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Alfred Russel Wallace Notes 25. Wallace and the 'Physical Environment'.

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Summary: Alfred Russel Wallace's natural selection essay of 1858 has been held to frame a greater role for the physical environment in forcing selection regimes than we find in Darwin's writings, but here that verdict is challenged by a re-examination of both the essay itself, and period usage of the term 'physical.' *Key words:* Alfred Russel Wallace, natural selection, physical nature, evolution, word history

As part of paying homage to Alfred Russel Wallace in this bicentennial year of his birth, we should be continuing to explore the many thoughts expressed across his extensive oeuvre. But it almost appears that for some, Wallace has been left where they want him left: on the second-rung to Darwin, a non-threatening figure projecting a few too many difficult-to-reconcile ideas. Is this verdict really to our advantage, or are we instead suffering the results of too many years of neglect and off-target assessments?

To take one example... Practically everyone (myself included) who has written on Wallace's 1858 Ternate essay on natural selection has concluded that his treatment puts a greater emphasis on environmental (re: 'physical') causal influences than on biological ones. On reinvestigating this matter recently, however, I came upon evidence that has forced me to change my earlier position. In the following short write-up I explain my reversal by: (1) considering anew some relevant passages in the work itself (2) examining the likely basis for Wallace's use of certain terminology, per its 1850s context, and (3) showing how his manner of subject organization in other of his publications from directly before and after the 1858 work is more consistent with the revised interpretation.

(1.) The notion that, early on, Wallace appealed primarily to what we would now describe as 'physical' (or even 'environmental') forces – especially of a geological and/or climatological type – to force organic change is based largely on two facts. First, in his pre-1858 writings he appeals rather directly to the idea that 'physical' and/or 'geological' nature may be shaping populations. In Wallace (1855), for example, he writes: "it has been shown to be the violent extremes and rapid changes of physical conditions, rather than the actual mean state in the temperate and frigid zones, which renders them less prolific than the tropical regions, as exemplified by the great distance beyond the tropics to which tropical forms penetrate when the climate is equable, and also by the richness in species and forms of tropical mountain regions which principally differ from the temperate zone in the uniformity of their climate" (p. 193). Just before this he notes "it seems no less probable that a change in the physical conditions of a district, even small in amount if rapid, or even gradual if to a great amount, would be highly unfavourable to the existence of individuals, might cause the extinction of many species, and would probably be equally unfavourable to the creation of new ones" (pp. 192-193). Similar remarks are to be found in his even earlier essay 'On the Habits of the Butterflies of the Amazon Valley' (Wallace

1854). Thus, he felt, somewhat like Buffon and Maupertuis, that environment might be forcing organic change – even if he didn't quite know how. (See also remarks on geological contexts he made as late as 20 January 1858, while on Gilolo: Costa 2013, pp. 244-245.)

In the 1858 paper itself, however, Wallace uses the word 'climate' just twice, moreover to a purpose unrelated to current concerns, and 'geological' not at all. He does, however, apply the term 'physical conditions' three times, and 'physically unchanged' once (pages 56, 58 and 59), as follows: "so long as a country remains physically unchanged," "let some alteration of physical conditions occur," "and under adverse physical conditions," and "a change of physical conditions in the district." More to the point, however, on page 58 he gives by far his most direct explanation of just what he means by his usage of the term 'physical conditions': "Now, let some alteration of physical conditions occur in the district – a long period of drought, a destruction of vegetation by locusts, the irruption of some new carnivorous animal seeking 'pastures new' – any change in fact tending to render existence more difficult to the species in question, and tasking its utmost powers to avoid complete extermination; it is evident that, of all the individuals composing the species, those forming the least numerous and most feebly organized variety would suffer first, and, were the pressure severe, must soon become extinct."

It is apparent from this rather explicit grouping of examples that Wallace has adopted a more general interpretation of the word 'physical' than one merely connoting abiotic forces. And, in fact, the essay contains numerous allusions to how organic change in one population would have effects on change in others, and nothing whatsoever on physical science underpinnings. Climate and geology have been left entirely in the dust. Why this is so, is dealt with below; meanwhile, we next look at contemporary usage of the word 'physical,' as related to geographical subjects.

(2.) In current usage, the term 'physical' is almost always connected to the sciences of the inorganic. As it turns out, this was not at all the case in the early and mid-1800s. At that time, 'physical' philosophical studies were ordinarily distinguished by their not involving human culture subjects, as opposed to not involving biology. This was especially true in physical geography, of which animal and plant geography were considered subfields because of their emphasis on what we would now term ecological or biogeochemical forces and exchanges. This would all change with the advent of workable concepts of species evolution, but before Darwin and Wallace the absence of a process model had stifled thinking in that direction (a similar thing happened a century later, when continental drift became universally accepted only after the theory of plate tectonics was introduced). Darwin was more influenced by historical concepts of process than was Wallace; the latter, though he had also adopted Lyellian notions of gradualism during the period leading up to 1858, had supplemented these with Humboldtian ecological science concepts based on the latter's 'surface physics' (loosely, physical geography) and 'equilibrium of forces' perspectives.

In the influential *Aspects of Nature* (first published in German/French in 1808; English translation, 1849), which Wallace knew well, Humboldt wrote: "...Over a large part of the earth, therefore, there could only be developed organic forms capable of supporting either a considerable diminution of heat, or, being without leaves, a long interruption of the vital functions. Thus we see variety and grace of form, mixture of colours, and generally the

perpetually youthful energy and vigour of organic life, increase as we approach the tropics” (p. 232). Further on he states: “In a physical description of the universe, it should still be noticed that the same substances which compose the organic forms of plants and animals are also found in the inorganic crust of the globe; and that the same forces or powers which govern inorganic matter are seen to prevail in organic beings like wise, combining and decomposing the various substances, regulating the forms and properties of organic tissues, but acting in these cases under complicated conditions yet unexpected, to which the very vague terms of ‘vital phenomena,’ ‘operations of vital forces,’ have been assigned, and which have been systematically grouped, according to analogies more or less happily imagined” (p. 410). And then: “The difficulty of satisfactorily reducing the vital phenomena of organization to physical and chemical laws, is principally founded on the complication of the phenomena, and on the multiplicity of simultaneously acting forces, as well as the varying conditions of the activity of those forces” (Humboldt 1849, p. 467).

True, there were some signs of shifting positions during this period: most significantly, Lyell accepted the notion of physical landscape evolution (though not of biological forms), and Humboldt conceded that organic evolution remained a possibility, though he had yet to see a convincing process model suggested. The vast majority of educators of the time seem to have followed a fairly conservative path on the subject, ignoring the notion of organic evolution altogether, but continuing to view ‘physical geography’ in terms we would recognize now as ‘natural history,’ minus its organic evolution aspects. Just about all of the textbooks of the period with the words ‘physical geography’ in their title included chapters/sections on plants and animals (and a few on ethnography, as a biological matter viewed as distinct from the economics, political history, etc. of modern human society): see Somerville (1848–1877); Fitch (1855–69: “Physical Geography is a description of the general features of the earth’s surface, the organized beings placed upon it, and the operations of the atmosphere by which it is universally surrounded”); Day (1846); Woollaston (1836); Cartée (1855–1861); Reid (1850–1887); Hughes (1849–1876); David Page (1868–1893, 1873–1883). This format was also followed in one-off regional and anthropological studies of the time such as Fournel (1849–1854), Mosquera (1853), Strzelecki (1845), and Prichard (1813–1851). This pattern of including biological elements as a part of ‘physical’ geography has continued on into recent years through texts by, for example, geoscientists Arthur Strahler and his son Alan, and the geomorphologist Richard Huggett (2010).

(3.) Finally, it is clear that Wallace adopted this definitional position in other of his own writings, both previous to, and just after, the Ternate essay. In his autobiography *My Life* (1905, v. 1, p. 285) he mentions a letter dated 20 January 1851 he sent from Guia on the Upper Rio Negro to Thomas Sims in which he describes a book he is planning on the ‘physical history’ of the Amazon valley: “I am collecting information, & thinking about a work on the Physical History of the Great Amazon valley, comprising its Geography, Geology, distribution of Animals and Plants, Meteorology & the history & Languages of the Aboriginal tribes – to be illustrated by a great map showing the colour of the waters, the extent of the flooded lands, the boundaries of the great forest district &c, &c...”. Further, in his preface to the original edition of *Narrative of Travels on the Amazon and Rio Negro* he writes: “From the fragmentary notes and papers which I have saved I have written the intermediate portion, and the four last chapters on the Natural History of the

country and on the Indian tribes, which, had I saved all my materials, were intended to form a separate work on the Physical History of the Amazon” (Wallace 1853, p. iv). A bit later, in his landmark 1863 paper ‘On the Physical Geography of the Malay Archipelago’ he writes: “On the present occasion I propose to give a sketch of what is most interesting in the physical geography of this region, including in that term the general relations of the organic world to the present and past conditions of the earth's surface.” (Wallace 1863, pp. 217–218).

Discussion

Wallace’s deploy of terminology in this context was in part the result of a lack of aptly expressive words at that point. For example, the term ‘biogeography’ practically did not exist as yet (and it will surprise many that he never did use this word in his writings, even once, over the whole of his career). Nor did ‘ecology,’ ‘density dependent/independent feedback,’ ‘cybernetics,’ ‘ecosystem,’ etc. Although this realization doesn’t much change our appreciation of the greater ‘water-under-the-bridge’ historical narrative, it does help contextualize certain revisionist interpretations of Wallace. While on the one hand it brings the thoughts expressed by Darwin and Wallace in 1858 even closer together (no longer should it be suggested that the causal influences adopted in the former’s words are ‘more biological’ than those of the latter’s), it also serves to highlight their rather different roads to understanding how natural selection serves evolution.

Prior to his 1858 epiphany, Wallace: (1) had adopted Robert Chambers’s overarching vision of a general evolutionary progression toward super-beings (2) was uncertain as to how biological evolution might proceed at the individual and species level, and (3) had rejected the idea that adaptive structures were *necessarily* utilitarian (probably largely because necessary utility seemed to argue for a prescriptive teleology of first causes). Before that date, he appears to have felt that some kind of geological/climatological influence was driving evolution, but he couldn’t come up with an actual mechanism. Then, in 1858, it occurred to him that new adaptations needn’t just accommodate already-existing niches, instead emerging probabilistically in the war to achieve *some kind* of superiority over competitors; meanwhile, Malthus provided the final argument regarding the economical implications of that superiority.

Wallace later came to describe natural selection as the rule of ‘the elimination of the unfit’ (Smith 2012) – that is, as a law of nature demanded by the collision of three inevitable universal tendencies: potential superfecundity in all populations, absolute limits to the availability of vital resources, and variation within populations. His famous likening of its action to that of a governor on a steam engine – a negative feedback loop ensuring a continuing (but dynamic) balance between environment (abiotic and biotic) and population levels – has been cited as one of the first examples of cybernetic reasoning. But, and more exactly, it is also the most perfect, culminating, application of the ‘equilibrium of forces’ thinking of Humboldt.

Wallace saw at once he would have to give up his earlier, negative, position on necessary utility; accepting it now became central to the model. Understanding how Wallace applied the term ‘physical’ in his 1858 paper is critical to gauging its intent: it signaled his acceptance that *any* kind of impinging influence might bring forth a (i.e., *some*

kind of) countering biological adaptation. We can thus comprehend an otherwise strange detail in the story: despite Wallace's direct application of his ideas from the 1855 Sarawak law paper to his (Aru) essay of 1857, the Ternate work, written only some six months after the latter, contains no reference to either of these, nor to their line of reasoning. It has often been claimed that the Sarawak law paper was a precursor to the work from three years later, but actually they have almost nothing in common, the earlier one emphasizing a vicariance-like understanding of the results of a historical process, the later one, an ecological interpretation of how the planetary 'equilibrium of forces' play out as natural law.

At the same time, Wallace had not given up on the Chambers position touting a likely natural evolutionary progression toward super-human domination. He followed this muse to the end, two of the most obvious indications being his adoption of spiritualism in 1866, and his much later views on the cosmos that have been pointed to as an anticipation of modern-day anthropic principle thinking. Throughout, Wallace invokes notions of final causation, as distinct from a first-causes-based teleology, and it might serve us well to further consider the options along these lines before dismissing his train of thought as mere 'history.'

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