e15 The reality of evolution and the rock record

< lacunas, Wallace-Darwinian evolution >

> ... [scientific] truth cannot [*sic*] contradict [revealed] truth. ... It is indeed remarkable that this theory [of evolution] has been progressively accepted by researchers, following a series of discoveries in various fields of knowledge. The convergence, neither sought nor fabricated, of the results of work that was conducted independently is in itself a significant argument in favour of this theory. —Pope John Paul II, 1996.[1]

Darwin, schooled by Lyell's *Principles*, could avoid the logical trap in Thomas Burnet's assertion in *Telluris theoria sacra*, 1681, that: "We are not to suppose that any truth concerning the natural world can be an enemy to religion; for truth cannot be an enemy to truth, God is not divided against himself."[2] Also, from *Principles*, he was aware of the vastness of geologic time. He was aware also that the geological record of that time is very incomplete (matching the fossil succession in the rock record from one locality with that of another reveals numerous unconformities). In stratigraphy, gaps in the rock record of a locality are called *lacunas*. Each lacuna represents the time-stratigraphic record of both, or either, a time of nondeposition (hiatus) or a time of erosion (degradation vacuity).

Darwin's *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life*, that appeared in 1859 in a stingy first edition run by publisher John Murray of 1,250 copies—1,192 copies to sellers (who collectively had requested 1500) and the remainder for review and gifts as to Isa Gray who arranged for a single American edition in 1860, and Louis Agassiz—sold out in days.[3] Six ensuing publication runs of "*Origin*" (by which shortened reference the book is known) made a fortune for Murray III (who also published Lyell, David Livingstone, and, novel at the time, travel handbooks),[4] and added to Darwin's already comfortable inheritance. In this book, a "mere abstract"of a planned magnum opus to be called "*Natural Selection*" begun on October 8, 1856 he had confided in a letter to William Darwin Fox (1805-1880) his second cousin and beetle-collecting chum from Cambridge days.[5] And indeed during weekend visits with their wives to Down, Darwin had revealed his thesis, in confidence, verbally to Lyell early in 1856 and (later) in April to Huxley and Hooker (privy to his idea since 1844, see below). Darwin presented a theory of evolution that traces plausible lines of descent that make seemingly diverse organisms related. Sensible of mid-Victorian values, Darwin omitted the case of humans being derived from "apes." This he later addressed in *The Descent of Man, and Selection in Relation to Sex*, 1871.[6] Man did not in fact descend from species of apes as others are now but all are evolved from one ancestral stock with those characters that differentiate today not present then. But where was the proof? He could not explain how new characteristics arise (which needs the science of genetics). For this reason, in *Origin* he avoids the word "evolve" (past or present tense) until the book's end when, hopefully, he had made his case that evolution (a word he leaves for *The Descent of Man*) has been by the natural selection of novel features that appeared and which had not existed in an organism's progenitor(s). Thus, the word "evolve," which in his day meant to unfold, roll out, or unfurl what was already there but hidden, was given an entirely new meaning. The concluding sentence in *Origin* is:

> Whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved.

However, that oft quoted sentence is poetic only by being incomplete and should have ended "but oh, the cost!" as the book's main message is that natural selection is a hideous mechanism and as he came to know this Darwin "wholly lost, to my great regret, all pleasure from poetry of any kind."[7]

At the time, his decision to publish had been more to secure priority than to an overwhelming feeling of security in his conclusions (***Footnote e15.1***). In 1858, 48 year old Darwin received a letter out of the blue from 24 year old Alfred Russel Wallace (***Figure e15.1***) in which that naturalist revealed that he had arrived at the same general conclusions as, unbeknownst to him, had Darwin. But not so identical, it turns out, that the "theory of evolution" attributed to Darwin should be called correctly the *Darwin-Wallace Theory*. But at the time, ruing his 22 year long procrastination in publishing his like thesis, we read in a covering letter to Lyell: "Please return to me the MS., which

he does not say he wishes me to publish, but I shall, of course, at once write and offer to send to any journal. So all my originality, whatever it may amount to, will be smashed." What Darwin could glean from the 40 rice-paper pages of closely written script received from Wallace in Malaya was that: "if Wallace had my MS. sketch ... he could not have made a better short abstract!" It began: "There is a general principle in nature which will cause many varieties to survive the parent species, and to give rise to successive variations departing further and further from the original type."

In context, as Adrian Desmond (in his must-read book *Huxley*, 1994)[8] points out, Wallace was "a former builder's apprentice and surveyor, whose politics came from the socialist Hall of Science and evolution from *Vestiges*.[9] He was another 1840s activist outraged by wealth disparities and organized religion. And his sojourn in the Indies had only increased his socialist faith in morality as a cultural product and mankind as an evolved animal. Socialist spectacles gave his nature a pink hue. For him the environment expunged the unfit, not competition; and his evolution would realize the ideal of 'perfect man.'" By contrast, for Darwin: "Perfect adaption was a delusion, part of the defunct argument for a wise design. Individuals were blemished and locked in struggle."

Wallace in 1864 went on to proposed that our apelike ancestors had spread throughout the world and became adapted to various local conditions. Charles Darwin agreed but thought that the distinctions evident to the eye were too sharp, especially where different ethnicities live side by side, for a purely biogeographical explanation. He argued that sexual selection formed and kept the distinctions. Evolution produces characteristic physical traits of the races, but not immediately those of the mental and moral qualities that distinguish humans from other apes. These, evolved though social interactions that selected for linguistic, intellectual, and ethical refinements; evident in people of advanced societies. That chauvinism had taken a knock in South America where he was confronted with the reality of "noble Indians" (an oxymoron for his readers unaware of the grain of truth to Jean-Jacques Rousseau's (1712-1778) romanticized image[10] following on from John Dryden's (1631-1700), "When wild in the wood the noble savage ran")[11] slaughtered by seemingly "morally inferior gauchos" (a sentiment to be echoed by Wallace in *In The Malay Archipelago,* 1869, wherein the natives are describe as more truly civilized than his own people at home).[12] However, in Tierra del Fuego (so named by natives for the *signal-fires lit ashore*), Darwin's notion that appearance is a measure of a people's evolutionary advance from the brutish seemed true. Of the naked Yahgans (extinct since the 1960s) of its southern islands he wrote, "if the world was searched, no lower grade of man could be found." Then in *Descent,* 1871, revealing a (dated) sense of humor? but sadly no, aping such as Engels and Spencer[13] he continues, "that the Irish might be an exception."

In 1844, Darwin had skim read *Vestiges* in the British Museum library. As its authorship was anonymous he had worried that its advocacy of: a non-miraculous, natural origin of all species including humankind,[14] could start a rumor by those acquainted with his developing ideas that he was the author. To defuse that he confided to others that "the writing & arrangement are certainly admirable [we now know now that Robert Chambers (***Figure e15.2***) a prolific publisher-author of phrenology had written *Vestiges*], but the geology strikes me as bad, & his zoology as far worse."

In 1858, when priority became an issue, Darwin recalls: "On my return home, it occurred to me, in 1837, that something might perhaps be made out on this question [of the origin of species] by patiently accumulating and reflecting on all sorts of facts which could possibly have any bearing on it. After I allowed myself to speculate on the subject, and drew up some short notes; these I enlarged in 1844 into which then seemed to me probable." Joseph Dalton Hooker (***Figure e15.3***), who had become his confidant for his speculations on the origin of the species, "read my sketch of 1844."

In his letter to Harvard botanist Asa Gray in 1857: "Selection acts only by the accumulation of slight or greater variations, caused by external conditions, or by the mere fact that in generation ... changed conditions of existence is the main cause of the child not exactly resembling its parents." And explicitly, in 1875, in a letter to his half-cousin Francis Galton (***Figure e15.4***), Darwin expressed his growing conviction that to give rise to species, natural selection must be supplemented by the inheritance of acquired characteristics (as was earlier conceived by Jean Baptiste Lamarck). Such, we know now is not the correct mechanism (*see* Topic *f14*).

Darwin also labored under the false opinion that new characteristics can become diluted in a population by blending. However, the claim that domestic animals gone feral will revert in time to

the ancestral type he found absurd for the simple reason that there is no certain record of the ancestral type. Selection by almost certain death naturally prevents most highly domesticated animals from going feral in the first place. This is why we do not find persian alley cats nor do we find wild packs of chihuahuas. Domesticated animals and plants are the result of artificial selection of desired characteristics (smaller livestock than wild ancestors for easier management, plants with larger and better-tasting edible parts, varieties of wheat and rice that will not shatter in the field before or during harvesting but will conveniently at the time of threshing).[15]

"That continued selection leads to prodigious extremes of adaptation, and also eventually to divergence of lineages," is Darwin's thesis for speciation.[16] How the variations for selection arise in the first place is the problem. For this, Darwin was at a loss except to defer to the (false) Lamarckian concept of acquired characteristics. These perpetuate in a race "whilst kept in a considerable body, so that free intercrossing might check, by blending together, any slight deviations in their structure." But then natural selection must fail, as a perceptive critic pointed out in the 1860s, to produce species, for rare advantageous variations must naturally fade rapidly. Later Darwin struggling, toyed in *The Variation of Animals and Plants Under Domestication*, 1868,[17] with the idea that acquired characteristics were distributed throughout the body as "gemmules" which physical bodies could be passed to the offspring. Not so, he learned, when Francis Galton found that blood transfused between different rabbit-breeds had no effect on their offspring.[18]

Huxley accepted Darwin's reasoning that natural selection is a functioning process in nature. It could explain variation found within orders and families of organisms known to him by his study of life and fossils. It as easily could explain why in his study of fossils succession he could find no evidence of progressive modification of life: orders and families, as a result of extinctions, are now fewer than in the fossil record and all are venerable. Once an organism was fit for an ecological niche no change would be an advantage and migration to where the same niche relocated by reason of climate or elevation change would be a natural response. Also, negated is any certainty that a fossil species found in two places were contemporaneous. In 1862, Huxley's verdict was: "'not proven, and not provable'—must be recorded against the grand hypotheses of the paleontologist respecting the general succession of life on the globe." But in the same paper, *Geological Contemporaneity and Persistent Types of Life*, he does find evidence that along with the persistent groups that "exhibit no sign of progressive modification, there are others, co-existing with them, under the same conditions, in which more or less distinct indications of such a process are traceable."[19] The invertebrates provide some show of progressive change at times but not over the long haul. For example, of the shelled "Cephalopoda, the forms of the shells and of the septal sutures exhibiting a certain increase of complexity in the newer genera. Here, however, one is met at once with the occurrence of *Orthoceras* and *Baculites* at the two ends of the series, and of the fact that one of the simplest Genera, *Nautilus*, is that which now exists." However, in 1868, Huxley could use typological descriptions of toothed and tailed *Archaeopteryx* (Owen, 1863), and small bipedal reptile *Compsognathus* (Andreas Wagner, 1861) from the Solnhofen quarries to example transitional forms between reptile and bird classes.[20]

Darwin's experience with paleontology was that the rock record, because of its incompleteness, could not provide a test for his hypothesis of gradual evolution of organic life.[21] Species within a stratum had not been described to change. Sandra Herbert finds: "He scored passages in Sedgwick and Murchison's article [[22]] that emphasized their point that 'the zoological groups of Devonian rocks are all of characters intermediate between those which mark the Carboniferous and Silurian epochs.'"[23] However, such noted changes, even when progressive, were between strata and were, thereby, discontinuous. Darwin's gradualism therefore needed that intervals between were great. In 1859, to illustrate how long such a lacuna (time missing) could be, he referred to the Weald scenery of southern England where domed strata are eroded across, essentially, horizontally. He estimated that for marine denudation (***Footnote e15.2***) by cliff retreat to have achieved that single truncation would have taken 300 million years (an order of magnitude too much we now know and this exaggeration may have been avoided had concepts of peneplaination been available[24] for Darwin at the time). Skeptics as John Phillips were spurred to make their own estimates of the time recorded by the rock. He found 96 million years for the formation of Earth's crust and from that reasoned that little time was not represented by the strata.[25] Physicist William Thomson (Scottish variant spelling of Thompson), by other calculations (*see* Topic *k6*) could gloat in 1871: "The limitations of

geological periods, imposed by physical science, cannot, of course [a snide redundancy], disprove the hypothesis of transmutation of species; but it does seem sufficient to disprove the doctrine that transmutation has taken place through 'descent with modification' [quoting Darwin's phrase for organic evolution]." Others, including Huxley who upon finally reading in 1867 Ernst Haeckel's *General morphology of organisms*, 1866,[26] which showed how embryonic relationships in the living can help the tracing back of genealogical trees of fossil life, would be less pessimistic. ❑

Figure e15.1 [27] Alfred Russel (*sic*)[28] **Wallace** (1823-1913)
Upon reading newspaper reviews and attending debates on the sensational book *Vestiges,* he opined in 1845 that it offered an "ingenious hypothesis strongly supported by some striking facts and but which remains to be proved by more facts & the additional light which future analogies researches may throw upon the subject." Thereupon, he quit a secure surveying job in Wales to become a traveler (supporting himself for the next ten years by being a commercial collector of specimens for naturalists) to dwell upon his novel "law" (which he published in 1855) that "every species has come into existence coincident both in space and time with pre-existing closely allied species"[29] (as several species of kangaroo in Australia none in Africa, several species of zebra in Africa none in Australia, in spite of like environments), and finally in 1858 to formulate "the law [of natural selection] which has regulated the introduction of new species"[30] —but *not* humans (for whom evolution was purely mental, social, and spiritual, not physical) and so, bobbing beyond the surf on this wave-making point, he was *not* cofounder of the Theory of Evolution, which capping wave of the Enlightenment, Darwin surfed bravely to the beach.

To prove Earth is not flat, Wallace in 1870 stepped out of his spiritualist silliness and used the surface of a reach of canal water.[31]

Figure e15.2 Robert **Chambers** (1802-1871)
Conclusions reached in his *Vestiges of the Natural History of Creation*,1845, are that: "The system of nature assures us that benevolence is a leading principle in the divine mind. But that system is at the same time deficient in a means of making this benevolence of invariable operation.

"To reconcile this to the recognised character of the Deity, it is necessary to suppose that the present system is but a part of a whole, a stage in a Great Progress, and that the Redress is in reserve. Another argument here occurs—the economy of nature, beautifully arranged and vast in its extent as it is, does not satisfy even man's idea of what might be; he feels that, if this multiplicity of theatres for the exemplification of such phenomena as we see on earth were to go on for ever unchanged, it would not be worthy of the Being capable of creating it. An endless monotony of human generations, with their humble thinkings and doings, seems an object beneath that august Being. But the mundane economy might be very well as a portion of some greater phenomenon, the rest of which was yet to be evolved. It therefore appears that our system, though it may at first appear at issue with other doctrines in esteem amongst mankind, tends to come into harmony with them, and even to give them support." [32]

Upon reading *Vestiges*, pronouncements from other than geologists ranged from vitriolic: as Samuel Bosanquest's exposé of it as "whore of Babylon," to rhapsodic: as Edwin Binn's reference to it as "beautiful and profound." Working geologists referenced in *Vestiges* saw from its numerous errors of fact and its popularist style that the author was not one of them but few apparently felt motivated to issue comments although in the month after its publication geologist George W. Featherstonhough was worried enough to write his Cambridge friend Sedgwick: "Perhaps it may be thought best to say little about it; if not, it is to men like yourself and Whewell that we must look for the antidote." He need not have worried. Both were prepared to decry the work: Whewell by ridicule in *Indications* which he had printed in the format of *Vestiges* to mock it as a work "daintily dressed for dainty people," and Sedgwick, when he had gotten around to reading it, more robustly and protractedly as being "rank, unbending, and degrading materialism (in which emergence is not preordained). From the character of its text he, as had Whewell, concluded that the author was woman, probably Ada Lovelace: "a right true blue."

Figure e15.3 Joseph Dalton **Hooker**, second son of William Jackson Hooker, was born in Halesworth on 30th June 1817 (d. 1911). The family, when he was age four, moved to Glasgow were he attended school and later university to graduate in 1839 with Doctor of Medicine. "This and his father's influence" write Michael and Sheila Gooch in *The People of a Suffolk Town (Halesworth 1100-1900)* "enabled him to sail as botanist (nominally enrolled as surgeon) on the *Erebus* under Captain James Ross, to explore Antarctica and visit Australia, New Zealand, and the Falklands. While in Antarctica, the Ross ice barrier and Mount Erebus were named. On the expedition's return in 1843, Hooker published his botanical findings.

"A second expedition was to India, collecting in the Himalayas and Sikkim. He returned home in 1851 and married Frances Henslow. ... In 1855 he was appointed assistant director to his father at Kew Gardens, and [Charles] Darwin wrote to congratulate him 'though the income is but a poor one.'"[33]

Charles Darwin, with whom Joseph Hooker corresponded regularly, was also a confidant: "I believe I was the first to whom he communicated [in 1844] his then new ideas on the subject [of evolution]."

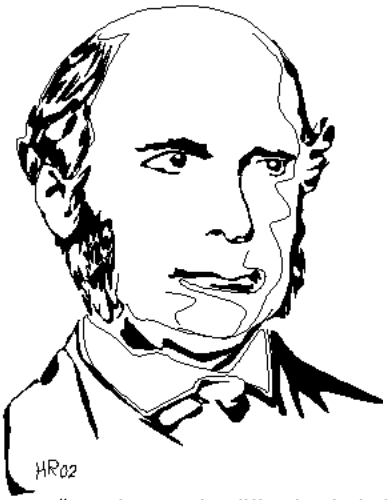

Figure e15.4 Francis **Galton** (1822-1911) His motto: "Whenever you can, count," and coiner of the dichotomy: "Nature versus nurture."[34]

Galton pioneered pedigree-analysis and comparative identical- and fraternal-twin studies, and to analyze scatter plots of data, he invented the mathematical tools of regression analysis and the correlation coefficient. *Eugenics*—from Greek words meaning "good birth"—is the name he gave in an 1865 article entitled "Heredity, Talent and Breeding" that urged a program of selective breeding to improve humanity's stock.[35] This led to enthusiasm by others for human sterilization programs and, for their excesses in the 1930s through 1970s, mention of Galton's name now arouses consternation. Even the seeming common sense of making such studies for policy, which continues to surface, as in Richard Herrnstein and Charles Murray's *The Bell Curve*, 1996,[36] is countered by the secular humanist position, well phrased by Noam Chomsky in *Language and Problems of Knowledge*:[37]

> "Surely people differ in their biologically determined qualities. The world would be too horrible to contemplate if they did not. But discovery of a correlation between some of these qualities is of no scientific interest and of no social significance, except to racists, sexists and the like. Those who argue that there is a correlation between race and IQ and those who deny this claim are contributing to racism and other disorders, because what they are saying is based on the assumption that the answer to the question makes a difference; it does not, except to racists, sexists and the like."

Footnote e15.1 The title-page verso quotations in *Origin* are: "But with regard to the material world, we can at least go so far as this—we can perceive that events are brought about not by insulated interpositions of Divine power, exerted in each particular case, but by the establishment of general laws." —W. Whewell: *Bridgewater Treatise III*, 1833; and, "To conclude, therefore, let no man out of a weak conceit of sobriety, or an ill-applied moderation, think or maintain, that a man can search too far or be too well studied in the book of God's word, or in the book of God's works; divinity or philosophy; but rather let men endeavour an endless progress or proficience in both." —Bacon: *Advancement of Learning*, 1605.

Footnote e15.2 A second edition of the *Ninth Bridgewater Treatise*, 1938, by Charles Babbage that Darwin owned and discusses in his geological *Notebook A* includes Herschel's letter dated February 1836 addressed to Lyell with the precis: "According to the general tenor of your book [*Principles of Geology*, 4th edition, June 1835], we may conclude, that the greatest transfer of material to the bottom of the ocean, is produced at the coast line by the action of the sea; and that the quantity carried down by rivers from the surface of continents, is comparatively trifling [false]."[38]