

From Oceans through Islands to Mountains: Creating the ‘Correspondence Principle’

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Like men of every age, we see in Nature what we have been taught to look for, we feel what we have been prepared to feel.

Nicolson (1997)

INTRODUCTION: OCEAN HIGHWAYS

Imagine a large map of the globe, a simple Mercator projection the size of a poster board, with green continents and blue oceans. There is little relief on this map beyond a few shaded areas representing mountain ranges. The ocean is entirely empty. Now, with a red felt-tip pen, begin tracing the early voyages of exploration, one by one, as they embarked from the main ports of Europe. Your red marks will follow one on top of the other, creating a set of ocean highways linked by pivot points in the middle of the oceans. Those pivot points, of course, are islands.

While islands of the past served as stepping-stones for European voyages of exploration, islands of the present serve as the preferred geographies for the study of biogeography. As David Quammen has explained, ‘they are natural laboratories of extravagant evolutionary experimentation’ where ‘a catalogue of quirks and superlatives’ present themselves in small, tidy spaces. ‘Islands have been especially instructive’, Quammen explains, ‘because their limited area and their inherent isolation combine to make patterns of evolution stand out starkly’ (Quammen 1996, pp. 18–19).

Islands have been studied biogeographically for their isolation, but they are significant historically because of their connectivity. ‘Islands are a third kind of place’, notes John Gillis, ‘something betwixt and between’ (Gillis 2004, p. 3). They unite more than they isolate; they connect more

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than they divide. And the manner in which they connect things – voyages, plants, ideas – is linked directly to their unique physical geography. They are three-dimensional landscapes surrounded by a seemingly endless waterscape. They present to the prepared observer a unique opportunity to revamp the spatial relations of science, the perfect geographies for acquiring a synoptic view.

These two seemingly divergent facets of islands – their geographic isolation and historic connectivity – combined to make them perfect geographies for the foundation of ecology as well. Our environmental consciousness, at least in terms of the devastation wrought by humans on natural ecosystems, began on islands. According to Richard Grove, as early as the sixteenth century, particularly on the Canary Islands and Mauritius, Europeans had already grasped the ‘concept of rarity and a fear of extinction’ that by the end of the eighteenth century was ‘well developed in the minds of French and British colonial botanists’ (Grove 1995, p. 9).

In this paper, I will discuss these varied aspects of islands – their isolation, connectedness and ecological significance – as part of a larger question of the process of constructing scientific places. Islands serve as a potent example of the manner in which humans ascribe meaning to a particular geography – transforming a space into a place (Tuan 2001). They are part of a ‘collective historical experience’, highly constructed physically, symbolically and emotionally through time (Said 200, p. 175).

The first steps on soil outside Europe for virtually every naturalist in the nineteenth century – beginning with Humboldt but including many of his British followers – was on the volcanic soil of islands. Humboldt described with ecstasy the moment he stepped foot on Tenerife, the largest of the Canary Islands, to climb the island’s highest peak, the Pico de Teide. ‘The ground of the island rises to form an amphitheatre’, Humboldt wrote, ‘and contains in miniature all the possible climates, from African heat to alpine cold’ (Humboldt 1995, p. 34). These same temperature zones, he noted, had been encountered by other naturalists only by travelling horizontally from the tropics to the poles. The correspondence between ocean and island, vividly portrayed as he travelled from sea to peak, led Humboldt to formulate, for the first time, the themes that would occupy him for the rest of his career: the manner in which vertical geographies mirror the horizontal, the interconnectedness of biological and physical forces in nature and,

ultimately, his prescient ecological vision, including how humans affect all natural environments.

British naturalists in the nineteenth century followed Humboldt's footsteps (often deliberately up the Pico de Teide). They first stepped from their ocean-bound vessels onto the vertical geographies of volcanic islands. Beginning with Humboldt, the true significance of island geographies lay in the correspondence of these vertical landscapes to the horizontal waterscapes surrounding them. As Kären Wigen has noted, 'the notion of a correspondence between latitude and altitude was in fact a central principle of nineteenth-century geography' (Wigen 2005, p. 25). That 'correspondence principle' became a foundational principle for the study of biogeography, first formulated on islands by naturalists forced to cross the wide expanse of oceans. By following the initial steps of these naturalists, from the oceans to islands and up mountains, I will trace the initial formation of this correspondence principle. In the process, I will integrate a history of ocean-bound voyages of exploration with the terrestrial-focused history of biogeography in order to uncover the preliminary steps toward our modern ecological worldview.

HUMBOLDT AND ISLANDS OF THE IMAGINATION

No words can evoke the feelings of a naturalist who first steps on soil outside Europe.

Humboldt (1995)

Humboldt's ability to establish an island as a microcosm for the entire globe, as a special, even fortuitous laboratory, enabled him to clearly define the boundaries of biogeography. In essence, he turned islands into controlled, measurable and generalisable environments. Before Humboldt, aspiring naturalists wanted to circumnavigate the globe. After reading Humboldt, they wanted to travel specifically to islands.

To follow the *Pizarro* as it set sail from Europe, follow the thickest red line on your Mercator projection (Walls 2009, p. 51). After the long journey along the ocean's currents, the *Pizarro's* first extended stop was on Tenerife, the largest of the Canary group. Humboldt had finally been transported to a different latitudinal zone, but Tenerife also enabled him to experience

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the vertical realm as well. The island housed a lofty volcano that extended directly from sea to summit. The *Pizarro's* orders had been set in advance to remain on Tenerife, Humboldt was assured, 'as long as was needed for us to visit the port of Orotavo and climb the Pico de Teide'.¹

For Humboldt, altitude and latitude came together on this thoroughly explored and increasingly devastated island in the Atlantic. He did not require an untouched wilderness, a virgin peak or a new way of seeing. All he needed was a vantage point, a specific locality that linked horizontal latitudes seamlessly with vast vertical altitudes. That is why he requested that the *Pizarro* stop at Tenerife, and why the first thing he did was climb its highest peak. Even on the summit, he admitted that he saw nothing new. 'What links an excursion to the peak with similar ones to Chamonix or Etna is that one is obliged to follow guides, and sees only what has already been seen and described by previous travellers' (Humboldt 1995 p. 29). What he did see supported a way of viewing nature that he had learned from his former teacher, Carl Ludwig Willdenow, and from the travel narratives of the Forsters, father and son. He saw 'not only the sea to the horizon, but also the forests of Tenerife and the inhabited coastal strips ... how plants were distributed according to the decreasing temperatures of altitudes' (p. 35). The experience solidified his vision. He had seen what he was supposed to see and felt what he was supposed to feel. He had hatched his correspondence principle.

He also solidified his ecological vision.² Though the term ecological is anachronistic, Humboldt wrote about the devastation wrought by humans in surprisingly modern terms. His lengthy passages concerning the felling of trees and manipulation of water placed humans at the centre of the relationship between the physical and biological realms. Indeed, the main difference between Humboldt's ecological vision and our own is that Humboldt had fully integrated humans into the confluence of forces at work. This confluence, moreover, was for Humboldt a question of social justice, a link we are just beginning to reinvent. He found this on Tenerife as well.

Though Humboldt found what he needed on Tenerife, he chose a different horizontal and vertical space to exemplify his all-encompassing vision. Almost two years later, Humboldt crossed the Cordillera by land to

1 Humboldt 1995 p. 19. The Pico de Teide rises to 3,718 metres.

2 That Humboldt created a surprisingly modern ecological vision with links to social justice is one of the main arguments found in Walls 2009 and Sachs 2006.

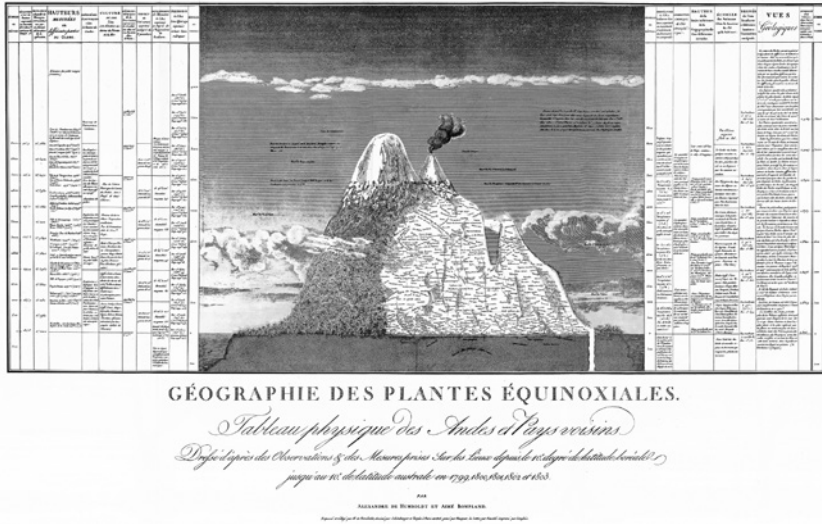


Figure 1. Geography of plants in tropical lands. A tableau of the Andes and neighbouring regions. Source : A. de Humboldt, *Essai sur la géographie des plantes* (1805), Vème partie. <http://cybergeo.revues.org/25478>

Quito, Ecuador, where he attempted to scale Chimborazo, long considered the highest mountain in the world. A thousand feet from the summit, he was forced back by altitude sickness, though he held the world altitude record for over thirty years for this climb. He was extremely proud of his accomplishment. Along with Aimé Bonpland, he had also scoured the countryside for new plants, taken thousands of physical measurements, sketched the topographical and geological features of the Cordillera and interacted with its inhabitants. He was proud of this as well. For the exposition of his correspondence principle, he chose the Cordillera to represent the horizontal and Chimborazo the vertical. The horizontal continent of South America and the vertical topography of its highest peak became his laboratory, the bounded environment he presented as his archetype. It was a sound choice. The vast interior of South America was virtually unexplored, shut off from explorers for more than half a century. Humboldt knew that he could produce the first detailed scientific exploration of the continent. For the vertical realm, the picture he wanted to present was not one of an

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increasingly devastated island in the Atlantic but, rather, the tallest unclimbed peak in the world, with him gasping for oxygen near its summit.

Humboldt presented this vision to the world in his *Essay on the Geography of Plants*, the first book he published upon his return. It is now considered a seminal text in the history of biogeography (note, however, not island biogeography). In the *Essay*, Humboldt demonstrated how to view the world as a unified connected whole, including physical, biological and cultural elements, all sown together in a three-dimensional synoptic pattern organised around the correspondence of altitude and latitude.

Above all, Humboldt was interested in global patterns, in formulating an overarching synoptic vision. But he had to find a way to do this from particular, specific geographies. The move from the local to the global was fraught with difficulties, problems that Humboldt solved by using a single island to stand for the entire globe, a place where a truly global vision was possible. He used the island of Tenerife as a unifying, archetypal geography that he then transported, first to other islands, then to the larger islands we call continents and finally to the biggest island of all, the globe itself (Nicolson 1995, p. xxv; Jackson, 'Preface' and 'Introduction', in Humboldt and Bonpland 2008, p. viii and 4). In the process, he transformed islands in the imagination of all those naturalists who followed in his footsteps. After Humboldt, islands became the preferred setting for acquiring a synoptic view, and thus the ideal geography to establish a new type of field research. He successfully transformed islands from worlds in miniature to archetypal worlds at large.

Before leaving Tenerife, Humboldt experienced one of his childhood fantasies, to see the Dragon Tree of Orotavo. He then boarded the *Pizarro* and left the island, following the red marks on your Mercator projection. 'We followed the same route', Humboldt explained, 'as Columbus had taken on his first voyage out to the Antilles'. As he watched the island fade into the ocean, with only the summit of the Pico de Teide visible, he deluded himself that he would 'again visit the Canary Islands' (Humboldt 1995, p. 37). He never got that chance; nor did he need to. 'Once discovered', notes Gillis, 'islands remained fixed in place' (Gillis 2004, p. 106). It would be left to other naturalists to visit in his stead.

CHARLES DARWIN AND THE FRUITS OF CORRESPONDENCE

I will never be easy till I see the peak of Teneriffe and the great Dragon tree.

Charles Darwin to Caroline Darwin, 28 April 1831

Little more needs to be written about the role of islands in Darwin's life and work. As the importance of his theory of evolution became rooted in our culture, so too have the Galapagos and island biogeography. The creation of this historical memory surrounding the Galapagos, however, has muted the overarching importance of geographical space, both horizontal and vertical, in Darwin's own thinking. Darwin proffered special status to the study of biogeography in his *Origin*, the only subject that he thought required two chapters. The first of these chapters is dedicated entirely to mountains, the second entirely to oceans. They are arguably the most convincing chapters in his revolutionary text (Sulloway 1979). The correspondence between oceans and mountains, between the horizontal and the vertical, became a unifying vision for Darwin, even before he left England. As the *Beagle* set sail, he was well prepared to see what he was supposed to see.

Like Humboldt before him, Darwin yearned to travel on the currents of the world's oceans. 'In the morning I go and gaze at Palm trees in the hot-house', he wrote to his sister while at Cambridge, 'and come home and read Humboldt'.³ Above all else, he dreamed of recreating Humboldt's experiences on Tenerife. 'I talk, think, and dream of a scheme I have almost hatched of going to the Canary Islands' (quoted in Harmon 2009, p. 85). When his upcoming voyage was finally in the works, he could hardly check his enthusiasm. 'I hope you continue to fan your Canary ardor', he wrote to his mentor John Stevens Henslow, 'I read & reread Humboldt, do you do the same, & I am sure nothing will prevent us seeing the Great Dragon tree'.⁴

What a sight Tenerife must have been for Darwin as he sat transfixed on the swaying deck of the *Beagle* – and how deep the disappointment never to be able to set foot on its volcanic soil. Quarantined for twelve days offshore, the *Beagle* crew set sail without seeing Dragon Trees or scaling volcanoes. The next set of islands on the route, the Cape Verde Islands,

3 Darwin to Caroline Darwin, [28 April 1831], Darwin Correspondence Project (DCP), Letter 98.

4 Darwin to J.S. Henslow, [11 July 1831], DCP, Letter 102.

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served as a disappointing substitute, but the vision he related to the public was the same, one of the land and sea intertwined, with an island forming the nexus. It was from the deck of the *Beagle*, anchored off the coast of the island, that Darwin chose to begin his popular *Voyage of the Beagle*.

The country rises in successive steps of table land, interspersed with some truncate conical hills, and the horizon is bounded by an irregular chain of more lofty mountains. The scene, as beheld through the hazy atmosphere of this climate, is one of great interest; if, indeed, a person, fresh from the sea, and who has just walked, for the first time, in a grove of cocoa-nut trees, can be judge of any thing but his own happiness (Darwin 1989, p.41).

The vertical viewpoint, described ‘fresh from the sea’, is repeated throughout Darwin’s narrative, his way of mimicking Humboldt’s way of seeing. When the *Beagle* anchored off the Falkland Islands, for instance, Darwin related his first impressions through Humboldt’s correspondence principle, connecting the distant island to his own. ‘Every one has heard of the climate of these regions; it may be compared to that which is experienced at the height of between 1,000 and 2,000 feet, on the mountains of North Wales’ (pp. 185–6). When the *Beagle* visited Tahiti, after a ‘long passage of 3,200 miles’ from the Galapagos, Darwin once again recreated Humboldt’s vertical explorations. By ascending the island’s mountains, ‘sometimes along edges, and sometimes along knife-edged ridges’, Darwin experienced Humboldt’s vegetation zones first-hand. ‘The climb up from sea level’, explains historian Alistair Sponsel, ‘gave him the uncanny feeling that he was crossing great portions of the globe, moving from the equator back toward his home’ (Sponsel 2009, p. 104). Darwin had been taught to feel ‘uncanny’ by Humboldt, to appreciate the connection between latitude and altitude. The need to climb mountains on islands in the middle of oceans dictated both Darwin’s thoughts and actions. ‘The *Beagle* staid at St Helena five days’, he wrote of his next island visit, ‘during which time I lived in the clouds in the centre of the Is[lan]d’.⁵

Darwin’s interest in island biogeography heightened after the *Beagle*’s return to England. He began a correspondence with Joseph Hooker, then a rising expert in the distribution of plants around the globe. The vast majority of their early correspondence focuses on questions of island biogeography, guided by the correspondence principle. Hooker offered to work through all of Darwin’s island material. ‘Amongst them’, Hooker enthused, ‘I hope

5 Darwin to Caroline Darwin, 18 July 1836, DCP, Letter 305.

to find much that is curious and something new too, as it is the alpine plants of the Fuegian Islands which I want more than any thing else'.⁶ Darwin replied by pointing specifically to the different elevations, from the 'the summits & bases', in which he had collected plants.⁷ 'A discussion on the relations of the Floras', Darwin later instructed Hooker, 'especially the alpine ones, of Azores, Madeira & Canary Is[lan]d would be, I sh[oul]d think, of general interest'.⁸ Increasingly, both naturalists were concerned, not with island plants in general, but rather with alpine plants on tropical islands in particular – that is, the most astonishing illustration of the correspondence principle.

After Darwin had come to his theory in the late 1830s, written a pencil sketch in 1842 and a more complete 'Essay' in 1844, the importance he attached to alpine flora on tropical islands diminished. Darwin equated islands with mountains, deserts and other geographies as a means of isolation, what for Darwin had become the 'chief concomitant or cause of the appearance of new forms'.⁹ Like Humboldt before him, Darwin was interested in a large-scale, synoptic vision, one that encompassed the entirety of the earth. Although he used examples of island species in his *Origin*, and placed special significance on his time in the Galapagos, his aim was to present a unified vision of zones throughout the earth, latitudinal and altitudinal. It is a connected, integrated worldview, one adopted from Humboldt and transformed to support a comprehensive evolutionary theory.

Like Humboldt, Darwin distorted the manner in which he first came to his views. After verifying Humboldt's correspondence principle on islands throughout the Atlantic and Pacific, by the time the *Origin* was published, his biogeography focused heavily on South America. He chose to begin his revolutionary text with the spatial approach he had gleaned from Humboldt, but the physical geography had changed. 'When on board H.M.S. *Beagle*, as naturalist', Darwin famously began, 'I was much struck with certain fact in the distribution of the inhabitants of South America and in the geological relations of the present to the past inhabitants of that continent' (Darwin 1988, p. 65). As with Humboldt, the need for an archetypal setting prompted this move. Darwin's theory rested on both

6 Hooker to Darwin, 28 November 1843, DCP, Letter 717.

7 Darwin to Hooker, 31 March [1844], DCP, Letter 744.

8 Darwin to Hooker, 25 December [1844], DCP, Letter 803.

9 Darwin to Hooker, [8 September 1844], DCP, Letter 776.

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a transformation of space (following Humboldt) and a transformation of time (following Lyell). For temporal, geological purposes, South America worked best. Fossils had been collected there for some time, and this was where Darwin made the correlation between extant species and their fossil ancestors. Darwin transferred his spatial, geographic approach to South America as well. The manner in which Darwin came to his views and the subsequent manner in which he later articulated those views in print, therefore, matched that of Humboldt. Both had initially come to their views on islands, and both carried these initial insights to larger, more archetypal settings on the South American continent.

JOSEPH DALTON HOOKER AND THE PROBLEM OF
CORRESPONDENCE

I was greatly pleased with finding my most Antarctic plant, *Lecanora miniata* at the top of the pass, and today I saw stony hills at 19,000 feet stained wholly orange red with it, exactly as the rocks of Cockburn Island were in 64 degrees South; is not this most curious and interesting? To find the identical plant forming the only vegetation at the two extreme limits of vegetable life is always interesting.

Joseph Hooker to William Hooker, 13 September 1849

Lecanora miniata is a species of lichen that thrives in extreme environments. When Hooker first sighted it on the rocky shores of Cockburn Island off the coast of Antarctica, he was serving as the official naturalist on the famed James Clark Ross expedition to the South Pacific (1839–1842). When he saw it again ten years later, he was on the Sikkim–Tibet border, perched precariously high on the side of a cliff well above 18,000 feet, with streaming glaciers and frozen lakes below. Hooker, it seems, was drawn to the extremes, a trait that he shared with the lichen he was hunting.

Yet, as ‘pleasing’ and ‘interesting’ the find was, it was certainly not very ‘curious’. Hooker was well prepared to see what he was supposed to see. He had travelled all that way specifically to find just such a connection. He had made his name as a high latitude explorer before he became a mountain traveller. He had written several books on island biogeography before he wrote his book on the Himalayas. All are spatial and Humboldtian, and the important transition from the horizontal to the vertical occurred on islands.

The four-year sojourn of the *Erebus* and *Terror*, with stops at as many of the pivot-points as possible, offered the young Hooker plenty of islands to plunder and ponder. Published in separate instalments upon his return to England, *The Botany of the Antarctic Voyage* is a testament to the vertical and horizontal geographies he had created in his mind from reading Humboldt. The crew's first stop was Madeira, where they remained for eleven days, then Tenerife (Humboldt) and the Cape Verde Islands (Darwin). Three long tours in the Southern Ocean followed, all botanically represented by extended sojourns on islands. In the first tour south, three islands predominated, a two and a half month anchorage at Kerguelen's and extended stays at Lord Auckland's and Campbell's. The second tour entailed a 'prolonged stay' in the Falklands, and the third cruise focused on the visit to Cockburn's Island (where he first found his *Lecanora miniata*).

Though the publication is his, and he did all the travelling, the questions he asked were those of Humboldt and Darwin. He viewed islands through their eyes. Islands not only served as central connecting points, the pivots of his voyage, but also represented the perfect geographies to form a unifying vision of plant distribution. 'Hence it will appear that islands so situated furnish the best materials for a rigid comparison of the effects of geographical position and the various meteorological phaenomena on vegetation, and for acquiring a knowledge of the great laws according to which plants are distributed over the face of the globe' (Hooker 1844, p. xii). These great laws for Hooker, as they had been for Humboldt and Darwin, were synoptic and global. His account of Campbell's Island, for instance, where mountains rise abruptly to almost 400 metres, is a Humboldtian account in miniature, with the correspondence principle providing the means of seeing and feeling. Searching for one plant in particular, *Gentiana*, Hooker was struck by its scarcity and relieved once he found it. 'The fact of the occurrence, and the great number, of species of *Gentiana* inhabiting only the more elevated regions of the temperate and tropical zones, and there reaching the snow limit, renders it very remarkable that they should be so proportionally scarce in the higher latitudes of the northern and southern hemisphere. Generally speaking, the inhabitants of these elevated and cold regions are species of such Natural Orders and genera as compose the mass of the Polar vegetation' (p. 57). It was 'very remarkable' because it did not fit into Humboldt's or Darwin's global vision, and he could speak 'generally' because that was what mattered, even when such a generality appeared

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unsustainable. He was looking for what he was taught to look for, and once found, he felt what he was supposed to feel.

By the time Hooker was working on his publication, problems were beginning to arise in the global patterns of distribution. Concerning species of ferns on St Helena and Ascension, he was struck by the difference of species on islands set close together geographically. These facts were difficult for Hooker to interpret. He had been well prepared to see a unifying vision, yet the overarching law-like nature of plant distribution eluded him (Browne 1983).

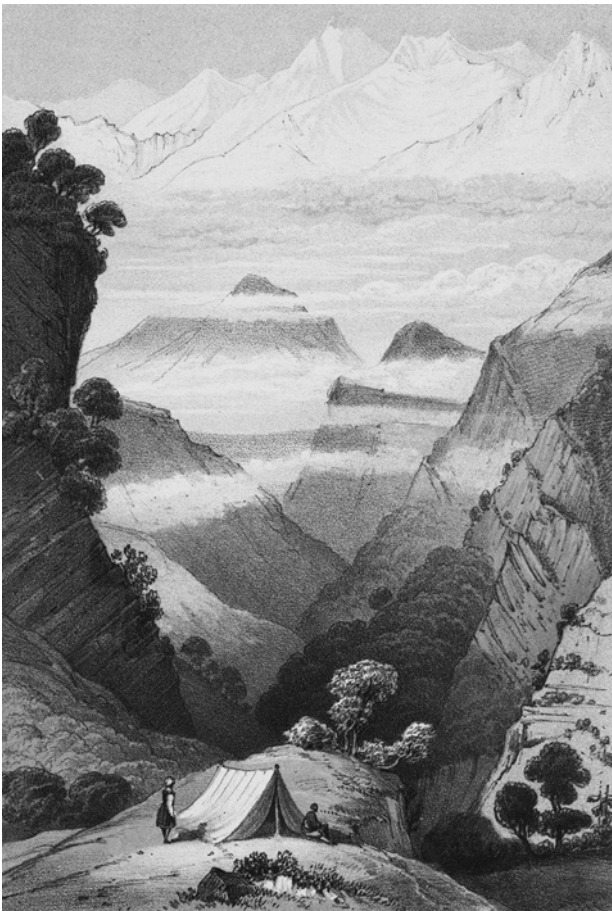


Figure 2. Campsite in the Himalayas, from Joseph Hooker, *Himalayan Journals*, 1854.
<https://archive.org/details/himalayanjourna00hookgoog>

When Hooker was planning his next great exploratory voyage, these same questions were still haunting him. His first great voyage of exploration gave him a thorough grounding in the vegetation of islands, but very little in the way of global, overarching laws. Climbing in the Himalayas, Hooker reasoned, would enable him to explore and compare three distinct vegetation zones in a single day: a tropical zone, a temperate zone and an alpine zone (Reidy 2010, p. 29). His pioneering treks in 1849 and 1850 into the heights of the Himalayas, and his resulting *Himalayan Journal* (1854), constituted a testing ground. Guided by the correspondence principle, he was there to supplement his extreme latitudinal studies with equally extreme altitudinal ones, all with the goal of finding synoptic laws that governed the distribution of species. Although the trip was helpful for Darwin, who subsequently used much of his friend's material in the *Origin*, it failed to answer Hooker's own overarching questions. He was stuck in the rut of the correspondence principle. Perched high on the cliffs above the Tibet–Sikkim border, he found the species of *Lecanora* for which he was searching, but little else.

ALFRED RUSSEL WALLACE AND THE DEMISE OF CORRESPONDENCE

Mere distance is one of the least important of the causes which have determined the likeness or unlikeness in the animals of different countries (Wallace 1880).

Like Hooker, Alfred Russel Wallace went on two major expeditions that helped establish his career. The first was an extended sojourn through the Amazon. His second trip, a decade-long excursion to the Malay Archipelago (present-day Indonesia and Malaysia), transformed him from a collector into an evolutionist, and from a landlubber into an island-hopper. He became the premier island biogeographer in the nineteenth century. He returned to England in 1862 with enough material to publish numerous books and articles on the distribution of plants and animals, including his classic travel narrative, *The Malay Archipelago* (1869), the two-volume *Geographical Distribution of Animals* (1876) and his seminal *Island Life* (1880).

In these texts, oceans and islands took centre stage. While his first text, *The Malay Archipelago*, was primarily concerned with the animals and plants on each island, and the differing languages and customs of their na-

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tives, it did allude to the strict division of animals between the islands of Bali and Lombok, what became known as ‘Wallace’s Line’. In his next text, *The Geographical Distribution of Animals*, Wallace expanded on this still inchoate concept of divisions between regions, extending it to the grand scale of the earth. It was a break from previous work on the distribution of species, focusing on ‘zoological regions’ – not altitudinal or latitudinal zones (Wallace 1876, pp. vi–x). The accompanying illustrations are primarily maps depicting each of these regions or subregions. Though he also included a series of twenty plates illustrating animals and plants, they too are organised geographically, emphasising the ‘physical aspect and the special zoological character’ of each ‘well-marked division of a region’. ‘Zoological regions’ had replaced altitudinal and latitudinal ‘zones of vegetation’. The vantage point had changed as well, from the cross-sectional views of Humboldt to a global projection of asymmetrical regions. His frontispiece, for instance, a large Mercator map of the globe – ‘The World on Mercator’s Projection shewing the ZooGeographical Regions and the Approximate Undulations of the Ocean Bed’ – depicts different zoological regions and different depths of the ocean according to number and colour.

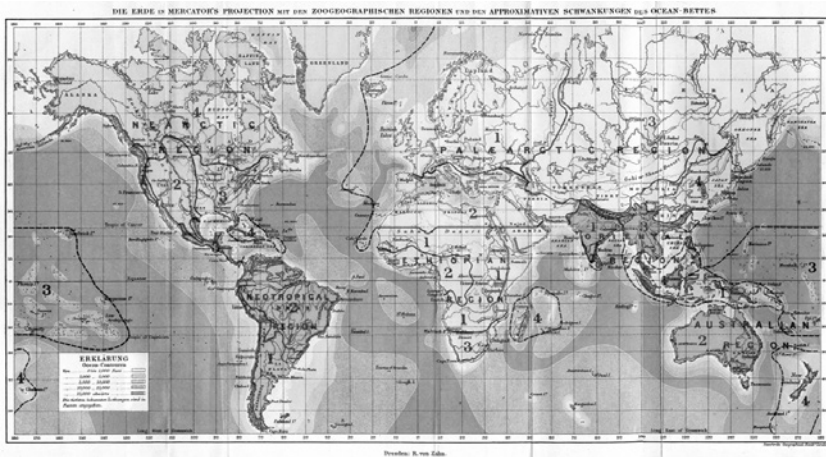


Figure 3. Map of terrestrial zoogeographic regions of the world published in *The Geographic Distributions of Animals* (1876) by Alfred Russell Wallace. http://macroecology.ku.dk/resources/wallace/wallace_map.jpg

Humboldt's influence remained visible in these maps as well. Along with the importance of the ocean depths, Wallace included the 'zones of altitude above the sea level' as also contributing fundamentally to the distribution of animals. His maps of each 'zoological region', therefore, also included 'belts of altitude' depicted through contour shading (pp. ix–x). Thus, horizontal and vertical spaces retained their importance; they were, however, depicted in a different manner, for different reasons and with an entirely different result. There is no correspondence principle in Wallace's new scheme.

Wallace expanded on this theme in *Island Life*, a book that cemented his differences from past researchers. He began on the ocean: 'When an Englishman travels by the nearest sea-route from Great Britain to Northern Japan he passes by countries very unlike his own, both in aspect and natural productions'. Yet, after a 'circuitous voyage of thirteen thousand miles', Wallace continued, 'when he visits the interior of the country he sees so many familiar natural objects that he can hardly help fancying he is close to his home' (Wallace 1880, pp. 3–4). Similar sea-voyages had been undertaken by previous naturalists, their eyes taught to see what they were supposed to see, transfixed on zones of vegetation dictated by latitude and altitude. How could they explain, Wallace asked, the extreme diversity found on islands within a day's journey? 'In the Malay Archipelago there are two islands, named Bali and Lombok, each about as large as Corsica, and separated by a strait only fifteen miles wide at its narrowest part. Yet these islands differ far more from each other in their birds and quadrupeds than do England and Japan' (p. 4). No difference in climate, soil or position could account for it. The problem, moreover, appeared universal, exhibited on 'every continent, every country, and every island on the globe' (p. 6). According to Wallace, no universal law of correspondence would help solve it.

Wallace attempted his own solution in *Island Life*. It is a text that uses the physical geography of islands, combined with the mechanism of natural selection, to analyse the complex interaction between physical and biological forces that explains where animals and plants are found and why. Several classes of facts are needed, according to Wallace, including adequate knowledge of the flora and fauna of the world, the geological history of the earth and 'the exact depth and contour of the ocean-bed' (p. 10). This last point was crucial. A distinct and thorough knowledge of the ocean was required to understand both the former existence of submerged lands that

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united islands to continents and the deepest parts of the ocean that isolated them. It was, for instance, the most significant clue for explaining 'Wallace's Line'. The fifteen-mile strip of ocean between Lombok and Bali is extremely deep, forming the necessary barrier between zoological regions. Here, as elsewhere, the depth of the ocean proved far more important than distance.

As suggested by the title of the text, islands for Wallace were the essential physical geographies for studying the complex confluence of biological and physical forces at work. Their 'restricted area and definite boundaries' present the distribution of species in 'their simplest form' (p. 233). They serve as a methodological tool, the first place to study before expanding out to the larger landmasses of the world. 'When we have mastered the difficulties presented by the peculiarities of island life we shall find it comparatively easy to deal with the more complex and less clearly defined problems of continental distribution' (p. 234). His method was similar to Humboldt's and Darwin's, to begin with islands and transfer the lessons to continents. However, his viewpoint was a radical departure from those before him. He replaced the correspondence principle, which had guided research for over eighty years, with 'areas of distribution' and 'zoological regions' (p. 500). The correspondence principle had run its course.

CONCLUSION

Doth not a Tenerife, or higher Hill
 Rise so high like a Rocke, that one might thinke
 The floating Moone would shipwrack there, and sinke?
 ...
 Are these but warts, and pock-holes in the face
 Of th' earth?

John Donne, 'An Anatomy of the World', 1611

The way we approach the natural world is conditioned by our culture. John Donne lived during a time that viewed mountains, such as Tenerife, as abominations, mere warts on an otherwise beautifully round planet. The transition, from mountain gloom to mountain glory, was relatively fast-paced; in a period of fifty years mountains began to elicit grandeur rather than the grotesque (Nicolson 1997).

Humboldt was a product of the Romantic age that had transformed our conceptions of mountains. By the time he sailed on the *Pizarro*, Tenerife

was primed to elicit far more than disgust. Humboldt used it to solidify an entirely new conception of space in the production of knowledge. Before the nineteenth century, most naturalists studied the biogeography of plants by encountering different zones of vegetation as they sailed from the higher latitudes to the equator. Zones of latitude drove the study of biogeography. With the work of Willdenow and Forster as his guide, Humboldt transformed this process by transforming the space of islands into a place for science. As archetypal geographies uniting horizontal latitudes with vast vertical altitudes, islands could now serve as microcosms for the entire global environment. Surrounded by oceans and reaching into the heavens, islands could be illustrative and comprehensive, a physical space where a global vision was possible. For Humboldt, nothing was in isolation. Everything was connected. His approach to nature prepared him for this. Tenerife demonstrated it. He connected oceans and mountains through islands.

After Humboldt, naturalists learned to think *with* islands (Gillis 2004, p. 107). They followed in his footsteps, using islands to experience the 'correspondence principle'. On islands, naturalists could symbolically travel around the world, from the equator to the poles, from the ocean to the summit of mountains. For Darwin, Hooker and other British naturalists, the combination of the horizontal with the vertical was central to their thinking as they searched for the unifying laws of biogeography. Humboldt's principle directed the science of biogeography for three quarters of a century. Most naturalists recognised anomalies, often challenging Humboldt's relatively simple views on the relationship between temperature and plant life (Browne 1983). Yet, the principle itself remained firmly entrenched, underpinning how naturalists were supposed to look at the world. It was not questioned because it had become unwittingly assumed.

Wallace was the first researcher to fully recognise the problems in the correspondence principle and offer the most enduring solution. Mere distance, temperature or any such simple correlation would no longer do. The vertical orientation of Wallace's thinking, present even in his chaotic and untidy maps, is a testimony to the enduring influence of Humboldt, even if the visual productions and scientific conclusions are different. The reciprocal influence of oceans and landmasses was retained, as was the fundamental role of islands as stepping-stones for migration and physical geographies of transmission. And lastly – Humboldt would say most importantly – the overarching lessons of Wallace's text, the apt moral to be gleaned from his

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tale, is Humboldtian to the core. 'I trust that the reader who has followed me throughout', Wallace concludes *Island Life*, 'will be imbued with the conviction that ever presses upon myself, of the complete interdependence of organic and inorganic nature' (Wallace 1880, p. 511). Wallace ends where Humboldt had begun, with how we should approach the natural world, a confluence of the physical and biological, the inorganic earth with organic life. Our term for this is 'ecology'.

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