*The Voyage of the Beagle*), and Charles Lyell's *Principles of Geology*.[9][16] One evening Wallace met the entomologist Henry Bates, who was 19 years old, and had published an 1843 paper on beetles in the journal *Zoologist*. He befriended Wallace and started him collecting insects.[14][15]

When Wallace's brother William died in March 1845, Wallace left his teaching position to assume control of his brother's firm in Neath, but his brother John and he were unable to make the business work. After a few months, he found work as a civil engineer for a nearby firm that was working on a survey for a proposed

railway in the Vale of Neath. Wallace's work on the survey was largely outdoors in the countryside, allowing him to indulge his new passion for collecting insects. Wallace persuaded his brother John to join him in starting another architecture and civil engineering firm. It carried out projects including the design of a building for the Neath Mechanics' Institute, founded in 1843.[17] William Jevons, the founder of that institute, was impressed by Wallace and persuaded him to give lectures there on science and engineering. In the autumn of 1846, John and he purchased a cottage near Neath, where they lived with their mother and sister Fanny (his father had died in 1843).[18][19] During this period, he exchanged letters with Bates about books. He had re-read Darwin's *Journal*, and said "As the Journal of a scientific traveller, it is second only to Humboldt's 'Personal Narrative'—as a work of general interest, perhaps superior to it." In 1845, Wallace had been convinced by Robert Chambers's anonymously published treatise on progressive development, *Vestiges of the Natural History of Creation*, and found Bates to be more critical.[20][21]

Exploration and study of the natural world

Inspired by the chronicles of earlier and contemporary travelling naturalists, Wallace decided to travel abroad.[22] He later wrote that Darwin's *Journal* and Humboldt's *Personal Narrative* were "the two works to whose inspiration I owe my determination to visit the tropics as a collector."[23] After reading *A voyage up the river Amazon*, by William Henry Edwards, Wallace and Bates estimated that by collecting and selling natural history specimens such as birds and insects they could meet their costs, with the prospect of good profits.[9] They therefore engaged as their agent Samuel Stevens who would advertise and arrange sales to institutions and private collectors, for a commission of 20% on sales plus 5% on despatching freight and remittances of money.[24]

In 1848, Wallace and Bates left for Brazil aboard the *Mischief*. They intended to collect insects and other animal specimens in the Amazon Rainforest for their private collections, selling the duplicates to museums and collectors back in Britain to fund the trip. Wallace hoped to gather evidence of the transmutation of species. Bates and he spent most of their first year collecting near Belém, then explored inland separately, occasionally meeting to discuss their findings. In 1849, they were briefly joined by another young explorer, the botanist Richard Spruce, along with Wallace's younger brother Herbert. Herbert soon left (dying two years later from yellow fever), but Spruce, like Bates, would spend over ten years collecting in South America.[25][26] Wallace spent four years charting the Rio Negro, collecting specimens and making notes on the peoples and languages he encountered as well as the geography, flora, and fauna.[27]

On 12 July 1852, Wallace embarked for the UK on the brig *Helen*. After 25 days at sea, the ship's cargo caught fire, and the crew was forced to abandon ship. All the specimens Wallace had on the ship, mostly collected during the last, and most interesting, two years of his trip, were lost. He managed to save a few notes and pencil sketches, but little else. Wallace and the crew spent ten days in an open boat before being picked up by the brig *Jordeson*, which was sailing from Cuba to London. The *Jordeson*'s provisions were strained by the unexpected passengers, but after a difficult passage on short rations, the ship reached its destination on 1 October 1852.[28][29]

The lost collection had been insured for £200 by Stevens.[30] After his return to Britain, Wallace spent 18 months in London living on the insurance payment, and selling a few specimens that had been shipped home. During this period, despite having lost almost all the notes from his South American expedition, he wrote six academic papers (including "On the Monkeys of the Amazon") and two books, *Palm Trees of the Amazon and Their Uses* and *Travels on the Amazon*.[31] At the same time, he made connections with several other British naturalists.[29][32][33]

Bates and others were collecting in the Amazon area, Wallace was more interested in new opportunities in the Malay Archipelago as demonstrated by the travel writings of Ida Laura Pfeiffer, and valuable insect specimens she collected which Stevens sold as her agent. In March 1853 Wallace wrote to Sir James

Brooke, Rajah of Sarawak, who was then in London, and who arranged assistance in Sarawak for Wallace.[34][35] In June Wallace wrote to Murchison at the Royal Geographical Society (RGS) for support, proposing to again fund his exploring entirely from sale of duplicate collections.[36] He later recalled that, while researching in the insect-room of the British Museum, he was introduced to Darwin and they "had a few minutes' conversation." After presenting a paper and a large map of the Rio Negro to the RGS, Wallace was elected a Fellow of the society on 27 February 1854.[37][38] Free passage arranged on Royal Navy ships was stalled by the Crimean War, but eventually the RGS funded first class travel by P&O steamships. Wallace and a young assistant, Charles Allen, embarked at Southampton on 4 March 1854. After the overland journey to Suez and another change of ship at Ceylon they disembarked at Singapore on 19 April 1854.[39]

A map from *The Malay Archipelago* shows the physical geography of the archipelago and Wallace's travels around the area. The thin black lines indicate where Wallace travelled; the red lines indicate chains of volcanoes.

From 1854 to 1862, Wallace travelled around the islands of the Malay Archipelago or East Indies (now Singapore, Malaysia and Indonesia).[40] His main objective "was to obtain specimens of natural history, both for my private collection and to supply duplicates to museums and amateurs". In addition to Allen, he "generally employed one or two, and sometimes three Malay servants" as assistants, and paid large numbers of local people at various places to bring specimens. His total was 125,660 specimens, most of which were insects including more than 83,000 beetles,[41][42] Several thousand of the specimens represented species new to science,[43] Overall, more than thirty men worked for him at some stage as full-time paid collectors. He also hired guides, porters, cooks and boat crews, so well over 100 individuals worked for him.[44]

After collecting expeditions to Bukit Timah Hill in Singapore, and to Malacca, Wallace and Allen reached Sarawak in October 1855, and were welcomed at Kuching by Sir James Brooke's heir Captain John Brooke. Wallace hired a Malay named Ali as a general servant and cook, and spent the early 1856 wet season in a small Dyak house at the foot of Mount Santubong, overlooking a branch outlet of the Sarawak River. He read about species distribution, and wrote his "Sarawak Paper".[45] In March he moved to the Simunjon coal-works, operated by Ludvig Verner Helms, and supplemented collecting by paying workers a cent for each insect. A specimen of the previously unknown gliding tree frog *Rhacophorus nigropalmatus* (now called Wallace's flying frog) came from a Chinese workman who told Wallace that it glided down. Local people also assisted with shooting orangutans.[46][42] They spent time with Sir James, then in February 1836 Allen chose to stay on with the missionaries at Kuching.[47][48]


Mount Santubong around 1855, watercolour by missionary Harriette McDougall

On reaching Singapore in May 1836, Wallace hired a bird-skinner. With Ali as cook, they collected for two days on Bali, then from 17 June to 30 August on Lombok.[49] In December 1855, Darwin had written to contacts worldwide to get specimens for his continuing research into variation under domestication.[50][51] At Lombok's port city, Ampanam, Wallace wrote telling his agent, Stevens, about specimens shipped,

including a domestic duck variety "for Mr. Darwin & he would perhaps also like the jungle cock, which is often domesticated here & is doubtless one of the originals of the domestic breed of poultry."[52] In the same letter, Wallace said birds from Bali and Lombok, divided by a narrow strait, "belong to two quite distinct zoological provinces, of which they form the extreme limits", Java, Borneo, Sumatra and Malacca, and Australia and the Moluccas. Stevens arranged publication of relevant paragraphs in the January 1857 issue of *The Zoologist*. After further investigation, the zoogeographical boundary eventually became known as the Wallace Line.[53][54]

Ali became Wallace's most trusted assistant, a skilled collector and researcher. Wallace collected and preserved the delicate insect specimens, while most of the birds were collected and prepared by his assistants; of those, Ali collected and prepared around 5000.[44] While exploring the archipelago, Wallace refined his thoughts about evolution, and had his famous insight on natural selection. In 1858 he sent an article outlining his theory to Darwin; it was published, along with a description of Darwin's theory, that same year.[55]

Accounts of Wallace's studies and adventures were eventually published in 1869 as *The Malay Archipelago*. This became one of the most popular books of scientific exploration of the 19th century, and has never been out of print. It was praised by scientists such as Darwin (to whom the book was dedicated), by Lyell, and by non-scientists such as the novelist Joseph Conrad. Conrad called the book his "favorite bedside companion" and used information from it for several of his novels, especially *Lord Jim*.[56] A set of 80 bird skeletons Wallace collected in Indonesia are held in the Cambridge University Museum of Zoology, and described as of exceptional historical significance.[57]

Specimens and illustrations

Arenga pinnata sketched by Wallace in Celebes, reworked by Walter Hood Fitch

Wallace collected many specimens, such as this *Mino anais anais* from South West Papua, 1863.

An illustration from *The Malay Archipelago* depicts the flying frog that a workman handed to Wallace.

Return to England, marriage and children

In 1862, Wallace returned to England, where he moved in with his sister Fanny Sims and her husband Thomas. While recovering from his travels, Wallace organised his collections and gave numerous lectures about his adventures and discoveries to scientific societies such as the Zoological Society of London. Later that year, he visited Darwin at Down House, and became friendly with both Lyell and the philosopher Herbert Spencer.[58] During the 1860s, Wallace wrote papers and gave lectures defending natural selection. He corresponded with Darwin about topics including sexual selection, warning coloration, and the possible effect of natural selection on hybridisation and the divergence of species.[59] In 1865, he began investigating spiritualism.[60]

After a year of courtship, Wallace became engaged in 1864 to a young woman whom, in his autobiography, he would only identify as Miss L. Miss L. was the daughter of Lewis Leslie who played chess with Wallace,[61] but to Wallace's great dismay, she broke off the engagement.[62] In 1866, Wallace married Annie Mitten. Wallace had been introduced to Mitten through the botanist Richard Spruce, who had befriended Wallace in Brazil and who was a friend of Annie Mitten's father, William Mitten, an expert on mosses. In 1872, Wallace built the Dell, a house of concrete, on land he leased in Grays in Essex, where he lived until 1876. The Wallaces had three children: Herbert (1867–1874), Violet (1869–1945), and William (1871–1951).[63]

A photograph of Wallace taken in Singapore in 1862

Financial struggles

In the late 1860s and 1870s, Wallace was very concerned about the financial security of his family. While he was in the Malay Archipelago, the sale of specimens had brought in a considerable amount of money, which had been carefully invested by the agent who sold the specimens for Wallace. Unfortunately, on his return to the UK, Wallace made a series of bad investments in railways and mines that squandered most of the money, and he found himself badly in need of the proceeds from the publication of *The Malay Archipelago*.[64]

Despite assistance from his friends, he was never able to secure a permanent salaried position such as a curatorship in a museum. To remain financially solvent, Wallace worked grading government examinations, wrote 25 papers for publication between 1872 and 1876 for various modest sums, and was paid by Lyell and Darwin to help edit some of their works.[65]

In 1876, Wallace needed a £500 advance from the publisher of *The Geographical Distribution of Animals* to avoid having to sell some of his personal property.[66] Darwin was very aware of Wallace's financial difficulties and lobbied long and hard to get Wallace awarded a government pension for his lifetime contributions to science. When the £200 annual pension was awarded in 1881, it helped to stabilise Wallace's financial position by supplementing the income from his writings.[67]

Social activism

In 1881, Wallace was elected as the first president of the newly formed Land Nationalisation Society. In the next year, he published a book, *Land Nationalisation; Its Necessity and Its Aims*,[68] on the subject. He criticised the UK's free trade policies for the negative impact they had on working-class people.[33][69] In 1889, Wallace read *Looking Backward* by Edward Bellamy and declared himself a socialist, despite his earlier foray as a speculative investor.[70] After reading *Progress and Poverty*, the best selling book by the progressive land reformist Henry George, Wallace described it as "Undoubtedly the most remarkable and important book of the present century."[71]

Wallace opposed eugenics, an idea supported by other prominent 19th-century evolutionary thinkers, on the grounds that contemporary society was too corrupt and unjust to allow any reasonable determination of who was fit or unfit.[72] In his 1890 article "Human Selection" he wrote, "Those who succeed in the race for wealth are by no means the best or the most intelligent ..."[73] In 1898, Wallace wrote a paper advocating a pure paper money system, not backed by silver or gold, which impressed the economist Irving Fisher so much that he dedicated his 1920 book *Stabilizing the Dollar* to Wallace.[74]

Wallace wrote on other social and political topics including to support women's suffrage, and repeatedly on the dangers and wastefulness of militarism.[75][76] In an 1899 essay, he called for popular opinion to be rallied against warfare by showing people "that all modern wars are dynastic; that they are caused by the ambition, the interests, the jealousies, and the insatiable greed of power of their rulers, or of the great mercantile and financial classes which have power and influence over their rulers; and that the results of war are never good for the people, who yet bear all its burthens".[77] In a letter published by the Daily Mail in 1909, with aviation in its infancy, he advocated an international treaty to ban the military use of aircraft, arguing against the idea "...that this new horror is "inevitable," and that all we can do is to be sure and be in the front rank of the aerial assassins—for surely no other term can so fitly describe the dropping of, say, ten thousand bombs at midnight into an enemy's capital from an invisible flight of airships."[78]

In 1898, Wallace published *The Wonderful Century: Its Successes and Its Failures*, about developments in the 19th century. The first part of the book covered the major scientific and technical advances of the century; the second part covered what Wallace considered to be its social failures including the destruction and waste of wars and arms races, the rise of the urban poor and the dangerous conditions in which they lived and worked, a harsh criminal justice system that failed to reform criminals, abuses in a mental health system based on privately owned sanatoriums, the environmental damage caused by capitalism, and the evils of European colonialism.[79][80] Wallace continued his social activism for the rest of his life, publishing the book *The Revolt of Democracy* just weeks before his death.[81]

Further scientific work

In 1880, he published *Island Life* as a sequel to *The Geographic Distribution of Animals*. In November 1886, Wallace began a ten-month trip to the United States to give a series of popular lectures. Most of the lectures were on Darwinism (evolution through natural selection), but he also gave speeches on biogeography, spiritualism, and socio-economic reform. During the trip, he was reunited with his brother John who had emigrated to California years before. He spent a week in Colorado, with the American botanist Alice Eastwood as his guide, exploring the flora of the Rocky Mountains and gathering evidence that would lead him to a theory on how glaciation might explain certain commonalities between the mountain flora of Europe, Asia and North America, which he published in 1891 in the paper "English and American Flowers". He met many other prominent American naturalists and viewed their collections. His 1889 book *Darwinism* used information he collected on his American trip and information he had compiled for the lectures.[82][83]

Death

On 7 November 1913, Wallace died at home, aged 90, in the country house he called Old Orchard, which he had built a decade earlier.[84] His death was widely reported in the press. *The New York Times* called him "the last of the giants [belonging] to that wonderful group of intellectuals composed of Darwin, Huxley, Spencer, Lyell, Owen, and other scientists, whose daring investigations revolutionized and evolutionized the thought of the century".[85] Another commentator in the same edition said: "No apology need be made for the few literary or scientific follies of the author of that great book on the 'Malay Archipelago'."[86]

Some of Wallace's friends suggested that he be buried in Westminster Abbey, but his wife followed his wishes and had him buried in the small cemetery at Broadstone, Dorset.[84] Several prominent British scientists formed a committee to have a medallion of Wallace placed in Westminster Abbey near where Darwin had been buried. The medallion was unveiled on 1 November 1915.[87]

Wallace's grave in Broadstone Cemetery, Dorset, restored by the A. R. Wallace Memorial Fund in 2000. It features a fossil tree trunk 7 feet (2.1 m) tall from Portland, mounted on a block of Purbeck limestone.

Theory of evolution

Early evolutionary thinking

Wallace began his career as a travelling naturalist who already believed in the transmutation of species. The concept had been advocated by Jean-Baptiste Lamarck, Geoffroy Saint-Hilaire, Erasmus Darwin, and Robert Grant, among others. It was widely discussed, but not generally accepted by leading naturalists, and was considered to have radical, even revolutionary connotations.[88][89] Prominent anatomists and geologists such as Georges Cuvier, Richard Owen, Adam Sedgwick, and Lyell attacked transmutation vigorously.[90][91] It has been suggested that Wallace accepted the idea of the transmutation of species in part because he was always inclined to favour radical ideas in politics, religion and science,[88] and because he was unusually open to marginal, even fringe, ideas in science.[92]

Wallace was profoundly influenced by Robert Chambers's *Vestiges of the Natural History of Creation*, a controversial work of popular science published anonymously in 1844. It advocated an evolutionary origin for the solar system, the earth, and living things.[93] Wallace wrote to Henry Bates in 1845 describing it as "an ingenious hypothesis strongly supported by some striking facts and analogies, but which remains to be proven by ... more research".[92] In 1847, he wrote to Bates that he would "like to take some one family [of beetles] to study thoroughly, ... with a view to the theory of the origin of species."[94]

Wallace planned fieldwork to test the evolutionary hypothesis that closely related species should inhabit neighbouring territories.[88] During his work in the Amazon basin, he came to realise that geographical barriers—such as the Amazon and its major tributaries—often separated the ranges of closely allied species. He included these observations in his 1853 paper "On the Monkeys of the Amazon". Near the end of the paper he asked the question, "Are very closely allied species ever separated by a wide interval of country?"[95]

In February 1855, while working in Sarawak on the island of Borneo, Wallace wrote "On the Law which has Regulated the Introduction of New Species". The paper was published in the *Annals and Magazine of Natural History* in September 1855.[96] In this paper, he discussed observations of the geographic and geologic distribution of both living and fossil species, a field that became biogeography. His conclusion that "Every species has come into existence coincident both in space and time with a closely allied species" has come to be known as the "Sarawak Law", answering his own question in his paper on the monkeys of the Amazon basin. Although it does not mention possible mechanisms for evolution, this paper foreshadowed the momentous paper he would write three years later.[97]

The paper challenged Lyell's belief that species were immutable. Although Darwin had written to him in 1842 expressing support for transmutation, Lyell had continued to be strongly opposed to the idea. Around the start of 1856, he told Darwin about Wallace's paper, as did Edward Blyth who thought it "Good! Upon the whole! ... Wallace has, I think put the matter well; and according to his theory the various domestic

races of animals have been fairly developed into *species*." Despite this hint, Darwin mistook Wallace's conclusion for the progressive creationism of the time, writing that it was "nothing very new ... Uses my simile of tree [but] it seems all creation with him." Lyell was more impressed, and opened a notebook on species in which he grappled with the consequences, particularly for human ancestry. Darwin had already shown his theory to their mutual friend Joseph Hooker and now, for the first time spelt out the full details of natural selection to Lyell. Although Lyell could not agree, he urged Darwin to publish to establish priority. Darwin demurred at first, but began writing up a *species sketch* of his continuing work in May 1856.[98][99]

Natural selection and Darwin

By February 1858, Wallace had been convinced by his biogeographical research in the Malay Archipelago that evolution was real. He later wrote in his autobiography that the problem was of how species change from one well-marked form to another.[100] He stated that it was while he was in bed with a fever that he thought about Malthus's idea of positive checks on human population, and had the idea of natural selection. His autobiography says that he was on the island of Ternate at the time; but the evidence of his journal suggests that he was in fact on the island of Gilolo.[101] From 1858 to 1861, he rented a house on Ternate from the Dutchman Maarten Dirk van Renesse van Duivenbode, which he used as a base for expeditions to other islands such as Gilolo.[102]

Wallace describes how he discovered natural selection as follows:

> It then occurred to me that these causes or their equivalents are continually acting in the case of animals also; and as animals usually breed much more quickly than does mankind, the destruction every year from these causes must be enormous in order to keep down the numbers of each species, since evidently they do not increase regularly from year to year, as otherwise the world would long ago have been crowded with those that breed most quickly. Vaguely thinking over the enormous and constant destruction which this implied, it occurred to me to ask the question, why do some die and some live? And the answer was clearly, on the whole the best fitted live ... and considering the amount of individual variation that my experience as a collector had shown me to exist, then it followed that all the changes necessary for the adaptation of the species to the changing conditions would be brought about ... In this way every part of an animals organization could be modified exactly as required, and in the very process of this modification the unmodified would die out, and thus the definite characters and the clear isolation of each new species would be explained.[103]

Wallace had once briefly met Darwin, and was one of the correspondents whose observations Darwin used to support his own theories. Although Wallace's first letter to Darwin has been lost, Wallace carefully kept the letters he received.[105] In the first letter, dated 1 May 1857, Darwin commented that Wallace's letter of 10 October which he had recently received, as well as Wallace's paper "On the Law which has regulated the Introduction of New Species" of 1855, showed that they thought alike, with similar conclusions, and said that he was preparing his own work for publication in about two years time.[106] The second letter, dated 22 December 1857, said how glad he was that Wallace was theorising about distribution, adding that "without speculation there is no good and original observation" but commented that "I believe I go much further than you".[107] Wallace believed this and sent Darwin his February 1858 essay, "On the Tendency of Varieties to Depart Indefinitely From the Original Type", asking Darwin to review it and pass it to Charles Lyell if he thought it worthwhile.[3] Although Wallace had sent several articles for journal publication during his travels through the Malay archipelago, the Ternate essay was in a private letter. Darwin received the essay on 18 June 1858. Although the essay did not use Darwin's term "natural selection", it did outline the mechanics of an evolutionary divergence of species from similar ones due to

environmental pressures. In this sense, it was very similar to the theory that Darwin had worked on for 20 years, but had yet to publish. Darwin sent the manuscript to Charles Lyell with a letter saying "he could not have made a better short abstract! Even his terms now stand as heads of my chapters ... he does not say he wishes me to publish, but I shall, of course, at once write and offer to send to any journal."[108][109] Distraught about the illness of his baby son, Darwin put the problem to Charles Lyell and Joseph Hooker, who decided to publish the essay in a joint presentation together with unpublished writings which highlighted Darwin's priority. Wallace's essay was presented to the Linnean Society of London on 1 July 1858, along with excerpts from an essay which Darwin had disclosed privately to Hooker in 1847 and a letter Darwin had written to Asa Gray in 1857.[110]

The Darwin–Wallace Medal was issued by the Linnean Society on the 50th anniversary of the reading of Darwin and Wallace's papers on natural selection. Wallace received the only gold example.[104]

Communication with Wallace in the far-off Malay Archipelago involved months of delay, so he was not part of this rapid publication. Wallace accepted the arrangement after the fact, happy that he had been included at all, and never expressed bitterness in public or in private. Darwin's social and scientific status was far greater than Wallace's, and it was unlikely that, without Darwin, Wallace's views on evolution would have been taken seriously. Lyell and Hooker's arrangement relegated Wallace to the position of co-discoverer, and he was not the social equal of Darwin or the other prominent British natural scientists. All the same, the joint reading of their papers on natural selection associated Wallace with the more famous Darwin. This, combined with Darwin's (as well as Hooker's and Lyell's) advocacy on his behalf, would give Wallace greater access to the highest levels of the scientific community.[111] The reaction to the reading was muted, with the president of the Linnean Society remarking in May 1859 that the year had not been marked by any striking discoveries;[112] but, with Darwin's publication of *On the Origin of Species* later in 1859, its significance became apparent. When Wallace returned to the UK, he met Darwin. Although some of Wallace's opinions in the ensuing years would test Darwin's patience, they remained on friendly terms for the rest of Darwin's life.[113]

Over the years, a few people have questioned this version of events. In the early 1980s, two books, one by Arnold Brackman and another by John Langdon Brooks, suggested not only that there had been a conspiracy to rob Wallace of his proper credit, but that Darwin had actually stolen a key idea from Wallace to finish his own theory. These claims have been examined and found unconvincing by a number of scholars.[114][115][116] Shipping schedules show that, contrary to these accusations, Wallace's letter could not have been delivered earlier than the date shown in Darwin's letter to Lyell.[117][118]

Defence of Darwin and his ideas

After Wallace returned to England in 1862, he became one of the staunchest defenders of Darwin's *On the Origin of Species*. In an incident in 1863 that particularly pleased Darwin, Wallace published the short paper "Remarks on the Rev. S. Haughton's Paper on the Bee's Cell, And on the Origin of Species". This rebutted a paper by a professor of geology at the University of Dublin that had sharply criticised Darwin's comments in the *Origin* on how hexagonal honey bee cells could have evolved through natural selection.[119] An even longer defence was a 1867 article in the *Quarterly Journal of Science* called "Creation by Law". It reviewed George Campbell, the 8th Duke of Argyll's book, *The Reign of Law*,

which aimed to refute natural selection.[120] After an 1870 meeting of the British Science Association, Wallace wrote to Darwin complaining that there were "no opponents left who know anything of natural history, so that there are none of the good discussions we used to have".[121]

Differences between Darwin and Wallace

Historians of science have noted that, while Darwin considered the ideas in Wallace's paper to be essentially the same as his own, there were differences.[122] Darwin emphasised competition between individuals of the same species to survive and reproduce, whereas Wallace emphasised environmental pressures on varieties and species forcing them to become adapted to their local conditions, leading populations in different locations to diverge.[123][124] The historian of science Peter J. Bowler has suggested that in the paper he mailed to Darwin, Wallace might have been discussing group selection.[125] Against this, Malcolm Kottler showed that Wallace was indeed discussing individual variation and selection.[126]

Others have noted that Wallace appeared to have envisioned natural selection as a kind of feedback mechanism that kept species and varieties adapted to their environment (now called 'stabilizing", as opposed to 'directional' selection).[127] They point to a largely overlooked passage of Wallace's famous 1858 paper, in which he likened "this principle ... [to] the centrifugal governor of the steam engine, which checks and corrects any irregularities".[3] The cybernetician and anthropologist Gregory Bateson observed in the 1970s that, although writing it only as an example, Wallace had "probably said the most powerful thing that'd been said in the 19th Century".[128] Bateson revisited the topic in his 1979 book *Mind and Nature: A Necessary Unity*, and other scholars have continued to explore the connection between natural selection and systems theory.[127]

Warning coloration and sexual selection

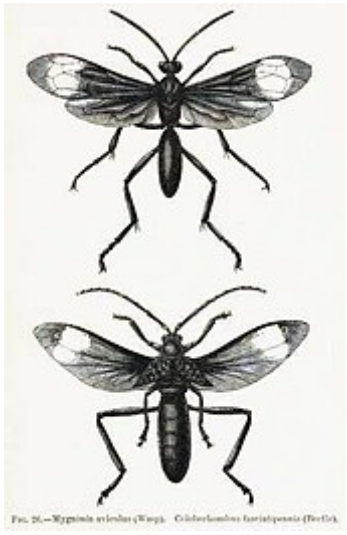


Illustration of Batesian mimicry: a wasp (top) mimicked by a beetle in Wallace's 1889 book *Darwinism*

Warning coloration was one of Wallace's contributions to the evolutionary biology of animal coloration.[129] In 1867, Darwin wrote to Wallace about a problem in explaining how some caterpillars could have evolved conspicuous colour schemes. Darwin had come to believe that many conspicuous animal colour schemes were due to sexual selection, but he saw that this could not apply to caterpillars. Wallace responded that he and Bates had observed that many of the most spectacular butterflies had a peculiar odour and taste, and that he had been told by John Jenner Weir that birds would not eat a certain kind of common white moth because they found it unpalatable. Since the moth was as conspicuous at dusk as a coloured caterpillar in daylight, it seemed likely that the conspicuous colours served as a warning to predators and thus could have evolved through natural selection. Darwin was impressed by the idea. At a later meeting of the Entomological Society, Wallace asked for any evidence anyone might have on the topic.[130] In 1869, Weir published data from experiments and observations involving brightly coloured caterpillars that supported Wallace's idea.[131] Wallace attributed less importance than Darwin to sexual selection. In his 1878 book *Tropical Nature and Other Essays*, he wrote extensively about the coloration of animals and plants, and proposed alternative explanations for a number of cases Darwin had attributed to sexual selection.[132] He revisited the topic at length in his 1889 book *Darwinism*. In 1890, he

wrote a critical review in *Nature* of his friend Edward Bagnall Poulton's *The Colours of Animals* which supported Darwin on sexual selection, attacking especially Poulton's claims on the "aesthetic preferences of the insect world".[133][134]

Wallace effect

In 1889, Wallace wrote the book *Darwinism*, which explained and defended natural selection. In it, he proposed the hypothesis that natural selection could drive the reproductive isolation of two varieties by encouraging the development of barriers against hybridisation. Thus it might contribute to the development of new species. He suggested the following scenario: When two populations of a species had diverged beyond a certain point, each adapted to particular conditions, hybrid offspring would be less adapted than either parent form and so natural selection would tend to eliminate the hybrids. Furthermore, under such conditions, natural selection would favour the development of barriers to hybridisation, as individuals that avoided hybrid matings would tend to have more fit offspring, and thus contribute to the reproductive isolation of the two incipient species. This idea came to be known as the Wallace effect,[135][136] later called reinforcement.[137] Wallace had suggested to Darwin that natural selection could play a role in preventing hybridisation in private correspondence as early as 1868, but had not worked it out to this level of detail.[138] It continues to be a topic of research in evolutionary biology today, with both computer simulation and empirical results supporting its validity.[139]

Application of theory to humans, and role of teleology in evolution

An illustration from the chapter on the application of natural selection to humans in Wallace's 1889 book *Darwinism* shows a chimpanzee.

In 1864, Wallace published a paper, "The Origin of Human Races and the Antiquity of Man Deduced from the Theory of 'Natural Selection'", applying the theory to humankind. Darwin had not yet publicly addressed the subject, although Thomas Huxley had in *Evidence as to Man's Place in Nature*. Wallace explained the apparent stability of the human stock by pointing to the vast gap in cranial capacities between humans and the great apes. Unlike some other Darwinists, including Darwin himself, he did not "regard modern primitives as almost filling the gap between man and ape".[140] He saw the evolution of humans in two stages: achieving a bipedal posture that freed the hands to carry out the dictates of the brain, and the "recognition of the human brain as a totally new factor in the history of life".[140] Wallace seems to have been the first evolutionist to see that the human brain effectively made further specialisation of the body unnecessary.[140] Wallace wrote the paper for the Anthropological Society of London to address the debate between the supporters of monogenism, the belief that all human races shared a common ancestor and were one species, and the supporters of polygenism, who held that different races had separate origins and were different species. Wallace's anthropological observations of Native Americans in the Amazon, and especially his time living among the Dayak people of Borneo, had convinced him that human beings were a single species with a common ancestor. He still felt that natural selection might have continued to act on mental faculties after the development of the different races; and he did not dispute the nearly universal view among European anthropologists of the time that Europeans were intellectually superior to other races.[141][142]

Shortly afterwards, Wallace became a spiritualist. At about the same time, he began to maintain that natural selection could not account for mathematical, artistic, or musical genius, metaphysical musings, or wit and humour. He stated that something in "the unseen universe of Spirit" had interceded at least three times in

history: the creation of life from inorganic matter; the introduction of consciousness in the higher animals; and the generation of the higher mental faculties in humankind. He believed that the raison d'être of the universe was the development of the human spirit.[143]

While some historians have concluded that Wallace's belief that natural selection was insufficient to explain the development of consciousness and the higher functions of the human mind was directly caused by his adoption of spiritualism, other scholars have disagreed, and some maintain that Wallace never believed natural selection applied to those areas.[144][145] Reaction to Wallace's ideas on this topic among leading naturalists at the time varied. Lyell endorsed Wallace's views on human evolution rather than Darwin's.[146][147] Wallace's belief that human consciousness could not be entirely a product of purely material causes was shared by a number of prominent intellectuals in the late 19th and early 20th centuries.[148] All the same, many, including Huxley, Hooker, and Darwin himself, were critical of Wallace.[149]

As the historian of science and sceptic Michael Shermer has stated, Wallace's views in this area were at odds with two major tenets of the emerging Darwinian philosophy. These were that evolution was not teleological (purpose driven), and that it was not anthropocentric (human-centred).[150] Much later in his life Wallace returned to these themes, that evolution suggested that the universe might have a purpose, and that certain aspects of living organisms might not be explainable in terms of purely materialistic processes. He set out his ideas in a 1909 magazine article entitled *The World of Life*, later expanded into a book of the same name.[151] Shermer commented that this anticipated ideas about design in nature and directed evolution that would arise from religious traditions throughout the 20th century.[148]

Assessment of Wallace's role in history of evolutionary theory

In many accounts of the development of evolutionary theory, Wallace is mentioned only in passing as simply being the stimulus to the publication of Darwin's own theory.[152] In reality, Wallace developed his own distinct evolutionary views which diverged from Darwin's, and was considered by many (especially Darwin) to be a leading thinker on evolution in his day, whose ideas could not be ignored. One historian of science has pointed out that, through both private correspondence and published works, Darwin and Wallace exchanged knowledge and stimulated each other's ideas and theories over an extended period.[153] Wallace is the most-cited naturalist in Darwin's *Descent of Man*, occasionally in strong disagreement.[154] Darwin and Wallace agreed on the importance of natural selection, and some of the factors responsible for it: competition between species and geographical isolation. But Wallace believed that evolution had a purpose ("teleology") in maintaining species' fitness to their environment, whereas Darwin hesitated to attribute any purpose to a random natural process. Scientific discoveries since the 19th century support Darwin's viewpoint, by identifying additional mechanisms and triggers such as mutations triggered by environmental radiation or mutagenic chemicals.[155] Wallace remained an ardent defender of natural selection for the rest of his life. By the 1880s, evolution was widely accepted in scientific circles, but natural selection less so. Wallace's 1889 *Darwinism* was a response to the scientific critics of natural selection.[156] Of all Wallace's books, it is the most cited by scholarly publications.[157]

Other scientific contributions

Biogeography and ecology

In 1872, at the urging of many of his friends, including Darwin, Philip Sclater, and Alfred Newton, Wallace began research for a general review of the geographic distribution of animals. Initial progress was slow, in part because classification systems for many types of animals were in flux.[158] He resumed the work in

earnest in 1874 after the publication of a number of new works on classification.[159] Extending the system developed by Sclater for birds—which divided the earth into six separate geographic regions for describing species distribution—to cover mammals, reptiles and insects as well, Wallace created the basis for the zoogeographic regions in use today. He discussed the factors then known to influence the current and past geographic distribution of animals within each geographic region.[160]

A map of the world from *The Geographical Distribution of Animals* shows Wallace's six biogeographical regions.

These factors included the effects of the appearance and disappearance of land bridges (such as the one currently connecting North America and South America) and the effects of periods of increased glaciation. He provided maps showing factors, such as elevation of mountains, depths of oceans, and the character of regional vegetation, that affected the distribution of animals. He summarised all the known families and genera of the higher animals and listed their known geographic distributions. The text was organised so that it would be easy for a traveller to learn what animals could be found in a particular location. The resulting two-volume work, *The Geographical Distribution of Animals*, was published in 1876 and served as the definitive text on zoogeography for the next 80 years.[161]

The book included evidence from the fossil record to discuss the processes of evolution and migration that had led to the geographical distribution of modern species. For example, he discussed how fossil evidence showed that tapirs had originated in the Northern Hemisphere, migrating between North America and Eurasia and then, much more recently, to South America after which the northern species became extinct, leaving the modern distribution of two isolated groups of tapir species in South America and Southeast Asia.[162] Wallace was very aware of, and interested in, the mass extinction of megafauna in the late Pleistocene. In *The Geographical Distribution of Animals* (1876) he wrote, "We live in a zoologically impoverished world, from which all the hugest, and fiercest, and strangest forms have recently disappeared".[163] He added that he believed the most likely cause for the rapid extinctions was glaciation, but by the time he wrote *World of Life* (1911) he had come to believe those extinctions were "due to man's agency".[164]

The line separating the Indo-Malayan and the Austro-Malayan region in Wallace's *On the Physical Geography of the Malay Archipelago* (1863)

In 1880, Wallace published the book *Island Life* as a sequel to *The Geographical Distribution of Animals*. It surveyed the distribution of both animal and plant species on islands. Wallace classified islands into oceanic and two types of continental islands. Oceanic islands, in his view, such as the Galapagos and Hawaiian Islands (then called Sandwich Islands) formed in mid-ocean and never part of any large continent. Such islands were characterised by a complete lack of terrestrial mammals and amphibians, and their inhabitants (except migratory birds and species introduced by humans) were typically the result of accidental colonisation and subsequent evolution.

Continental islands, in his scheme, were divided into those that were recently separated from a continent (like Britain) and those much less recently (like Madagascar). Wallace discussed how that difference affected flora and fauna. He discussed how isolation affected evolution and how that could result in the preservation of classes of animals, such as the lemurs of Madagascar that were remnants of once widespread continental faunas. He extensively discussed how changes of climate, particularly periods of increased glaciation, may have affected the distribution of flora and fauna on some islands, and the first portion of the book discusses possible causes of these great ice ages. *Island Life* was considered a very important work at the time of its publication. It was discussed extensively in scientific circles both in published reviews and in private correspondence.[165]

Environmentalism

Wallace's extensive work in biogeography made him aware of the impact of human activities on the natural world. In *Tropical Nature and Other Essays* (1878), he warned about the dangers of deforestation and soil erosion, especially in tropical climates prone to heavy rainfall. Noting the complex interactions between vegetation and climate, he warned that the extensive clearing of rainforest for coffee cultivation in Ceylon (now called Sri Lanka) and India would adversely impact the climate in those countries and lead to their impoverishment due to soil erosion.[166] In *Island Life*, Wallace again mentioned deforestation and invasive species. On the impact of European colonisation on the island of Saint Helena, he wrote that the island was "now so barren and forbidding that some persons find it difficult to believe that it was once all green and fertile".[167] He explained that the soil was protected by the island's vegetation; once that was destroyed, the soil was washed off the steep slopes by heavy tropical rain, leaving "bare rock or sterile clay".[167] He attributed the "irreparable destruction"[167] to feral goats, introduced in 1513. The island's forests were further damaged by the "reckless waste"[167] of the East India Company from 1651, which used the bark of valuable redwood and ebony trees for tanning, leaving the wood to rot unused.[167] Wallace's comments on environment grew more urgent later in his career. In *The World of Life* (1911) he wrote that people should view nature "as invested with a certain sanctity, to be used by us but not abused, and never to be recklessly destroyed or defaced."[168]

Astrobiology

Wallace's 1904 book *Man's Place in the Universe* was the first serious attempt by a biologist to evaluate the likelihood of life on other planets. He concluded that the Earth was the only planet in the solar system that could possibly support life, mainly because it was the only one in which water could exist in the liquid phase.[169] His treatment of Mars in this book was brief, and in 1907, Wallace returned to the subject with a book *Is Mars Habitable?* to criticise the claims made by the American astronomer Percival Lowell that there were Martian canals built by intelligent beings. Wallace did months of research, consulted various experts, and produced his own scientific analysis of the Martian climate and atmospheric conditions.[170] He pointed out that spectroscopic analysis had shown no signs of water vapour in the Martian atmosphere, that Lowell's analysis of Mars's climate badly overestimated the surface temperature, and that low atmospheric pressure would make liquid water, let alone a planet-girding irrigation system, impossible.[171]

Richard Milner comments that Wallace "effectively debunked Lowell's illusionary network of Martian canals."[172] Wallace became interested in the topic because his anthropocentric philosophy inclined him to believe that man would be unique in the universe.[173]

Other activities

Spiritualism

Wallace was an enthusiast of phrenology.[174] Early in his career, he experimented with hypnosis, then known as mesmerism, managing to hypnotise some of his students in Leicester.[175] When he began these experiments, the topic was very controversial: early experimenters, such as John Elliotson, had been harshly criticised by the medical and scientific establishment.[176] Wallace drew a connection between his experiences with mesmerism and spiritualism, arguing that one should not deny observations on "a priori grounds of absurdity or impossibility".[177]

Wallace began investigating spiritualism in the summer of 1865, possibly at the urging of his older sister Fanny Sims.[178] After reviewing the literature and attempting to test what he witnessed at séances, he came to believe in it. For the rest of his life, he remained convinced that at least some séance phenomena were genuine, despite accusations of fraud and evidence of trickery. One biographer suggested that the emotional shock when his first fiancée broke their engagement contributed to his receptiveness to spiritualism.[179] Other scholars have emphasised his desire to find scientific explanations for all phenomena.[176][180] In 1874, Wallace visited the spirit photographer Frederick Hudson. He declared that a photograph of him with his deceased mother was genuine.[181] Others reached a different conclusion: Hudson's photographs had previously been exposed as fraudulent in 1872.[182]

Spirit photograph taken by Frederick Hudson of Wallace and his late mother in 1882; he may have used double exposure.

Wallace's public advocacy of spiritualism and his repeated defence of spiritualist mediums against allegations of fraud in the 1870s damaged his scientific reputation. In 1875 he published the evidence he believed proved his position in *On Miracles and Modern Spiritualism*.[183] His attitude permanently strained his relationships with previously friendly scientists such as Henry Bates, Thomas Huxley, and even Darwin.[184][185] Others, such as the physiologist William Benjamin Carpenter and zoologist E. Ray Lankester became publicly hostile to Wallace over the issue. Wallace was heavily criticised by the press; *The Lancet* was particularly harsh.[185] When, in 1879, Darwin first tried to rally support among naturalists to get a civil pension awarded to Wallace, Joseph Hooker responded that "Wallace has lost caste considerably, not only by his adhesion to Spiritualism, but by the fact of his having deliberately and against the whole voice of the committee of his section of the British Association, brought about a discussion on Spiritualism at one of its sectional meetings ... This he is said to have done in an underhanded manner, and I well remember the indignation it gave rise to in the B.A. Council."[186][187] Hooker eventually relented and agreed to support the pension request.[188]

Flat Earth wager

In 1870, a flat-Earth proponent named John Hampden offered a £500 wager (roughly equivalent to £51,000 in 2021[189]) in a magazine advertisement to anyone who could demonstrate a convex curvature in a body of water such as a river, canal, or lake. Wallace, intrigued by the challenge and short of money at the time, designed an experiment in which he set up two objects along a six-mile (10 km) stretch of canal. Both objects were at the same height above the water, and he mounted a telescope on a bridge at the same height above the water as well. When seen through the telescope, one object appeared higher than the other, showing the curvature of the earth. The judge for the wager, the editor of *Field* magazine, declared Wallace the winner, but Hampden refused to accept the result. He sued Wallace and launched a campaign, which persisted for several years, of writing letters to various publications and to organisations of which Wallace was a member denouncing him as a swindler and a thief. Wallace won multiple libel suits against Hampden, but the resulting litigation cost Wallace more than the amount of the wager, and the controversy frustrated him for years.[190]

Anti-vaccination campaign

In the early 1880s, Wallace joined the debate over mandatory smallpox vaccination. Wallace originally saw the issue as a matter of personal liberty; but, after studying statistics provided by anti-vaccination activists, he began to question the efficacy of vaccination. At the time, the germ theory of disease was new and far from universally accepted. Moreover, no one knew enough about the human immune system to understand why vaccination worked. Wallace discovered instances where supporters of vaccination had used questionable, in a few cases completely false, statistics to support their arguments. Always suspicious of authority, Wallace suspected that physicians had a vested interest in promoting vaccination, and became convinced that reductions in the incidence of smallpox that had been attributed to vaccination were due to better hygiene and improvements in public sanitation.[191]

Another factor in Wallace's thinking was his belief that, because of the action of natural selection, organisms were in a state of balance with their environment, and that everything in nature, even disease-causing organisms, served a useful purpose; he feared vaccination might upset this balance.[192] Wallace pointed out that vaccination, which at the time was often unsanitary, could be dangerous.[192]

In 1890, Wallace gave evidence to a Royal Commission investigating the controversy. It found errors in his testimony, including some questionable statistics. *The Lancet* averred that Wallace and other activists were being selective in their choice of statistics. The commission found that smallpox vaccination was effective and should remain compulsory, though they recommended some changes in procedures to improve safety, and that the penalties for people who refused to comply be made less severe. Years later, in 1898, Wallace wrote a pamphlet, *Vaccination a Delusion; Its Penal Enforcement a Crime*, attacking the commission's findings. It, in turn, was attacked by *The Lancet*, which stated that it repeated many of the same errors as his evidence given to the commission.[191]

Legacy and historical perception

Honours

As a result of his writing, Wallace became a well-known figure both as a scientist and as a social activist, and was often sought out for his views.[193] He became president of the anthropology section of the British Association in 1866,[194] and of the Entomological Society of London in 1870.[195] He was elected to the American Philosophical Society in 1873.[196] The British Association elected him as head of its biology section in 1876.[197] He was elected to the Royal Society in 1893.[197] He was asked to chair the

Wallace and his signature on the frontispiece of *Darwinism* (1889)

International Congress of Spiritualists meeting in London in 1898.[198] He received honorary doctorates and professional honours, such the Royal Society's Royal Medal in 1868 and its Darwin Medal in 1890,[195] and the Order of Merit in 1908.[199]

Obscurity and rehabilitation

Wallace's fame faded quickly after his death. For a long time, he was treated as a relatively obscure figure in the history of science.[152] Reasons for this lack of attention may have included his modesty, his willingness to champion unpopular causes without regard for his own reputation, and the discomfort of much of the scientific community with some of his unconventional ideas.[200] The reason that the theory of evolution is popularly credited to Darwin is likely the impact of Darwin's *On the Origin of Species*.[200]

Recently, Wallace has become better known, with the publication of at least five book-length biographies and two anthologies of his writings published since 2000.[201] A web page dedicated to Wallace scholarship is maintained at Western Kentucky University.[202] In a 2010 book, the environmentalist Tim Flannery argued that Wallace was "the first modern scientist to comprehend how essential cooperation is to our survival", and suggested that Wallace's understanding of natural selection and his later work on the atmosphere should be seen as a forerunner to modern ecological thinking.[203] A collection of his medals, including the Order of Merit, were sold at auction for £273,000 in 2022.[204]

Centenary celebrations

The Natural History Museum, London, co-ordinated commemorative events for the Wallace centenary worldwide in the 'Wallace100' project in 2013.[205][206] On 24 January, his portrait was unveiled in the Main Hall of the museum by Bill Bailey, a fervent admirer.[207] Bailey further championed Wallace in his 2013 BBC Two series "Bill Bailey's Jungle Hero".[208] On 7 November 2013, the 100th anniversary of Wallace's death, Sir David Attenborough unveiled a statue of Wallace at the museum.[209] The statue, sculpted by Anthony Smith, was donated by the A. R. Wallace Memorial Fund.[210] It depicts Wallace as a young man, collecting in the jungle. November 2013 marked the debut of *The Animated Life of A. R. Wallace*, a paper-puppet animation film dedicated to Wallace's centennial.[211] In addition, Bailey unveiled a bust of Wallace, sculpted by Felicity Crawley, in Twyn Square in Usk, Monmouthshire in November 2021.[212]

Anthony Smith's statue of Wallace, looking up at a bronze model of a Wallace's golden birdwing butterfly. Natural History Museum, London, unveiled 7 November 2013.

Memorials

Mount Wallace in California's Sierra Nevada mountain range was named in his honour in 1895.[213] In 1928, a house at Richard Hale School (then called Hertford Grammar School, where he had been a pupil) was named after Wallace.[214][215] The Alfred Russel Wallace building is a prominent

feature of the Glyntaff campus at the University of South Wales, by Pontypridd, with several teaching spaces and laboratories for science courses. Lecture theatres at Swansea and Cardiff universities are named after him,[215] as are impact craters on Mars and the Moon.[214] In 1986, the Royal Entomological Society mounted a year-long expedition to the Dumoga-Bone National Park in North Sulawesi named Project Wallace.[215] A group of Indonesian islands is known as the Wallacea biogeographical region in his honour, and Operation Wallacea, named after the region, awards "Alfred Russel Wallace Grants" to undergraduate ecology students.[216] Several hundred species of plants and animals, both living and fossil, have been named after Wallace,[217] such as the gecko *Cyrtodactylus wallacei*,[218] and the freshwater stingray *Potamotrygon wallacei*.[219]

Writings

Wallace was a prolific author. In 2002, a historian of science published a quantitative analysis of Wallace's publications. He found that Wallace had published 22 full-length books and at least 747 shorter pieces, 508 of which were scientific papers (191 of them published in *Nature*). He further broke down the 747 short pieces by their primary subjects: 29% were on biogeography and natural history, 27% were on evolutionary theory, 25% were social commentary, 12% were on anthropology, and 7% were on spiritualism and phrenology.[220] An online bibliography of Wallace's writings has more than 750 entries.[33]

The standard author abbreviation **Wallace** is used to indicate this person as the author when citing a botanical name.[221]

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Notes

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Further reading

There is an extensive literature on Wallace. Recent books on him include:

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- The Alfred Russel Wallace Website (https://wallacefund.myspecies.info/) by George Beccaloni
- Alfred Russel Wallace (http://people.wku.edu/charles.smith/index1.htm) at Western Kentucky University
- The Alfred Russel Wallace Correspondence Project (https://wallaceletters.myspecies.info/)
- Wallace Online (http://wallace-online.org/) – The first complete online edition of the writings of Alfred Russel Wallace
- Great Lives – Bill Bailey on his hero Alfred Russel Wallace (https://www.bbc.co.uk/programmes/m000cldv) on BBC Radio 4
- Works by Alfred Russel Wallace (https://www.gutenberg.org/author/Wallace,+Alfred+Russel) at Project Gutenberg
- Works by or about Alfred Russel Wallace (https://archive.org/search.php?query=%28%28subject%3A%22Wallace%2C%20Alfred%20Russel%22%20OR%20subject%3A%22Wallace%2C%20Alfred%20R%2E%22%20OR%20subject%3A%22Wallace%2C%20A%2E%20R%2E%22%20OR%20subject%3A%22Alfred%20Russel%20Wallace%22%20OR%20subject%3A%22Alfred%20R%2E%20Wallace%22%20OR%20subject%3A%22A%2E%20R%2E%20Wallace%22%20OR%20subject%3A%22Wallace%2C%20Alfred%22%20OR%20subject%3A%22Alfred%20Wallace%22%20OR%20creator%3A%22Alfred%20Russel%20Wallace%22%20OR%20creator%3A%22Alfred%20R%2E%20Wallace%22%20OR%20creator%3A%22A%2E%20R%2E%20Wallace%22%20OR%20creator%3A%22A%2E%20Russel%20Wallace%22%20OR%20creator%3A%22Wallace%2C%20Alfred%20Russel%22%20OR%20creator%3A%22Wallace%2C%20Alfred%20R%2E%22%20OR%20creator%3A%22Wallace%2C%20A%2E%20R%2E%22%20OR%20creator%3A%22Wallace%2C%20A%2E%20Russel%22%20OR%20creator%3A%22Alfred%20Wallace%22%20OR%20creator%3A%22Wallace%2C%20Alfred%22%20OR%20title%3A%22Alfred%20Russel%20Wallace%22%20OR%20title%3A%22Alfred%20R%2E%20Wallace%22%20OR%20title%3A%22A%2E%20R%2E%20Wallace%22%20OR%20title%3A%22Alfred%20Wallace%22%20OR%20description%3A%22Alfred%20Russel%20Wallace%22%20OR%20description%3A%22Alfred%20R%2E%20Wallace%22%20OR%20description%3A%22A%2E%20R%2E%20Wallace%22%20OR%20description%3A%22Wallace%2C%20Alfred%20Russel%22%20OR%20description%3A%22Wallace%2C%20Alfred%20R%2E%22%20OR%20description%3A%22Alfred%20Wallace%22%20OR%20description%3A%22Wallace%2C%20Alfred%22%29%20OR%20%28%221823-1913%22%20AND%20Wallace%29%29%20AND%20%28-mediatype:software%29) at Internet Archive
- Works by Alfred Russel Wallace (https://librivox.org/author/4452) at LibriVox (public domain audiobooks)

Alfred Russel Wallace centenary

The **centenary** of the death of the naturalist **Alfred Russel Wallace** on 7 November 1913 was marked in 2013 with events around the world to celebrate his life and work. The commemorations was co-ordinated by the Natural History Museum, London.

Events between October 2013 and June 2014 were planned by the Natural History Museum and other organisations including the Zoological Society of London, Cardiff University, the University of Alberta, Dorset County Museum,[2] Swansea Museum, Dorset Wildlife Trust, Ness Botanical Gardens (South Wirral), the Royal Society, the Linnean Society, the Harvard Museum of Natural History, the American Museum of Natural History,[3] Hertford Museum[4] and the National Museum of Wales.[5]

Statue in bronze of naturalist Alfred Russel Wallace (1823-1913) by Anthony Smith. He is looking up at a bronze model of a Wallace's golden birdwing butterfly (*Ornithoptera croesus*). The statue was commissioned by the Wallace Memorial Fund and was given to the Natural History Museum, London, where it was unveiled by Sir David Attenborough on November 7th 2013 - the 100th anniversary of Wallace's death.[1]

Contents

Context

The naturalist, explorer, geographer, anthropologist and biologist Alfred Russel Wallace (born 8 January 1823) died on 7 November 1913. He is principally remembered now for having independently conceived the theory of evolution through natural selection, which prompted Charles Darwin to publish *On the Origin of Species*. Some of his books such as *The Malay Archipelago* remain in print; it is considered one of the best accounts of scientific exploration published during the 19th century. Wallace is also remembered for recognizing the presence of a biogeographical boundary, now known as the Wallace Line, that divides the Indonesian archipelago into two distinct parts: a western portion in which the animals are almost entirely of Asian origin, and an eastern portion where the fauna reflect the influence of Australasia.[6]

Events

The South Kensington Natural History Museum, London, co-ordinating commemorative events for the Wallace centenary worldwide in the 'Wallace100' project,[7] created a website to celebrate Wallace's centenary.[8] The museum holds the Wallace Collection of memorabilia including letters, Wallace's

An illustration from Wallace's *The Malay Archipelago*, signed 'T. Baines', showing men from Timor holding palm leaf umbrellas, plant artefacts like one he gave to the Royal Botanic Gardens, Kew[6]

notebooks and other documents, and 28 drawers of insects and other specimens that he collected on his expeditions to the Malay Archipelago and to South America.[8] The museum describes Wallace as "Father of biogeography", as a committed socialist, and as a spiritualist.[8]

The Royal Society planned a two-day discussion meeting in October 2013 for researchers on "Alfred Russel Wallace and his legacy", with speakers including George Beccaloni, Steve Jones, Lynne Parenti, Tim Caro and Martin Rees.[9] Cardiff University's School of Earth & Ocean Sciences had a lecture series in 2013-2014 as part of the centenary commemoration of Wallace.[10]

Hertford Museum held several events including an evening of illustrated talks on 15 January 2014 at Hertford Theatre. Errol Fuller discussed Wallace and the curious 19th-century social phenomenon that guided his life; Sandra Knapp talked about Wallace's life and explorations in the Amazon.[11]

The Linnean Society held a two-day celebration of Wallace's centenary in Bournemouth on 7 and 8 June 2013, together with the Society for the History of Natural History, Bournemouth University and Bournemouth Natural Sciences Society. The event included talks about Wallace, his thoughts on natural selection, his evolutionary insights, and his notebooks and letters. A theatrical performance, *You Should Ask Wallace*, was put on by Theatre na n'Og. On the second day the group visited Wallace's grave and went on a nature walk in Wallace's memory.[12]

The Royal Botanic Gardens, Kew ran a display of Wallace memorabilia including letters, photographs, artefacts made from plants, and herbarium specimens in 2013.[13] *Kew* magazine likewise published an article "The Wallace Connection" to mark the centenary.[6]

The American Museum of Natural History, New York City, planned a talk by naturalist and broadcaster David Attenborough for 12 November 2013, entitled 'Alfred Russel Wallace and the Birds of Paradise'. Birute Galdikas, one of Louis Leakey's 'ape women', spoke about her orangutans at the museum's Wallace conference.[14]

In 2013 the BBC broadcast a two-part television series, *Bill Bailey's Jungle Hero: Alfred Russel Wallace*, in which the musician and comedian Bill Bailey travelled in the footsteps of Wallace in Indonesia to show what the naturalist achieved.[15]

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- Wallace Fund: Wallace100 (https://archive.today/20131008003444/http://wallacefund.info/wallace100)
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