

When I was in grad school, I had the good luck to get to know G. Evelyn Hutchinson, an original thinker, a charismatic teacher and a founding father in the fields of limnology, biogeochemistry, and theoretical ecology. For years, every issue of *Natural History* contained one of his evocative and learned essays. He wrote a number of influential books, the best known being *The Ecological Theater and the Evolutionary Play*. The Mycological Theater pays homage to Hutch. –S.G.

The following is a sad story of pursuing an apparently promising line of research into a dead end—an occurrence more common than we might think, since such results are rarely published. Consider it educational.

I yield to none as an admirer of Alfred Russel Wallace. The more of his writings (and he wrote as easily and as frequently as most of us breathe) I read, the more I'm impressed by the depth of his knowledge, the breadth of his interests, and the clarity of his style. (Also, I must confess, the fearlessness with which he jumped into radical beliefs, such as phrenology, spiritualism, mesmerism, etc.; beliefs in which, I am sorry to say, he often exhibited a gullibility at odds with and damaging to his scientific reputation.) When I consider that family poverty ended his formal education at 14, my admiration increases.

If you've heard of Wallace, it's most likely as the tag along to Darwin's discovery of evolution by natural selection. While Darwin was in the twentieth year of his labors on what was (after one of the longest gestation periods in literary history) to become *The Origin of Species*, Wallace was off collecting in the Malay Archipelago. On the island of Gilolo, chilling and fevering

from malaria, Wallace came up with the very same theory of the origin of species by the action of natural selection upon variation, wrote it up and, upon returning to his headquarters in Ternate, mailed it off to Darwin. Since Wallace had had prior correspondence with Darwin, he knew that Darwin would be interested in this topic. But, since *Origin* was still only a gigantic pile of notes, he had no idea just how interested Darwin was. Basically, he'd sent Darwin the 19th century equivalent of a letter bomb, forcing Darwin to finish that damn book he would have preferred to work on indefinitely, and linking his name with that of Darwin forever, although time is disentangling these two and allowing Wallace some space of his own. 2013 was the centennial of Wallace's death—a date that puts him surprisingly close to us, considering that only four years prior, in 2009, we were celebrating the 200th birthday of Charles Darwin—and the many celebrations of Wallace's centennial, as well as the biographies, reprints and vast troves of his writings online, have certainly put paid to all those articles, lectures, etc. about Wallace which start off describing him as, "unjustly ignored," the pathetic step-child in that Victorian children's tale, *Chas & Alf*.

One effect of those centennial celebrations was to inspire me to re-read Wallace's *The Malay Archipelago*, the most popular of his books. It's a remarkable and surprisingly readable book (Joseph Conrad named it his favorite bedside book, and patterned the entomologist Stein in *Lord Jim* after Wallace, paraphrasing some of ARW's writing on Stein's behalf) leaving one full of admiration for Wallace, who was a talented naturalist and an indefatigable traveler and collector; the former because

he wanted to, and the latter because he had to. Contrary to popular opinion, Wallace was born into the same social class as Darwin. The difference was that Wallace's father (who'd actually hung out with Beau Brummel in Bath) seemed better equipped to spend money than to make it; being unable to resist a bad investment, while the Darwins seemed effortlessly to maintain excellent portfolios. The fact that Darwin was a Wedgewood on his mother's side and married a Wedgewood, didn't hurt, but he was also an astute investor of those funds, while Wallace carried on in his father's tradition of money management and would have ended up bankrupt, had not Darwin and others arranged a government pension. This is why Darwin was able to take one trip (paid for by his dad) and then retire home to work on his theories, while Wallace spent eight years in the Malay Archipelago collecting specimens for sale. And this was after his four years in the Amazon—at the end of which he lost everything except what had been sent home in advance, when his ship home caught fire. (After watching his notes and collections, including his painstakingly maintained live animals, burn up; recollecting his ten days in a small leaky lifeboat suffering from heat, sunburn and thirst while bailing continually with a badly burned hand, he was able to write, "During the night I saw several meteors, and in fact could not be in a better position to observe them, than lying on my back in a small boat in the middle of the Atlantic.")

During his years in the Malay Archipelago, from 1854 to 1862, Wallace travelled close to 14,000 miles and collected 110,000 insects, 7500 shells, 8050 bird skins, and 410 mammal and reptile specimens, including probably more than 5000 species new to science. (Of all bird species known today, two percent were first collected by Wallace.) In his off hours, he amassed vocabularies of native languages and made observations on everything that he saw. Well... almost everything. Despite the fact that his observations there led to his formulation of what is still known as Wallace's Line (that invisible demarcation between Australasian and Asian animals), which started the study of biogeography and presaged the discovery of continental drift and tectonic plates, and that essay on the origin of species by natural selection, both of which were to bring him lasting fame, he mentions neither of these major achievements in *The Malay Archipelago*. Nor does the book seem to acknowledge the existence of the Fifth Kingdom (although it wasn't the fifth at that time, but a subset of cryptogam plants). Surely, I thought, during his 14,000 miles of journey, gazing with such a keen eye at the scenery, native peoples, plants and animals, there must have been a mushroom or two that caught his eye. But there aren't, although he does mention a butterfly with protective patterning imitating the minute dots of fungi growing on leaves (on pages 205-6).

Ever patient, I then started going through his Amazon travels to see if any fungi had made it into that book, but again I came up negative, except for his statement that the effects of niopo snuff, a native narcotic stimulant, resemble those produced by *Amanita muscaria* (he's careful to say that his knowledge of the latter is academic and not personal). At this point, I began to read through those of his letters which are online. There is one, written in 1905, celebrating the 25th anniversary of the Epping Forest Field Club and noting that his early participation in their "fungus forays" were as delightful as they were instructive." So he was aware of fungal fruitings; they simply seemed to be off the Wallacean radar.

It was therefore a real and happy shock to me to read in an

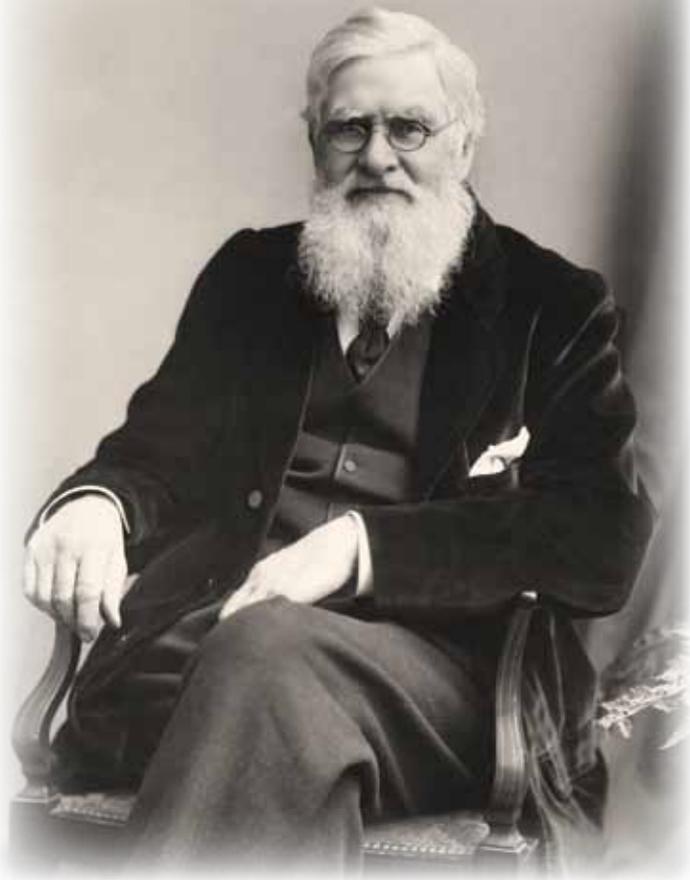


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article on zombie ants, that, "The first biologist documented to have seen *Ophiocordyceps*-induced body snatching extended phenotypes was Alfred Russel Wallace in 1859, as this features in his travelling notes from Sulawesi" (Hughes et al., 2011). I grabbed my copy of *The Malay Archipelago* and hunted through it frantically yet again. I couldn't even find any mention of Sulawesi, although Google kindly informed me that it was called Celebes in Wallace's day. But there was no mention of body snatching fungi in the book, letters or any other Wallace writings that I could access, although motivated by this statement, I was now diving into all the Wallaciana and Wallace biographies (as well as his massive two volume autobiography) I could find. But, the great thing about having this statement published in a scientific journal was that there was a reference. True, the reference was to a paper published in 1886, and the author was not Wallace, but there it was: Fawcett W: Description of *Cordyceps llyodii* in ants. *Annals and Magazine of Natural History* 1886, 5(XVIII): 317.

Happily, I had access to the library (and, more importantly, the librarians) at Harvard's Herbaria, and it took them only a few minutes to access Fawcett's paper. But this short note has no references, and says merely, "In the British Museum collection *Cordyceps unilateralis* also occurs on *Camponotus atriceps* from Brazil, and on *Echinopoa melanarctos* and *Polyrhachis merops*, both collected by Mr. A. R. Wallace at Tondano, a village in the Celebes; *Formica sexguttata*, from Brazil, is also attacked by a fungus, too incomplete for identification." It was but the work of a moment to email the British Museum, which quickly emailed me back, saying, "Dear Sir, You need to contact the Natural History Museum." At this point, seeing myself on a constant round of emails, bouncing between the BM, the NHM and the Linnean Society (and with the esteemed editor of FUNGI having cruelly vetoed

writing a check to send me to London), I had the happy idea of contacting David Hughes, author of the paper which attributed the discovery to Wallace, and here I hit paydirt although—like so many miners before me—not the paydirt I’d hoped for. David was both prompt and generous in sharing what information he had. He had corresponded with the Linnean Society of London, which holds Wallace’s journals, and Lynda Brooks, the Librarian and Linnaeus Link Co-ordinator (we should all give thanks for librarians) had emailed the following:

“I had already scanned through the journal covering 1858-9. There are scarcely any illustrations at all in this volume and none of ants.

“I have now looked in depth at the section of the journal that deals with his journey to Tondano and can see no mention of the ants or the fungus... (here there is a description of Wallace’s travels and events during the time in question)

“I am sorry that none of this answers your specific questions...”

So the long and the short of it is that both David and I were first thrilled and then deflated. Although, as David wrote to the Linnean Society, “the fungus is pretty dramatic and easy to spot,” there is no evidence that Wallace ever spotted it. If he did, he did not record it, although we assume that the ants in question had sunk their mandibles into blades of grass from which they could not be separated, and Wallace—a first rate naturalist and observer—would have known this was not normal behavior (to say nothing of the fungal stroma sticking up between the ant’s head and thorax). Of course, as David pointed out, Wallace used collectors and didn’t take all specimens himself, although he, rather than native helpers, would have been credited. We know (from my crazed digging in the archives) that in 1865, Wallace attended a meeting of the Entomological Society of London at

which “Entomogenous Fungi” were exhibited and stated to be of the genus *Cordyceps* [sic], and did not claim discovery or indeed, say anything. (In fact, four years later at another meeting of the same Society, when an insect covered with what is presumed to be a fungoid growth is exhibited, “Mr. Wallace enquired whether the supposed fungus had been microscopically examined, as it seemed highly improbable that a living animal should habitually have a living vegetable growing on it. More probably, if it really existed during the life of the beetle, it was a natural animal growth: an allied species has a hairy covering, and it was but one step further for a hairy covering to assume a fungoid appearance, a protective resemblance to the fungi or lichens growing on the trees upon which the beetle was found.”) So much for Wallace as mycologist.

I’m undecided as to whether this saga shows that a little learning is a dangerous thing, or whether it shows that you should leave well enough alone. I wish (and I bet David also wishes) that ARW really had been the discoverer of *Cordyceps* and zombification. He wasn’t, and the sad truth is that our hero seems to have been interested in everything except fungi. But he’s still a hero. Even heroes have feet of clay.

Further Reading

- Berry, A. (Ed.). 2002. *Infinite Tropics: An Alfred Russel Wallace Anthology*. Verso, London & New York.
- Hughes, D.P., S.B. Andersen, N.L. Hywel-Jones, W. Himaman, J. Billen, and J.J. Boomsma. 2011. Behavioral mechanisms and morphological symptoms of zombie ants dying from fungal infection. *BMC Ecology* 11:13. Available online at: www.biomedcentral.com/1472-6785/11/13.
- Raby, P. 2001. *Alfred Russel Wallace: A Life*. Princeton University Press.

Note: All (and I do mean **all**) of Wallace’s writings can be accessed in full at: www.wallace-online.org including those mentioned in this article:

- Wallace, A.R. 1853. *Narrative of Travels on the Amazon and Rio Negro, with an Account of the Native Tribes, and Observations on the Climate, Geology, and Natural History of the Amazon Valley*. Reeve & Co., London.
- Wallace, A.R. 1858. On the tendency of species to depart indefinitely from the original type. *Journal of the Proceedings of the Linnean Society of London Zoology* 3: 53-62.
- Wallace, A.R. 1869. *The Malay Archipelago: The Land of the Orang-utan, and the Bird of Paradise. A narrative of travel, with studies of man and nature*. (two volumes) Macmillan & Co., London.
- Wallace, A.R. 1905. *My Life: A Record of Events and Opinions*. (two volumes) Chapman & Hall, London.
- Wallace, A.R. 1865. Discussion [of remarks by Francis P. Pascoe regarding how insects melt snow]. *Journal of Proceedings of the Entomological Society of London 1865 in Transactions of the Entomological Society of London* 2(91): 88-92. Wallace Online; Periodical contribution S 108a.
- Wallace, A.R. 1869. Discussion [regarding Francis P. Pascoe’s comments on fungus on a beetle]. *Proceedings of the Entomological Society of London 1869*: xxv. Wallace Online; Periodical contribution S 154a.
- Woodcut portrait of Wallace from Edward Drinker Cope’s *Alfred Russel Wallace* (1891); apparently reprinted from *Popular Science Monthly* 11, June 1877, opposite page 129. ¶

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