Final Causes in Alfred Russel Wallace's Science and Cosmology

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ALFRED RUSSEL WALLACE.

It is now just one hundred years since the adventure that was Alfred Russel Wallace's life ended. Over the past century we have made considerable progress in coming to grips with his contributions, yet there is much left to be done. In this connection I am reminded of remarks made by biologist Theodore Cockerell in a Wallace obituary printed in the pages of *Science*:

> **His activities covered such a long period, and were so varied, that no one living is in a position to critically appreciate more than a part of them . . . All must agree that a great and significant career has just been closed, but its full measure will probably never be known to any single man.**

Maybe so, but perhaps continuing efforts in this direction will not only keep his memory alive, but instruct us in new and rewarding ways. In this talk I should like briefly to sketch my interpretation of Wallace's intellectual evolution, keying on what I feel are the essential philosophical foundations of his world view, and especially how these developed in his early years. Not everyone will agree with my observations, possibly, but I would argue that this portrait provides the best foundation for a consistent understanding of his work, early and late.

The 'Early' Wallace

As we all know, Wallace's early years, through his teens, were spent in Wales, western England, and London. His early London experiences with Owenists in 1837, and subsequent reading of tracts by figures such as Thomas Paine and Robert Dale Owen, provided him with an initial moral compass that would inform his views from that point on. Most particularly, it would turn him towards agnosticism, skepticism, and free-thinking. By his mid-teens he was in the field in western England and Wales with his older brother William, apprenticing as a surveyor. Soon he was taking interest in nature, especially geology, astronomy, and botany. He became involved with mechanics institutes, even giving lectures on subjects such as botanical systematics and the value of gaining varied forms of knowledge. In 1843 he was so bold as to send a short essay on telescope lenses to Fox Talbot, then the leading English innovator in the burgeoning field of photography.

But it was not until his move to Leicester in early 1844, precipitated by a work slowdown in Wales, that the Wallace we know began more clearly to manifest itself. He was perhaps not a great success as a teacher at the private school there, but this mattered little. He met another young man, Henry Walter Bates, who, though living a largely monotonous existence as a clerk, had been fully bitten by the collecting bug (or perhaps one should say, the collecting of bugs…). Bates's enthusiasm converted Wallace from a botanist to an entomologist, and he would tend a primarily zoological path thereafter.

While Wallace was at Leicester, he attended a demonstration of mesmerism by Spencer Hall, a leading advocate. Although many were skeptical as to the reality of this newly presented phenomenon, Wallace found that he was capable of inducing trance in his own subjects, and took from this a lesson: not to assume *a priori* that obscure subjects were necessarily invalid ones.

He also encountered a number of writings during this period that would strongly influence his future thoughts and activities. Among these were well-known issuances by Charles Lyell, Alexander von Humboldt, Thomas Malthus, Charles Darwin, Robert Chambers, and George Combe. Chambers's *Vestiges of the Natural History of Creation*, a transformist tract, turned him into an evolutionist, though he recognized the book's general inability to suggest a specific mechanism of change.

In the Spring of 1845 Wallace's brother William died suddenly, and he was obliged to return to Wales to tie up loose ends connected to his business. This work did not go so well, and he began to immerse himself more and more in philosophical matters connected to natural history. His reading of Chambers, taken together with Lyellian uniformitarianism, had provided a solid foundation for further thinking, but he soon found that the prevailing hypotheses on the workings of nature were not getting him anywhere. The options available to him were limited to creationism, catastrophism, and Lamarckism, and none suited him. He agreed with Lyell that environmental changes, however in detail they might come about, were likely to be gradual, and not abrupt. First causes-based approaches he rejected outright. And, there seemed to be no evidence to support Lamarckism.

Help was coming, however. Sometime in 1845 he became aware of a new book by Humboldt, titled *Cosmos*. In a letter dated 28 December 1845 he wrote to his friend Bates how he had heard "the venerable Humboldt" supported views expressed in *Vestiges of the Natural History of Creation*, and that he (Wallace) had "a great desire to read" the new work.

***Cosmos* does not in fact advance transformist doctrine, but nevertheless it did provide Wallace with conceptual and methodological guidance. Many of Wallace's lifelong convictions may be traced to this work, which he very likely got to read before he left for the Amazon in the Spring of 1848. Humboldt had already greatly influenced a generation of naturalists through his fathership of "terrestrial physics," his name for physical geography. Included were a number of people who themselves were heavy influences on Wallace: Lyell, Darwin, (perhaps Chambers), Whewell, and two protégés, the botanist Franz Julius Ferninand Meyen, and the great chemist Justus von Liebig. Humboldt's role in the development of natural science is so significant that a specific term, "Humboldtian science," has been attached to it. *Wikipedia* succinctly describes this as a:**

> **…movement in science in the 19th century with ideals and central themes resulting from the work of German scientist, naturalist and explorer Alexander von Humboldt … Humboldtian science incorporates many ideals and concepts, though it roughly encapsulates a shift toward an understanding of the interconnectedness of nature through accurate measurement. One central concept was what Humboldt called "terrestrial physics," which encompassed an extensive and pervasive study of the earth's many features and forces with accurate scientific instrumentation. Humboldtian science is founded on a principle of "general equilibrium of forces." General equilibrium was the idea that there are infinite forces in nature that are in constant conflict, yet all forces balance each other out.**

Armed with the idea that some great principle of organization was behind evolution's path, Wallace and Bates set out for South America to begin careers in professional natural history collecting. Following Humboldt's lead (Humboldt had also traveled in South America in 1799 to 1804), Wallace collected specimens of several different groups of organisms, also taking

physical measurements as he moved from place to place. Using his surveying experience, he constructed a long-useful map of the Rio Negro in Brazil. He paid attention to the native peoples he encountered, recording vocabulary lists of their languages. But his observations did not lead to an understanding of the working mechanism of organic change. After he returned to England in 1852 he wrote in his *Travels on the Amazon and Rio Negro*:

> **In all works on Natural History, we constantly find details of the marvellous adaptation of animals to their food, their habits, and the localities in which they are found. But naturalists are now beginning to look beyond this, and to see that there must be some other principle regulating the infinitely varied forms of animal life…**

What this "other principle" was he didn't yet know, but he remained interested in trying to find out. He set out for the field again in early 1854, this time sailing to the Far East.

A year later he produced his proto-evolutionary tract 'On the Law Which Has Regulated the Introduction of New Species,' but this was a work identifying the *results* of evolution, not its causes. The following year, in a paper describing the habits of the orangutan, he shows that his still Humboldtian-dominated approach has not gotten him past his general suspicions regarding the role of adaptations in evolution:

> **Do you mean to assert, then, some of my readers will indignantly ask, that this animal, or any animal, is provided with organs which are of no use to it? Yes, we reply, we do mean to assert that many animals are provided with organs and appendages which serve no material or physical purpose. The extraordinary excrescences of many insects, the fantastic and many-coloured plumes which adorn certain birds, the excessively developed horns in some of the antelopes, the colours and infinitely modified forms of many flower-petals, are all cases, for an explanation of which we must look to some general principle far more recondite than a simple relation to the necessities of the individual. We conceive it to be a most erroneous, a most contracted view of the organic world, to believe that every part of an animal or of a plant exists solely for some material and physical use to the individual, – to believe that all the beauty, all the infinite combinations and changes of form and structure should have the sole purpose and end of enabling each animal to support its existence, – to believe, in fact, that we know the one sole**

end and purpose of every modification that exists in organic beings, and to refuse to recognize the possibility of there being any other. Naturalists are too apt to imagine, when they cannot discover, a use for everything in nature.

Words such as these coming from the man later characterized as a "hyper-selectionist" may seem a bit strange, but Wallace was just holding to his anti-creationist, anti-Lamarckian agenda. Finally, in 1858, he realized that it was not necessary to think in terms of particular adaptations leading inexorably to other particular adaptations, but instead to any new kind of structure that, simply, "worked." Thus, any given adaptation was not pre-ordained. Add in a few sprinkles of Malthus and Wallace's many observations on variation in the natural world, and the principle of natural selection followed as a logical conclusion.

Wallace would immediately pitch his new idea into battle: specifically, to shore up his criticisms of Lyell in Wallace's then-just-published article on the biogeography of the Aru Islands (itself largely an application of the central tenets of his 1855 Sarawak law paper). He did not even wait to publish the new theory; instead he sent off a ms. to Darwin, hoping he would find its ideas interesting enough to pass along to Lyell for "comment." But of course a different sequence of events unfolded.

Note, however, that while it was the failings of Lyell's creationist biogeography views that got Wallace thinking, it was still the Humboldtian "general equilibrium of forces" idea that ultimately assured the conceptual victory. Consider the most famous quotation from the Ternate essay:

We have also here an acting cause to account for that balance so often observed in nature, – a deficiency in one set of organs always being compensated by an increased development of some others – powerful wings accompanying weak feet, or great velocity making up for the absence of defensive weapons; for it has been shown that all varieties in which an unbalanced deficiency occurred could not long continue their existence. The action of this principle is exactly like that of the centrifugal governor of the steam engine, which checks and corrects any irregularities almost before they become evident; and in like manner no unbalanced deficiency in the animal kingdom can ever reach any

conspicuous magnitude, because it would make itself felt at the very first step, by rendering existence difficult and extinction almost sure soon to follow.

Here we have a perfect example of the "general equilibrium" model – so perfect, in fact, that it represents something other than an evolutionary depiction. Anthropologist Gregory Bateson later correctly identified it as an early example of cybernetics modeling; that is, as a regulatory negative feedback mechanism. Wallace may well have been indebted to Humboldt's protégé Justus von Liebig for making this connection, as Wallace was familiar with Liebig's writings, very likely including his identification of the limiting factors concept, which involves similar thinking.

Wallace would later specifically characterize natural selection as "the elimination of the unfit," and now we can see why – and why, in turn, Wallace viewed domestication processes as being antithetical to "natural" evolutionary processes. Domestication involves selection for pre-determined objectives, in contrast with the kind of selection that leads to "whatever works." But if the "elimination of the unfit" is merely a negative feedback-maintained mechanism for keeping populations healthy, to where do we look for a complementary positive feedback mechanism that can push populations away from their "balance," and onto evolutionary paths? Elsewhere I have suggested an answer, but getting into this here would pull us too far away from current concerns.

It is worth noting, however, that this is why Wallace continued to regard the environment, very generally speaking (including its living elements) as fundamental to the process of selection. And as before his discovery of natural selection, so too after it he would continue to look to "more recondite" forces, another Humboldtian notion, as contributing to the evolutionary trace. Moreover, even as of 1858 he still had a big problem to deal with in this regard.

The 'Middle' Wallace

It is just about universally unappreciated that there is absolutely no evidence to suggest that Wallace felt his 1858 natural selection model explained the coming into being, or further development, of humankind's

higher qualities. Thus just about all writers on the subject accept uncritically the idea that around 1865 Wallace had a "change" – actually, a *reversal* – of mind regarding natural selection's ability to deal with the issue. But the essay itself says nothing on this matter, and Wallace himself later denied, in print, undergoing any such reversal. Further, the main pieces of evidence in Wallace's oeuvre that have been used to defend such a switch are easier to explain as responses to other immediate issues, as I have discussed elsewhere.

Most people who know much about Wallace regard him as one of history's most brilliant field observers. As far back as the early 1840s (and his essay on Welsh farmers) he was exercising this enormous talent, and his penchant for study certainly had not deteriorated any during his many years of living among native peoples in the Amazon and Far East. This very familiarity with the range of human talents quite likely was one of the reasons it took him so long to come to a utility-based appreciation of adaptive structures in plants and animals: that is, like the many different ways animals and plants had responded to similar impinging ecological forces, so too had humans developed infinitely varying coping mechanisms. Some of these abilities, moreover – such as mathematics, selflessness, and the arts – seemed to have limited immediate utility value, and no natural selection-related reason for emerging at all.

The elimination of the unfit concept made it possible to understand the evolutionary progression as being secondarily influenced by more recondite forces. Yes, all populations were forced to go through the "sieve" of natural selection, but this did not mean variation was not somehow being injected into nature from additional directions, prior to selection. And, even with the Ternate theory in hand, as of 1858 Wallace could not suggest how. Still, the natural selection concept was a big step forward: at least it could be used to understand how particular adaptation strategies related to immediate environmental constraints and opportunities. Wallace gave his support to Darwin's version of natural selection, but perhaps not whole-heartedly. It was a full five and a half years after the Ternate essay that he finally published a study (on the hexagonal shape of bees' cells) related to the theory, in late 1863.

Several months after this Wallace presented a paper to the Anthropological Society that featured an application of the theory to the evolution of human

races. This incorporated a deliberate nod to Spencerian/Darwinian materialism, and Darwin was delighted by it. But Wallace was not quite satisfied with the model. Later, in his revision of the work for the collection *Contributions to the Theory of Natural Selection* in 1870, he mentions just this (and in later reminiscences he reaffirms). Still worried about how the process worked at the human level, through late 1864 and early 1865 he published a series of essays contemplating various mechanisms that might lead to societal improvement. Then he hit upon something that seemed, potentially at least, to provide the desired effect.

Around June of 1865 his sister, already a follower, suggested that he look into the philosophy and phenomena of spiritualism. He did so, proceeding through four distinct phases over the next four years: (1) from roughly June 1865 to December 1865, interested investigator (2) from then to about November 1866, lobbyist to the cause of *investigating* spiritualism (3) from then to about the middle of 1868, unapologetic believer, and (4) from then on, promoter of spiritualism-as-a-part-of-the-evolutionary process.

A lot of nonsense has been written about Wallace's adoption of spiritualism, and there is not time here to go through it all with a mind toward dismissal. Most importantly, however, Wallace certainly had no reversal of mind regarding the proper domain of natural selection as the result of his newfound belief. Never having had any clear picture from 1858 on of how humankind's higher attributes had come into being and were now being modified, he simply *added* spiritualism onto the model to explain them. What was the reasoning?

First, in the late 1860s especially, he witnessed phenomena at séances that he found, rightly or wrongly, to be convincing indicators of "an existence beyond." Second, his extensive examination of the literature of spiritualism led him to conclude that its philosophical underpinnings were logically sound, and of a high moral/ethical standard. Most importantly, perhaps, it provided a way of understanding how people might be evolving in spite of themselves (a subject he had taken up in his anthropological essays of late 1864 and early 1865), without a direct awareness of the process.

Spiritualists believe that the "world of spirit" contacts individuals through the medium of dreams and other subliminal communications. Such contacts allegedly deliver subtle forms of instruction (for example, through the effects of conscience) that ultimately influence behavior, especially moral/ethical behavior. Advances in such behavior lead to advances in social systems – that is, through laws and other constructs that codify generally-improving senses of right and wrong. In short, another feedback loop is involved, quite analogous to the steam engine governor control Wallace originally identified to describe the action of the elimination of the unfit.

Wallace now had a model of evolutionary change that could be applied both to the rote adaptive processes of biology, and progress at the level of human consciousness. In each case, evolutionary "advance" was a probabilistic commodity. In the case of biological entities, the emergence of adaptive traits was on a "whatever worked" basis, and there was no guarantee that later conditions would continue to support their survival. So too human consciousness, proceeding through multiple stages of "every man for himself" to eventual aspirations of global cooperation.

The 'Late' Wallace

We have now seen how Wallace's early attention to the writings of Alexander von Humboldt was the beginning of an ever-expanding fascination with the world of "more recondite" forces. One must not suppose this journey to have included an acceptance of first causes in the natural (or for that matter, human) world. Wallace's aversion to the idea of an omnipotent, personal, God, originating in his teens, was one that would continue all the way through to his death. He is not known to have belonged to any church (at least, as a practitioner), and though he was willing to entertain the possibility that a God-figure existed, he was convinced that such an entity could only make its wishes operational through natural chains of causality (as opposed to miraculous direct interventions). And, even with his adoption of this hyper-naturalistic stance, he was left with some gaps to deal with.

One of the most important of these was the matter of the origin of variation. Both he and Darwin regarded this subject in black box terms; for

natural selection to work characters had to vary, and this turned out to be universally so. But what was the origin of the variation that natural selection worked on? Neither man had any idea.

Of even greater difficulty was the apparent problem that there seemed to be great organizational gaps in the hierarchy of nature: especially, between inert and living things, and life and higher consciousness. Eventually Wallace concluded that there somehow had to have been three "influxes" of "something that was not there before" during the evolution of the universe. These led to the development of plant life from inorganic antecedents, animal life, and finally beings exhibiting higher levels of consciousness. But again, he had no exact idea of how or why this should be so.

Taking a leap of faith, he concluded that forces existed that inexorably had led to human beings, the only possessors of "higher levels of consciousness" we now know of. This is not exactly a teleological pose, as Wallace denied any intervention in the process through first causes. It is more aptly characterized as a faith in organization through the exertion of final causes. Thus, he imagined a natural process confined by forces not yet understood, leading ultimately to the development of highly conscious beings: us. This is one statement of what is now known as the anthropic principle, which comes in several versions, depending on the degree of "necessity" of the outcomes involved.

Wallace's penchant for accepting that there are likely to be ever "more recondite" forces affecting natural organization is distinctly of Humboldtian origin, as noted earlier. Throughout his adult life he appears to have accepted this. Early on, his approach to adaptations included thinking that what are now known to be vestigial structures were actually incipient ones, the first evidence of the development of "higher" traits pursuant to overarching laws. He extended this understanding, even after Darwin provided a correct interpretation of the biological evolution involved, to the occasional emergence of mediumistic qualities – that is, to the appearance of mental abilities that would become and more common in the future, according to some underlying plan of universal development.

In the years following the advent of natural selection, moreover, he continued to suppose that in many instances "local influences" were secondarily affecting, or even overriding, natural selection. An essay he delivered at the 1876 meetings of the British Association for the Advancement of Science specifically addressed this issue. A few years later, however, new ideas on mimicry by the German naturalist Fritz Müller caused him to change his mind somewhat. Similarly, he eventually came to believe that a number of physical characteristics of human beings that he originally posed as being "above selection" could yet be accounted for by it.

As an old man Wallace spoke less and less of natural selection as an inventive force, probably taking his own advice of thinking of it as the "elimination of the unfit." Instead, he spoke more and more of perfections, and directions. He would not much have cared for modern "random walk" interpretations of adaptive processes, and an uncritical attitude that evolution is proceeding the same way now as it did ten million years ago, and might ten million years in the future. But consider this: It was Wallace, not Darwin, who gave us a model of natural selection featuring the "elimination of the unfit," a process based on a "whatever can work" philosophy of the origin of adaptive structures. The interesting question that remains is, "What *can't* work, and why not?" Are there super-extending forces such as Wallace imagined that confine process in ways leading to the results we ultimately witness? If so, it will be Wallace, not Darwin, who has given us the last word in understanding the evolutionary process.