Contributions

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History of the Ecological Sciences, Part 36: Hewett Watson, Plant Geographer and Evolutionist

Hewett Cottrell Watson (1804–1881) was an English botanist who rebelled against his father's conservative religion, politics, and legal profession, but accepted inherited family wealth (Watson 1839, Egerton 1976, 2003, 2004, Stevens 2004). His parents had seven daughters before his birth, and for five years he was the center of much attention from sisters and parents. However, in 1809 and 1811 two younger brothers were born, and Hewett was unhappy about the new competition. His mother diverted him by sending him out to help the family gardener, which was the source of his interest in plants.

After years of boredom at several schools, at age 17 he was apprenticed to a law firm in Manchester, where he lasted two years before moving to Liverpool. There, he acquired an interest in phrenology, the first attempt to develop a science of the mind and brain (Van Wyhe 2004). In autumn 1828 he went to Edinburgh to associate with its phrenologists and to study medicine. Botany was part of the medical curriculum, since plants were important sources of medicines. Botany professor Robert Graham (1786–1845) was neither a great scientist nor a great teacher, but he was a congenial mentor who enjoyed taking students on field trips (Fletcher and Brown 1970:99–112, Egerton 1979:100, note 3, Bellon 2004, McConnell 2004). He also sponsored a yearly contest for the best essay on some botanical subject. In 1831 the subject was geographical distribution of plants. This challenge led Watson to the dominant interest of his life.

The research and writing of his untitled essay—exactly 100 pages of text plus 11 pages to explain five tables—was an excellent way to achieve a broad perspective on this new science. It won the gold prize; unpublished, it survives in the archives of the Royal Botanic Garden, Kew. Watson considered two models for organizing his essay: Alexander von Humboldt's "Prolegomena" in *Nova Genera et Species Plantarum* (Volume 1, 1816), and John Lindley's discussion in *Introduction to the Natural System of Botany* (1830). Humboldt provided general laws and illustrative examples; Lindley provided geographical ranges and degrees of prevalence of each plant family within a region. Watson followed neither model, but divided his essay into two equal parts, one descriptive and the other dynamic.

His descriptive part divided the world's flora into six latitudinal zones. This discussion was considerably indebted to Humboldt, but also drew upon 23 other lists and Floras of various parts of the world. His discussions of percentages of different plant families within a zone followed the pattern established by Gottfried R. Treviranus, Robert Brown, and Humboldt (Egerton 2009:269–271). He reviewed in some detail the well-known parallel between latitudinal and altitudinal ranges of species. He also noticed that temperate species have a more northern distribution on western than on eastern coasts of continents, a fact he attributed to differences in temperature on the two coasts. Arctic species of northern continents are more similar to each other than are species further south in these continents. He also showed the similarities of floras in eastern Asia and eastern North America using lists of species from these localities.

Part II, "Conditions of Vegetation," discussed temperature, moisture, soil, and some minor influences. Moisture seemed to be physiologically more important, but temperature has the most influence on species distribution. The plausibility of that conclusion is questionable for aquatic and desert species, and he acknowledged the primacy of water when discussing them. Since the same species can grow in different kinds of soil, he thought that texture, moisture, temperature, and organic remains are more important than chemical composition. He noted some exceptions: *Ophrys* orchids were confined to chalk soils in England, and *Erica vagans*, a heath, was confined to slates and serpentine soils. Minor environmental factors Watson identified were shade, animals, protection by man, winds, and water currents. By not discussing them he slighted dynamical aspects of plant geography, but it was still an impressive student essay.

Although Watson did not take the exam for the M.D. degree, he remained in Edinburgh through 1832 and published there his first book, *Outlines of the Geographical Distribution of British Plants*. This was much narrower in scope than his prize essay, but that had been a literature review. His book was a new investigation, also divided into two parts. This time, he borrowed its organization from Göran Wahlenberg's three regional floras (1812, 1813, 1814). Wahlenberg did for Sweden and part of Central Europe much of what Watson wanted to do for Britain (Erikssen 1976, Stafleu and Cowan 1976–1988, VII:17–21). The first part of *Outlines* was a general discussion, and the second part provided brief indication of habitation, topographic range, and world-wide distribution for vascular species found in the British Isles.

William MacGillivray, Scottish botanist and zoologist (Stafleu and Cowan 1976–88:3, 221–222; see part 38), had suggested (1831) that a general picture of the Scottish vegetation could be built upon a collection of local studies. Watson agreed that a group effort was necessary, but felt that someone should coordinate to insure uniformity and compatibility of results. He offered his *Outlines* as a guide to that more detailed understanding of British plant geography. He asked how plants got where they were and suggested several possible answers. Nathaniel Winch (1819) had estimated that almost 50 species had spread into Northumberland and Durham hills from dumped ship ballast. Watson pointed out that introduced species persist only when they encounter congenial climate and soil. For example, when American tropical plant seeds are brought to British shores by the Gulf Stream, they perish (Watson 1832a:1–4). The section on climate and physical aspects of Britain included data on temperatures: the mean annual, winter, spring, summer, and autumn, and the hottest and coldest months for Penzance,

London, Edinburgh, Aberdeen, and Kendal (1832a:14–17). He had data on annual rainfall and elevation for about 530 places in England and Scotland. An "Outline of the Topographical Distribution of British Plants" divided British vegetation into three regions, each of which was subdivided into two zones, for a total of six zones (illustrated in Egerton 1979:91, 2003:35). These three regions subdivided into six topographic zones summarized at a British scale what was a major world-wide discussion in his prize essay. In later works, he sometimes modified, but never abandoned, these three regions and six zones.

Watson's vegetation classification was useful, and his works were highly regarded by other botanists (Stafleu and Cowan 1976–1988, VII:98–101); nevertheless, his system was one of convenience. He had not "discovered" some fact of nature, such as the fact that water consists of H_20. Arthur G. Tansley (1911), for example, decided to use a classification of British vegetation that ignored latitude and altitude for one based on types of vegetation: woodlands, grasslands, hydroseres, heath and moor, mountain vegetation, maritime, and submaritime. Watson seems not to have understood the distinction between discovering a fact of nature and developing a system of convenience. In 1845, he began the biggest dispute of his life when Edward Forbes classified British vegetation into five zones rather than six (Egerton 2010:187–188, and below).

Both Graham and William Jackson Hooker (1785–1865) at the University of Glasgow (Allan 1967:16–111, 1972, Desmond 2004, FitzGerald 2004) conducted popular field trips with their students into neighboring regions. In 1831 Watson accompanied Hooker's trip and in the summer of 1832 he went on a field trip into northern Scotland with some of Graham's students. They soon left him because, like a good Humboldtian, he was more interested in measuring elevations with an Adie sympiesometer (Middleton 1969:38) and temperatures with a Fahrenheit thermometer than he was in collecting lots of plants. He wanted to relate such data to the distribution of species. He found the same species at different elevations on different mountains and decided "Absolute altitude is of little importance in the geography of plants, [and therefore] my attention was for the most part limited to the observation of their relative height in regard to each other"(Watson 1832b:357). He listed the upper and lower limits for several species at four mountains: Clova, Braemar, Fort William, Tongue. Although he did not explain why he thought the variations occurred, he gave relevant information. An important factor was "situation," by which he evidently meant both the angle and direction of slope: "The influence of situation is well exemplified by the fact that *Empetrum nigrum*, under the steep snow rocks on the northern side of Ben Nevis, fails 600 feet below its height on the western side." Another clue for his meaning of situation is his explanation of why wheat could not be cultivated on the mountains he studied: "Braemar is too high; Fort William is too wet; Glen Clova [is] exposed to a north sea, with high ground to the south" (Watson 1832*b*:361).

Watson left Edinburgh in January 1833, and in September he bought a house in Thames Ditton, south of London but on the railroad line, where he spent the rest of his life. He had three sisters in London whom he visited, and in 1834 he joined the Linnean Society of London. He continued his Humboldtian orientation in seven brief articles, 1833–1835, one of which (Watson 1833*b*) so impressed English ecologist Eville Gorham that he quoted its six conclusions in *Ecology* (1954). Watson's second book, *Remarks on the Geographical Distribution of British Plants; chiefly in Connection with Latitude, Elevation, and Climate* (1835) expanded beyond his first, with new data. However, after 1842 no new insights emerged, and he collected fewer environmental measurements.

Fig. 1. Hewett C. Watson (1839), by Haghe, etching by R. D. D.

Watson read the second volume of Charles Lyell's *Principles of Geology* (1832), with its long exposition of, and discrediting of, Lamarck's theory of species changes over time. Watson reacted the way several other readers did; Lyell convinced him that evolution has occurred, just not the way Lamarck thought it did. On 7 October 1834, he wrote to a friend, Nathaniel Winch, and explained his new perspective (from Egerton 1979:92).

> Species *in any sense or degree I look on as human divisions, not as the creations of nature. The changes, proved by geological evidence, to have occurred in organic forms, and those now*

effecting by climate, elevation, crop-breeding, &c. &c. strongly discountenance the idea of absolute and permanent distinctions.

He was not ready to defend evolution in his second book, but he did point out that British botanists could not agree on how many species of flowering plants lived in Britain. Estimates ranged from 1500 to 1636, but his own estimate at the time was, after removing doubtful claims, about 1400 (Watson 1835:39). This was a telling argument that Charles Darwin repeated in *The Origin of Species* (1859:58). Watson (1835:41–42) also estimated that every British county contained half of the British flora, an estimate that Joseph Hooker thought notable enough to pass on to Darwin on 28 September 1846 (Darwin 1987:342).

For three years, 1837–1840, Watson edited the *Phrenological Journal*, in the vain hope of raising the subject to the level of a respected science. Concurrently, he published three brief notes on plant geography and completed a guide to the distribution of British plants (Watson 1835–1837, 1836, 1837, 1838). By 1841, he was fully recommitted to plant geography and evolution (Watson 1841*a*, *b*, 1842*a*, *b*, *c*, *d*). In 1832, he had toyed with the idea of botanical exploration abroad (Egerton 2003:37), and in March 1842, since he was again a botanist, Hooker, who had become director of the Royal Botanical Garden at Kew, asked if Watson would like to be a naturalist on a naval vessel going to map the Azores Islands. Since the ship needed carpentry repairs and painting, it did not leave until 18 May, which gave Watson time to consult at Kew both plant specimens and literature on the botany of the Canary and Azores Islands.

Captain Alexander Thomas Emeric Vidal (1792–1863), a capable hydrographer (Ritchie 2004), commanded the steamer *Styx*. They reached Fayal, one of the 10 Azores, on 25 May. Watson was thrilled at the sight of "the lofty Peak of Pico, rising high and sharp into the deep blue sky, with a wreath of white clouds floating like a loose drapery around its dark sides, much below the summit." The extinct crater of Fayal was "as peaceful and lovely a scene as I ever beheld," with "a natural botanic garden, where the true Flora of the Azores, above the cultivated region, reigns undisturbed by plough or spade"(1843–1844:4, 127). Such descriptive language was uncharacteristic of Watson. Perhaps the travel narratives of Humboldt and Darwin had prepared his mind to emulate their comments. Following their examples, he described the geography of domestic as well as wild species: "Strawberries do not succeed well, and the fruit which they do bear is with difficulty preserved from the innumerable blackbirds"(1843–1844:5).

No disciple of Humboldt could resist an ascent of Pico, and on 1 July Watson accompanied Captain Vidal, Lieutenant Cleaveland, Assistant Surgeon Speer, and two porters. The previous summer Watson had studied the influence of elevation on the composition of vegetation in Scotland's Grampian Mountains, and now he did the same on Pico, noting both cultivated species and weeds growing along the road. At about 1000 feet elevation, "the *orange* has disappeared; *fig* trees had become more numerous than below; and the *vines* were giving place to *apple* trees, of stunted size (1843–1844:397–398). As they continued upward, yams (*Caladium*) "indicated a transition from orchards to field crops." Still higher, "indigenous shrubs took the place of planted fruit trees; single bushes or clumps of *Laurus* (*Canariensis* or *Barbasana*?), *Myrica Faya*, *Myrsine retusa*, *Erica scoparia* and *Juniperus* (*communis*?) being left to grow on stony or rocky spots that were unsuitable for the cultivation of the tuber-bearing vegetables."

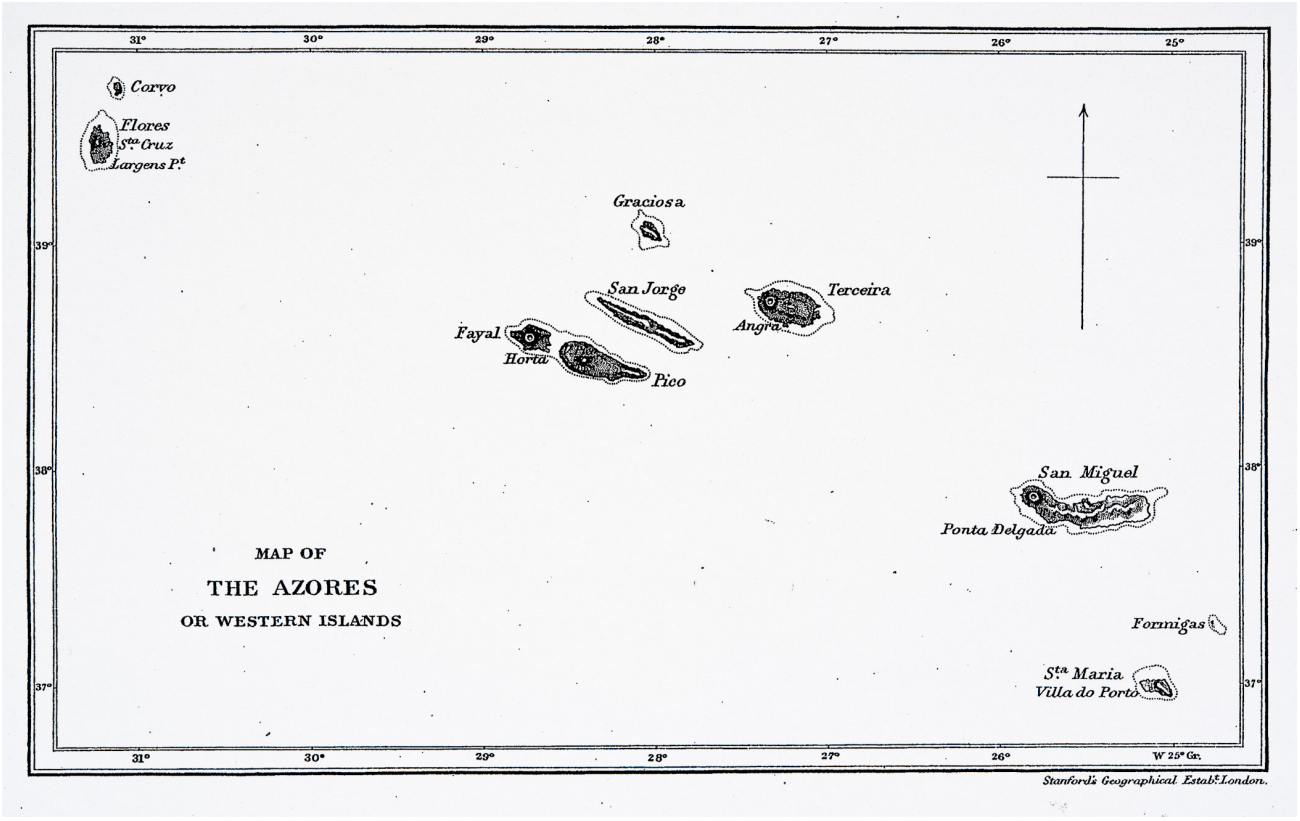

Fig. 2. The Azores (Godman 1870).

Cultivated plants disappeared as they continued climbing into a zone of shrubs, with other plants, whose relative frequencies he described, found in openings. Above the zone of mostly shrubs were clumps of shrubs interspersed within "grassy swards" which contained

> *many small pools of stagnant water, which gave an abode to* Scirpus fluitans*,* Scripus Savii*,* Carex stellulata*,* Callitriche verna*,* Peplis Portula *and* Potamogeton natans*. Though very small and shallow, these pools are kept supplied with water by the mists and clouds from which this part of the mountain is seldom quite clear.*

He identified half a dozen species of grass, two of which were seldom found below 1000 feet elevation. As they emerged above *Erica scoparia*, Vidal thought they were above the limits of heath, but Watson noticed bracken fern (*Pteris aquiline*), which in Scotland indicated the heath zone, and as they ascended to a less clouded atmosphere, between 4000 and 5000 feet, *Erica scoparia* reappeared. When Pico's summit came into view, they were again in a zone of evergreen shrubs, but tiny ones compared to the same species at lower elevations. The uppermost vegetation was ling (*Calluna vulgaris*), thyme (*Thymus caespititius*), a few mosses, and lichens interspersed among boulders, but the peak itself was almost

bare. The temperature at the peak was 53°F, 22° cooler than at sea level. Wind chill made the peak seem even colder. Vidal later determined Pico's elevation barometrically as 7616 feet.

Watson was able to visit four of the islands, and the only new species was a campanula which Vidal discovered, that Watson named *Campanula vidalii*.

Afterreturning home, Watson commented in letters to Hooker (12 October 1842, and undated no. 263) that the Azores had fewer species than he had expected ("scarcely 300"), given its wide range of elevations and climates, but that there were nevertheless species from about a dozen genera which appeared to be unknown elsewhere. In his published report (1843–1844), he indicated on which island and at what elevation each species was found, and he compared his specimens with others of the same species that were available at Kew from Madeira Island, southeast of the Azores (Fig. 2). From that comparison came this provocative comment at the end of his third installment (1843–1844)

> *The shrub which I have called* Vaccinium Maderense *is certainly the* V. cylindraceum *of Smith; but I cannot regard it as being specifically distinct from* V. Maderense*, of which, however, it is a very handsome variety, with flowers more numerous, and often twice the size of those in the Madeira specimens. Those botanists who delight in multiplying species on paper, by describing extreme forms, in disregard of intermediate and connecting links, will doubtless keep* V. Maderense *and* V. cylindraceum *distinct.*

The first installment of Watson's report was lead article in the 1843 *London Journal of Botany*. Coincidentally, the lead article in the 1843 *Archiv für Naturgeschichte* (Berlin) was "Übersicht der Flora der azorischen Inseln" by Moritz Seubert and Christian Friedrich Hochstetter. Seubert published a longer *Flora Azorica* (1844), which Watson obtained, and he also obtained additional specimens from T. Carew Hunt, British Consul for the Azores (Watson 1847, Egerton 2003:95–97). Watson might have, therefore, attempted a definitive Flora of the Azores, but he was not satisfied with the quantity and scope of his data. He went on to other studies and showed no inclination to continue research on the Azores flora, but returned to the subject when an English naturalist collected in the Azores in the late 1860s (see below).

In 1836 botanical societies arose in Edinburgh and London. Watson soon joined the Botanical Society of Edinburgh, founded by botanists, but he only joined the Botanical Society of London in 1839, since it had been founded by amateurs (Allen 1976:103–114, 1986:5–25, Egerton 2003:133–138). In both societies, members collected plant specimens, which were shared with other members, and it was that, not fellowship, which interested Watson. He became vice-president of the London society in 1840 and took charge of sorting and distributing specimens. There were various botanical journals, some edited by Hooker, and *The Phytologist* (not edited by Hooker) became the unofficial journal for BSL, and Watson became its dominant contributor.

We saw in Part 35 (Egerton 2010) that Edward Forbes had an early interest in all aspects of natural history, and that in 1842 he was appointed a professor of botany at the University of London. Forbes regretted that the appointment was not in natural history, but he had studied botany under Robert Graham at Edinburgh, he had published several brief papers on botany (Stafleu and Cowan 1976–1988, I:852,

Fig. 3. *Campanula vidalii* H. C. Watson (Hooker 1844).

Rehbock 1979:181–182), and Watson had published Forbes' list of flowering plants and ferns on the Isle of Man in *The New Botanist's Guide to the Localities of the Rarer Plants of Britain* (1835–1837, II:407). Forbes' professorship did not pay enough to support a family, and he also became paleontologist at the new Geological Survey of Great Britain. He decided to combine these two interests by comparing

the fossil plants in the British strata with the modern British flora in order to draw conclusions about how the living species reached Britain. It was a fine project if he had realized how much data he needed to analyze before he could publish his findings. Unfortunately, he rather quickly concluded that there were five sources of the British fossil plants, and then he proceeded to partition the living flora into a comparable five regions. He summarized this scheme at the annual meeting of the British Association for the Advancement of Science in 1845, and an abstract of his talk was soon published in several periodicals, followed later by a long summary in the *Report* of the BAAS (Forbes 1845, Egerton 2003:122–123).

But since Watson had already divided the British flora into six regions, he saw Forbes' scheme as a challenge to his competency by someone unqualified to do so. He suspected that Forbes' crucial data came from his *Remarks on the Geographical Distribution of British Plants* (1835), and he went to the library of the Linnean Society of London and found that Forbes had checked out that book on 16 June, about a week before he read his paper (Watson 1847–1859, I:468, 472). Forbes heard of Watson's unhappiness and attempted to make amends with a generous acknowledgement when he published the full paper in 1846, but since he retained his fivefold division of British plants for Watson's six-fold division, Watson was not mollified.

Charles Darwin wrote to Forbes, apparently after reading the 1845 summary, for more details, and Forbes replied on 25 February 1846 (before the full paper of 1846 appeared), with further explanation and a geological map (Darwin 1987:290–293). Darwin sent Forbes' letter to Joseph Hooker and confided in him that he could not understand Forbes' argument, but thought it was due to his own ignorance and lack of details (Darwin 1987:293–294). Hooker responded on 2 March in more detail than Forbes had provided, and was rather skeptical of Forbes' argument (Darwin 1987:295–297). However, neither wanted to render a final verdict before they saw the full published paper. On 3 September, Hooker wrote to Darwin that "This probable fracas between the 2 Geographers distresses me, for they are almost the only 2 men who have looked on British Flora with the eyes of philosophers. Watson in particular ranks in my opinion at the very head of English Botanists, whether for knowledge of species or of their distribution" (Darwin 1987:336–337). Finally, on 28 September Hooker had read the published details and wrote to Darwin (Darwin 1987:342): "I have not seen Forbes since studying his paper & really do not know what to say when I do, for…most unfortunately he does not seem to know the Geographic Distrib. of the English Plants."

Since Darwin was already friends with Forbes before Watson's conflict with Forbes, the conflict inhibited Darwin from contacting Watson until after Forbes died in 1854. Meanwhile, Hooker—friends with both Watson and Forbes—served as Darwin's intermediary to Watson. Hooker had sent Darwin Watson's first two parts of his Azores report on 12 December 1844, before the conflict emerged (Darwin 1987:92), and Darwin responded to Hooker on Christmas Day, 1844 (Darwin 1987:100)

> *Watson's Paper on Azores has surprised me much; do you not think it odd, the fewness of peculiar species, & their rarity on the alpine heights: I wish he had tabulated his results: c^{d}. you not suggest to him to draw up a paper of such results, comparing these isl^{d} with Madeira; surely does not Madeira abound with peculiar forms? A discussion on the relations of the Floras, especially the alpine ones, of Azores, Madeira & Canary Is^{d} would be, I sh^{d} think, of general interest:--How curious the several doubtful species, which are referred to by Watson, at the end of his Paper; just as happens with birds at the Galapagos.*

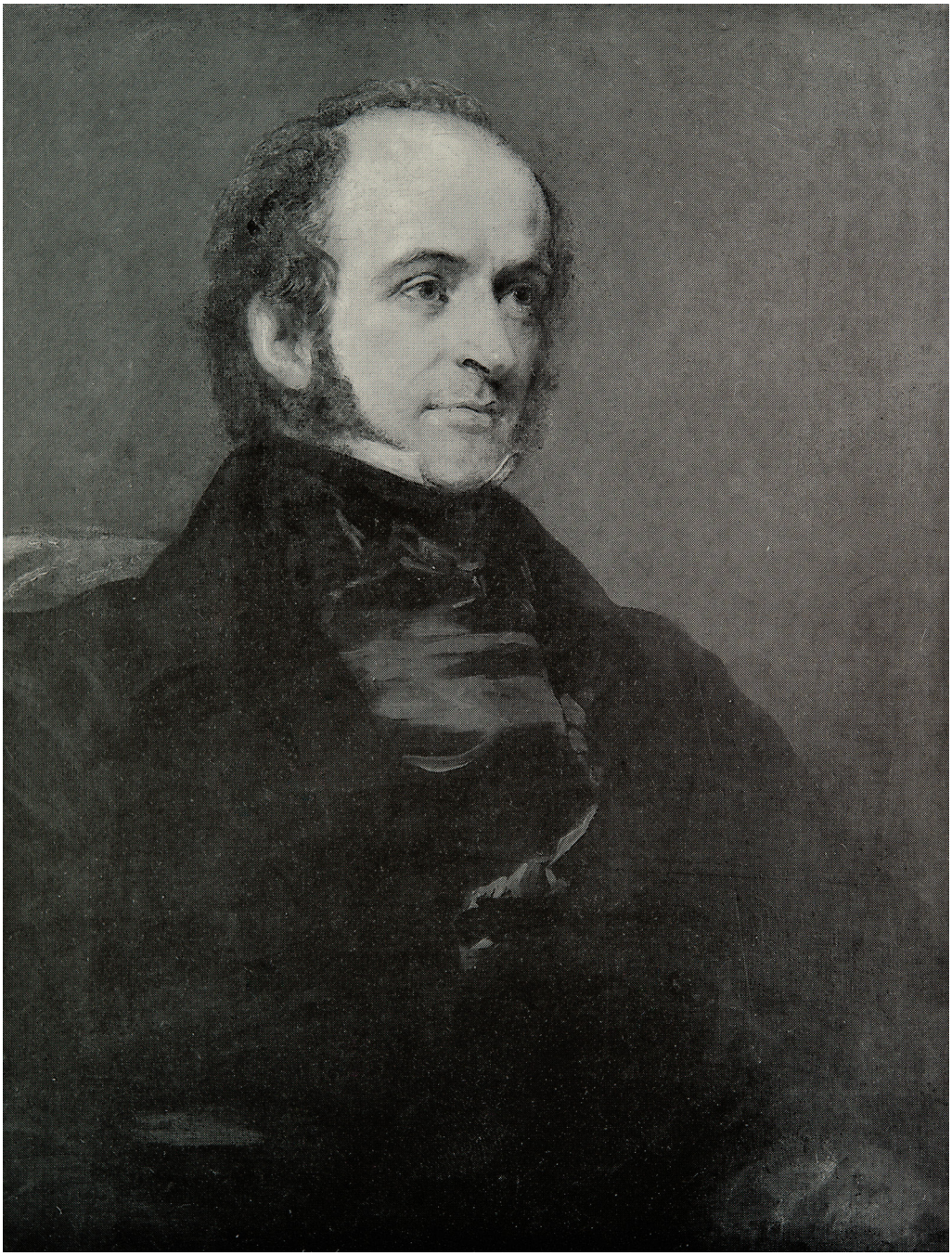

Fig. 4. Hewett C. Watson, by Margaret Sarah Carpenter (1846).

Hooker agreed that "The paucity of peculiar Azorean species is very strange & more particularly the want of W[est] Ind[ies] or N[orth] Am[erican] forms, though the current washes up canoes (if all [reports] be true) on their shores" (30 December 1844, in Darwin 1987:102). Hooker assured Darwin he had written to Watson on the questions raised, and Watson would have responded promptly, though he

waited until 1870 to expand his studies to include Madeira and the Canary Islands.

Watson discussed examples of possibly hybridizing British species, or species with unstable flowers: primrose, *Primula vulgaris*,; cowslip, *P. veris*,; oxlip *P. elatior* (Watson 1841*a*, 1842*d*, Egerton 2003:150–153). He found an opportunity in 1845 to openly discuss his views on evolution when he was asked to review the anonymous *Vestiges of the Natural History of Creation* (1844, by publisher Robert Chambers) for *The Phytologist*. He explained the faults of the book in a review in the March 1845 issue, then added his alternative views in the April, May, and July issues, providing respectively, general evidences, specific evidences, and conclusions (Watson 1845, Egerton 2003:153–158). Lacking theories of evolution and heredity, he could only show that his evidence made a reasonable case for evolution. In a letter to his friend and fellow phrenologist, George Combe, 14 May 1847, he expounded further his evolutionary ideas, including this glimpse of what Darwin later called a struggle for existence: "while the species is kept up by some more fortunate or favoured individuals, a vast number of individuals die prematurely"(Egerton 2003:159).

Hooker saw Watson's review and follow-up articles in *The Phytologist*, but apparently did not read them, since he reported to Darwin on 5 July 1845 that Watson was "an avowed believer in Progressive development, as enunciated & upheld in the already defunct 'Vestiges'"(Darwin 1987:211). On April 7, 1847 Darwin wrote Hooker for information on "cases of varieties between two other varieties being rare" (Darwin 1988:30). Hooker asked Watson and sent Darwin Watson's very impressive response (dated 12 April 1847). Darwin had a copy made of Watson's letter, which he annotated (Watson's letter is quoted in Darwin 1988:31–32, with Darwin's annotations), and drew upon Watson's letter with his own annotations when writing his long manuscript on natural selection which he later condensed into *On the Origin of Species* (Darwin 1975:268). His appetite for Watson's expertise having been whetted, Darwin was pleased in June 1847 when Hooker lent him the first two volumes of *The Phytologist* and the first volume of Watson's *Cybele Britannica*.

Watson could answer promptly Darwin's request for information because he had already begun his main life's work on the geographic distribution of British plants. In 1843 he published *The Geographical Distribution of British Plants*, Edition 3, Part 1, but later decided that it was too detailed for him to ever finish. He settled upon a less detailed version, *Cybele Britannica; or British Plants and Their Geographical Relations* (four volumes, 1847–1859), which he supplemented and abridged in later works (see bibliography), making the distributions of the British flora the most precisely documented in the world. To help accomplish this, he published a map of 18 provinces in Volume I (1847–1859, I:14–15), which he expanded as a frontispiece in Volume III (1852) into a fold-out map (8 × 12 inches, 20 × 30 cm) of 18 provinces, 38 sub-provinces, and 112 counties and vice-counties (Fig. 5). For each species, he listed under Area the number of provinces in which it grew, its ranges of: latitude, elevation, and mean annual temperatures.

He retained his six vegetation zones from his first book (1832), though he changed their names and indicator species (1847–1859, I:40). Contemporary British botanists were oriented toward systematics, and Watson did not convert them to phytogeography. Consequently, when he introduced two sets of terms to indicate the geographic status of species, his terms were dead on arrival, except as he used them. Yet, they are ecologically interesting (Chew 2006:27–32). For each term, he listed genera as examples

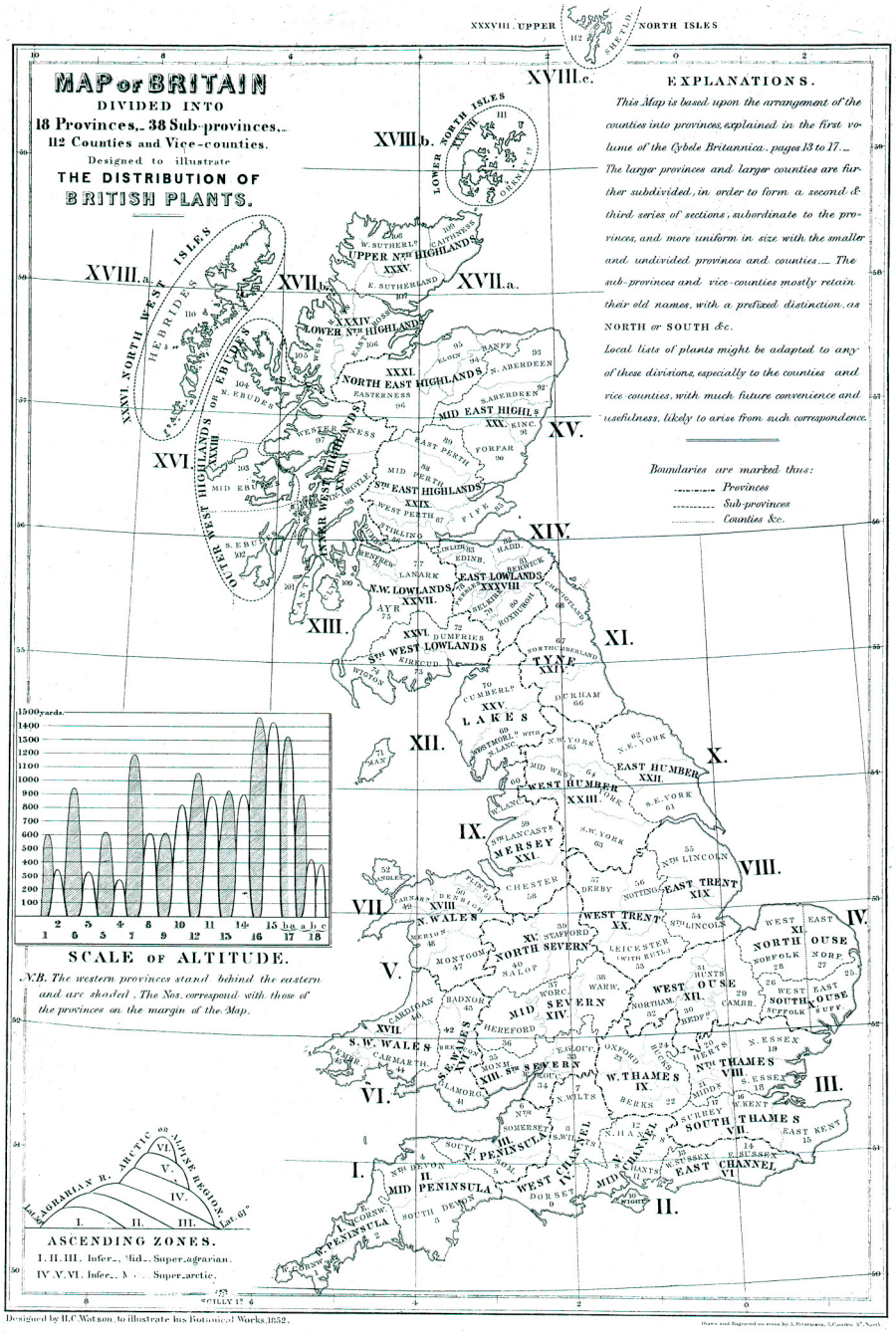

Fig. 5. Map of 18 provinces, 38 sub-provinces, and 112 counties and vice-counties of Britain. Six vegetation zones are indicated at lower left corner. Watson 1847–1859, III:Frontispiece.

(genera are omitted below). The first set of terms referred to whether a species was native or introduced (1847–1859:I, 63–64)

1. *Native—Apparently an aboriginal British species…*
2. *Denizen—At present maintaining its habitats, as if a native, without the aid of man, yet liable to some suspicion of having been originally introduced.*
3. *Colonist—A weed of cultivated land or about houses, and seldom found except in places where the ground has been adapted for its production by the operations of man…*
4. *Alien—Now more or less established, but either presumed or certainly known to have been originally introduced from other countries.*
5. *Incognita—Reported as British, but requiring confirmation as such.*
6. *Hibernian, or Sarnian—Native, or apparently so, in Ireland, or in the Channel Isles, though not found in Britain proper.*

His second set of terms indicated habitat (1847–1858, I:65–66).

1. *Pratal—Plants of meadows, or rich and damp grasslands.*
2. *Pascual—Plants of pastures and grassy commons, where the herbage is usually less luxuriant than in the meadow-lands.*
3. *Ericetal—Plants of moors and heaths.*
4. *Uliginal—Plants of swamps, or boggy ground.*
5. *Lacustral—Plants usually immersed in water, or floating on its surface.*
6. *Paludal—Plants of marshy ground, the roots of which are in water or wet ground most part of the year, or constantly.*
7. *Inundatal—Plants of places liable to be inundated in wet weather, but often dry in summer.*
8. *Vintical—Plants of road-sides, rubbish heaps, and frequented places.*
9. *Agrestal—Plants of cultivated ground.*
10. *Glareal—Plants of dry exposed ground, chiefly on gravel or sand.*
11. *Rupestral—Plants of walls and rocks.*
12. *Septal—Plants of hedge-banks and hedge-rows.*
13. *Sylvestral—Plants of woods and shaded places.*
14. *Littoral—Plants of the sea-shores.*

If other botanists had jumped onto his bandwagon, they might have complained that some of his categories were too subtle, and with consolidations, fewer terms would be needed.

Volume IV of *Cybele Britannica* (1859) contains Watson's summation and conclusions to his life's work. It was a good Humboldtian presentation of correlations between species distributions and environmental factors. He returned to the subject of trying to determine the status of native and introduced species, but without repeating his six terms to define status (1847–1858, IV:65–125). Yet, in his *Compendium of the Cybele Britannica* (1870:61–62) he did revive his terms "native," "denizen," "colonist," and "alien," but he substituted as a fifth term "casual" for "incognito," and he dropped his original sixth term. His habitat classification of Volume I was not repeated, apparently crowded out by other aspects of geographical distribution. Matthew Chew (2006:27–38) has surveyed ideas on

introduced species during the 1800s and has compared Watson's ideas to those of Alphonse de Candolle and Joseph Dalton Hooker. None of the three developed terms that became standardized.

A few months after he published Volume IV, it would be overshadowed by publication of Darwin's *On the Origin of Species*, but before that, two reviews appeared, one mostly positive by the Swiss plant geographer, Alphonse de Candolle (1806–1893), one hostile and anonymous by the English botanist John Lindley (1799–1865). Candolle noted that this was the first published botanical geography of a country (true, but Wahlenberg 1812, 1813, 1814 came close), that its level of accuracy seemed high, and that "It is desirable to have works of this character for other countries, as complements of their Floras, and as means of comparison in botanical geography" (1859:273; translated in Watson 1860:11). Candolle admitted that, as a foreigner, he may have (as Watson complained) accepted published British reports on species distributions that were not credit-worthy, but in return he criticized Watson for demanding precision where it could not readily be achieved, and for avoiding hypotheses that might advance science. Lindley, Professor of Botany at University College London, was horticultural editor of *The Gardners' Chronicle* (Stearn 1973, 1999, Drayton 2004, Elliott 2004), and his anonymous review appeared in this publication. He acknowledged Watson's enormous labor, but dismissed the results as inconsequential: "Instead of precise results, we have elaborately learned disquisitions, which really, when dissected, end in nothing."

Despite Lindley's review, British botanists had learned that they ignored Watson's publications at their peril, and they would have scanned *Cybele Britannica* for whatever seemed relevant to their work. The naturalist who most appreciated and used Watson's work was fellow evolutionist Charles Darwin. In his large manuscript entitled "Natural Selection," begun 14 May 1856, he cited Watson's evidences and judgments on 27 different pages (Darwin 1975: listed in index, 689). Watson would have been very gratified had Darwin published this work, but it was a victim of circumstances and did not appear until 1975. Alfred Russell Wallace sent Darwin his paper on evolution by natural selection in 1858, leading to reading of their joint writings on natural selection before the Linnean Society and their publication the same year. Darwin then abridged his "Natural Selection" into a more readily published *On the Origin of Species* (1859), which still cited Watson eight times and acknowledged "Mr. H. C. Watson, to whom I lie under deep obligation for assistance of all kinds"(Darwin 1859:48). Darwin knew better how to exploit Watson's data than did Watson himself. Watson had sent Darwin his books and Darwin reciprocated by sending Watson a copy of the *Origin*. Watson responded (21 November 1859): "Once commenced to read the 'Origin' I could not rest till I had galloped through the whole….You are the greatest Revolutionist in natural history of this century, if not of all centuries"(Egerton 2003:191).

In the late 1860s, a wealthy English naturalist, Frederick Du Cane Godman (1834–1919) went to the Azores with his brother and an entomologist and made extensive collections of plants and animals, then solicited help from several specialists outside his own expertise in birds and mammals in order to publish a collaborative volume, *Natural History of the Azores* (1870). This was a small-scale foreshadowing of Godman's gigantic collaborative *Biologia Centrali-Americana* (63 volumes, 1879–1915) (Mearns and Mearns 1998:292–294, Bircham 2007:191–193). Watson's 175-page contribution was the longest in the Azores volume, including Godman's. Watson could now provide critical accounts of 478 species, and he listed them with indications of whether each was known from Europe, Madeira, the Canaries, America, and Africa. Forty were unique to the Azores. He tested his data against Edward Forbes' hypothesis

that the Azores were remnants of a former continental extension from Europe, and discredited that hypothesis (Egerton 2003:205–206). He also concluded (1870:273–275) that the data for two pairs of species—*Erica azorica, E. scoparia*, and *Lysimachia azorica, L. nemorum*—supported Darwin's theory on the origin of species; that data from two other species did not seem to support his theory—*Veronica Dabneyi* and *Campanula Vidalii*—but that the positive evidence was stronger than the counter evidence (Egerton 2003:206–207).

> *The plants which must be held specially to characterize the Azores flora, at the present time, are precisely those which seem less fitted to endure a continental climate; being unable to bear any extremes of heat and cold, and especially dryness of climate.*

If Watson had a more out-going, positive personality (like Forbes), he might have gained more from his interactions with botanical colleagues. However, with a difficult personality, he still made a substantial contribution to British botany, plant geography, and plant evolutionary biology. The scope of his research narrowed over time, until it focused on refinement of data on the distribution of British plants. The Botanical Society of the British Isles acknowledged this contribution by naming its journal *Watsonia.*

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