Special Section

Alfred Russel Wallace

Illustration by Pete Von Sholly

MEET ONE OF THE GREATEST SKEPTICS OF ALL TIME…

Even in his own day, naturalist Alfred Russel Wallace (1823-1913) drove his friends and admirers mad. Were there two Wallaces? One was Darwin's co-discoverer of natural selection, the inventor of biogeography, and discoverer of Wallace's Line, the invisible boundary between Asian and Australian fauna. The other Wallace was convinced that the human mind was shaped by an evolutionary boost from "the unseen universe of Spirit."

This Special Section of Skeptic is part of the Alfred Russel Wallace Centenary Celebration Project, which began in 2013 when Sir David Attenborough lectured on Wallace and the Birds of Paradise at the American Museum of Natural History. As we wind up the three-year Project, settle in for some excellent reads.

It has been a delight to serve as Guest Editor for this Special Section, partnering with my longtime friends and colleagues Michael Shermer and Pat Linse. We thank the John Templeton Foundation for their generous support of the Wallace Centenary Celebration, and are delighted that so many top scholars and writers enthusiastically contributed their time, talents, and resources. As one of our writers put it, "Anything for Wallace!"

Richard Milner, Guest Editor and
Director, Alfred Russel Wallace Centenary Celebration

Alfred Russel Wallace —Species Seeker Extraordinaire

BY RICHARD CONNIFF

"I'm afraid the ship's on fire. Come and see what you think of it," the captain said. It was after breakfast, 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 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."

Alfred Russel Wallace at age 25

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

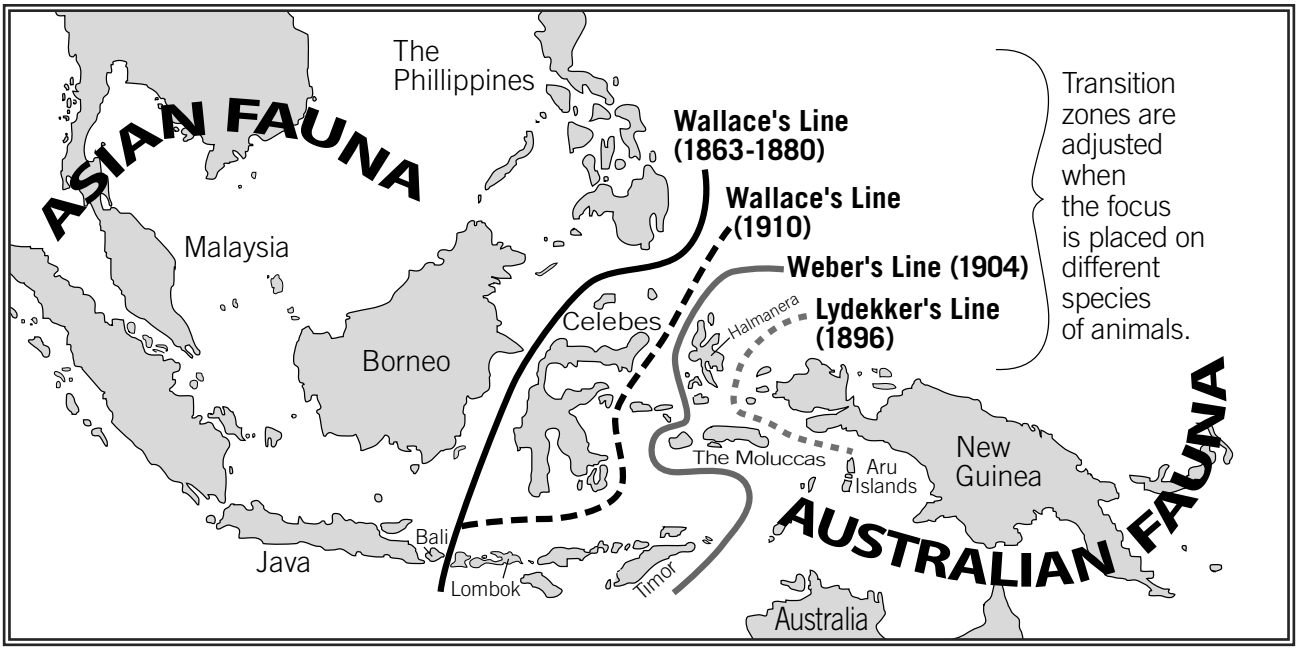
The extent of his loss did not dawn on him until he and the crew were finally rescued, seven days later, by a ship bound for London from Cuba. Then Wallace reflected:

> 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 and I had not one specimen to… [illustrate] the wild scenes I had beheld!

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 his mother nursed 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



Wallace was one of the creators of the science of evolutionary biogeography, the study of species dispersal across geographical regions. One of the most striking examples carries the eponymous name Wallace's Line because he was the first to note the distinct break in species across the deep channel between Borneo and the islands to the east, due to the fact that during the last ice age these islands were not connected by land bridges and thus species could not migrate easily. Additional lines have been drawn, including by Wallace, as knowledge of species dispersal improved over the decades.

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 memory and letters home.

Ruffling Feathers

Wallace was, as he later put it, "the young man in a hurry." It showed. At a meeting of the Zoological Society of London in December 1852, just two months after his return, he gave his fellow naturalists a cordial earful. To his dismay he had found 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."

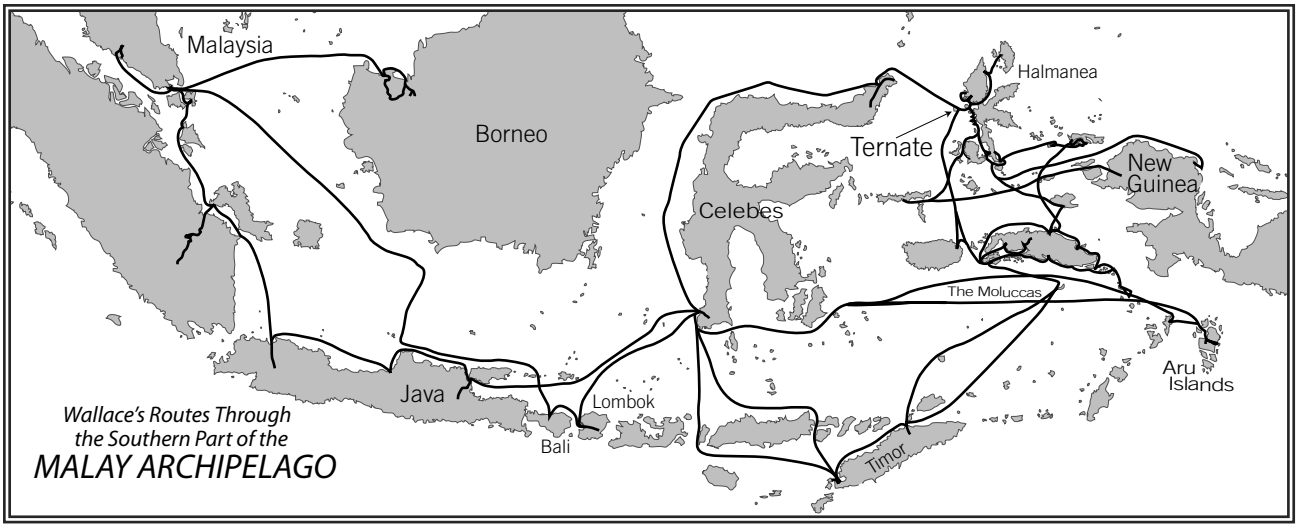
Conventional naturalists still mostly treated new species as the result of separate and seemingly random acts of creation by God. But Wallace was seeing connections and asking what they signified. Why did clusters of similar species all occur within a single small area? Why did species often vary only 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 piecerate basis.

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. The very idea of evolution (or transmutation, as it was called) was still considered radical and heretical by most scientists. 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.

Wallace 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



Wallace's travels throughout the Malay Archipelago in the late 1850s and early 1860s are noted on this map in dark lines. On the a tiny island called Ternate on the upper right side of the map Wallace wrote his essay on natural selection, which he feverishly (literally and figuratively) wrote down in a letter and sent it to Charles Darwin in March of 1858.

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 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 of 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* (now known as Wallace's golden birdwing), "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

priamus: four spots

poseidon: three spots

Wallace struggled to solve the species problem of how new species arise from existing ones. He puzzled over this butterfly species *Ornithoptera priamus* (top) and how it differed from the *Ornithoptera poseidon* (botton) by only the simple spot pattern in their bottom wings (four spots versus three spots). The butterflies were discovered in different locations in the Aru Islands (see map) in the Malay Archipelago. If these butterflies constitute different species merely by the difference in spot patterns, how many other ways may species come to separate in other regions of the world?

In Wallace's best selling book *The Malay Archipelago,* at once a great work of science, travel, and adventure, Wallace recounts awakening one morning to discover a giant python curled up three feet from his head that had kept him up much of the night with a rustling noise. The account was illustrated in the book with this engraving of his Malaysian assistants trying to remove the intruder from his hut. The bearded man holding rifle, at right, is believed to be Wallace himself.

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." Meanwhile, Wallace was a friend to funny old men in remote villages and, of course, still a glorified manual laborer who lived by catching birds and insects.

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 worldview, 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. Lyell's 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.

As he lay there he mulled over the species question and, one day, the same book that had inspired Darwin came to mind—Thomas 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 favorable 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.

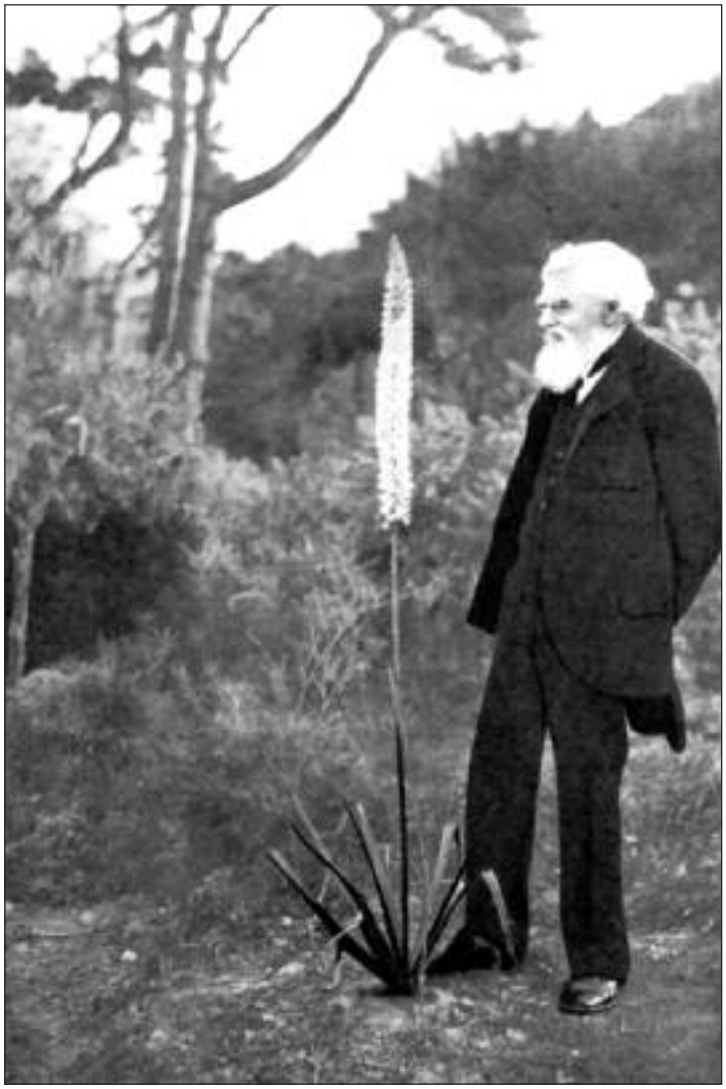
Great Minds Alike

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 favored 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.



Wallace in his garden at Broadstone standing next to a fully blooming king's-spear plant in 1905, the year his two-volume autobiography *My Life* was published. Wallace lived another eight years, during which time he remained highly productive writing additional books, scientific papers, and social commentaries on the most controversial issues of the day.

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 made a "delicate arrangement" to place Darwin and Wallace as co-authors of the theory on the same date; their papers were read together at a meeting of the Linnean Society of London. Wallace did not feel robbed of priority when he found out about the joint presentation three months later. He was, he later wrote, honored 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 systematized 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, as did Darwin some years earlier. .

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 joint presentation of the papers was read at a meeting of the Linnean Society on 1 July 1858, with neither author present. 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, emphasizing 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 emphasizing Darwin's "years of reflection," incidentally reducing Wallace to "his able correspondent."

The reading took place in a narrow, stuffy meeting room of the Linnean Society in 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. Both authors had good reason for not attending the meeting: Darwin had buried his infant son that day, and Wallace was hunting for birds of paradise in New Guinea, half a world away. 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 maneuvering 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. S

Note: This essay is adapted from his book The Species Seeker, *and an article in* Evolve *magazine, Issue 15, 2013 by permission of the author.*

Wallace at 86 beside a pond in the garden of his house Corfe View, Parkstone, Dorset. © George Beccaloni

The Consilient Mr. Wallace

How He and Darwin Independently Used the Same Method to Arrive at Natural Selection

BY JAMES T. COSTA

Perhaps the most remarkable attribute of the thoroughly remarkable naturalist Alfred Russel Wallace was his uncanny ability to see patterns in nature where others could not—or would not. This came naturally to Wallace, whether reading landscapes, geological formations, anatomical structures, or the relationships and distributions of species—he was an intuitive observer whose ability to read the natural world ultimately gave him a hand, like Thomas Paine, in two revolutions: founding modern biogeography and co-founding evolutionary biology. But if high achievement is as much perspiration as inspiration, Wallace certainly had sweat equity in spades. Penetrating deep into Amazonia during his first 4-year expedition and then criss-crossing the Malay Archipelago over the subsequent 8 years Wallace collected thousands of specimens, but also an astonishing range of observations on everything he saw: people and places, species and varieties, structure and function, habit and instinct, and geographical distributions— myriad strands of evidence he would methodically weave into an overarching explanatory framework. It was an exciting if heretical view of the organic world: the transmutation and common descent of species, what we now call "evolution." He was sure that a deep and essential relationship linked all species in space and time, a pattern that pointed to a grand, unending, branching and re-branching cascade of ancestor-descendant relationships. Of that much he was convinced from the start of his expeditions; what took him longer to uncover was *how* this happened.

William Whewell (1794–1866) coined the terms "science," "physicist," and "consilience."

Until recently it has been little appreciated just how systematic Wallace was in these pursuits; far from a mere "specimen-collector" who dabbled in grand philosophical ideas and got lucky, Wallace was pursuing a research program that reflected the very latest thinking on a rather intuitive approach to the study of nature. This approach was a highly useful philosophical yardstick for taking the measure of scientific explanations, or *vera causae* (true causes) in nature, as Newton had put it, and Wallace (like Darwin) brought it fruitfully to bear on the species question. This yardstick was recognized with a name: Consilience. For this we can thank William Whewell [pronounced "Hyule"], polymathic Cambridge philosopher, mathematician, theologian, architect, naturalist—and inveterate coiner of terms.

What is Consilience?

William Whewell (1794–1866) was the "go-to" wordsmith for fellow academics in search of a pithy moniker for their ideas and discoveries, and several of his neologisms are now long-familiar fixtures of our scientific lexicon. These include the terms "physicist," "ion," "cathode," anode," "catastrophism," and "uniformitarianism." The word "scientist" itself came from Whewell's pen, a term he proposed as an alternative to the time-honored but imprecise "natural philosopher" in his landmark 1840 work *The Philosophy of the Inductive Sciences*, a founding treatise on philosophy of science. "As we cannot use physician for a cultivator of

physics," wrote Whewell, "I have called him a physicist. We need very much a name to describe a cultivator of science in general. I should incline to call him a Scientist. Thus we might say, that as an Artist is a Musician, Painter, or Poet, a Scientist is a Mathematician, Physicist, or Naturalist." Another term Whewell coined in this seminal treatise, which is much less well-known but still highly useful is *consilience*. The term was intended to express an intuitive brand of philosophical reasoning—Whewellian "Philosophy of Science 101." An important current in the intellectual ferment of the nineteenth century was the attempt to define science itself—how one knew when one was *doing* science, and the proper or most efficacious methods for figuring things out scientifically.

It was a time when the belief reigned supreme that from the patient accumulation of careful observations the general truths of nature and her laws would emerge: the method of Inductive Reasoning. (This method was later superseded by explicit hypothesis-testing, the so-called "hypothetico-deductive" method, which also involves induction despite its name.) *Consilience* expresses those situations where different and apparently unrelated sets of observations combine and reinforce one another, giving the investigator added confidence that he or she is on the right track. As Whewell put it in his 1840 treatise: "…the cases in which inductions from classes of facts altogether different have thus jumped together, belong only to the best established theories which the history of science contains…I will take the liberty of describing it by a particular phrase; and will term it the Consilience of Inductions."

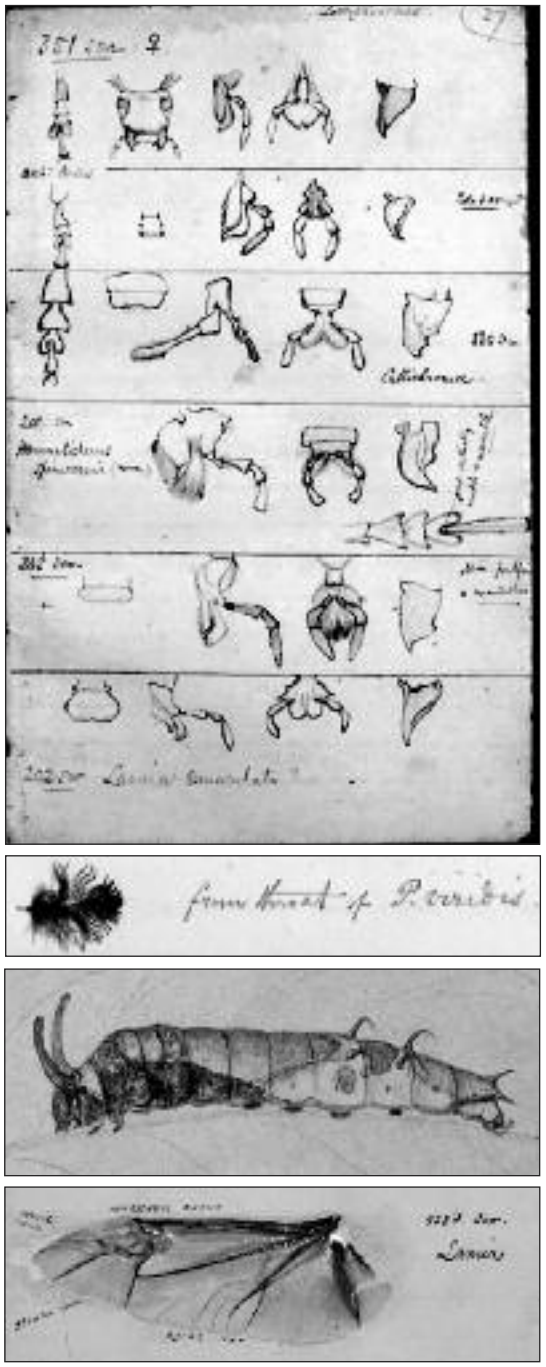
The key here is the congruence of "classes of facts altogether different"—and the more the better. Whewell put his finger on an appealing way of determining if one is on the right track with a pet explanation or theory: one set of observations might be consistent with it, but that could be a fluke. Better if another and altogether different set of observations is also consistent, the two reinforcing one another. And better still if a third set points in the same direction, then a fourth, and so on. Whewell argued that the more such unrelated sets of observations are brought under a common explanatory umbrella—the more disparate sets of observations are *consilient*—the greater our confidence should be in the veracity of that explanation. It's akin to the approach a prosecutor takes in making a case for guilt "beyond a reasonable doubt" in a court of law. Making sense of disparate clues, the more *independent* lines of evidence that are consistent with a posited scenario the more persuasive the case. Applied to the scientific pursuit, Whewell argued that the consilience principle is so powerful that it should be regarded as "a test of the truth of the Theory in which it occurs."

Indefatigable naturalists

Alfred Russel Wallace agreed. Or certainly would have. The self-taught Wallace read widely and voraciously including all manner of scientific and philosophical works. There is no evidence that he read Whewell's *Philosophy*, but he certainly embraced consilience in his pursuit of the burning question of species origins, that "mystery of mysteries" as John Herschel (the chemist/astronomer who was Whewell's friend and Cambridge colleague) had put it.

One day in the fall of 1845, the 22-year-old Wallace read a work that was to alter the course of his life: *Vestiges of the Natural History of Creation*. This wildly speculative "evolutionary" reverie was published anonymously the previous year and promptly took England by storm—not to high acclaim, however, but universal condemnation. Well, *nearly* universal: Wallace, sometime surveyor and school teacher, was quite taken with its central thesis that the history of organic life was one of constant and inexorable change. This is an idea we take for granted today, but it was roundly condemned at the time, an idea considered as pernicious as it was erroneous, a threat to the scientific, religious and political establishments of Britain at the time. But Wallace had a contrarian streak, and readily embraced ideas and causes dismissed by the traditional guardians of received knowledge. His embrace of the evolutionary message of *Vestiges* is a case in point. Even his friend Henry Walter Bates, a kindred spirit who turned Wallace on to the joys of beetle collecting and scientific natural history, was tentative about endorsing the scandalous tract when queried by Wallace about it. Wallace replied to Bates, chastisingly:

> I have rather a more favourable opinion of the "Vestiges" than you appear to have—I do not consider it as a hasty generalisation, but rather as an ingenious hypothesis strongly supported by some striking facts and analogies but which remains to be proved by more facts & the additional light which future researchers may throw upon the subject – it at all events furnishes a subject for every observer of nature to turn his attention to; every fact he observes must make either for or against it, and it thus furnishes both an incitement to the collection of facts & an object to which to apply them when collected.



Wallace's *Species Notebook* as Field Guide
From the top down: sketches of mouthparts of beetles from Sarawak; a feather from the manucode *Manucodia (Phonygama) viridis* of the Aru Islands, on a page with anatomical drawings of birds; a drawing of a *Papilio euchenor* caterpillar from Aru; one of several beetle wings pasted on a series of pages. This one, with wing veins identified, is from a long-horned beetle (*Cerambycidae*) collected in Sarawak. Pages 448, 290, 462, and 424 in Costa, *On the Organic Law of Change* (HUP, 2013). Courtesy of and © the Linnean Society of London.

Indeed, "an incitement to the collection of facts" nicely captures Wallace's plan. In April 1848 the two young naturalists landed in Amazonia, pulling off an amazing coup. High on *chutzpah* but low on funds, formal education, or social connections, the two nonetheless managed to secure the good offices of an agent in London and a passage to the New World tropics, bent on paying their way through specimen collection. At the time a brisk trade in natural history curios was flourishing, and their agent was to sell their specimens to museums and wealthy private collectors. They collected to pay for their expeditions, and kept thousands of duplicate specimens for their own prized "natural history cabinets," while Wallace made copious written observations and drawings.

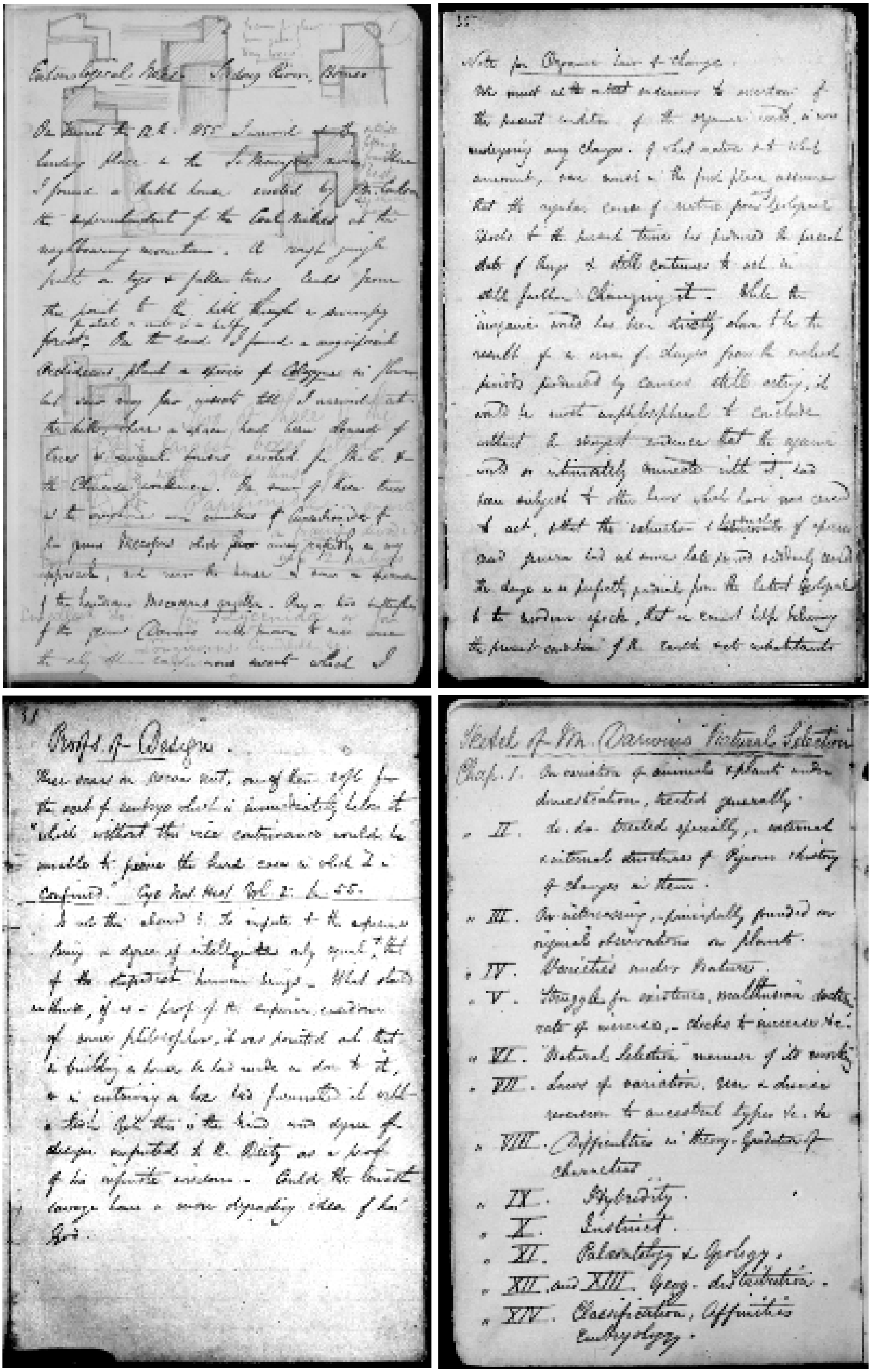
It is impossible to say just what insights regarding transmutation might have emerged from the many "facts" Wallace collected in Amazonia, as practically all of his notebooks and two years' worth of specimens went up in flames when his homeward-bound ship caught fire at sea. (Along with the ship's crew, he drifted in a lifeboat for ten days, until they were rescued near Bermuda.) His ideas were taking shape, however, and in some of the papers that Wallace was able to piece together from memory and surviving letters and papers we see certain evolutionary speculations—such as his suggestion that the "youngest" or most recently-arisen species of *Heliconia* butterflies are to be found in the geologically most recently formed parts of the Amazon basin, advanced in his paper "On the Habits of the Butterflies of the Amazon Valley." This paper was read at the Entomological Society of London in December 1853 and published the following April, the very month that Wallace arrived in Singapore at the start of his second grand adventure—eight years of exploring what he called the Malay Archipelago (modern-day peninsular Malaysia, Indonesia, and western New Guinea).

The Consilient Mr. Wallace

Early in 1855 Wallace waited out the rainy season at the foot of Santubong Mountain in northern Borneo, in a small bungalow that the "White Rajah" of Sarawak, Sir James Brooke, had kindly provided for his use. There he wrote a paper that was to be (later) hailed as a landmark contribution in evolutionary biology: the "Sarawak Law" paper, showing Wallace at his philosophical best in cutting through reigning confusion and seeing patterns that eluded others. Here Wallace pointed out a seemingly obvious but profound correspondence between species relationships in time (their distribution in the fossil record) and space (their geographical distribution): "*Every species has come into existence coincident both in time and space with a pre-existing closely allied species*" (which Wallace italicized in the original for emphasis).

In consilience mode, Wallace realized the deeper significance of his "law," how it "connects together and renders intelligible a vast number of independent and hitherto unexplained facts." He listed them: "The natural system of arrangement of organic beings, their geographical distribution, their geological sequence, the phaenomena of representative and substituted groups in all their modifications, and the most singular peculiarities of anatomical structure, are all explained and illustrated by it." Wallace may as well have been describing his research agenda of the next half-dozen years with this statement.

Just a few weeks after writing his astonishing essay and posting it home (where it was duly published the following September in the *Annals and Magazine of Natural History*), Wallace began a new notebook, *the* notebook that records this research agenda like no other contemporary writing by Wallace. This is the



Pages from Wallace's *Species Notebook*
Clockwise from upper left: the *Species Notebook* opens with insect collecting notes made in Sarawak, Borneo, written over sketches for an insect specimen case; notes for Wallace's "organic law of change" (i.e., evolution), the opening salvo of an extended critique of Lyell's anti-evolutionism; table of contents of Darwin's work-in-progress, then titled *Natural Selection,* sent to Wallace in the weeks following the Linnean Society readings of July 1, 1858; one of Wallace's many severe critiques of supposed "proofs" of divine design from natural history. Pages 30, 98, 430, and 90 in Costa, *On the Organic Law of Change* (HUP, 2013). Courtesy of and © the Linnean Society of London.

Species Notebook, now designated manuscript no. 180 in the collection of the Linnean Society of London. The rather run-of-the-mill appearance of this notepad, clad in handsome standard-issue marbled boards, belies its revolutionary contents. The first page, penned just days after completing the Sarawak Law paper, marks the beginning of a journey as much intellectual as physical: under the heading "Sadong River, Borneo" Wallace recorded "On March the 12th. 1855 I arrived at the landing place in the Si Munjon river…."

While the *Species Notebook* is a working field notebook containing all manner of collecting records, personal memoranda, observations, ideas, and schemes, its distinction lies in the fact that it also provides an unparalleled record of Wallace's thinking on transmutation, and his planned book on the subject—a book idea that, sadly, Wallace quietly abandoned after the events of 1858-1859 and the publication of *On the Origin of Species*.

How might Wallace have approached this species book that never was? Fortunately we do not have to rely on pure speculation: Wallace revealed his plan in the *Species Notebook,* and his approach is instructive. He had long been an admirer of the eminent geologist Charles Lyell, drawing inspiration as so many did from Lyell's eloquent and compelling case for slow, steady, mundane natural forces inexorably shaping the earth over time, an exciting worldview articulated in his watershed work *The Principles of Geology* (1830–1833). Despite advocating so effectively for gradual changes in and on the earth by natural processes, however, Lyell would not countenance any parallel process going on in the organic realm. A deeply religious man, Lyell was convinced that species transmutation was impossible and he dedicated considerable space in the *Principles* to an extended argument intended to be the final, damning, word on the subject. Enter the contrarian Wallace.

Lyell's vision of earth history was inspiring to Wallace, but thanks to his earlier conversion to the notion of species transmutation à la *Vestiges*, Lyell also became his foil on the species question. Wallace went through the *Principles* systematically and wrote out Lyell's arguments one by one in the *Species Notebook*, launching into a rebuttal following each. The subjects were expansive: lessons from the fossil record, challenges to claims that nature is balanced and harmonious, the significance of the unique species assemblages found on remote islands, domestication and the supposed limits of individual variation, and more. Wallace also "out-Lyelled" Lyell by crying foul on his inconsistency in advocating gradual change for the earth but not the flora and fauna upon it:

> It would be an extraordinary thing if while the modification of the surface [occurs by] natural causes now in operation & the extinction of species was the natural result of the same causes, yet the reproduction & introduction of new species required special acts of creation, or some process which does not present itself in the ordinary course of nature…

And here Wallace tipped his hand about the line of attack of his planned book: "Introduce this and disprove all Lyell's arguments first at the commencement of my last chapter," he parenthetically inserted above this passage.

Wallace then got into consilient high gear: the *Species Notebook* shows him at his rhetorical best in answering objection after objection from Lyell's book, and then some: how morphology provides clues to transmutation, and embryology informs classification; how morphological structure can be de-coupled from adaptive "habits;" case studies of new varieties arising; how the fossil record is consistent with a branching pattern of lineages through time; how geography and earth history, not environment, are the best predictors of spatial patterns of species relationships; pointed critiques of arguments for design in nature, and on and on.

What is even more striking is the fact that the dozens of topics tackled by Wallace in the *Species Notebook* are remarkably congruent with those independently pursued by Darwin, who, in his own consilience mode, had been investigating the same lines of evidence for transmutation. The geological record, instinct and habit, human variation and primate relationships, geographical distribution, comparative anatomy, origin of varieties or domestic breeds…observations, notes, and arguments on all these and more fill Darwin's notebook pages too. He and Wallace recognized what sorts of evidence to gather, sometimes even consulting the same sources. In writing up his soon-to-be-landmark "Ternate Essay" and mailing it to Darwin, of all people, the ensuing revelation that Darwin had long since gotten there and was writing a book on the subject led the magnanimous Wallace to defer to his senior colleague. For his part, Darwin, perhaps feeling a bit guilty, swiftly sent Wallace the table of contents of his book-in-progress, which at that time was still entitled *Natural Selection*. Wallace duly copied this out into the *Species Notebook,* and we see no further reference to his own planned book.

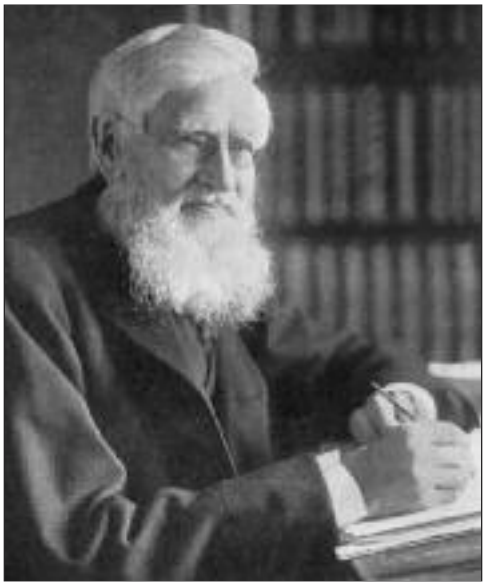
A copy of *On the Origin of Species,* sent by Darwin with compliments, wended its way to Wallace in southeast Asia in early 1860. Wallace found it nothing short of masterful, lauding the book's "vast accumulation of evidence, its overwhelming argument, and its admirable tone and spirit." He would have recognized the range of topics from the table of contents Darwin had sent him earlier, and would have understood readily why Darwin declared that the *Origin* was "one long argument" in the concluding chapter. The book was skillfully structured to pitch the argument, opening with domestication as analogous to natural selection, then moving to a case for the core argument for natural selection, and then, in the remaining half of the book, marshaling a consilience argument showing the explanatory power of the theory applied to widely disparate areas. To Darwin the consilience argument was the *Origin*'s strongest attribute. As he wrote to his friend Asa Gray, the Harvard botanist, shortly after the book came out: "I cannot possibly believe that a false theory would explain so many classes of facts as I think it certainly does explain." He underscored the point: "on these grounds I drop my anchor," he declared, "and believe that the difficulties will slowly disappear."

One Consilient Argument

Wallace emerged as an eloquent defender of his and Darwin's joint theory after his return to Britain in 1862—through papers, letters, books and lectures expounding on the subject in subsequent years Wallace rose to fame, and was about as tenacious as Huxley, "Darwin's bulldog." Indeed, such was the acclaim that Wallace met for his lucid explication of the theory on his North American lecture tour of 1886-1887, hailed by sold-out crowds as "the First Darwinian," that he was prompted to write at long last his own synthesis of the evolutionary process on his return home. Published in 1889 under the title *Darwinism*, this is not the book outlined in the *Species Notebook,* but rather Wallace's own "one long argument," laying out the case for evolution by natural selection in fine consilience form with chapters on, among other topics, the struggle for existence, variation, domestication, crossing and hybridism, natural and sexual selection, geographical distribution, and the fossil record. (However, the book also advanced Wallace's controversial stance on the apparent failure of natural selection to account for human cognitive evolution—about which Darwin had written him, "I differ grievously from you & I am very sorry for it. I can see no necessity for calling in an additional & proximate cause in regard to Man.")

Ironically, despite Darwin and Wallace employing to good effect William Whewell's philosophical yardstick of consilience, the Cambridge philosopher stubbornly rejected their theory. That was perhaps to be expected; Whewell was getting up in years by the time evolution by natural selection burst upon the scene, and it might be too much to expect a lifelong cleric and theologian to alter his conceptions near the end of a life committed to natural theology and divine design. After all, he was well known as author of a book aimed at refuting *Vestiges*, and another propounding evidence of design in nature.

Darwin sent him the *Origin,* to which Whewell politely wrote that his one-time pupil would probably "not be surprized to be told that I cannot, yet at least, become a convert to your doctrines." Perhaps feeling the powerful pull of his own doctrine of consilience, however, Whewell acknowledged that there was "so much of thought and of fact in what you have written that it is not to be contradicted without careful selection of the ground and manner of the dissent…" For now he must content himself, he concluded, "with thanking you for your kindness" in sending him a copy of the *Origin*.



Alfred Russel Wallace, ca. age 70.

It is not known if Wallace corresponded with Whewell on the subject, but no matter; just as Wallace "out-Lyelled Lyell" in his *Species Notebook* challenge to the eminent geologist, so too might he be said to have "out-Whewelled Whewell" in his intuitive grasp of the power of the consilience argument to establish a new, evolutionary framework for studying and understanding the natural world. S

Demolishing Wallace's "White Picket Fence" Around Human Cognition

BY LEE DUGATKIN

Alfred Russel Wallace, the co-founder of the theory of evolution, differed with his senior partner Charles Darwin over whether natural selection could plausibly account for the unique abilities of the human brain. He thought human consciousness and cognition warranted erecting a "white picket fence" around them, setting them off as separate and unique from anything else in nature.

Wallace insisted his notion about the "exceptionalism" of human cognition was not a denial of the mechanism of natural selection, but rather a logical deduction from a strict interpretation of how it operated. Since natural selection can only favor what works in the here-and-now, Wallace argued, it cannot anticipate future conditions. And he could simply not believe that human abilities for language and mathematics, for instance, could evolve in an ape or protohuman in advance of its needs. If such creatures were well adapted to survive and had sufficient intelligence to gather food and provide for shelter and defense, why would they develop advanced capabilities for art, mathematics, or language, none of which were necessary in that ancestral environment? Wallace wrote:

> Those facilities which but enable us to transcend time and space, to realize the wonderful conceptions of mathematics and philosophy, are evidently essential to the perfect development of man as a spiritual being, but are utterly inconceivable as having been produced through the action of a law which looks only, and can look only, to the immediate material welfare of the individual or the race…. This utilitarian hypothesis, which is the theory of natural selection applied to humans, seems inadequate to account for the developments of our own moral sense. If we look to primitive societies of that day, and if we think about evolutionarily ancient lineages that led to modern day humans, they possess a mental organ which is beyond their needs.[1]

Here, I'm going to explore a few studies about the cognitive capabilities of non-humans, with a view to asking: Would Wallace have thought differently about the human mind being fundamentally set apart from those of other animals if he could have taken into account certain facts we have recently learned about animal behavior? Would he perhaps have taken a different path to understanding how the human mind could have evolved by natural selection?

Let's examine some long-presumed "uniquely human" attributes in the light of current research on animals: altruism, morality and fairness, empathy, culture, teaching, and deception.

Altruism

Naturalists discussed altruism extensively even before Darwin turned his attention to the question, and I have devoted a good deal of my own research to the topic in animals. Here I shall provide just one

example of an interesting study of altruism and record keeping (or "payback") in non-humans by Indrikis Krams and colleagues at Daugavpils University in Latvia. This study has to do with the "mobbing behavior" of the European pied flycatcher, *Ficedula hypoleuca*.

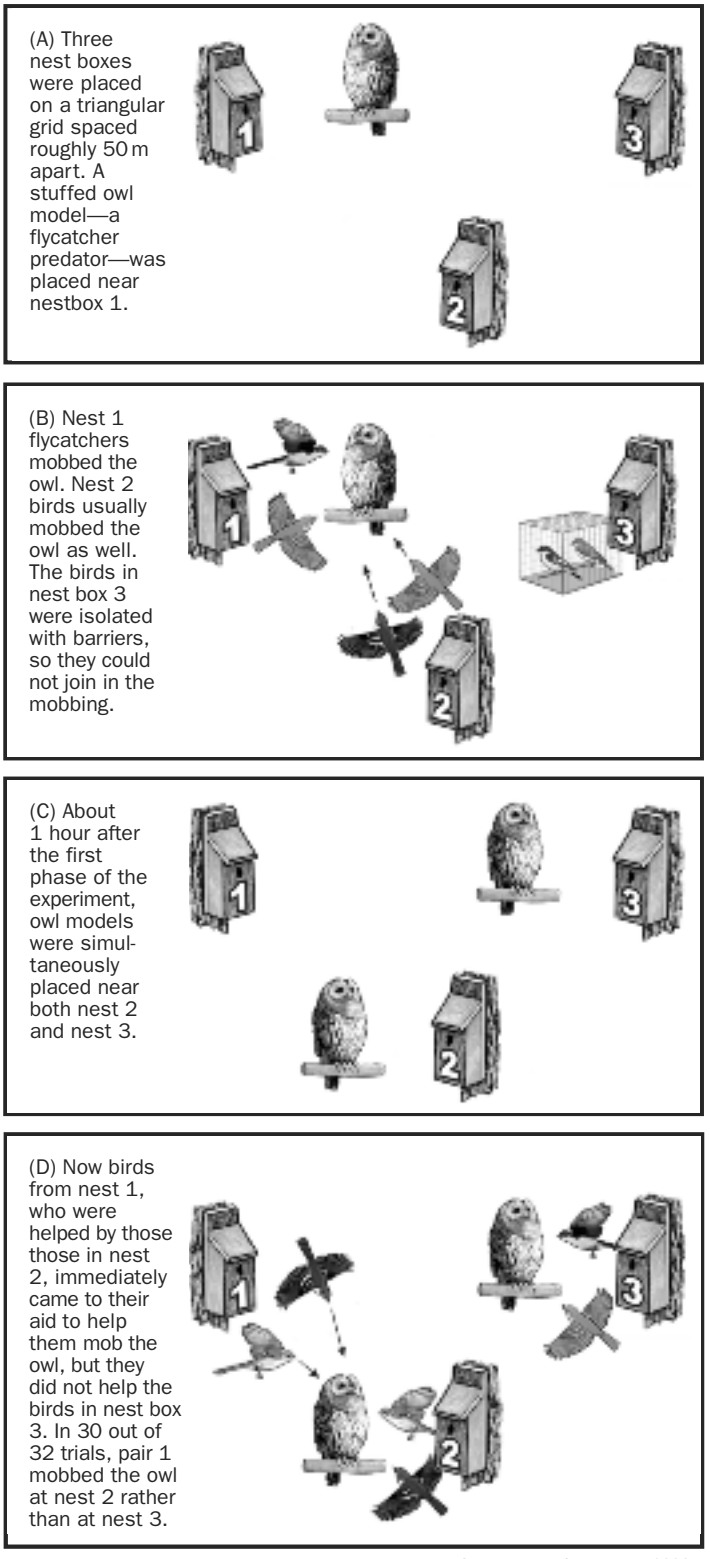
When these birds spot something that is potentially dangerous (a stuffed owl introduced into their living space, for instance), a group of them gathers together and "mobs" the dangerous bird with the courage of numbers, screaming and harassing the much larger predator to drive it away. When investigators recorded which birds helped which, they found that the birds remembered who came to help them, and then reciprocated the next time by rushing to the assistance of those individuals who aided them at a time of crisis.

Krams and colleagues constructed an enclosed habitat that included three nesting boxes. A stuffed owl model was placed near nest 1. Almost immediately, the closest flycatchers perceived that they were in great danger, so they came out and began to mob. The birds at nest 2 also could—and in fact usually did—come out and help by mobbing the owl as well, even though it is less threatening to them because it was placed a bit further away. The birds in nest box 3 were isolated with barriers, so they could not join in the mobbing even if they wanted to. The experimenters wondered, "If some birds were helped by others when they needed it, but not at all by those penned in, do they remember which individuals were helpful to them, and do they reciprocate that act of altruistic solidarity in the future?"

To examine this, the researchers placed owls near both nest 2 and nest 3. Now birds from nest 1, who were helped by those in nest 2, immediately came to their aid to help them mob the owl, but they did not help the birds in nest box 3. In short, the flycatchers kept track of who helped whom, and then when the opportunity arose to reciprocate, they did; but they ignored those that don't, adopting a "tit-for-tat-like" strategic behavior, which behavioral game theorists have discovered through both computer modeling and human trials is an excellent strategy.[2]

We can look deeper down than this kind of classic proto-sociality to try to get a handle on such elusive concepts as morality and fairness—certainly one of the things that Wallace seems to have had in mind when he posited his "white picket fence" around the human mind.

An Experimental Design for Examining Reciprocal Mobbing in Pied Flycatchers

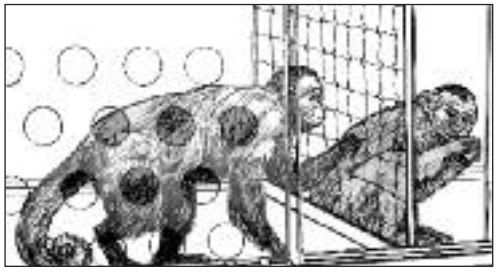


Adapted from Wheatcroft and Price (2008).

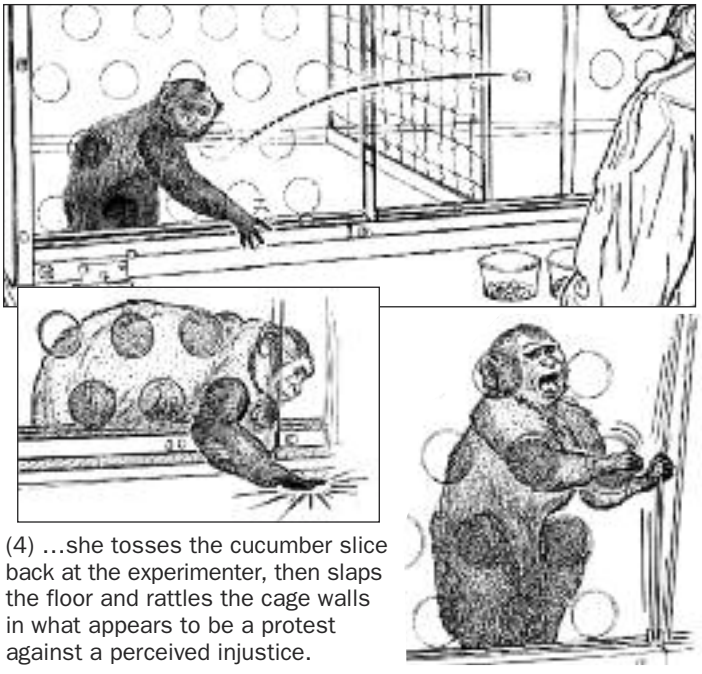
Monkeys Reject Unequal Pay in Classic Experiments by Primatologists Frans de Waal and Sarah Brosnan

(1) Two capuchin monkeys are situated in side by side cages such that they can see one another and the experimenter. Both have been trained to exchange a token stone for a piece of food, either a slice of cucumber or a grape.

(2) When offered a slice of cucumber in exchange for the stone token, both monkeys consume it with relish.



(3) But when the monkey on the right gets a grape, which they much prefer over cucumber, while the monkey on the left sees that, but only receives the usual cucumber…



(4) …she tosses the cucumber slice back at the experimenter, then slaps the floor and rattles the cage walls in what appears to be a protest against a perceived injustice.

Morality and Fairness

Whenever I show a video clip from some recent work on justice in capuchin monkeys—a clip that has received more than 2 million hits on YouTube—the audience reaction is always amazement, laughter, and instant identification with the monkeys' plight. The footage is from work on the evaluation of the monkeys' sense of morality and fairness by primatologists Frans De Waal and Sarah Brosnan.

Two capuchin monkeys are set up in adjoining Plexiglas cages in a way that they can easily observe each other's behavior. Both have been trained to hand the investigator a little stone token, for which they receive a food item in return. If the first monkey gives her little rock to the investigator and receives a piece of cucumber in return, she promptly eats it. And if the second monkey gives a rock to the scientist, she also receives cucumber, eats it, and both are content.

But when the investigators change the reward system all hell breaks loose. The key here is that while capuchins will eat both cucumbers and grapes, given a choice they much prefer the grapes. In this second condition, when the first capuchin hands over her stone, she receives a sweet, succulent grape, which she consumes with delight. The second capuchin, having seen the change in rewards, presents her token, but instead of receiving a grape she is again rewarded with a cucumber; but now, given what she saw the first monkey just received, this injustice appears unacceptable. She immediately protests the unequal rewards for performing the same task by throwing the cucumber back at the human investigator and launching an aggressive screaming tantrum, accompanied by rattling the cage walls and slapping the cage floor.[3] Monkeys don't have language so she cannot communicate her sense of injustice in words, but her nonverbal language sends a clear message.

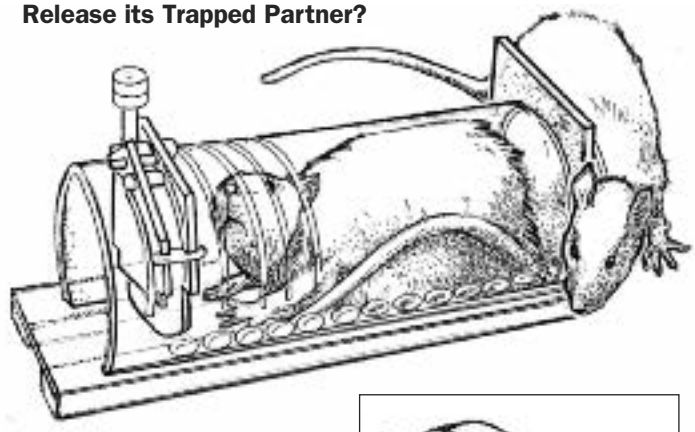
Empathy

Another quality that Wallace thought was unique to humans was empathy—the ability to identify with the plight or emotions of a fellow creature. He himself had that quality in abundance, enabling him to communicate easily with professors in London as well as tribal bird hunters in the tropical rain forests he explored. Work in animal behavior now suggests empathy may not be a uniquely human talent.

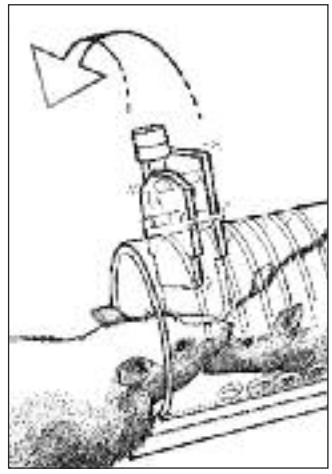
Peggy Mason and her colleagues placed two rats in an enclosure. One rat was allowed to roam around where there is plenty of space, but its little

cage mate was stuck inside a small clear plastic canister in the middle of the arena. The canister had a door that could only be opened from the outside. The trapped rat clearly did not like being confined, as it was emitting an ultrasonic distress call. The question was whether or not the "free" rat, which had lived with the other (now trapped) rat for a few weeks before the experiment, would attempt to release its trapped partner. And indeed, after a few days of figuring out how the experimental setup works, the free rat does free its confined comrade. What's more, the free rat never opens up the door to that canister if there was no other rat inside, nor if it contained a toy model. If the rat is put in a slightly modified setup, where one of its little comrades is stuck inside a transparent box, and there's another box that also has a door, but this one has chocolate in it (which the rodents love!) they choose to free the trapped individual first, even before attempting to open the door to the chocolate. Then they retrieve the treat and share it with the rat that they freed.[4] I don't know if that should be called empathy exactly, but surely it's something like it.

Empathy: Will a "Free" Rat Attempt to Release its Trapped Partner?



Two rats that have previously been cagemates are placed in an enclosure. One is trapped inside a small clear plastic canister that has a door that can only be opened from the outside



After eventually learning how the canister door works, the free rat will open the door for its comrade. The free rat never opens the canister door if the tube is empty, or if it contains a toy model.

Culture

Now let's examine an example of culture (the transmission of learned behavior) in non-humans, again with this idea that maybe positing a "white picket fence" around human cognition is not really necessary.

You've probably seen video clips of chimpanzees in an African forest cracking open nuts by smashing them with sticks. There have been many studies of culturally transmitted behaviors among chimps in many various sites across Africa, but one of my favorites is the handclasp.

After a bout of aggression, apes often clasp hands. It's a kind of reconciliation (reminiscent of humans shaking hands after an argument), and again we know that they learn this in part by watching adults when they're young; but the beautiful thing about the chimpanzee studies is that we can see the variation in cultural behaviors across six major sites that have been studied across Africa. Handclasps occur in three populations, and sometimes they are right next to a population where you don't see the behavior. This hodgepodge distribution can be seen for some 35 cultural variants—strongly suggesting they are the result of cultural transmission in chimps.[5]

Credit: © Ewa Krzyszczyk

A wild bottlenosed dolphin in Florida protects its tender snout while foraging by wearing a living sponge as a front bumper. The cetaceans originated this unique tool use and teach it to their young.

Teaching

There are not as many examples of teaching in the behavior literature as some of the other advanced cognitive behaviors but a particularly instructive one is by Janet Mann and her colleagues at Georgetown University, which incorporates both teaching and tool use in bottlenose dolphins. Dolphins forage for food in gravelly ocean bottoms or off sharp rocks. Often they try to scare up burrowing prey by pounding on the sea floor, which can easily injure their sensitive snouts. They search around, often for ten minutes or more, to find a perfectly sized sponge to cushion their snout, so that when they try to dislodge burrowing fish they don't hurt themselves.

Dolphins seek just the right size sponge, and repeat the search many times. There's some evidence that young individuals, who often spend four or five years with their mothers, learn how to do this kind of sponge-seeking and other foraging techniques by watching and learning from parental examples. And Mann and her colleagues even suggest "that all spongers are descendents of one recent "Sponging Eve."[6]

There are many other observations of teaching survival techniques to youngsters in various species. All of this is to say, whether or not some "human-like behavior" may seem to be beyond these animals' mental capabilities, we are frequently surprised at their abilities to pass on learned traditions that aid survival.

Deception and Theory of Mind

Nicola Clayton and her group at Cambridge have done some really fine work on food storing in western scrub jays from California. Jays in general, and scrub jays in particular, often cache thousands of food items that they will eat throughout the year. They scratch and peck holes in the ground, bury their foodstuffs, and months later exhibit an astounding memory to find them. Even more interesting is how they respond when other jays, which might be spying on their hiding places in order to steal their food, are hanging around.

When a jay is burying food, it behaves very differently if it spots another jay watching. First of all, it tries to place the food in areas that are hidden, rather than in the most obvious places. If a scrub jay has just cached something and soon after interacts with another bird that wasn't around when it buried the food, there is no problem. But if it interacts with a jay that was watching while it buried the item, then things can get very sticky. The individual may even attack the other bird that has seen him bury his treasure.

Remarkably, when jays spot another bird watching them, they will return to the hiding place after the observer has left, dig up the morsels, and bury them someplace else. The most incredible aspect of this behavior is that they only do it if they have been thieves themselves. If they stole another bird's food, they seem to be aware that the same thing could happen to their own stash. That suggests a kind of "theory of mind"—that the jay can put itself into the mind of others and predict what they're going to do, based on its own past experience in similar situations.[7]

Often when we ask the question in the right way, we find that many things that we thought—and often hoped—were uniquely human, are in fact not so. Our abilities are simply not as unique or special as we have assumed they are. Given his brilliance, if Wallace had known what we know today about animal behavior and cognition, he may never have felt the need to build the white picket fence around us in the first place. S

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Wallace, Darwin, and the Spiritualism Scandal of 1876

When a Young Scientist Prosecuted a "Psychic" Fraudster, the Co-Founders of Evolutionary Biology Took Opposing Sides

BY RICHARD MILNER

In 1876, a young zoologist named Edwin Ray Lankester—a student of evolutionary biologist Thomas Henry Huxley—launched a one-man crusade to unmask professional psychics and necromancers as frauds. Why would a busy scholar take it upon himself to expose and prosecute a celebrated medium who claimed to communicate with the dead? First, he saw "spiritualistic imposters" as a threat to the still-struggling young enterprise of science. "Mediums" represented themselves as earnest investigators into supernatural phenomena under so-called "controlled" conditions. Secondly, Lankester hoped to impress his mentor Huxley, and through him, even his elderly hero Charles Darwin himself—both of whom were implacable foes of professional spiritualists, whom they considered despicable frauds.

Darwin and Wallace, co-discoverers of natural selection, corresponded often on evolution and natural history, but when it came to the supernatural, Darwin was an adamant skeptic while Wallace was a passionate believer.

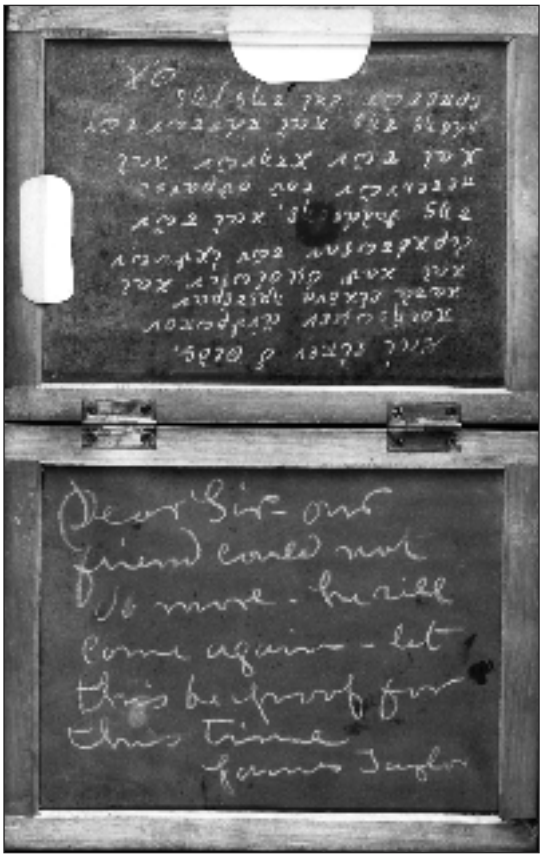
At the time, "spirit-mediums" ("channelers" in today's parlance), were riding high, bilking gullible Londoners of their coin by bringing the traditional Judeo-Christian idea of an "afterlife" into the newly ascendant legitimacy of Science. Their séances, they proclaimed, were actually "experiments and investigations" that should be embraced by scientists. Lankester's main target was the celebrated "Dr." Henry Slade, whose performances in darkened rooms called on the spirit of his dead wife Alison to write out answers to spoken questions on a hidden slate. By hauling Slade into court as "a common rogue," Lankester would become the first scientist to prosecute a professional psychic for criminal fraud—an action Darwin thought long overdue.

Although he was delighted to learn of Lankester's well-publicized attack on Slade, Darwin was distressed to learn that Alfred Russel Wallace, his friendly rival and co-discoverer of the theory of natural selection, was also a target of Lankester's ridicule. In fact, Wallace was convinced of Slade's sincerity and honesty, and agreed to be the star character witness for the defense.

The Slade trial was to become one of the strangest courtroom cases in Victorian England. Some saw it as a public arena where science could score a devastating triumph over superstition. For others, it was the declaration of war between professional purveyors of the "paranormal" and the fraternity of honest stage magicians who peddled self-admitted "illusion" as entertainment. Arthur Conan Doyle, the zealous spiritualist whose fictional detective, Sherlock Holmes, was logic personified, characterized it as "the persecution, rather than prosecution, of Slade." But what made the trial unique was that the two greatest naturalists of the nine-

Right: The celebrated spirit-medium "Dr." Henry Slade claimed he could talk to the dead through séances.

Below: Slate writing as a conduit to the other side became a favorite among spirit mediums in the 19th century. These slates, from one of Slade's séances, were discovered by the author at the Cambridge University Manuscript Library in 1995. Lankester accused Slade of using a thumb writer to fake the messages from beyond. © Richard Milner.



teenth century ranged themselves on opposite sides. The "arch-materialist" Darwin gave aid and comfort to the prosecution, while his old friend Wallace, a sincere spiritualist and mystic, was to be the defense's star witness—making it one of the more bizarre and dramatic episodes in the history of science.

Wallace was respected as an author, zoologist, botanist, the discoverer of scores of new species, the first European to study apes in the wild and a pioneer in the study of the distribution of animals. In addition to his classic volumes on zoogeography, natural selection, island life and the Malay Archipelago, he had written *Miracles and Modern Spiritualism* (1896), which lauded spirit-mediums. And, as President of the Anthropology Section at a meeting of the British Association for the Advancement of Science, he had just allowed a controversial paper on "thought transference" to be read at a meeting—touching off a backlash and uproar that caused him to avoid scientific meetings for the rest of his life.

Like Wallace, many Victorians recoiled from the materialism axiomatic in physical science; they sought a "wireless telegraph" to an intangible spirit-world. Although Darwin and most other "materialist" scientists kept miracles out of their theories, a few respected scientists shared Wallace's more mystical views. Among them were the physicist Oliver Lodge and the chemist William Crookes, discoverer of the element thallium.

Spiritualism attracted people with a wide spectrum of interests, but its major focus was on the possibility of communication with the dead. This part of the movement began in 1848, with the rise of Margaret and Kate Fox, sisters from Hydesville, N.Y. When the teenage girls conversed with "spirits," mysterious rapping sounds spelled out lengthy messages. (Thirty years later, after gaining fame and fortune, one of the sisters admitted that she had always produced the taps by snapping her big toe inside her shoe.) In England, the U.S. and Europe, over the next 80 years, spiritualism enjoyed tremendous popularity.

In contrast to Darwin, zoologist Thomas H. Huxley treated spiritualist claims with either disinterest or good humor. Once he was present when a clever, attractive American woman mystified a select company with a fraudulent display of psychic powers and thought reading. Although he saw through her game, Huxley later reported he was so charmed by the lady that he gallantly refrained from exposing her. "Fraud is often genius out of place," he mused, "and I confess that I have never been able to get over a certain sneaking admiration for Mrs. X."

When Wallace sent him a copy of his short book, *Miracles and Modern Spiritualism*, Huxley responded diplomatically: "It may all be true …but really I simply cannot get up any interest in the subject…. If anyone would endow me with the faculty of listening to the chatter of old women and curates, I should rather decline the privilege. … And if the folk in the spiritual world do not talk more wisely and sensibly than their friends report them to do, I put them in the same category. … Better live a crossing-sweeper than die and be made to talk twaddle by a 'medium" for a guinea a séance."

Huxley had enough interest, however, to master the art of loudly snapping his toes inside his boots, so that he, too, could feign summoning the spirits. "By dint of patience, perseverance [and] practice," he explained, the toe snaps "may be repeated very rapidly, and rendered *forte* or *piano* at pleasure. To produce the best effect, it is advisable to have thin socks and a roomy, hard-soled boot; moreover, it is well to pick out a thin place in the carpet, so as to profit by the resonance of the floor."

In the early 1870s Darwin's cousin and brother-in-law Hensleigh Wedgwood became a convert. Wedgwood yearned to become a respected savant like

Darwin, their cousin Francis Galton, and Darwin's grandfather Erasmus. But a pair of swindlers, Charles Williams and Frank Herne, recognized that he was the most gullible of the clan. At their urging, Wedgwood begged Darwin to come and see the self-playing accordions, levitating tables, automatic writing and glowing spirit hands at Williams's séances. Darwin always managed to be too tired, too busy or too ill to attend. "I am a wretched bigot on the subject," he once admitted.

In January 1874, however, Darwin sent two close members of his circle to attend a séance with Williams. His friend and lieutenant, Professor Thomas H. Huxley, introduced himself as "Mr. Henry" (his middle name). And Darwin's son George, then 29 years old, attended as well. Although bottles moved around the room and a guitar played by itself, the two concluded they had observed nothing but crude trickery. George, a budding astronomer, wrote that he was shocked to find that his uncle Hensleigh's account of Williams's séances was "so worthless." Later that year Darwin wrote to a newspaperman, urging him to expose Williams as "a scoundrel who has imposed on the public for so many years."

The following year Huxley's young laboratory assistant, Edwin Ray Lankester, decided to catch Williams and Herne in fraud—an act he knew would impress his heroes Darwin and Huxley. But after Huxley's and George's visit, Herne and Williams became wary, avoiding anyone connected to Darwin's circle. Then, in April 1876, a tempting new target moved into Lankester's sights: the celebrated American psychic, Henry Slade, had come to London "to prove the truth of communication with the dead." Slade claimed that his wife's spirit wrote him chalked messages on student writing slates.

Lankester and his fellow medical student, Horatio Donkin, went to Slade's pretending to be believers. They paid the admission fee, asked questions of the spirits and received mysteriously written answers. Then, in the darkened room, Lankester suddenly snatched a slate out of Slade's hands, found the written answer to a question he had not yet asked, and proclaimed him "a scoundrel and an impostor."

The next day Slade and his partner, Geoffrey Simmonds, were in the hands of the police, charged with violating the Vagrancy Act, an old law intended to protect the public from traveling palm readers and sleight-of-hand artists.

Throughout the fall of 1876, all London was abuzz over the Slade trial. The little courtroom was packed with Slade's supporters and detractors and 30 journalists, who spilled out into the street. The *Times of London* carried trial transcripts day after day. To Slade all publicity was good.

Darwin, whose beloved 10-year-old daughter Annie had died in 1851, had nothing but contempt for the "clever rogues" who preyed on grieving relatives. Yet he avoided saying so publicly—*On the Origin of Species* had stirred up enough controversies for a lifetime. Privately, he wrote Lankester an effusive letter of congratulations. Jailing Slade was a public benefit, he said, and insisted on contributing £10 to the costs of prosecution. (Under English law, the complainant paid court costs; £10 was a substantial sum, comparable to a month's wages for a workingman.)

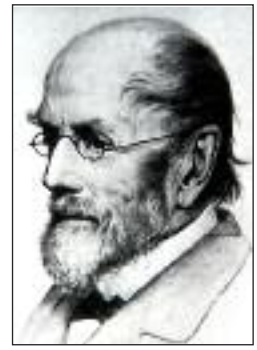
As the trial got under way, the prosecutor announced that famous stage magician John Nevil Maskelyne was prepared to reproduce all the "alleged phenomena" that were observed at the séance. The judge, in turn, warned that performing illusions of "magic slate tricks" in court would prove nothing; the question was whether Lankester and Donkin had actually caught the defendants faking the alleged spirit writing.

Both scientists turned out to be terrible witnesses; their observational skills, developed in anatomy and physiology labs, were useless in detecting fraud by professional cheats. As Huxley later noted, "In these investigations, the qualities of the detective are far more useful than those of the philosopher…. A man may be an excellent naturalist or chemist; and yet make a very poor detective."

Indeed, Lankester and Donkin apparently could not agree on anything much beyond their charge that Slade was an impostor. Did the medium use a thimble device for writing, or did he hold a pencil stub in his fingers even while his thumb was visible on the tabletop? Did he switch the blank slate for one that was previously written on? Was the table of ordinary construction, or did it have sliding bars and trick panels? The two could not establish when or how the writing had been done.

Maskelyne's courtroom conjuring, in contrast, was perfect. In answer to a question about instant writing—and before the judge could stop him—he began scrubbing a blank slate with a wet sponge until writing appeared: "THE SPIRITS ARE HERE!" Then he wiped the slate clean and ran the sponge over it again. The message reappeared, and Slade's partner, Simmonds, was fascinated. "Marvelous!" he exclaimed. "May I examine the slate?" Maskelyne shot back, "Oh, you know all about it."

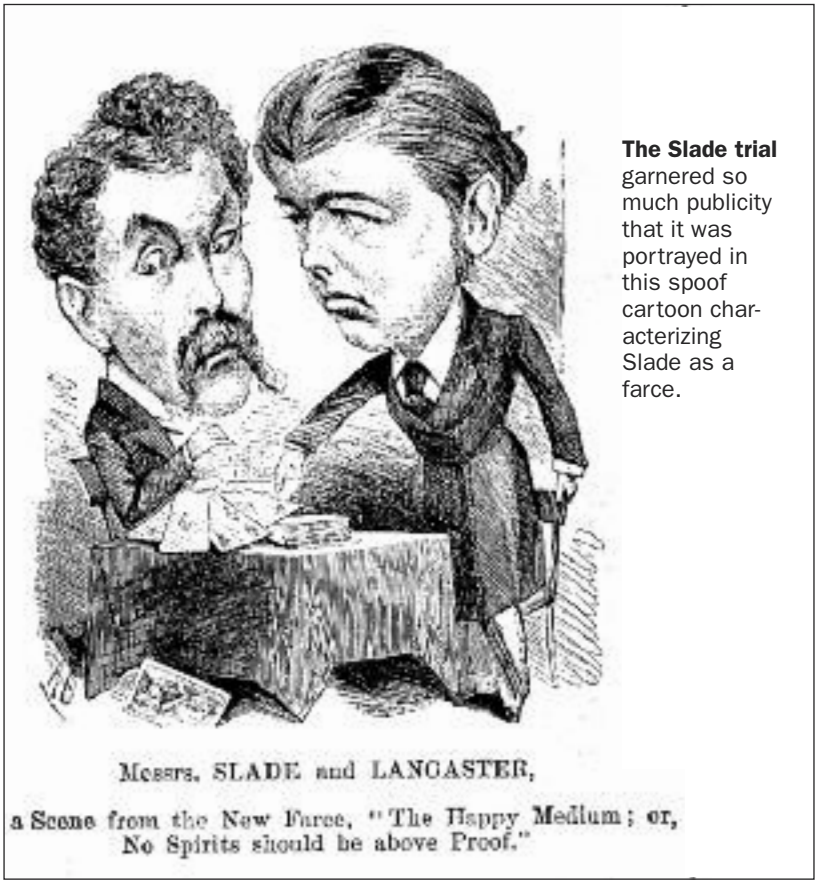
Whenever the prosecutor could, he had Maskelyne slip in another slate trick until the judge finally



Hensleigh Wedgwood, Darwin's cousin, was conned into believing that psychic power was real and urged Darwin to view slate writing and levitating tables for himself.

Zoologist Edwin Ray Lancaster who undertook a crusade to expose the psychics and spirit-mediums of his day, found support from both Charles Darwin and his old professor Thomas Henry Huxley.

Edwin Ray Lankester testifies on behalf of the prosecution in the celebrated 1876 trial of Henry Slade, the self-proclaimed spirit-medium who claimed to contact the dead through "automatic writing" on slates. Lankester holds up one of Slade's slates, while onlookers strain to glimpse the mysterious writing on them. The "spirit-medium" Slade and his bearded accomplice are seated at extreme left.



The Slade trial garnered so much publicity that it was portrayed in this spoof cartoon characterizing Slade as a farce.

barred them. The prosecutor then offered Slade two small slates joined by hinges and a hasp lock. Why not make writing appear inside the locked slates and convince the world? Slade replied he had been so pestered by such tests that Allie, his wife's spirit, had vowed never to write on a locked slate.

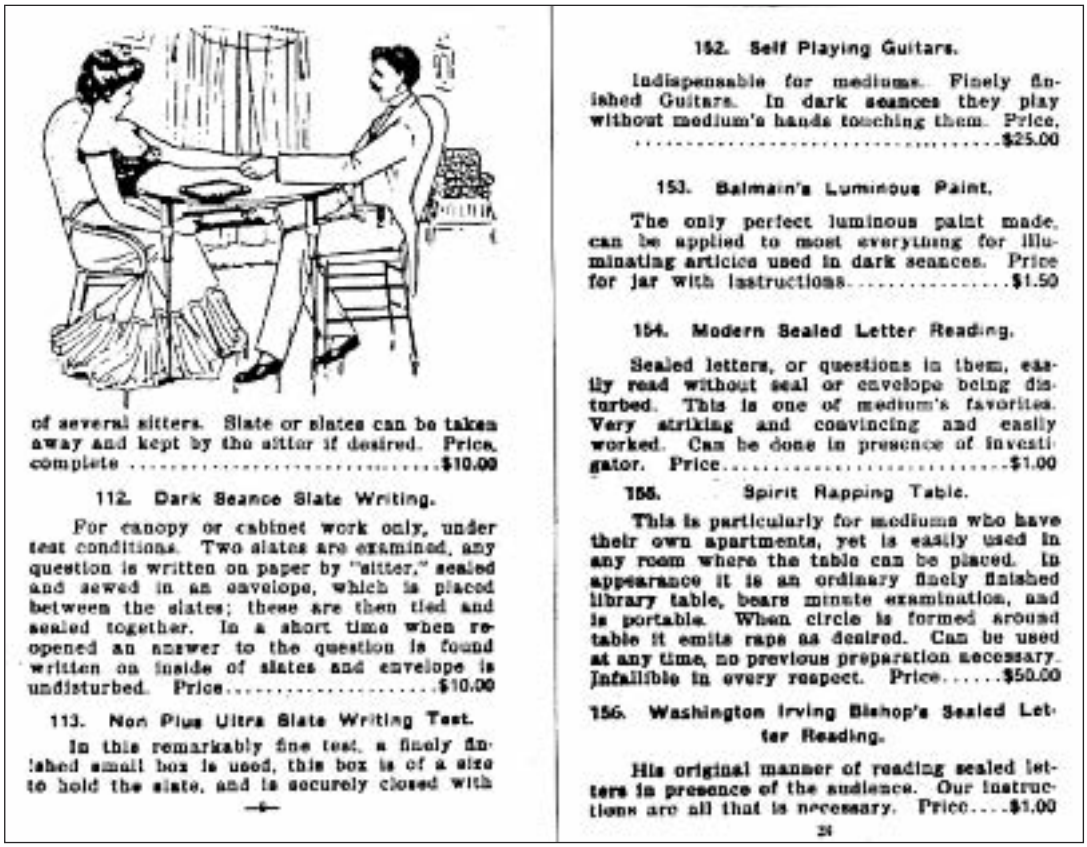
A chemist named Alexander Duffield was one of many witnesses for the prosecution. He said Slade had convinced him "that there could be established a sort of post office in connection with the 'other place.'" But now he had his doubts. Another witness testified that a few years earlier, in the U.S., someone had similarly snatched a slate from Slade in mid-séance and exposed him in fraud. But that did not deter the steady stream of suckers who flocked to Slade's parlor.

The high point of the trial was Wallace's appearance for the defense. His integrity and candor were well known to all. When called, he said that he had witnessed the alleged phenomena but refused to speculate on whether the writings were caused by spirits. He considered Slade to be an honest gentleman, "as incapable of an imposture …as any earnest inquirer after truth in the department of Natural Science."

In his summation, Slade's lawyer argued that there was no real evidence against his client. No one had proved the table was rigged, and Maskelyne's demonstrations of how the trick could have been done were irrelevant. The writing's appearance before the corresponding question was asked proved nothing about its origin, and Lankester and Donkin could not agree on exactly what they had seen during the séance. Moreover, such an eminent scientist as Wallace should be considered at least as credible as young Lankester. The barrister concluded by invoking Galileo, remarking that innovative scientists who challenge the beliefs of their time are always vilified. His irony was not lost on the evolutionists.

But nothing could save Slade. The judge said that he understood that spiritualism was "a kind of new religion" and did not wish to offend sincere believers. Still, the question before the court was whether Slade and Simmonds had fraudulently represented their own actions as paranormal phenomena. Concluding that he must decide "according to the well-known course of nature," the judge sentenced the defendant to three months' hard labor in the House of Corrections.

Slade never served his sentence. On appeal, another judge ruled that the Vagrancy Act, which prohibited palmistry, was not applicable to claims of spirit writing. Slade and his partner fled England



of several sitters. Slate or slates can be taken away and kept by the sitter if desired. Price, complete $10.00

112. Dark Seance Slate Writing.

For canopy or cabinet work only, under test conditions. Two slates are examined, any question is written on paper by "sitter," sealed and sewed in an envelope, which is placed between the slates; these are then tied and sealed together. In a short time when re-opened an answer to the question is found written on inside of slates and envelope is undisturbed. Price.....$10.00

113. Non Plus Ultra Slate Writing Test.

In this remarkably fine test, a finely finished small box is used, this box is of a size to hold the slate, and is securely closed with

152. Self Playing Guitars.

Indispensable for mediums. Finely finished Guitars. In dark seances they play without medium's hands touching them. Price, ...$25.00

153. Balmain's Luminous Paint.

The only perfect luminous paint made, can be applied to most everything for illuminating articles used in dark seances. Price for jar with instructions.....$1.50

154. Modern Sealed Letter Reading.

Sealed letters, or questions in them, easily read without seal or envelope being disturbed. This is one of medium's favorites. Very striking and convincing and easily worked. Can be done in presence of investigator. Price.....$1.00

155. Spirit Rapping Table.

This is particularly for mediums who have their own apartments, yet is easily used in any room where the table can be placed. In appearance it is an ordinary finely finished library table, bears minute examination, and is portable. When circle is formed around table it emits raps as desired. Can be used at any time, no previous preparation necessary. Infallible in every respect. Price.....$50.00

156. Washington Irving Bishop's Sealed Letter Reading.

His original manner of reading sealed letters in presence of the audience. Our instructions are all that is necessary. Price....$1.00

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Darwin's bulldog Thomas Henry Huxley attended a séance, noting: "In these investigations the qualities of the detective are far more useful than those of the philosopher." He concluded: "Better live a crossing-sweeper than die and be made to talk twaddle by a 'medium' hired at a guinea a seance."

Left: Spiritualist Secrets are for sale in this catalog. "Psychics" destroyed them after ordering tricks, which is why surviving copies are so rare.

for Germany. Within a short time, Slade had convinced his landlord, a local conjurer, the chief of police and several prominent German scientists (including the physicist Johann Zollner of the University of Leipzig) that he was in contact with spirits and various paranormal forces. When his act wore thin, he took to the road again. Eventually he wound up an alcoholic in a run-down New York boardinghouse, easy prey for tabloid editors who sent cub reporters to expose him one more time.

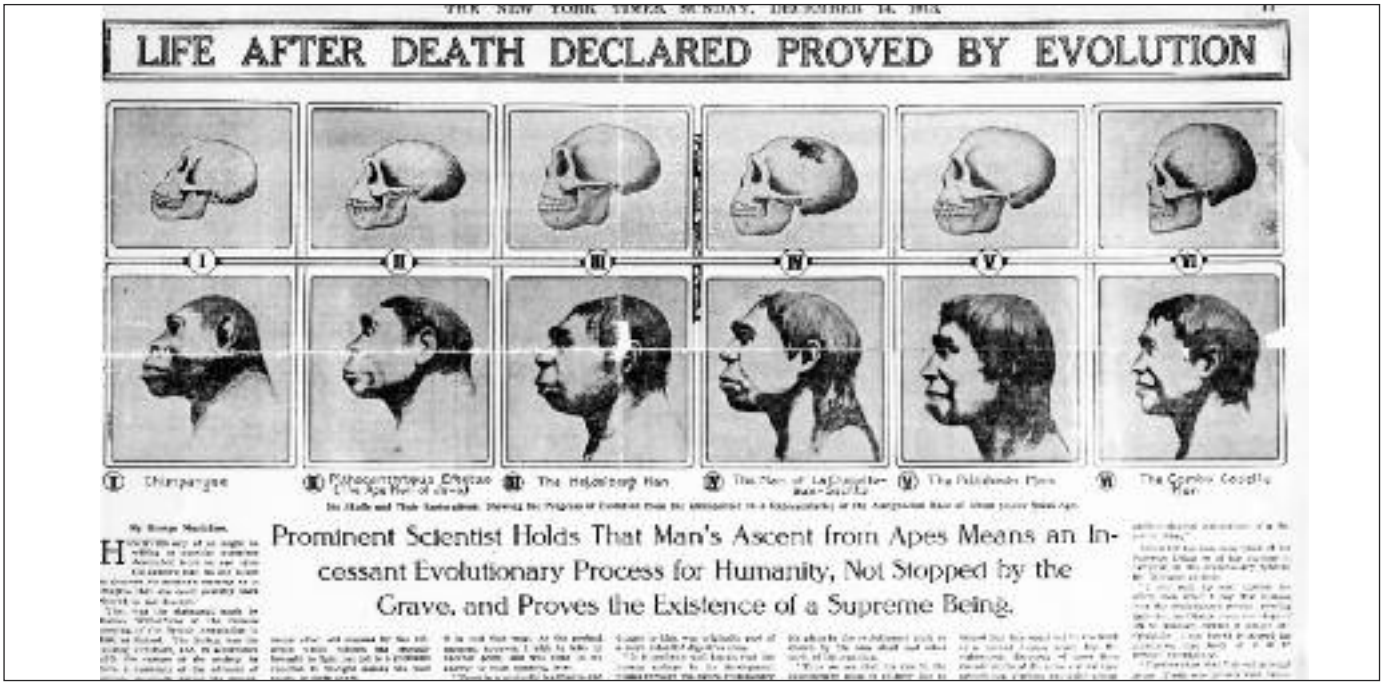
The controversy took a toll on participants other than Slade. In 1879 Darwin tried to drum up support for a government pension in recognition of Wallace's brilliant contributions to natural history. Wallace, he knew, had to earn his meager living in old age by grading examination papers. But when Darwin wrote to his friend Joseph Hooker, director of Kew Gardens, the botanist refused to help. "Wallace has lost caste terribly," he replied nastily, "not only for his adhesion to Spiritualism, but by the fact of his having deliberately and against the whole voice of the committee" allowed the paper on mental telepathy at the scientific meetings. In addition, he thought the government "should in fairness be informed that the candidate is a public and leading Spiritualist!"

Undaunted, Darwin replied that Wallace's beliefs were "not worse than the prevailing superstitions of the country," meaning organized religion. Darwin and Huxley twisted a few more arms, then Darwin personally wrote to Prime Minister William Gladstone, who passed the petition on to Queen Victoria. In the end, Wallace got his modest pension and was able to continue writing his articles and books all the way up to the day he died in 1913, at the age of 90.

In the years after the trial, Darwin and his brother-in-law Hensleigh Wedgwood did not see much of each other. In 1878 a reporter for the journal *Light* had finally managed to unmask Charles Williams, the medium who had attempted to use Wedgwood to win over Darwin's family. When the journalist suddenly turned on the lights at a séance, Williams was found to be wearing a false black beard, phosphorescent rags and, as Darwin later put it in a letter, "dirty ghost-clothes."

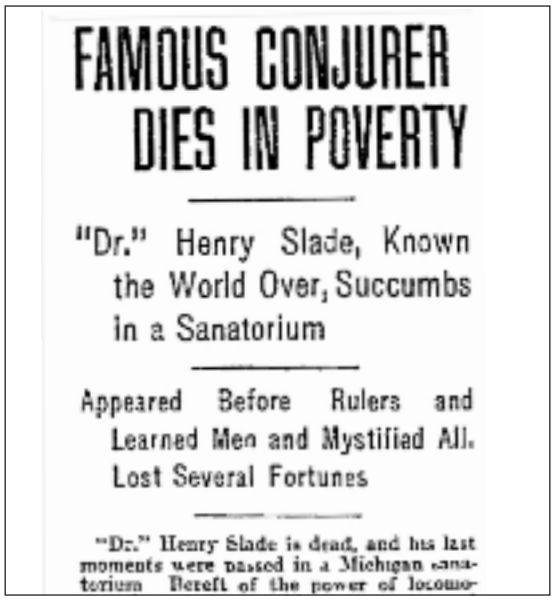
"A splendid exposure," crowed Darwin when he read of it. But even then, Hensleigh's faith remained unshaken; in his opinion, a few faked performances indicated only that the medium was having difficulty getting through to the other side and was under pressure not to disappoint his sitters. For Darwin, this was the last straw: "Hensleigh Wedgwood admits

Victorian cartoonists characterized sitters' enthusiastic testimony about séance marvels as "what Foxes will say, Geese and Asses will believe"—a reference to the celebrated Fox sisters of Hydesville, New York. The young Fox girls tricked hundreds with their phony "spirit raps," which began on March 31st, 1848—April Fools' Eve. (Courtesy, New York Public Library)



Combining science and religion, a Spiritualist anthropology professor from Columbia University claimed in 1913 that early human fossils "proved" that spiritual evolution had taken place. Most scientists disagreed, but the *New York Times* gave his views respectful coverage. One example, Piltdown Man, was later found to be a hoax. (Courtesy Research Library, the American Museum of Natural History)

Wallace sat for studio photographs by "spirit photographers" who claimed that their plates could reveal invisible "spirits" hovering about him. Such "spirits"—usually Native America chiefs or ancient middle-Eastern warriors—were later added to the negatives by "mysterious" double exposures, which anyone could spot today. Used by permission of the College of Psychic Studies.



FAMOUS CONJURER DIES IN POVERTY

"Dr." Henry Slade, Known the World Over, Succumbs in a Sanatorium

Appeared Before Rulers and Learned Men and Mystified All. Lost Several Fortunes

"Dr." Henry Slade is dead, and his last moments were passed in a Michigan sanatorium Bereft of the power of locomo-

Slade's 1905 Newspaper obituary seems to gloat that the once-celebrated "master of the occult" couldn't overcome disease and death in a Michigan sanatorium. "His once active mind dimmed, his wealth gone, and deserted by friends, he passed away," wrote the cruel obituarist, noting that "'Dr.' Slade made and lost several fortunes."

Williams is proved a rogue," he fumed, "but insists he has seen real ghosts at Williams's séances! Is this not a psychological curiosity?"

In 1880 Wedgwood sent Darwin a long handwritten manuscript: a spiritualist synthesis of science and religion. Would Darwin read it and perhaps suggest where it might be published? In a melancholy mood, Darwin sat down to reply to his cousin. He may have remembered the times Wedgwood had gone to bat for him many years before: he had helped persuade Darwin's uncle and father to let him go on the HMS *Beagle* expedition, and it was to his cousin that Darwin had once entrusted publication of his theory of natural selection in the event of his early death.

"My dear Cousin," Darwin wrote, "It is indeed a long time since we met, and I suppose if we now did so we should not know one another; but your former image is perfectly clear to me." He refused even to read Hensleigh's paper, writing that "there have been too many such attempts to reconcile *Genesis* and science." The two cousins, who had once been so close, were now hopelessly estranged over the question of science and the supernatural.

That same year Lankester, now a professor of zoology, declined requests to continue ghostbusting. "The Spirit Medium," he wrote in an 1880 letter to the *Pall Mall Gazette*, "is a curious and unsavoury specimen of natural history, and if you wish to study him, you must take him unawares …. I have done my share of the skunk-hunting; let others follow." He was later appointed director of the British Museum of Natural History. Ironically, in 1912 this nemesis of fakers was completely fooled by the Piltdown man hoax, one of the most notorious frauds in the history of evolutionary biology.

As for the "evidence" of spiritualism in the Slade trial, there are a few slates with the chalk "spirit writing" on them, still perfectly pristine and undamaged after 150 years. I saw the first one in 1994 at the American Society for Psychical Research in New York. When I asked if their collection included one of Slade's slates, the curator's eyes lit up. He went straight to the artifact in its archival box and showed it to me with evident pride and pleasure. I told him I wanted to return and photograph it sometime, and he invited me to do so.

More than a year later, I returned, but that curator was no longer there, and a new man was in charge of the library and collections. I asked about Slade's slate, and he said he had heard of it, but couldn't locate it and asked me to come back again. When I returned, he said he had spent several hours trying to track it down, but no one knew what had become of it. There went my opportunity to get a photo to illustrate my article. I heard myself saying, "What do you *mean* you can't find it? Aren't you supposed to be the Psychic Society?" He was not amused.

About two years later another slate with Slade's "spirit writing" turned up. This was in England, at Cambridge University Manuscript Library. I was not looking for it there, and was doing some research on Sir Arthur Conan Doyle, but the archivist, knowing my interests, steered me to a collection of material that was not yet catalogued, and had recently been donated by the British Psychic Society. The pair of hinged slates had been stored together with a long handwritten letter by Hensleigh Wedgwood, insisting that he had observed "no trickery" during the séance. Alas. S

Wallace and the Flat Earthers

Charles Lyell Counseled Charles Darwin to Avoid Public Controversies, while Encouraging Alfred Wallace to Lock Horns with a Malicious Crackpot

BY RICHARD MILNER AND MICHAEL SHERMER

Antievolutionist John Hampden, the self-proclaimed champion of biblical "Flat Earthism," drew the great evolutionist Alfred Russel Wallace into one of the most bizarre episodes in the history of science. Son of a rector and nephew of a bishop, Hampden had sworn to destroy the "infidel pagan superstitions" of modern science.

A zealous disciple of Samuel Birley ("Parallax") Rowbotham, author of the 1869 book *Earth Not a Globe*, Hampden warned that if schools continued to teach the "Satanic globular theory" to the young, it would mean the destruction of all morality and religion. Evolution, he believed, was only the latest wrinkle in the more basic blasphemies of Copernicus and Sir Isaac Newton.

In 1870, Hampden publicly challenged any scientist to prove the Earth a spheroid and offered to bet £500 (about a year's salary for the average worker) that no one could prove the "globular theory" to the satisfaction of independent referees. To collect, the challenger had to demonstrate the existence of a convex railway track or curving surface on a large body of water.

The Old Bedford Canal

His preferred targets—wealthy, influential gentlemen-scientists like Charles Darwin or Sir Charles Lyell—ignored Hampden's bait. But Alfred Russel Wallace, with his openness, trusting nature, and perpetual near-poverty, thought he might make a few points for science and win an easy five hundred quid. After all, he had started his career as a surveyor. Hesitant, he asked the great geologist Lyell whether he thought it wise to accept such a challenge. "Certainly," Sir Charles replied, "it may stop these foolish people to have it plainly shown to them."

Wallace had chosen the worst possible advisor to protect his interests. Lyell had pushed Charles Darwin to publish quickly, warning that Wallace was also developing a theory of natural selection and might beat him into print. The same Lyell, Darwin wrote in his 1876 autobiography, "strongly advised me never to get entangled in a controversy, as it rarely did any good and caused a miserable loss of time and temper." While counseling Darwin to avoid public debates, however, Lyell encouraged Wallace to lock horns with one of the most malicious, abusive crackpots in all of England.

Confident of his scientific prowess, Wallace entered the contest unconcernedly, like a lamb to the slaughter. Hampden asked him to pick an umpire, and Wallace chose a man named J. H. Walsh, who was a stranger to him. As the well-known editor of *The Field*, a newspaper for country

gentlemen, Walsh had a reputation for fairness and objectivity. Graciously, Wallace offered to let Hampden appoint another impartial judge of his own choosing. He named a printer, who was a close friend and dedicated flat-earther, which Hampden did not think it necessary to mention.

On Saturday morning, March 5, 1870, the parties met near the north end of Old Bedford Canal, about 80 miles from London. The waterway ran straight and unobstructed for six miles between two bridges. Wallace affixed large cloth rectangles to the facing sides of each bridge, both bearing a bold black stripe running parallel to the ground and both placed exactly the same height above the water. Halfway between the two bridges, Wallace stuck a tall pole in the bank, bearing two large discs as height markers. He measured the height of the lower disc, placing it exactly the same distance above the water level as the black stripes mounted on the bridges.

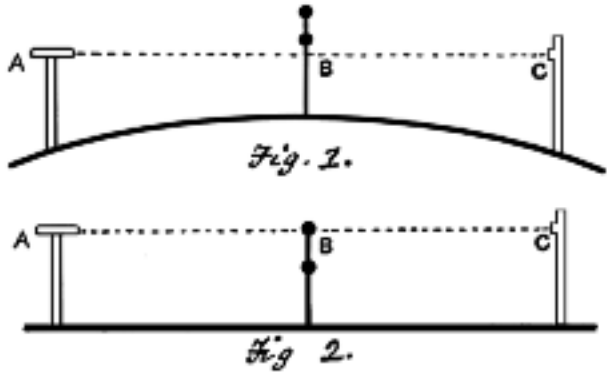
After carefully lining up a surveyor's level-mounted telescope at the same height as the markers, Wallace asked the referees to sight through it from either bridge. From whichever vantage point, the pole's discs appeared much higher than the bars mounted on the bridges, which seemed to be on a downslope.

Walsh and another man looked through the telescope and both confirmed immediately that Wallace had proved his point. But Hampden's referee disagreed and actually jumped for joy, proclaiming the demonstration proved the flatness of the Earth. Hampden said it wasn't even necessary for him to look through the telescope, as he trusted his colleague.

Wallace was stunned. He had not reckoned with the strange logic of "Zetetic" astronomy, as set forth in Rowbotham's book, which explains away such a result as a mere optical illusion, to be expected if the Earth is flat. Hampden immediately claimed victory and demanded his money.

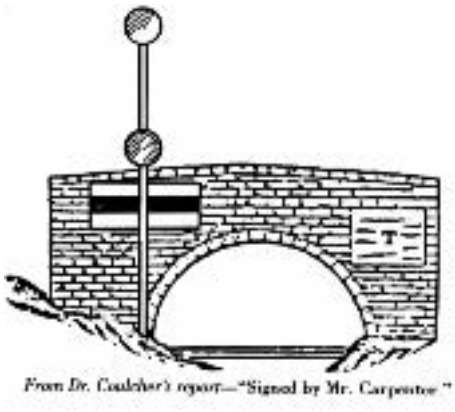
Walsh took the drawings and interpretations of what was seen through the telescope, studied them for a week, then published them in his paper with an announcement that Wallace was clearly the winner. Furious, Hampden demanded his money back, but Walsh sent it to Wallace with congratulations. At this "perfidy," Hampden directed a barrage of letters and pamphlets at Walsh, Wallace, and all their friends and colleagues, calling them liars, thieves, cheats and swindlers. He kept it up for the next 16 years, even haranguing the officers of all the scientific societies to which Wallace belonged, such as the President of the Royal Geographical Society on October 23, 1871 (see handwritten letter):

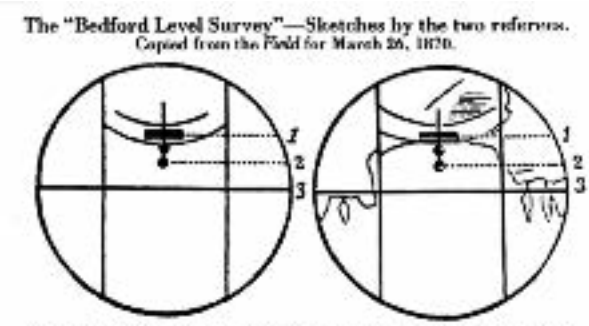
Wallace challenges the flat-earthers, March 5, 1870, at the Old Bedford Canal. (Courtesy of the Royal Geographical Society)



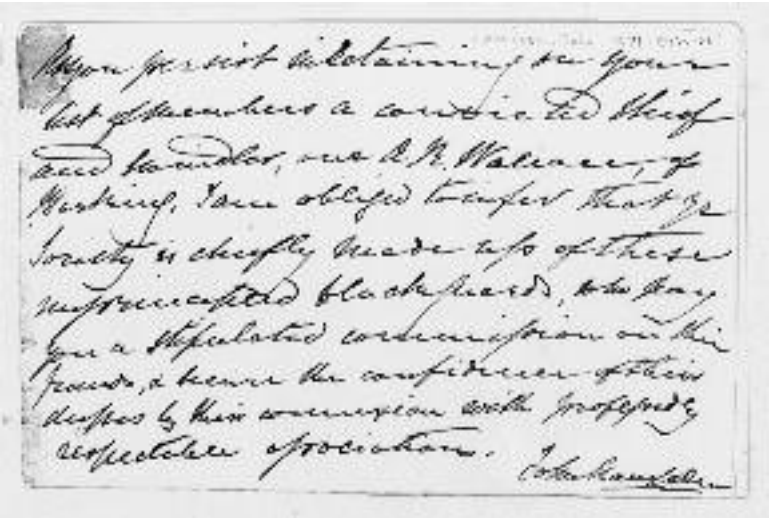
A. A telescope, a disk, and a black band were all placed at exactly the same height above the water along a straight six-mile stretch of this canal. If the six-mile surface of the water is convexly curved, then the top disk will appear higher than the black band (Fig. 1). If the surface of the water is a perfectly straight line for the six miles, the three objects will be at exactly the same level and the disk will be seen through the telescope as superimposed upon the black band (Fig. 2).

B. The view through the telescope of the canal bridge, showing the disks and black band.





C. Illustration of two views through the telescope demonstrating the curvature of the Earth. These views, as seen by means of the inverting telescope, are exact representations of the sketches made by the mutually agreed upon referee John Henry Walsh, editor of *Field* magazine, and attested to by Wallace's witness Dr. Coulcher, who confirmed them as being correct in both cases: first, from Welney Bridge; and second, from the Old Bedford Bridge.



Wallace had no idea what he was getting himself into by taking up the challenge of proving that the Earth is round. He proved it unquestionably, but collecting the prize money for doing so turned out to be the least of his problems. Flat-Earther John Hampden harangued him for years with abusive letters and notes, including this one to the President of the Royal Geographical Society.

> If you persist in retaining on your list of members a convicted thief and swindler, one A. R. Wallace, of Barking, I am obliged to infer that yr Society is chiefly made up of these unprincipled blackguards, who pay you a stipulated commission on their frauds, & secure the confidence of their dupes by their connexion with professedly respectable associations.

When Wallace brought his own criminal action for libel, the court ordered Hampden to stop his flow of venom and "keep the peace" for a year. He managed it for a few months, then sent Mrs. Wallace a note:

> MADAM— If your infernal thief of a husband is brought home some day on a hurdle, with every bone in his head smashed to a pulp, you will know the reason. Do you tell him from me he is a lying infernal thief, and as sure as his name is Wallace he never dies in his bed. You must be a miserable wretch to be obliged to live with a convicted felon. Do not think or let him think I have done with him.

Wallace brought Hampden back to court, where he was fined and spent a week in jail, but over the next four years he kept repeating the offense and was convicted three times. He got several months in jail the next time, six more when he harassed Wallace again and was directed to pay damages and court costs, which he never did. Instead, he brazenly hid all his assets under a relative's name and declared bankruptcy.

Then Hampden began turning the tables in the law courts. He sued Walsh, the stakeholder, for his £500 when his barrister reminded him that English law did not recognize wagers. Losers of bets had no legal obligation to pay, and Hampden had asked for his money back before Walsh had paid it to Wallace. Hampden won, and Wallace bore Walsh's expenses in the suit. Although he had been declared winner of the challenge and wager, and several times winner in the courtroom, Wallace ended up deep in the red, disgusted with British justice. As he grumbled in a letter: "The two law suits, the four prosecutions for libel, the payments and costs of the settlement, amounted to considerably more than the 500 pounds…besides which I bore all the costs of the week's experiments, and between fifteen and twenty years of continued persecution—a tolerably severe punishment for what I did not at the time recognize as an ethical lapse."

The difference, of course, between Wallace and Hampden was the extent to which they would allow the evidence to answer a question of nature. Despite his best efforts to use science to debunk a pseudoscientific claim, however, Wallace's response to Hampden was one that would never have been made by his more conservative colleagues Darwin and Lyell. Nevertheless, Wallace's personality dictated his need to take on such a radical claim. His were the actions of a heretic-personality. (See accompanying article.) Fascinated with all ideas on the radical edge, Wallace simply had to take up the cause regardless of the cost, which was substantial.

In his 1905 autobiography Wallace expressed continuing amazement at Hampden's virulence, as if he were some strange specimen of natural history. "Seldom has so much boldness of assertion and force of invective been combined with such gross ignorance…. And this man was educated at Oxford University!" S

Heretic Scientist

Why Alfred Russel Wallace Got Involved In So Many Heretical Ideas

BY MICHAEL SHERMER

One key to understanding Alfred Russel Wallace's lifelong attitude toward heretical ideas may be found in his personality, because personality traits and temperament tend to hold steady throughout the life of an individual, influenced of course by life events. Wallace's humble origins and self-made career, for example, may help to explain his generosity and kindness to others. His varied and diverse education and experiences also shaped a separatist personality and created an independent thinker—good for creativity in breaking out of a paradigmatic mold (for example, his discovery of natural selection), but making him more gullible to unusual claims (for example, spiritualism), especially when mainstream science failed to account for such human skills as mathematical reasoning, art, and language, leading Wallace to conclude that there must be a higher intelligence that guided and enhanced nature's selective hand.

Taking Wallace as a case study in finding the essential tension between conservatism and openness in science, he usually erred on the side of the latter, preferring to risk being right rather than playing it safe and possibly missing out on an intellectual revolution. Thus, the life and personality of Wallace is itself a test case for resolving the boundary problem in science—where do we draw the line between science and pseudoscience, or science and non-science? More importantly, why are some people drawn to the fringe side of the boundary, willing to risk careers gambling on revolutionary ideas, while others greatly prefer the more conservative approach of playing it safe until a consensus is reached?

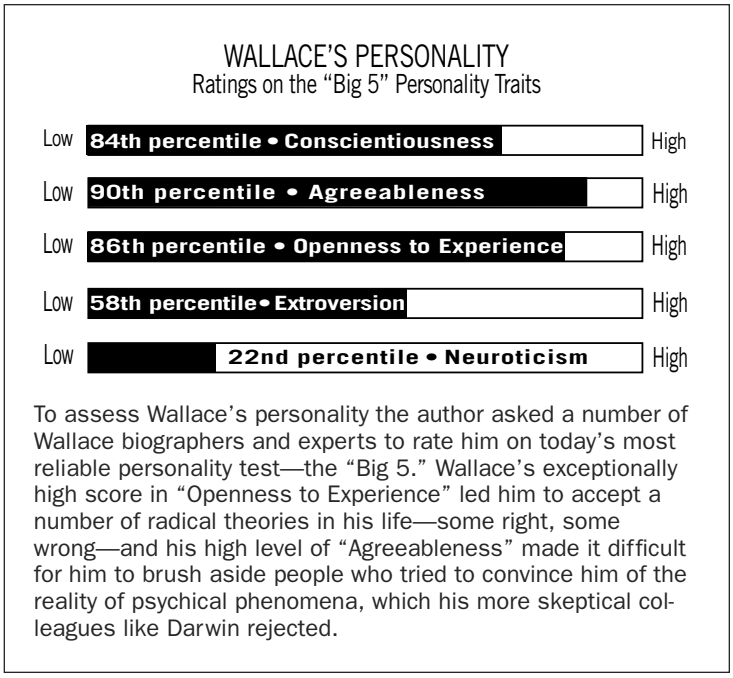
The Personality of a Heretic Scientist

What was Alfred Russel Wallace like as a person? A number of magazine profiles and interviews with Wallace that appeared in the final decades of his life help flesh out his personality and temperament. During his lecture tour of America in 1886 he was interviewed by *The Sunday Herald of Boston*, when he was in that city to present his "Lowell Lectures on the Darwinian Theory." The interviewer's portrayal of his personality is very American: "His face lights up in conversation, and there is nothing in his manner or features to distinguish him from an American. He has the bearing of an ordinary citizen rather than that of a scientist, but there is a strong individuality beneath the quiet exterior, and, after the first steps of acquaintance are entered upon, he reveals himself as a very agreeable gentleman. His presence is so good, and his enunciation is so clear for an Englishman, that he ought to be easily heard by his audience, which, at least on Monday night, will be as distinguished as any that has greeted an English lecturer before the Lowell Institute for some time."

In 1898 a journalist for *The Bookman* noted that "Dr. Wallace's travels and adventures in early life seem to have hardened his physique. No symptom of feebleness, physical or mental, is perceptible. With his tall substantial figure, still erect but for slight 'scholar's stoop,' his head thickly covered with smooth white hair, Dr. Wallace's appearance is at once robust and dignified." Like most descriptions of Wallace, this author "is charmed by the native simplicity and modesty of his speech and demeanour; he seems never to regard himself as one of the notable men of the century." Tellingly, when asked to compare his personal habits to those of Darwin, Wallace responded: "Darwin was a continuous worker at his one great subject; I am not. I should not be happy without some work, but I vary it with gardening, walking, or novel reading. Even when in the midst of writing a book I never cease to read light literature."

In the final two years of his life Wallace granted several interviews, one of which labeled him as "The Last of the Great Victorians." Frederick Rockell of *The Millgate Monthly* "pushed open the gate, which bore the inscription, 'Old Orchard-A. R. Wallace'—and found myself in a luxurious garden where flowers of many varieties contested in a friendly rivalry of shape, colour, and perfume. As I entered the porch, two merry children ran out of the house into the garden, and I realised that in the winter of his life the great scientist was still closely in touch with the innocence and fragrance of childhood."

He remained so to the end, along with his



To assess Wallace's personality the author asked a number of Wallace biographers and experts to rate him on today's most reliable personality test—the "Big 5." Wallace's exceptionally high score in "Openness to Experience" led him to accept a number of radical theories in his life—some right, some wrong—and his high level of "Agreeableness" made it difficult for him to brush aside people who tried to convince him of the reality of psychical phenomena, which his more skeptical colleagues like Darwin rejected.

sanguine personality described by W. B. Northrop in the New York-based magazine *The Outlook* just days after his death in 1913, as "a man of great modesty. It is seldom that greatness in this world is allied to humility; but Dr. Wallace possessed self-abnegation to a rare degree."

Most contemporary observers thought Wallace a highly agreeable personality. In fact, Wallace described his own "natural disposition" as "reflective and imaginative," which he attributed to "the quiet and order of my home, where I never heard a rude word or an offensive expression." This, he said, "was intensified by my extreme shyness."

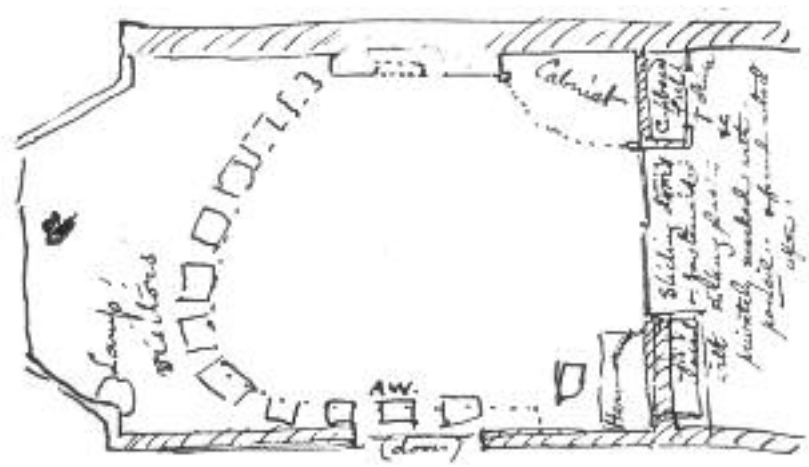
Personality and temperament, of course, do not a great scientist make. To explore this question further I asked experts who had assessed Wallace's personality for my book *In Darwin's Shadow: The Life and Science of Alfred Russel Wallace*, "how would you describe Alfred Russel Wallace's unique intellectual style? In other words, what are his strengths and weaknesses as a scientist? In particular," I also asked them, "I am interested in answering the question of how and why a world-class scientist like Wallace was so interested in fringe and heretical sciences and social causes."

The answers were revealing. Linnean Society archivist and librarian Gina Douglas noted: "I think he had a very open mind…a person with a very broad outlook." Historian of science Michael Ghiselin made this modern comparison: "There is nothing unusual about Wallace's interest in such matters. Had he been at Berkeley in the 1960s he would have been opposed to fluoridation and 'into' acupuncture and communal life styles. Such interests made him open to novelty but there is a serious tradeoff if one is a bit gullible as was he." Linnean Society Executive Secretary, the late John Marsden wondered: "Is there an answer to this? Most Nobel laureates I have been acquainted with (around seven or eight) have had severely flawed personalities. I don't think Wallace was that bad. In fact, he seems to have been a pretty decent sort. A number of people of this kind were attracted to socialism, not least Marx and a variety of intellectuals. Look at the alternatives! Hardly wonderful. As you note he had this weakness for psychics. Perhaps those who live in glass houses should not throw stones!"

Wallace archivist and biographer Charles Smith's comments were especially insightful in integrating Wallace's personality with his intellectual style, philosophy of science, and the boundary problem and Wallace's role in determining what constitutes legitimate science:

> As far as his "fringe" interests go, I would suggest that they were then (and in many cases still are) considered "fringe" only because others had not yet caught up with the thinking involved (or in addition, in the case of spiritualism, still cannot devise adequate tests of related matters, or refuse to entertain the notion that the basic idea may be correct, though anthropomorphized). I would describe Wallace as an absolutely "fearless" thinker, but not a foolhardy one. To me, his strongest weakness as a thinker was his tendency to too absolutely trust some kinds of physical data as being finally diagnostic: thus, his errant conclusions in some aspects of biogeography, astronomy and glaciology. I realize he is also criticized for being gullible in his dealings with mediums; however, it seems to me that some of his experiences (especially those which took place in his own quarters) are difficult to easily discount. I am a reasonably skeptical person; still, it seems to me (as someone who has spent a good deal of time over the years considering the evolutionary process and related systems concepts) that Wallace's model of evolution, incorporating social and spiritualist components, is more on target than anyone else's.

Historian of science Richard Milner considered Wallace's personality to be the source of both his strengths and weaknesses with this rather different assessment of Wallace's forays into the unknown: "I don't see how anyone who has seriously studied the man's character can fail to be deeply



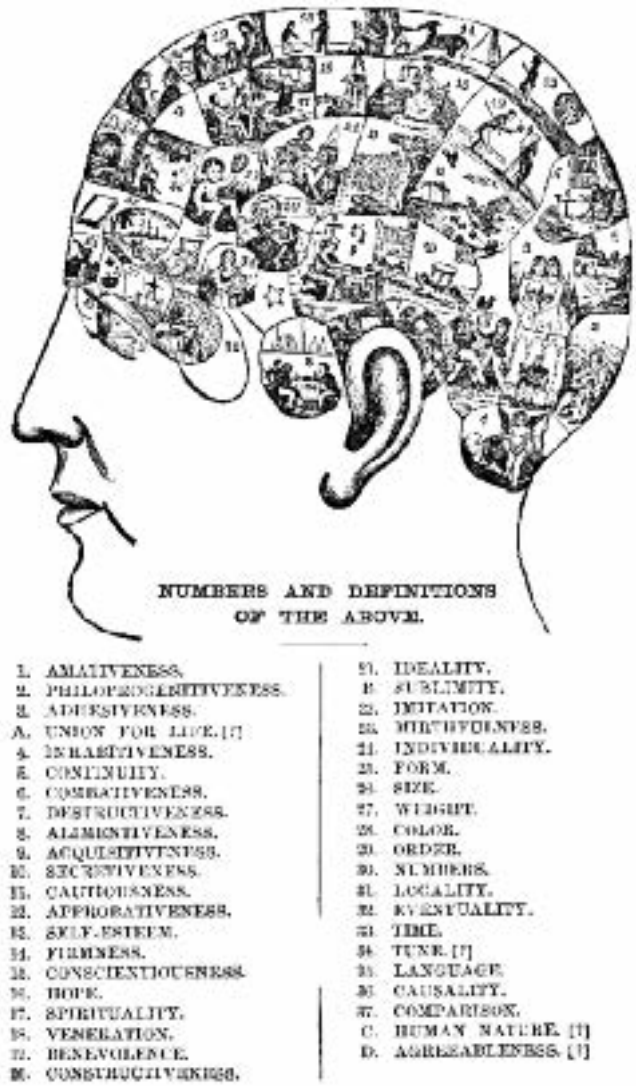
Left: Wallace's openness (some would say gullibility) to all matters spiritual was evident in his personal participation in séances, which he considered to be a form of experimentation. Here is a diagram in Wallace's hand from his American journal depicting a séance he participated in when he was in Boston in 1886. Wallace has indicated where he ("AW") sat, the cabinet where the medium was encased, and the sliding doors "privately marked with pencil & found untouched after." Courtesy of the Linnean Society of London.

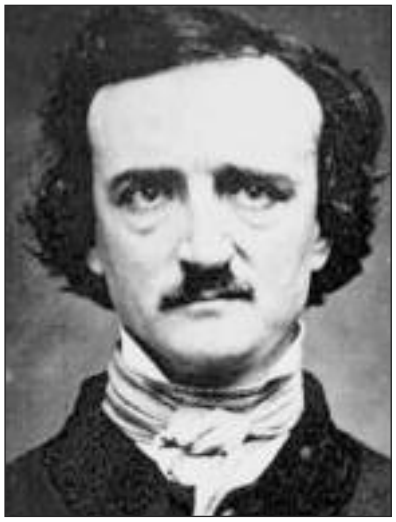
Below: Wallace's heretic personality led him to be open-minded to radical new ideas, such as evolution by natural selection, but to also accept scientific theories that turned out to be pseudoscience, such as phrenology. While it is true that certain brain areas have specific functions, phrenology's categories based on bumps on the skull were entirely imaginative.

impressed by the contradictions and paradoxes of his personality. I think he was an extraordinarily good man with an uncommonly trusting attitude. Because he was so honest and straightforward, he thought that everyone was like that. He could not conceive that men who spoke like gentlemen interested in exploring the frontiers of knowledge could be calculating deceivers, who lied to his face for monetary gain. (I'm talking here about the various Spiritualist imposters and conmen, of course.)"

As for the contrast of Wallace's personality with Darwin, Milner made this insightful observation that supports modern theories of happiness as a temperament independent of social status or wealth: "I think the contrast between Wallace and Darwin at the end of their lives is most interesting. Darwin became depressed and melancholy, could no longer find any joy in scenery, art, or music, and peered gloomily into the coming darkness, where thoughts and personality would cease forever. Wallace lived much longer and happily, despite his penury, and cheerfully looked forward to his adventures in the Spirit World. Another glorious expedition into the Unknown."

We can do no better than follow the precepts of such eminent naturalists in our exploration of the natural history of personality, starting with a *heretic personality*, or *the unique pattern of relatively permanent traits that makes an individual open to subjects at variance with those considered authoritative*. This description well fits Wallace, who routinely maintained opinions on a variety of subjects typically at odds with the received authorities. A heretic personality is an individual, like Wallace, who differs from the majority in his openness to and support of ideas considered heretical, while also maintaining anti-authoritarian, pro-radical sympathies. These traits, being "relatively permanent," are not temporary conditions, or "states" of the environment, the altering of which changes the personality.






Left: Edgar Allan Poe, the American writer whose "last poem" Wallace mistakenly believed he had discovered. "Leonainie" was, in fact, a fake Poe poem penned by **James Whitcomb Riley (Right),** who was known as the "Hoosier" or Children's Poet for his homespun dialect-sprinkled works. He is credited with the oft quoted skeptic phrase, "When I see a bird that walks like a duck and swims like a duck and quacks like a duck, I call that bird a duck." Riley photo courtesy of The James Whitcomb Riley Museum Home.

The heretic personality, like any other personality trait, tends to act consistently over most environmental settings, throughout much of a lifetime.

Wallace became interested in heretical theories as a very young man, investigating, for example, phrenology, and considered controversial biological problems such as the mutability of species. This was not, however, a temporary flirtation with anti-authoritative ideas by a young, undisciplined mind. In mid life, after co-discovering with Darwin their innovative (and at the time moderately heretical) theory on the origin of species by means of natural selection, Wallace began experimenting with spiritualism and many other controversial beliefs. What establishes Wallace as a genuine heretic personality was that he demonstrated a unique pattern of relatively permanent traits that caused him to maintain opinions upon a variety of subjects throughout his life at variance with those considered authoritative. In addition to phrenology, spiritualism, and his collision with one litigious flat-Earther, the following incident in Wallace's life is emblematic of a heretic personality.

"Leonainie"— In Search of the Lost Poem of Poe

In digging through the stacks at the Honnold Library of the Claremont Colleges in search of any minutia on Wallace, I was surprised to find—under the section on Edgar Allan Poe—a posthumous publication first published circa 1930 entitled *Edgar Allan Poe: A Series of Seventeen Letters Concerning Poe's Scientific Erudition in Eureka and His Authorship of "Leonainie"*. The author of this tiny monograph (18 pages) was none other than Alfred Russel Wallace, who penned 15 letters (and two extracts never mailed) to one Ernest Marriott, Esq., between October 29, 1903 and March 23, 1904. The incident in question—a rediscovered poem of Edgar Allan Poe supposedly written "at the Wayside Inn in lieu of cash for one night's board and lodging"—is typical of Wallace's vivid imagination and willingness to jump to conclusions on the scantiest of evidence.

The story, as I have been able to reconstruct it, is as follows. Sometime around 1893, just seven years after a lecture tour of America, Wallace received a letter from his brother living in California, which included a poem entitled "Leonainie," allegedly written by Poe. Wallace, however, was "occupied with other matters" and thus "made no enquiry how he got it, but took it for granted that he had copied it from some newspaper." Ten years later, on November 3, 1903, Wallace wrote to Ernest Marriott (with no explanation offered of Marriott's role, other than that he was an attorney) to inquire about confirmation of the claim: "I think you will agree with me that it is a gem with all the characteristics of Poe's genius." Wallace also made a bizarre reference in this letter about the last poems of Poe, "The Streets of Baltimore" and "Farewell to Earth," which Wallace believed were written *after* Poe's death "through another brain," and while they are "in my opinion fine and deeper & grander poems than any written by him in the earth-life… they are deficient in the exquisite music & rhythm of his best known work."

With typical enthusiasm for all matters heretical, Wallace threw himself into an intense study of Poe's writings, obsessed with finding out if "Leonainie" was indeed his long lost, and perhaps last, poem (in this world anyway). One week later he told Marriott: "Since I wrote to you about 'Leonainie' I have read it many times & have it by heart, & on comparing it with the other poems by Poe which I have it seems to me to be in many respects the most perfect of all. The rhythm is most exquisite, and the form of verse different from any other I can call to mind in the double triplets of rhymes in each verse, carried on throughout by simple, natural and forcible expressions while the last verse seems to me the very finest in any of his poems." Wallace reprinted the poem for Marriott at the end of the November 2 letter:

Leonainie

Leonainie, angels named her, and they took the light
Of the laughing stars and framed her, in a smile of white,
And they made her hair of gloomy midnight, and her eyes of bloomy
Moonshine, and they brought her to me in a solemn night.

In a solemn night of summer, when my heart of gloom
Blossomed up to greet the comer, like a rose in bloom.
All foreboding that distressed me, I forgot as joy caressed me,
Lying joy that caught and pressed me, in the arms of doom.

Only spake the little lisper in the angel tongue,
Yet I, listening, heard the whisper; "songs are only sung
Here below that they may grieve you,
tales are told you to deceive you,
So must Leonainie leave you, while her love is young."

Then God smiled, and it was morning, matchless and supreme,
Heaven's glory seemed adorning earth with its esteem,
Every heart but mine seemed gifted
with a voice of prayer and lifted,
When my Leonainie drifted from me like a dream.

With little evidence to go on, however, on the first day of 1904 Wallace noted that he still needed a scene and a motive for the poem: "I presume Poe was never in California, but I shall be glad to know if, at anytime, shortly before his death, he is known to have travelled anywhere in an almost penniless condition, where such an incident as his paying for a night's board & lodging with a poem might have occurred."

Undaunted by a lack of evidentiary support, however, and in his usual eagerness to get into print with an exciting new find, on January 6 Wallace told Marriott: "I think I can see when 'Leonainie' was probably written & I shall now send it with a few preliminary remarks to the Editor of the Fortnightly, & its publication may possibly lead to its origin being traced in America." Growing bolder by the day, on January 10 Wallace announced that the poem would be published and that "taking all the circumstances into consideration…I have come to the conclusion that this was the very last thing Poe wrote, & it was probably written only a few days before his death."

Five days later Wallace was in print with the poem and, as usual, he found himself embroiled in controversy. Apparently someone identified the poem as a fake, written by one James Whitcomb Riley, but Wallace spin-doctored this attribution, setting a standard of proof he had not held for himself: "Till we have the alleged proof that Riley wrote 'Leonainie', it seems to me quite as probable that *he* found it, and on the suggestion of a friend made use of it to gain a reputation" (February 8). But then Wallace received a letter from a Mr. Law (reprinted in the February 8th letter to Marriott), implicating Riley as the perpetrator of the hoax, cajoled by friends who told him that if he could write like Poe he could achieve enough fame to establish himself as a poet of high caliber. Riley, speculates Wallace, then wrote "Leonainie," submitted it, and "after it had run the gauntlet of Poe critics and been pronounced genuine if not canonical Riley proved the authorship. This drew attention to his own works, and he has never since lacked for praise and pudding."

On February 15, Wallace received more bad news, this from the "Librarian of the London Library," who "obtained a copy of Riley's 'Armazindy'—which contains 'Leonainie' & has sent it to me. The publishers say that this vol. 'contains some of Mr. Riley's latest and best work including 'Armazindy' & the famous Poe Poem.'" Despite the overwhelming evidence that "Leonainie" was a hoax, Wallace was unable to recant. The remainder of the February 15th letter is a critique of Riley's other poetry, with Wallace's analysis that Riley did not have the skill to write "Leonainie," and his conclusion that the real hoax is that Riley found the Poe poem and pretended to have written it!

The entire incident encapsulates Wallace's heretic-personality: his eagerness to investigate unusual claims, his thorough, almost obsessive analysis of a subject, his willingness to make a serious commitment to a position early in the absence of substantial evidence, and his resolution, regardless of contrary evidence, to maintain his original position (even using contradictory evidence in his favor). When he was right, as in his discovery of natural selection, these traits worked in his favor. But when he was wrong, as appears to be the case here as in his investigations of spiritualism, Wallace's heretic-personality brought down upon him the scorn and ridicule of scientists and more cautious personalities.

* * *

Those with heretic personalities—scientists and nonscientists alike—must be more cautious than most, for while their boldness may lead them to extraordinary success in one field, it may occasionally turn to temerity and lead them down the road to deception and self-deception in others. The rub in science is to find the right balance between being so open to heretical ideas that it becomes difficult to separate sense from nonsense; and so closed to heretical ideas that it becomes difficult to abandon the status quo. Heretic personalities, so numerous among the various pseudosciences, need to temper their beliefs with a little caution. Skeptics, so numerous among the various sciences, need to moderate their skepticism with a little boldness. Where the heretic meets the skeptic a creative scientist will emerge. S