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"Two Distinct Creators": Comparing Darwin's and Wallace's Formative Travels, and How it Influenced their Theory of Evolution

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Abstract

Charles Darwin and Alfred Russel Wallace independently arrived at similar theories of evolution by natural selection as announced in 1858. Both men had undertaken transformative travels that provided data for their conclusions. This article compares and contrasts their published travel narratives and shows how it impacted their interpretations. While Darwin's voyage aboard the *H.M.S. Beagle* (1831-1836) was largely in the southern hemisphere temperate zone, Wallace's (1854-1862) island-hopping expedition was confined to the Malayan (Indonesian) Archipelago. Although very similar, there were slight differences in their resulting theories of natural selection. The debates that would divide them on this issue related especially to sexual dimorphism in birds and butterflies, with examples from their travels. Both men, however, perceived the profound differences between the Australian fauna and that of the rest of the world. Wallace was able to identify the exact boundary between these two different "creations," later dubbed "Wallace's Line."

Keywords: Charles Darwin, Alfred Russel Wallace, evolution, natural selection, sexual selection, Wallace's Line, Darwin Industry.

> *"As a number of isolated facts soon becomes uninteresting, the habit of comparison leads to generalization."*— Charles Darwin

1. Introduction

The year 2023 is the bicentenary of the birth of Alfred Russel Wallace (1823-1913). It's a fitting moment to revisit this lesser-known co-discoverer of the theory of evolution by natural selection, alongside Charles Darwin (1809-1882) (Figure 1). Both men undertook extensive world travels in their youth, which were the key events in their respective lives (Egerton, 2012). Moreover, they were inspired by the same books, such as Humboldt's *Personal Narrative* and Lyell's *Principles of Geology*. To some extent, Wallace modeled his own travel book on Darwin's *Journal of Researches* (1839). Amazingly, their journeys of discovery did not overlap, and yet, their theories converged, in 1858. In this paper I will use a comparative analysis of their travels – Darwin on the *H.M.S. Beagle*, and Wallace in the Malay Archipelago – showing how it provided essential background for that theory.

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- Darwin and Wallace independently arrived at similar theories of evolution.
- Both men undertook transformative travels that provided data for their conclusions.
- Differences related especially to sexual dimorphism in birds and butterflies.
- Wallace's Line identifies the boundary between two different "creations."

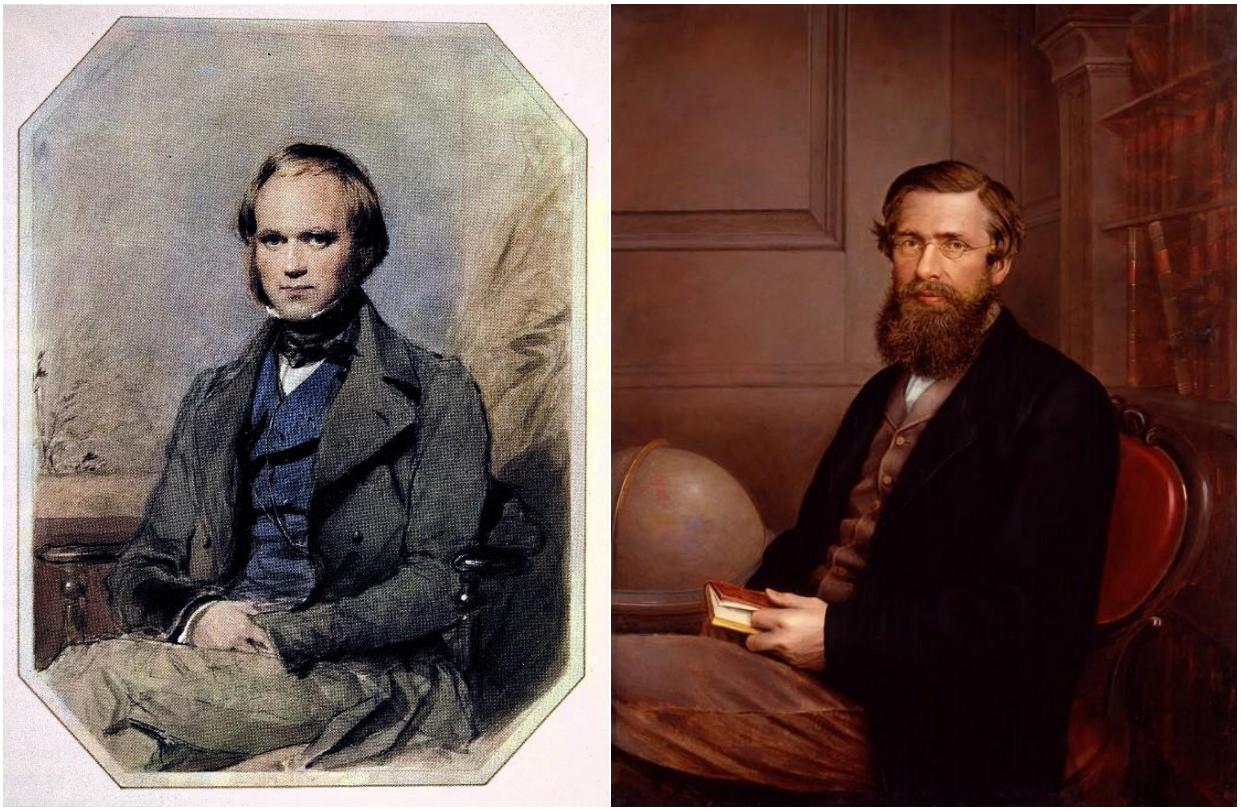

Figure 1. Charles Darwin (left) in 1840 by George Richmond, and Alfred Russel Wallace (right) in 1862. Courtesy of Wikimedia.

2. Trip comparison

First, an overall comparison between Darwin's 5-year voyage (1831-1836) and that of Wallace's 8-year sojourn (1854-1862). Darwin's was the voyage of a naval vessel, the ten-gun brig *H.M.S. Beagle*, which logged 64,000 km. Whereas Wallace, upon reaching Singapore via the commercial P&O Line, used small watercraft (such as praus or mail packet ships) to get about the Indonesian Archipelago (which he called the Malay Archipelago), for a total of 22,500 km. Darwin's narrative is chronological, traveling from east to west overall. Whereas Wallace used a regional format, progressing from west to east, but discussing his many zigzag trips among groups of islands in unified chapters (Van Wyhe, 2015: 27-28). Most of Wallace's trip was spent within several degrees of the equator, while Darwin was mostly in the temperate zone of the Southern Hemisphere. Their nearest approach to overlap was Darwin's stop at Cocos Keeling, in the Indian Ocean—an island inhabited by Malays, a people with which Wallace grew very familiar in Indonesia (Figure 2).

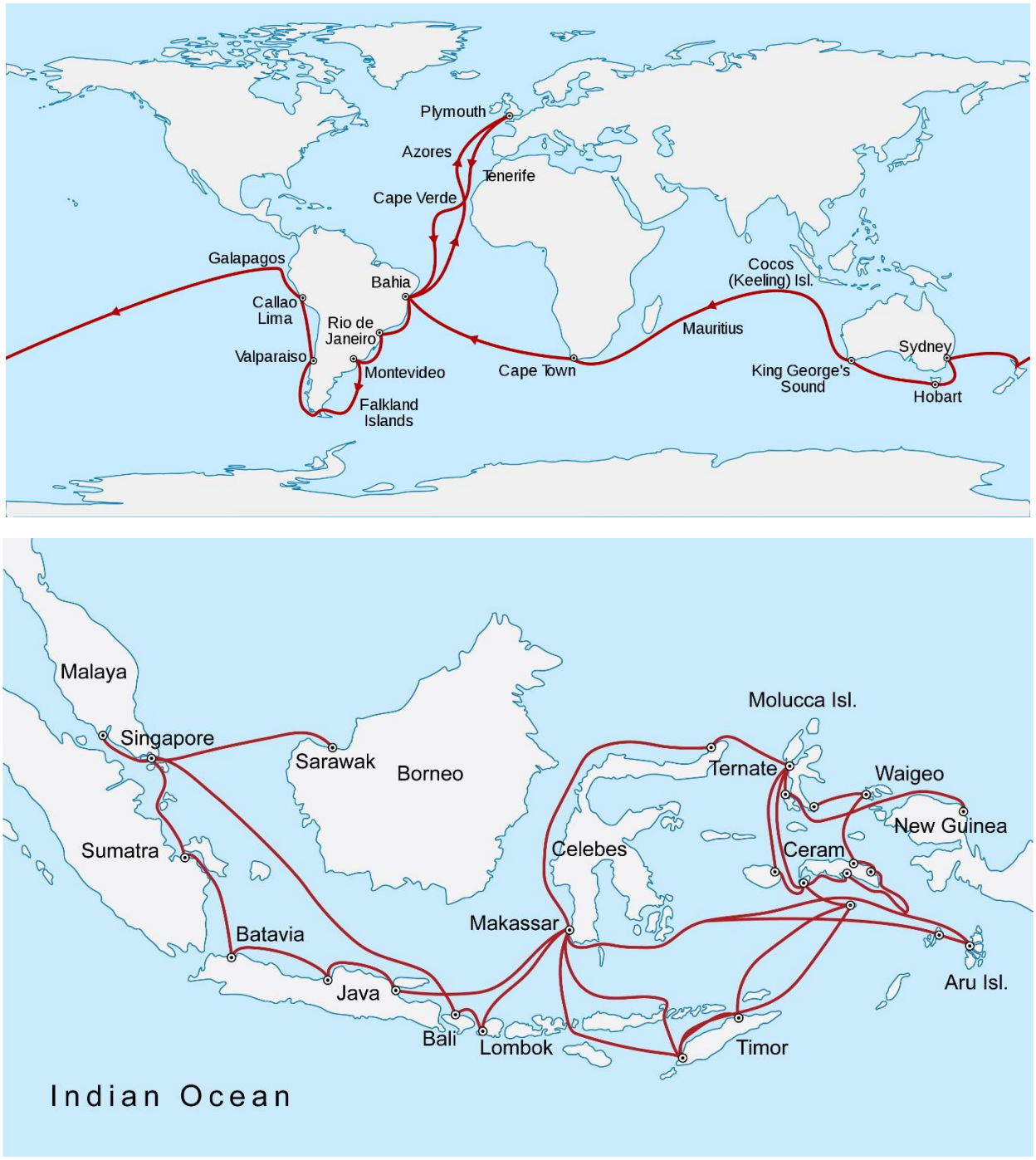

Figure 2. Darwin's Beagle voyage (top) courtesy of Wikimedia, and Wallace's Malayan travels (bottom) map by Jessica Rogge. Both routes have been simplified for clarity.

Wallace's trip was largely commercial, to obtain beetles, butterflies ("the very finest Ornithopterae"), and birds, for the British Museum, the Zoological Society of London, and individual collectors (Camerini, 1996). By contrast, Darwin, the *Beagle*'s substitute naturalist, collected a wider range of specimens, including plants, rocks, and minerals, but not in commercial quantities. When Darwin did collect zoological specimens, it was often just a male/female pair (Sulloway, 1982). Darwin also collected 1,400 plant specimens during his trip, which were later studied by the Kew botanist Joseph Dalton Hooker. These plants, considering the high endemicity

(nativeness) of the two Australian floras (southeast and southwest Australia, respectively) and the Cape flora of Africa, contributed to the development of the idea for the ancient continent we now call Gondwanaland (Hopper and Lambers, 2009). Wallace did not collect plants, because as he explained, "I cannot afford to collect plants. I have to work for a living, and plants would not pay unless I collect nothing else, which I cannot do, being too much interested in zoology" (Fagan, 2008: 73).

Collecting specimens entails killing them. Both Darwin and Wallace employed young men to shoot birds. Indeed, Darwin's servant, Syms Covington, was the focus of a 1998 biography by Roger McDonald titled, *Mr. Darwin's Shooter*. Darwin frequently landed at isolated oceanic islands where the fauna appeared tame because it was not accustomed to human presence. This contrasts with the wariness of the wildlife experienced by Wallace in long-inhabited lands. To modern sensibilities, the most unpalatable passages are in the chapter where Wallace shoots orangutans in the trees of Borneo, subsequently preserving their skins in arrack (Java rum) for the British Museum.

Health impacted their activities. Wallace was plagued with tropical fevers, like malaria, which sometimes incapacitated him, most notably at the island of Ternate, when he underwent his intellectual "epiphany" about the mechanism of evolution in 1858. Darwin did not spend nearly so much time in the tropics, as compared with temperate climes, and thus he escaped the tropical fevers. But he did become a lifelong sufferer from what was often said to be Chagas's disease, a result of being bitten by "the big black bug of the Pampas" in South America, a conclusion first published by parasitologist Saul Adler (1959). Both men were laid up with sea-sickness while afloat.

3. Comparing results

Wallace's Chapter I is a general description of the physical geography of the entire region through which he traveled for eight years. Whereas Darwin used his first chapter to state the goals of the five-year trip and the incidents of the first leg, reaching the shores of South America. Wallace took this opportunity to emphasize his "most important" find, in 1856, which was "Wallace's Line" (a name later coined by English biologist Thomas Henry Huxley), separating the Asian fauna from that of Australia. The line ran between the neighboring islands of "Bali and Lombok [which] became for Wallace as provocative as the Galapagos Islands were for Darwin" (Egerton, 2012). In a striking comparison, Wallace himself later wrote that "these islands differ far more from each other in their birds and quadrupeds than do England and Japan" (Wallace, 1880: 4). Yet they are only 24 km apart! Wallace chose a sort of representative "mascot" for each region: an orangutan for the Asian, and a bird of paradise, for the Australian. Darwin, upon reaching Australia, had his own epiphany and mascots, writing that the marsupials and placental mammals, respectively, suggested "two distinct Creators" (Barlow, 1934: 383). But Darwin was far from identifying the exact line between them, as Wallace had done. In the twentieth century, of course, Wallace's Line was found to reflect a plate tectonic boundary, and some biologists chose to emphasize a transition zone named Wallacea, after the great naturalist, rather than a sharp line of demarcation (Ali & Heaney, 2021) (Figure 3). Ultimately, it was absorbed into a network of lines delimiting the biogeographical regions of the world (Wallace, 1876).

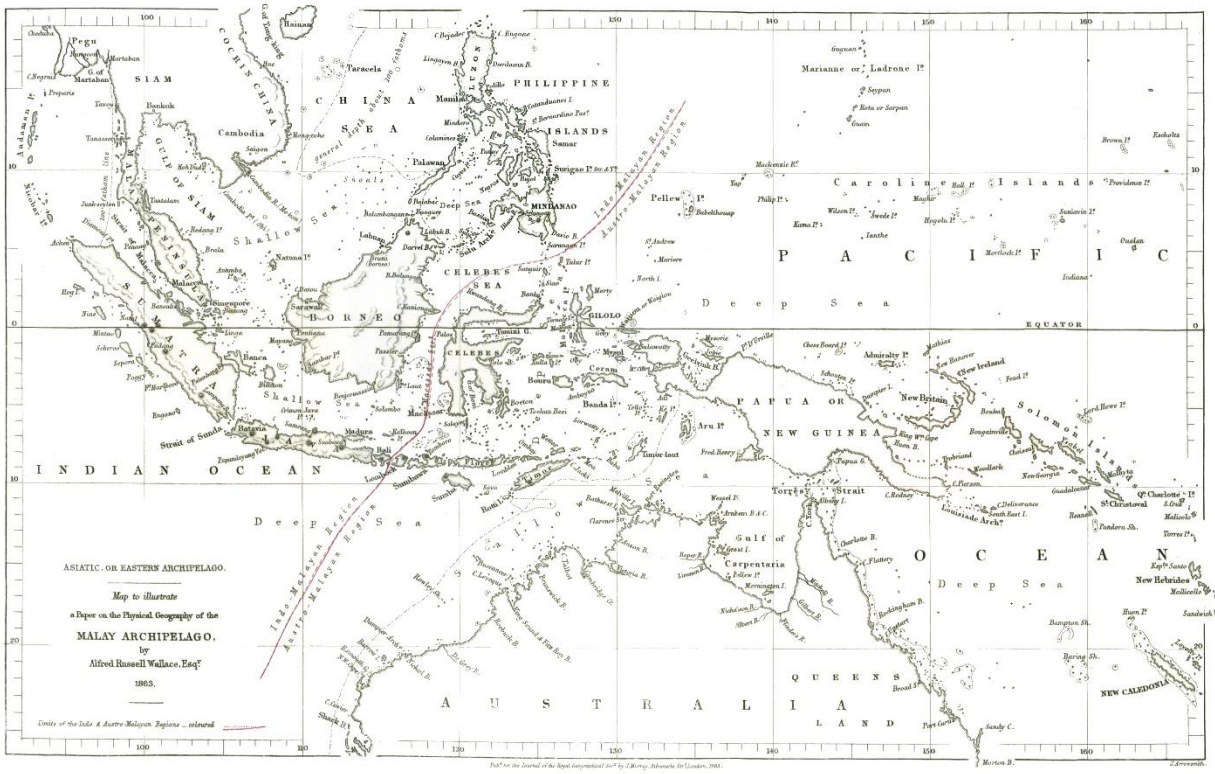

Figure 3. Wallace's Line (in red). Courtesy of Wikimedia.

The respective decades in which Darwin and Wallace wrote, relative to the wide acceptance of Louis Agassiz's glacial theory, was significant to their insights. As for broad biogeographic patterns, Darwin published the first edition of his *Journal of Researches* (it only became *Voyage of the Beagle* after 1903) before the glacial theory expounded by Agassiz became widely accepted, beginning in 1840. Most of Darwin's so-called glacial explanations at this time involved using the drifting iceberg theory to account for the distribution of glacial erratics (stones that are transported by ice) (Mills, 1983) and possible dispersal of plant seeds. Wallace, while not a skilled practical field geologist like Darwin, nonetheless wrote at a time thirty years later when advanced glacial explanations had become common. He skillfully used the concept of sea-level lowering (namely, that as the great ice sheets formed, sea level dropped) to explain faunal distribution of Indonesian islands relative to mainland Asia. During ice ages, the shallow waters of the surrounding seas dropped enough to expose the Sunda Shelf, i.e., to convert the shallow sea to dry land, which allowed the Asian fauna to populate the islands. Conversely, beyond the 100-fathom depth line (his usual standard, equal to 183 meters), islands had many endemics, because even during the lowest sea-level stand, they remained islands. This was somewhat different from the popular land bridge theory, which postulated that natural bridges could form even in deep oceans, which Wallace rejected. Wallace's conjecture also stood in contrast to the "flotsam and jetsam theory" whereby the animal populations of oceanic islands are a matter of random chance.

Darwin's distinction between oceanic and continental islands was adopted by Wallace. Oceanic islands, typically the result of basaltic volcanism, are more isolated, in deep water, and usually show an absence of terrestrial mammals and reptiles. Darwin noticed that coral reefs frequently develop around subsiding volcanic islands. He developed the 3-fold scheme of coral reefs, divisible into atolls, fringing, and barrier reefs. Wallace, upon visiting the Matabello Islands in Indonesia, found Darwin's scheme useful in understanding what he observed.

Both men experienced violent volcanic phenomena. Darwin's travels took him along the Chilean coast, where the volcano Osorno was in eruption, shortly before the devastating

Chilean earthquake of 1835, leading him to speculate on the connection between volcanoes and earthquakes. Further melding the two, Wallace's description of a volcanic eruption paralleled Darwin's experience of earthquakes. Darwin had observed that "A bad earthquake at once destroys our oldest associations; the earth, the very emblem of solidity, has moved beneath our feet like a thin crust over a fluid; --one second of time has created in the mind a strange idea of insecurity, which hours of reflection would not have produced." Wallace wrote in a similar vein that "The inhabitant of most parts of northern Europe sees in the earth the emblem of stability and repose. His whole life-experience, and that of all his age and generation, teaches him that the earth is solid and firm, that its massive rocks may contain water in abundance, but never fire; and these essential characteristics of the earth are manifest in every mountain his country contains. A volcano is a fact opposed to all this mass of experience." Darwin described the terrified inhabitants of the town of Valdivia, Chile, running from their houses during aftershocks, to avoid impending collapse. Wallace described similar behavior in a stricken area, but repeated so many times by the inhabitants that it became absurd, as if they were "playing at earthquakes." Where Darwin described the tsunami washing ashore at Concepcion harbor, Wallace wrote of "the tremendous surf at Ampanam," caused by earthquakes. Darwin described the elevated beaches of the Chilean coastline resulting from earthquakes, some of which had risen "1,300 feet [396 m] since the epoch of existing shells." Wallace described several minor shocks in seismically active Indonesia, as at Ternate. He traveled along the islands of Java and Sumatra, whose backbones are formed by a line of volcanoes, describing extensive cliffs of raised coral limestone.

Darwin's hero, Alexander von Humboldt, had mapped the altitudinal vegetation zones on the Andean volcano Chimborazo, in Ecuador, which he climbed in 1802 (Moret et al., 2019). The *Beagle*, however, in its hydrographic surveys, did not sail that far north along the South American coast, so Darwin was not able to revisit the spot. But Darwin carried out a similar exercise on the peaks of Tahiti, just as Wallace later did on the slopes of Mt. Ophir (1220 m) on the Malayan peninsula. On Java, Wallace ascended the extinct volcano Pangerango (3050 m), noting how Java's peaks had served as a glacial refugium for cold-adapted plants. Temperate flora, whose range was compressed toward the equator during the ice ages, could only survive in the tropics by retreating upslope to this cooler regime.

Both narratives included arduous river ascents, too. Darwin, with his crew, ascended the River Santa Cruz in Argentina. After weeks of hauling their whaleboats upstream through a bleak landscape, passing the Condor Cliffs, they turned back when in sight of the Andes. Wallace ascended the sources of the Sadong River in Borneo, meeting the savage Dyaks along the way.

The two men had diverging impressions of tropical rain forest. To Darwin, alighting in Brazil, it was magical. Whereas Wallace described "a sombre green…monotony… The idea that nature exhibits gay colours in the tropics…is totally false" and "Many persons in Europe…will no doubt be surprised to learn that the truly wild fruits of this grand and luxuriant archipelago…are in almost every island inferior in abundance and quality to those of Britain." While Wallace did not collect botanical specimens, he had much to say about the various palms of Indonesia. Indeed, he had published a guidebook to palms after his earlier trip to the Amazon (Knapp et al., 2002). Of special interest to Wallace was "the great sago district" near the island of Waigiou, Indonesia. The sago palm was a source of starch and he reported that ten days of work with a sago palm would provide enough subsistence for a man to live the rest of the year, contributing to "the abject state of poverty…where the sago-tree is abundant." Paradoxically, the sago made life so easy that the natives could slack off the rest of the year, leaving them in poverty!

The high point of Wallace's eight years in Indonesia was collecting birds of paradise in the Aru Islands – "this 'Ultima Thule' of the East," as he dubbed it. Their striking colors, metallic plumage, long tail wires, and the mystery surrounding their exact domicile, intrigued Wallace. Whereas for Darwin the nearest to an avian epiphany are the mockingbirds and finches of the Galapagos Islands, which contributed so much to development of his evolutionary idea. As for

mammals, Darwin's tales of jaguars are somewhat tamer than Wallace's claim that tigers "kill on an average a Chinaman every day" in Singapore.

Darwin devoted more attention to observations of aquatic life, such as an octopus changing color, or the zoophytes of the Keeling coral reefs, than did Wallace (Keynes, 2003). Darwin's observations of the kelp forests off the Falkland Islands, and the associated vertebrate and invertebrate fauna, foreshadowed important ecological concepts such as keystone species and the food web (Armstrong, 1992: 101-103). Wallace did not list fishes among his specimen totals and presented no extended accounts of aquatic life like Darwin's. This contrasts with Wallace's strong interest in and collection of freshwater fishes during his previous, Amazonian journey (Fagan, 2008: 72).

While Darwin was shocked by the lowly moral and physical condition of the inhabitants of Tierra del Fuego, at the southern tip of South America, Wallace was more sympathetic toward "savage" peoples, as when he visited the Dyaks of Borneo. While they were headhunters, he surprisingly overlooked such gruesome details and ranked them, in other ways, as morally superior to the more technically savvy Malays – and even Europeans. Where Darwin pointed the contrast between savages and Europeans, or between the warlike Maoris of New Zealand and the civilized Tahitians, Wallace dwelt upon the "two radically distinct races" (Malays and Papuans), who predominated in his part of the world. Surprisingly, he praised Dutch colonialism and monopolies, observing that British working-class people at home paid higher prices for the cotton goods they manufactured themselves than did the remotest Aru Islands savages. Wallace devotes much space to describing such native commerce, while Darwin only occasionally mentioned economics, as with the cocoanut-based commerce of the Keeling Islands.

Finally, Wallace adds a craniological appendix and a "List of Vocabularies Collected" to his narrative. Being an advocate of phrenology and a scientific "headhunter" of sorts, it was common at the time to think that measuring skull parameters could help to classify races. Wallace hoped to confirm the distinctness of the Malays and Papuans statistically. Darwin did not pay any special attention to craniometry during his travels.

4. Evolving similar theories

The first sentence in Darwin's *Origin of Species*, published in 1859, stated that, "When on board *H.M.S Beagle*, as naturalist, I was much struck with certain facts in the distribution of the inhabitants of South America, and in the geological relations of the present to the past inhabitants of that continent. These facts seemed to me to throw some light on the origin of species – that mystery of mysteries, as it has been called by one of our greatest philosophers." So, let's consider in more detail how their respective travels led to this theory.

First, the obvious one. The classic story of Darwin's conversion to evolutionary thinking upon the *Beagle's* visit to the Galapagos Archipelago in 1835 has always held center stage in this regard. Upon arriving among the islands, the story goes, the differing beak adaptations among the finches, and the different tortoises, led to an epiphany. As Sulloway (1982) has shown, however, this story has been oversimplified, and indeed it was not until after the voyage that the pieces came together in the Red Notebook of 1837 and thereafter.

Wallace wrote to Darwin (from Ternate), explaining his own version of natural selection, which he preferred to call "survival of the fittest." Subsequently, in 1858, a joint paper by Darwin and Wallace was read by others at the Linnean Society of London, outlining their theory of evolution. As noted above, Wallace had made a trip to the Amazon before going to the Malay Archipelago, and even at that time he was pondering the notion of organic evolution (Smith, 2015). However, while returning to England, the ship, carrying rubber goods, caught fire and sank, taking with it his specimens and detailed notes. So, it was material from the subsequent Malayan trip

that formed the basis for his theory of natural selection. In subsequent years, after their 1858 joint paper, Wallace gave four separate accounts of how he came upon the principle of natural selection, and they corroborate each other (McKinney, 1966). Wallace's interest in the ethnology of the Malay Archipelago led him to recall Malthus' account of the struggle for existence, which Wallace first applied to human beings, subsequently extending it to animals.

Both Darwin and Wallace recognized that the living species in an area are similar to the fossil forms of that same area, suggesting a succession of forms through time. Darwin was fascinated with South American fossils, which lived at a time when "[the Americas] must have swarmed with great monsters," such as the "nine great quadrupeds" (large, four-footed mammals), which he found at Punta Alta, Brazil. Indeed, the British paleontologist who described them, Richard Owen, won the Wollaston Medal, highest honor that the Geological Society could bestow, for his efforts (Lister, 2018: 184). Wallace, on the other hand, did not collect fossils (considering how heavy they are and how light he had to travel) but he did make an important generalization, the so-called "Sarawak Law" of 1855 (named from when he was staying in Sarawak), his first big step toward evolution. As stated by Wallace, "The rule is, that just as the productions of adjacent areas usually resemble each other closely, so do the productions of the same area at remote epochs." Darwin emphasized that although we do not find gigantic quadrupeds in South America today, they are related to the diminutive descendants we see there nowadays.

Wallace's recognition of what became known as Wallace's Line was another validation of the succession of forms: "Or [else] we should not see countries the most opposite in character with similar productions, while others almost exactly alike as respects climate and general aspect, yet differ totally in their forms of organic life" (Wallace, 1857).

According to Kutschera (2003), Wallace "was the spiritual father of the most obvious experimental proof of the Darwin-Wallace concept: industrial melanism in the peppered moth." Before the industrial revolution, white moths peppered with black spots were common in England. However, with widespread air pollution, darker forms were favored because predatory birds could not distinguish them, camouflaged as they were when resting on darkened tree bark (Kettlewell, 1965).

5. Conclusion

The "Darwin Industry" has spawned a vast literature but much of it involves relitigating minor points. On the present topic, however, the conclusions appear widely established. While very similar, there were slight differences in Darwin's and Wallace's theories of natural selection (Kottler, 1980, 1985). Darwin put greater emphasis on sexual selection, especially as manifested in color differences between males and females, than did Wallace. The debates that would divide them on this issue over the years related especially to sexual dimorphism in birds and butterflies, with both men citing examples from their respective travels. While Wallace agreed in principle that sexual selection took place, he maintained that it was secondary to factors such as mimicry in insects, and the need for birds to conceal their nests. Sexual selection has recently come under scrutiny again (Shuker & Kvarnemo, 2021). Wallace's later assertion that the human mind could not be a product of natural selection was a development associated with his growing belief in spiritualism (Gross, 2010).

Wallace underwent his "conversion" experience in the midst of his Malayan travels, whereas Darwin seems to have done so only after his return but relying upon information collected during those travels. In both cases however they arrived at very similar concepts and their status as the two creators of current evolutionary theory is unassailable.

Notes

The comparison and quotations in this paper are based on the second edition of Darwin's *Voyage of the Beagle* (edited by Leonard Engel) and the *Annotated Malay Archipelago* (edited by John Van Wyhe).

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