

WALLACE

Species seeker extraordinaire

Darwin's inspiration for the theory of evolution came from a single voyage. Across the globe, Alfred Russel Wallace, one of the world's greatest species seekers, travelled a different path. In the year of the centenary of Wallace's death, writer **Richard Conniff** traces his history.

I'm afraid the ship's on fire. Come and see what you think of it,' the captain said. It was after breakfast, 6 August 1852, and the writer recounting this awful moment was Alfred Russel Wallace. He was the only passenger on the 235-tonne brig *Helen*, aflame, in the middle of the Atlantic. Wallace wandered numbly down to his cabin, through the suffocating smoke and heat, to retrieve a single tin box with a few notebooks and drawings from his travels. He left behind three years of journals and a large folio of drawings and notes. In the hold of the ship were boxes and boxes of species never seen outside the Amazon. He had gathered it all by means of long, difficult travel, complicated by malaria, yellow fever, dysentery and other hardships. He was still recovering from a bout of fever as the ship burned, and he felt 'a kind of apathy about saving anything'.

When the time came, Wallace went over the stern on a rope, tearing up his hands as he

slid down into a boat that was 'rising and falling and swaying about with the swell of the ocean'.

LOST AT SEA

The extent of his loss did not dawn on him until they were finally rescued, seven days later, by a ship bound for London from Cuba.

Wallace now felt secure enough to reflect on his loss: 'How many times, when almost overcome by the ague [malaria], had I crawled into the forest and been rewarded by some unknown and beautiful species! How many places, which no European foot but my own had trodden, would have been recalled to my memory by the rare birds and insects they had furnished to my collection! How many weary days and weeks had I passed, upheld only by the fond hope of bringing home many new and beautiful forms from those wild regions... And now everything was gone.' It was as if Darwin's *Beagle* had sunk with all



his Galapagos treasures still unmined for scientific insights. But 'I tried to think as little as possible about what might have been', Wallace later wrote, 'and to occupy myself with the state of things which actually existed'.

Arriving back in England that October, after almost three months at sea, including a week in an open lifeboat, Wallace was tattered, unwashed, thin – and jubilant. 'Oh glorious day!' he cried, going ashore at Deal in Kent. 'Oh beef-steaks and damson-tart, a paradise for hungry sinners'. In London, his agent Samuel Stevens got him a new suit of clothes and had his own mother feed him back to health at the family home. Stevens had taken the precaution of insuring all shipments from his collectors. So Wallace at least had the £200 insurance payout, small compensation for his loss, but enough to live on for now.

Within days of his return, Wallace was already contemplating his next expedition. Over the next year, he also busied himself writing four scientific papers and two books, one a technical treatise on Amazonian palms, the other his *A Narrative of Travels on the Amazon and Rio Negro*, cobbled together from letters home and from memory.

RUFFLING FEATHERS

He was, as he later put it, 'the young man in a hurry', and it showed. At a meeting of the Zoological Society of London in December 1852, just two months after his return, Wallace gave his fellow naturalists a cordial earful. He had found to his dismay that the labels in museums and in natural history books seldom recorded more than the vaguest hint of where a specimen came from: 'Brazil', 'Peru', even 'S. America'.

Conventional naturalists still mostly treated new species as the result of separate and seemingly random acts of creation by God. But Wallace was seeing connections and asking what they signified. Why did clusters of similar species all occur within a single small area? Why did species often vary only slightly from one island to the next? Wallace felt that these questions could not be satisfactorily answered until the exact geographical limits of a species were accurately determined.

This idea that they'd been going about their business in the wrong way irritated other naturalists, not least because it came from a field collector who earned his wages like a shoemaker on a piece-rate basis. 'The professional experts in the museums of London, and the connoisseurs of the rectories and country houses' did not even want to allow the likes of Bates and Wallace into their learned societies, according to

Wallace biographer Peter Raby. Edward Newman, the president of the Entomological Society, had to admonish members in 1854 for their snobberies.

ASKING QUESTIONS

Wallace was thinking far more deeply about species than the experts and connoisseurs who bought his specimens. Though he was careful not to say so out loud, he was still focused on testing the idea, put forward by an anonymous writer in an 1845 book, *Vestiges of the Natural History of Creation*, that natural laws could drive evolutionary change. Such a law was already forming in his mind, and he might well have come to it, and to the idea of natural selection, far more rapidly except for the loss of so much valuable evidence.

He cast about for ways to renew his attack on what he later called 'the most difficult and... interesting problem in the natural history of the earth' – the origin of species. The Malay Archipelago, sweeping from Malaysia to Papua New Guinea, seemed to offer 'the very finest field for the exploring and collecting naturalist' on account of its 'wonderful richness' and relatively unexplored state. It bridged the gap between the very different fauna of Asia and Australia, and its 17,500 islands offered an almost infinite variety of habitats, of all sizes, and all degrees of isolation. Wallace needed, as he later explained to his bewildered family, to 'visit and explore the largest number of islands possible and collect animals from the greatest number of localities in order to arrive at any definite results' about the geography of species.

By the start of 1855, Wallace was holed up during the monsoon in a small house at the mouth of the Sarawak River, just opposite the blue mass of Santubong Mountain, on the north coast of Borneo.

His books had arrived belatedly by the long route around Africa, and now he took time to consult them and brood over his findings about the puzzling distribution of hummingbirds, toucans, monkeys and other species in the Amazon. The resulting article in that September's *Annals and Magazine of Natural History* proposed a simple law: 'Every species has come into existence coincident both in space and time with a pre-existing closely allied species'. They hadn't just dropped down from heaven.

Wallace titled his article *On the Law Which Has Regulated the Introduction of New Species*. A knack for compelling titles clearly eluded him. But the text struck an unmistakable note of urgency: 'Hitherto no attempt has been made to explain >

This page Wallace's flying frog *Rhacophorus nigropalmatus*. Photographed in the Danum Valley Conservation Area, Sabah, Malaysian Borneo. **Next page** A tray of butterflies collected by Alfred Russel Wallace during his expedition in the Malay Archipelago.



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these singular phenomena, or to show how they have arisen. Why are the genera of Palms and of Orchids in almost every case confined to one hemisphere? Why are the closely allied species of brown-backed Trogons all found in the East, and the green-backed in the West? Why are the Macaws and the Cockatoos similarly restricted? Insects furnish a countless number of analogous examples... and in all, the most closely allied species [are] found in geographical proximity. The question forces itself upon every thinking mind – why are these things so?’

NATURAL WONDER

Wallace avoided the language of evolution. Instead of saying new species had ‘evolved’ he said ‘created’ and instead of connecting them to an ‘ancestral species’ or ‘common ancestor’

he used the unfamiliar word ‘antitype’. This vocabulary obscured his logical conclusion, that allied species occur close together because one species has evolved from another. Wallace also neglected to propose a mechanism for how this kind of evolution could occur. So even Darwin missed the point when he read the article, scribbling ‘nothing very new’ and ‘it seems all creation with him’.

Wallace recorded both his developing theories and his field notes in a journal now kept at the Linnean Society in London. The cardboard covers, quarter-bound with faded old leather, are falling apart and many of the pages are loose and have brittle, broken edges. But the greatest field collector of the nineteenth century still lives between the lines. Capturing an *Ornithoptera*, ‘the largest, the most perfect, and the most beautiful of butterflies’ in the Aru Islands near New Guinea,

for instance, Wallace recorded the moment of discovery: ‘I trembled with excitement as I saw it come majestically toward me and could hardly believe I had really obtained it till I had taken it out of my net and gazed upon its gorgeous wings of velvety black and brilliant green, its golden body and crimson breast. It was six and a half inches across its expanded wings and I have certainly never seen a more gorgeous insect.’ Wallace thought he had discovered a new species and named it *Ornithoptera poseidon*. ‘I had almost by heart the characters of all the known species’, he wrote, ‘and I thought I could not be deceived in pronouncing this to be a new one’.

WORLDS APART

Though Wallace thought it had sunk without notice, his 1855 paper the *Introduction of New Species* had in fact stirred up interest

in important circles. Charles Lyell, Darwin’s friend and mentor, took Wallace seriously enough to open his own series of notebooks on the species question.

Lyell had long espoused the Creationist dogma that all species were adapted from the start to the places of their origin and did not change significantly thereafter. But his anti-evolutionary convictions were beginning to waver. His first notebook entry, two days after reading the Wallace article, disputed the idea that limb rudiments in a snake-like reptile were evidence for its evolution from a quadruped ancestor. ‘Arguments against such variability of species are too powerful’, he wrote – and seemed almost to add, ‘Aren’t they?’ Wallace meanwhile was jotting notes to himself about how just such limb rudiments in whales revealed their descent from quadruped mammals, not fish. For the next few months, at a distance of 12,800 kilometres, Lyell and Wallace harrowed each other’s thoughts.

The two men inhabited distinctly different worlds, and not just geographically. Lyell had ‘a Lord Chancellor Manner’ according to one acquaintance. He was also ‘clubbable and cultured; a friend to peers and Prime Ministers’, according to Darwin biographer Adrian Desmond. ‘He was a lawyer by training and a gentleman by status: he lived on his capital and made geology his vocation’. Wallace meanwhile was a friend to funny old men in remote villages and, of course, still a glorified manual labourer who lived by catching butterflies.

But Lyell’s 1,200-page *Principles of Geology* was a continuing influence. With lawyerly precision, it made the case that natural rather than miraculous forces had caused the raising of seabeds, delving of canyons and upthrusting of mountains. Lyell thought geologic changes had occurred gradually, from forces still operating in the modern world. He debunked Georges Cuvier’s romantic vision of an Earth alternating between epochs of catastrophic upheaval (when waves of extinction swept across the planet) and periods of relative calm (when new species sprang up). In contrast to this catastrophist world view, Lyell’s uniformitarians saw a steadier, slower process of change, with the past not all that different from the present, give or take a few extinctions. But catastrophists and uniformitarians alike believed that new species, and particularly human beings, were the result of ‘special creations’ by God, and also mostly permanent in character.

Lyell had devoted the second volume of his *Principles* to refuting the evolutionary thinking of Jean-Baptiste Lamarck.

But reading and rereading *Principles* in the field, Wallace thought that the slow power of natural forces could produce major changes, not just in geological phenomena but also in living plants and animals, even leading to the origin of new species. It bothered Wallace that Lyell did not also see it.

The reliance on ‘special creations’ set Wallace off on a transmutationist tear in his journal: ‘In a small group of islands not very distant from the mainland, like the Galapagos, we find animals and plants different from those of any other country but resembling those of the nearest land. If they are special creations why should they resemble those of the nearest land? Does not that fact point to an origin from that land’. It was just a quick note to himself, jotted down too fast for proper punctuation. But it wasn’t really a question, anyway.

MAKING WAVES

From one island to the next, Wallace’s thoughts came back to Lyell, often in a spirit of contention. The geologist’s talk of the ‘balance of species’ pushed Wallace to the brink. ‘This phrase is utterly without meaning’, he began. ‘Some species are very rare and others very abundant. Where is the balance?’ And then the key phrase (italics added), ‘To human apprehension this is no balance but a struggle in which one often exterminates another’. In his state of high critical dudgeon, Wallace seemed to miss, for the moment, the full import of his own words. What he was describing was natural selection.

For almost 20 years, Darwin had managed to conceal the full extent of his evolutionary thinking from Lyell, the top anti-evolutionary voice of his generation. But during a visit in April 1856 the shocking truth came out, Darwin believed in the almost infinite possibility of species to vary and evolve, by natural or artificial selection. Lyell was alarmed. This wasn’t some dubious continental like Lamarck. Darwin was a cautious and highly regarded naturalist,

and, no small thing, a member of his own social class. He grew more alarmed later that month, when Darwin convened a gathering at Down House where he subtly lobbied for the evolutionary cause with his guests, the biologist and writer T H Huxley, the botanist Joseph Hooker, and entomologist T Vernon Wollaston, who had just published a book on variation in beetle species.

But Lyell also could not help seeing that Darwin’s ‘species-making’ mechanism – natural selection – might actually make sense. So despite his own lingering anti-evolutionary beliefs, he did the right thing as a scholar and friend, urging Darwin to publish at least ‘some small fragment of your data... and so out with the theory and let it take date – and be cited – and understood’. If Darwin didn’t strike now, somebody else would.

By now, Wallace and Darwin were also corresponding. Through his agent, Wallace sent Darwin poultry specimens from Bali and Lombok. Darwin replied in May 1857 with encouragement, cautiously praising Wallace’s paper on the introduction of species, ‘I can plainly see that we have thought much alike and to a certain extent have come to similar conclusions... I agree to the truth of almost every word of your paper’. But he also gently warned Wallace off: ‘This summer will make the 20th year (!) since I opened my first notebook on the species question’, he wrote, adding that it might take him another two years to go to press.

IN SICKNESS AND IN HEALTH

Early in the new year, at the other end of the earth, Wallace’s travels took him to a ramshackle hut with a leaky roof on the coast of a mountainous island he called Gilolo, now known as Halmahera, just west of Papua New Guinea. He seems to have passed much of the trip prostrate, wrapped in blankets against the hot and cold fits of malaria. Sickness made him think, if only by forcing a pause in his restless collecting.

‘I trembled with excitement as I saw it come majestically towards me and could hardly believe I had really obtained it till I had taken it out of my net..’

This page Red bird of paradise *Paradisaea rubra* collected by Wallace. Plate 31 from John Gould's *The Birds of New Guinea*, Vol. 1 (1875–1888). Hand-coloured lithograph. Specimen drawer of golden birdwing butterflies *Ornithoptera croesus*, collected by Wallace.

Next page A map from *The Malay Archipelago* (1874) by Alfred Russel Wallace.



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As he lay there he mulled over the species question and, one day, the same book that had inspired Darwin came to mind – T R Malthus's *An Essay on the Principle of Population*. 'It occurred to me to ask the question, why do some die and some live,' he later recalled. Thinking about how the healthiest individuals survive disease, and the strongest or swiftest escape from predators, 'it suddenly flashed upon me... in every generation the inferior would inevitably be killed off and the superior would remain – that is, the fittest would survive'. Over the next three days, literally in a fever, he wrote out the idea. On 9 March, 1858, back on the volcanic island of Ternate, the commercial centre for the region, he posted it to Darwin.

It was arguably the greatest career miscalculation in the history of science. Wallace was clearly flattered to be treated as a colleague by the eminent Charles Darwin. He could perhaps contemplate no greater success than contributing to the manuscript Darwin had been working at (and dawdling over) for 20 years. One of Darwin's recent letters had also mentioned Lyell's favourable impression of Wallace's work, and in his cover letter Wallace asked Darwin to show the new manuscript to Lyell, if he deemed it worthy. But had he simply followed his practice with his previous articles, sending the manuscript via Stevens to the editors of *Annals and Magazine of Natural History*, credit for the discovery of natural selection would have been entirely his, and the name Wallace might now be as famous as Darwin.

GREAT MINDS ALIKE

Wallace may simply have been too distracted by his species seeking to think about the manuscript more strategically. Upon his return to Ternate, he immediately became caught up in plans for 'my four-month campaign' in New Guinea. By the end of March Wallace was off exploring 'those dark forests' of New Guinea that had given birth 'to the most extraordinary and the most beautiful of the feathered inhabitants of the Earth, the birds of paradise'.

One morning a few months later, in mid-June 1858, Charles Darwin wandered out of his study to leaf through the mail on the hall table. A fat envelope awaited his attention, containing Wallace's 20-page handwritten manuscript, *On the Tendency of Varieties to Depart Indefinitely from the Original Type*. Darwin read it with dawning recognition – and horror.

'The life of wild animals is a struggle for existence', Wallace wrote, and 'the weakest and least perfectly organised must always succumb'. He described some of the variations that occur normally within a species, and theorised about how different forms could determine whether animals lived or died: an antelope with shorter or weaker legs would be easier prey for big cats. A passenger pigeon with less powerful wings would have a harder time finding enough food, 'and in both cases the result must necessarily be a diminution of the population of the modified species'. On the other hand, a change in circumstances – a drought, a plague of locusts or the appearance of some new predator – could make the parent

form of a species extinct and enable some modified offshoot to 'rapidly increase in numbers and occupy the place of the extinct species and variety'.

Wallace devoted a lengthy section of his essay to showing how his theory differed from Lamarckian evolution – it wasn't about giraffes getting longer necks because they 'desired' to reach higher vegetation. On the contrary, individual giraffes with somewhat longer necks simply got favoured over time because they could secure 'a fresh range of pasture over the same ground as their shorter-necked companions, and on the first scarcity of food were thereby enabled to outlive them'. It was, in a nutshell, natural selection.

Darwin had long recognised that someone might beat him to the natural selection jackpot and 'fancied that I had grand enough soul not to care', he later wrote. But now he saw how mistaken he had been. 'All my originality, whatever it may amount to, will be smashed', he lamented in a note to Lyell.

SET IN HISTORY

What happened next was, for some modern critics, a case of gentlemen friends using their social class and professional status to protect one of their own. Lyell and Hooker conspired, they argue, to deny a little-known outsider's rightful claim to priority. But Wallace himself did not feel that way when he found out about it three months later. He was, he later wrote, honoured that his 'sudden intuition' had received credit 'on the same level with the prolonged labours of Darwin'. His essay had been 'hastily written and immediately sent off'. But Darwin had worked for years

'to present the theory to the world with such a body of systematised facts and arguments as would almost compel conviction'.

Instead of publishing his essay outright, Wallace had merely sent a letter from one naturalist to another. And on those grounds, Darwin had fair claim to priority. On 5 September 1857, six months before Wallace sent his letter, Darwin had outlined his theory in a letter to American botanist Asa Gray. His wording foreshadowed Wallace's almost point for point: 'I cannot doubt that during millions of generations individuals of a species will be born with some slight variation profitable to some part of its economy... this variation... will be slowly increased by the accumulative action of Natural selection; and the variety thus formed will either coexist with, or more commonly will exterminate its parent form'. In addition to this letter, Darwin had also showed his 1844 manuscript on natural selection to Hooker.

The compromise cobbled together by Lyell and Hooker called for a joint presentation before a meeting of the Linnean Society a few days later, on 1 July 1858. Lyell and Hooker wrote an introductory letter in which the 'two indefatigable naturalists', Darwin and Wallace, started out on equal footing, having 'independently and unknown to one another, conceived the same very ingenious theory'. But they also made it clear that Darwin had come first, emphasising the 1844 manuscript, 'the contents of which we had both of us been privy to for many years' – a stretch in Lyell's case, as he had only heard about Darwin's theory for the first time in

April 1856. The letter ended by emphasising Darwin's 'years of reflection', incidentally reducing Wallace to 'his able correspondent'.

The reading took place in a narrow, stuffy ballroom at Burlington House, just off Piccadilly Circus. An audience of about 30 men heard an excerpt from Darwin's 1844 manuscript, then an abstract from his letter to Asa Gray and finally Wallace's essay. Neither author was present. Darwin had buried his son that day. Wallace was hunting for bird of paradise specimens in New Guinea. Darwin himself later expressed surprise at the order of the presentation, having thought that the Lyell-Hooker letter and his own letter to Asa Gray 'were to be only an appendix to Wallace's paper'. He had half-written a letter conceding all priority to Wallace 'and should certainly not have changed it' except for the manoeuvring by Lyell and Hooker. 'I assure you I feel it and shall not forget it,' he wrote to Hooker, with good reason.

At Burlington House, the Linnean Society meeting ended, after a long series of other scientific papers, with no discussion of natural selection. The society's president went home muttering about the lack of any 'striking discoveries' that year. And so began the greatest revolution in the history of science.

Richard Conniff is an award-winning magazine writer. This is an edited extract of his book *The Species Seekers: Heroes, Fools, and the Mad Pursuit of Life on Earth*.

The Species Seekers

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