Troubles in Paradise "In the Beginning" James Downard
1.4 • The Big Theory: Natural Common Descent (Updated 4 April 2017)

1.4 Section 1—Stepping back a bit, the context before Darwin came along.

Before launching into the grisly details of the evidence for evolution and the manifest failure of antievolutionists to get a grip on any of it, or even before outlining more clearly what it means to do sound reasoning in a general sense—outlined in **Chapter 1** of Downard (2004), it is useful to step back a ways and trace how science and popular culture got so disconnected in the first place.

The major lights of early to mid-19th century science, from paleontologist Georges Cuvier (1769-1832) to geologist Louis Agassiz (1807-1873) on down, might all be regarded today as "creationists" of a sort (where discontinuities or origins were attributed to some manner of external divine activity), though their religious opinions were seldom close to those of modern creationists—Cuvier was raised a Protestant, for example, but ended up as a minimal deist, Crosland (1992, 200-201). They did not subscribe to any evolutionary explanations for life in the sense scientists do now, as a natural process of descent with modification, but then neither did they accept the simplistic Flood Geology favored by easily a half of today's Biblical creationists. Although there were hot debates about what might have caused certain deposits, Cuvier's catastrophism or Agassiz's glaciation theories were set against the recognition that the earth was nowhere near as young as Genesis chronology had thought. Indeed, the Englishman James Hutton (1726-1797) had got that ball rolling back in the 18th century when his pioneering geology work helped establish the great antiquity of the earth, Baxter (2003) or Repcheck (2003).

As the uniformitarian approach of Charles Lyell (1797-1875)—at that time another non-evolutionist, by the way—came to dominate geological thinking, catastrophic explanations fell by the wayside in geology. The full story of how geological processes and dating get mangled by Young Earth Creationists these days are covered in **Chapter 3** of Downard (2004), but the main lesson here was how natural processes *observable in the present* came to be seen as the key to the past, so by the time Darwin (1809-1882) came on the scene give the study of living things his particular evolutionary spin, the essential outlines of the geological sequence and its temporal implications had been solidly established. Simpson (1983, 59-62) supplies a compact survey of the development of the 19th century geological system, as do Strahler (1987, 296) or Eldredge (1982, 98-101; 2000, 103-107) from the standpoint of the creation/evolution debate. Gohau (1990) and Rudwick (2008) provide fuller technical and historical discussion.

The latest absolute chronology for the various periods may be found in any good encyclopedia or geology source, as well as online resources obtained by googling "age of the earth," reflected in the scale for my own **Figure 1** in Downard (2003b, 15). Viewing things from the early 21st century, though, what is most clear about this process is how the advent of radiometric dating in the 1950s confirmed the 1920s consensus that had greatly expanded the time frame of the Precambrian era into billions of years, while only fine-tuning the values worked out over the preceding century for the more recent life-bearing deposits by studying the animal and plant turnover in the rock sequences themselves.

The other big change from 19th century uniformitarian geology relates to plate tectonics, which in the 1960s overturned the view that the continents were fixed blocks of real estate. Douglas Palmer (1999) from the *Discovery Channel* effectively illustrates this, relating the geological ages to changing global continental configurations. For a grand overview of the whole current view of what has happened on earth up to now, Hartmann & Miller (1991) is still an exhilarating hoot.

The digest version: the Earth was formed during a period of unbelievably intense bombardment, as chunky debris coalesced under gravity. This process continued for two billion years, through the Late

Heavy Bombardment (LHB) phase, traceable today in the remains of ancient impact events surveyed by Kyte (2012) and H. Thompson (2012) on Bottke *et al.* (2012) and B. Johnson & Melosh (2012). Once the asteroid and cometary rain dropped to the point where our developing atmosphere and oceans could avoid being vaporized by incoming, though, life originated (very possibly around some of the very hydrothermal vents generated by the previous waves of impacts). Whether this occurred solely by brute chemical processes or involved some divine fiat is the hotly contested issue, of course. But whatever the cause, this still took place *very* early in earth's history, by around 3.5 Ga (using the standard science abbreviation for "giga-years ago"—giga standing in for billions, as mega does for millions, and kilo for thousands).

Life then spent the next *three billion years* in a bacterial rut, though with a major development along the way being the appearance (by around 2.5 Ga) of the plucky cyanobacteria, whose toxic excretion (oxygen) so many later life forms would grow positively addicted to, and later the nucleated eukaryotic cells (around 2 Ga) from which more complex life would develop. Once animal life worked out first how to be multicellular (around 1 Ga) and then how to devour one another more expeditiously, around 540 million years ago there commenced the "Paleozoic Age," launched by the Cambrian Explosion that current antievolutionists have grown so enamored of as supposedly undermining the credibility of "Darwinism". The subsequent proliferation of fish, land plants, insects, amphibians, and primitive reptiles had all developed by the time the Permian stumble took place about 245 Ma, which ushered in the "Mesozoic Age" that the dinosaurs, early mammals and first birds called home. The lesser K-T gearshift 65 Ma that we covered in the section on mass extinctions brought on the present "Cenozoic Age" of Henry Morris and Phillip Johnson.

Seeing the big picture in this way makes one wonder just how the eminent 19th century creationist scientists might have amended their attitudes toward "evolution" in light of subsequent discoveries. Baron Cuvier, for example, never had a crack at explaining the weird Cambrian fauna of the Burgess Shale in British Columbia, because they were only discovered at the turn of the 20th century, and their full evolutionary implications were not recognized until modern paleontologists began to reexamine them in the 1970s.

But given how the Cambrian Explosion figures in modern thinking (scientific as well as creationist) it is likely that whatever religious convictions the older scientists had would have been just as decisive in their response to it as it is for people today. For those inclined to think there is a Grand Plan to it all (especially one laid out authoritatively in a certain revealed scripture) it is an unattractive option indeed to accept the implication that things only turned out the way they did by mere happenstance. This philosophical difference is manifested in the paleontological venue by secularist Stephen Jay Gould (1989; 1998c) readily open to the possibly contingent nature of the past (that had the tape of life's history been rewound any replay would have been unlikely to have run out along anything like the same track) and the opposing view of the more theistically inclined Simon Conway Morris (1998a-b; 2010) seeing deep developmental trends toward complexity that would have resulted in similar types of winners and losers no matter how often the tape were rerun. The topic remains an active one in the scientific literature, with Vermeij (2006), Dick *et al.* (2009) and Conway Morris (2010) offering some recent middle ground perspectives.

The reluctance to come to terms with the specter of happenstance naturally runs even more intensely among the overtly antievolutionist, of course, such as Phillip Johnson (1991, 167) finding this "tape of life" contingency issue the "least interesting" feature of Gould's 1989 book *Wonderful Life*. For Johnson the only thing that mattered was the anatomical disparity of the new forms that Gould highlighted, as though a proliferation of unexpected arthropods somehow ruled out their common descent from earlier models, or how a penchant for gilled appendages would made an Intelligent Designer any more plausible an explanation for them.

Johnson's cavalier disinterest is not the most peculiar riff off Gould's contingency argument, though. C. Stephen Layman (2007, 211-212) tried to use Gould's assertion of natural contingent evolution as somehow precluding the accommodation of evil in a naturalistic framework. More will be said of Layman's convoluted arguments in the discussion of religious apologetics.

In his zeal for pigeonholing data Johnson was ironically reversing the stance of the Burgess Shale's own discoverer, Charles Walcott (1850-1927), who (as Gould had fully noted in that same *Wonderful Life* Johnson had relied on) *downplayed* that same anatomical disparity of the Cambrian fauna because it did not fit into his narrow Belle Époque brand of theistic evolution whereby God had been creating limited forms prior to his beeline for people as the pinnacle of evolved creation. One may be tempted to see the theistic commonality of Johnson and Walcott as being the stumbling block here, religiously over-primed minds refusing to just let the facts inform the result.

What can be all too easily overlooked in this either-or seesaw is the realization that that these polarities of chance and necessity are by no means mutually exclusive. There could be both naturally evolving developmental constraints that nonetheless play out in many *unpredictable and undirected* ways depending on inevitably contingent conditions. We'll be seeing this idea surfacing a lot concerning the issue of evolutionary convergence, where similar anatomical shapes or biological systems evolve independently (from repeated appearances of specialized sabertooth predators all the way down to deep metabolic processes, such as endothermic metabolism in birds and mammals with the same genes applying to the disparate feathers and hair that festoon them).

What Cuvier and others did have to face in the nineteenth century (and modern antievolutionists have had to step around so much more gingerly today) was the reality of something which only became apparent once the great span of **Deep Time** was recognized: *change* and *extinction*. This realization ultimately upended the very foundation of the creationist view of things, for if all life had been perfectly static since some initial starting point, no matter how far back that may have been, evolutionary theorizing would never have entered the picture because there would not have been any change to explain, and Charles Darwin might well have ended up but a scientific footnote for his methodical taxonomy of barnacles.

But instead of nice familiar lions and tigers and bears (oh my) with nothing else appearing on the stage since, the paleontological facts kept accumulating that this picture of fixed creation was utterly and irremediably *wrong*. The past was nothing but *change*, new forms appearing and eventually going extinct, century on millennia on eon, all the way back as far as they could see, until the strangest and least familiar of ancient life seemingly dropped off the Precambrian cliff (which we now know was the long pre-multicellular bacterial rut mentioned above).

And something else: there appeared to be a relationship between the strangeness and all that change. The farther back you went, the less those extinct forms seemed like modern ones. Indeed, this principle applied no matter where or when you started. Pick any spot in the parade and you can do the same trick: go backward or forward and the forms you see start diverging from whatever you began with. This looked enough like some sort of evolutionary process might be at work that many thinkers by 1800 had taken a stab at explaining it, surveyed by Corsi (2005), including Darwin's famous philosopher grandfather, Erasmus Darwin (1731-1802). Though national linguistic limitations slowed the interchange of ideas (bouncing around via haphazard translations, authors in French had an advantage over English, German or Italian writers), in the end the main snag for pre-Darwinian evolutionary thinking involved *mechanism*. Modern science isn't very comfortable with just isolated observation. If you don't end up discovering some coherent system of natural causation for it all, from the scientific perspective there isn't much point in bothering.

This attitude, by the way, is one that modern antievolutionists rather pointedly do not adhere to, as shall be explored in due course. The "testable model for Creation" proposed by OEC proponent Hugh Ross (2009b) might seem a counterexample here until you start teasing apart the fiddly bit details.

Leaving aside the far from quibbling methodological point that Ross is trying to establish the effect of supernatural (not natural) agency here, that Ross thinks his argument actually constitutes a genuinely "testable model" (in that he has standards for being proven wrong and would change his mind based on such "testing") testifies to the ingenious lengths tortucans can go to in pursuit of a foreordained conclusion.

1.4 Section 2—The ghost of Lamarck and epigenetics (more new science antievolutionists get wrong)

Now the leading pre-Darwinian form of evolution was that ultimate "by-your-bootstraps" model of biological improvement, the inheritance of acquired characteristics. This idea has come to be associated exclusively (and undeservedly) with the Frenchman Jean-Baptiste Lamarck (1744-1829), who was flirting with the transformation of species early in the 19th century, Milner (2009, 268-270). The concept is simple enough: if only you pumped iron thoroughly enough, you might pass on those hefty muscles to your descendants without their actually having to work at it themselves. It was a very attractive idea (Darwin himself dallied with such explanations in some of his work, as when trying to explain the giraffe's long neck), that hung over general science until modern genetics finally knocked it out of the court. The idea that animals mutate and change because they "want" or "need" to occasionally gets a revival moment, as Sniegowski & Lenski (1995) and Brisson (2003) noted of Cairns *et al.* (1988) regarding "directed mutation" (more on the directed mutagenesis issue in due course), but in the public education world the idea of intentionality in evolution hangs on as such a common student conceptual error that science educators have to labor at ways to correct it, Colburn (1994) and Gregory (2009c).

Milner (2009, 253-254. 319-320, 322-323) surveys the Neo-Lamarckian crannies of evolutionary history. Though explicit inheritance of acquired characteristics didn't pan out, the contested experiments of Paul Kammerer (1880-1926) early in the 20th century would have been bumping into the area of *epigenetics* (whereby gene expression or even physical appearance can be influenced apart from DNA coding) prompting recent reevaluations of Kammerer's work, Pennisi (2009f) and Randy Moore (2011b). Several genetic systems turn out to function in a "Lamarckian" way, Koonin & Wolf (2009), especially ones relating to how bacteria deal with viral attackers or develop resistance to other organism's defenses (including aspects of Horizontal Gene Transfer between bacteria, which issue will crop up repeatedly in the antievolutionism debate).

Though the concept of epigenetics had been knocking around for decades, improvement in genetic analysis and measuring gene expression opened the field up to detailed investigation in the 1990s and work in the area has ballooned in the last few years. A measure of how far the field had advanced came in October 2010 when *Science* devoted a special issue to it: Riddihough & Zahn (2010) re Bonasio & Tu *et al.* (2010), Bourc'his & Voinnet (2010), Chandler (2010), Feng *et al.* (2010), Halfmann & Lindquist (2010) & Hemberger & Pedersen (2010).

Epigenetic factors have been found to operate at various levels: why identical twins can grow up far from *identical*, G. Martin (2005) re Fraga *et al.* (2005), or P. Miller (2012); the dynamics of skeletal variations, R. Young & Badyaev (2007); genetic conflict between the sexes, Lemos *et al.* (2010); the mammalian immune system, propensity for obesity and brain gene expression, Tykocinski *et al.* (2010), Ng & Lin *et al.* (2010) and Luo & Ecker (2015); as well as human cognition and behavior, G. Miller (2010d-e) and Nestler (2011). They run into politically and culturally contentious areas: from the specialization of stem cells, such as Loh & Lim (2012) re Doege *et al.* (2012) or Sassone-Corsi (2103) re Shimazu *et al.* (2013) & Shyh-Chang *et al.* (2013),to the origins of human homosexuality, S. Richards (2013) re Rice *et al.* (2012), and Balter (2015d). Such research has spilled over into politics and environmental controversies by suggesting that inherited epigenetic reactions might be triggered by chemical pollutants, such as the work of Michael Skinner noted by Kaiser (2014), though Skinner's findings have been dogged with difficulties in replication and even some data fabricated by a less than

scrupulous postdoc, Hughes (2014a).

Given such notoriety, it was inevitable that the term would filter out into the general culture, to be muddled and added in due course to the lexicon of those who like to dangle the latest scientific jargon in their apologetics, such as the relentlessly trendy peacock Deepak Chopra, Coyne (2015bq). There can be loose terminology by scientists who bring it up in a popular context, too, as demonstrated by the fuss Siddhartha Mukherjee (2016a-b) stirred up among critics, recounted by Woolston (2016), including Jerry Coyne (2016w) and Ptashne & Greally (2016). Mukherjee's piece had implied epigenetic markers were the driving force in gene regulation, leaving out the protein transcription factors and short RNA which actually are the main players, as seen in test organisms like *Drosophila* fruit flies and the nematode *Caenorhabditis* that do their developing without any of those DNA epigenetic modifiers. Astrophysicist Neil de Grasse Tyson stepped onto the epigenetic trapdoor too, occasioning a riposte from Coyne (2016z).

On the Lamarckian science side of things, though, some epigenetic tracers have turned out to be both heritable and of importance in revealing how their part in modulating the expression of genes can result in individual bodily (phenotypic) variation without any notable changes being needed in the underlying genes, Crews *et al.* (2007; 2012), Mango (2011) re Greer *et al.* (2011), Mattick (2012) re V. Nelson *et al.* (2012), Guerreo-Bosagna *et al.* (2014), McCarrey (2015) re Siklenka *et al.* (2015), Skinner (2015), Hanson & Skinner (2016) and McCarrey *et al.* (2016). To take a specific example, Schmitz (2014) re Cortijo *et al.* (2014) experimentally tracked how the "epialleles" (counterparts of the variant alleles of regular genes that are distinguished not by difference in their underlying DNA but by the specialized epigenetic signatures attached to them) in the plant *Arabidopsis* contribute to changes in the complex traits of flowering time and root length.

The moment the epigenome qualifies as an agent of heritability, of course, it becomes grist for the Darwinian natural selection mill to cull or preserve—though still not in quite the archetypal "Lamarckian" manner of altering the organism's base DNA, Pennisi (2013h), but instead through attached expression signals that can remain in place through the replication process in descendants.

But a lot of factors come into play as to what effect they have and how long they last. For example, long noncoding RNAs (LncRNA) are involved in a "Wild West" tangle of epigenetic signaling explored by Latos et al. (2012), J. Lee (2012) and K. Morris (2012). These in turn have to run through the gauntlet of conformation changes chromosomes go through during the cell cycle, which actively work against preserving epigenetic tracers trying to hitch a ride down to descendants, Kleckner *et al.* (2013) re Naumova *et al.* (2013). As Stephanie Keep (2014c-e) summarized, cell processes tend to sweep clean a lot of epigenetic markers, but anything that makes it through can play a continued role. The dynamics of vertebrate sexual reproduction plays a part here too, as the paternal side of cellular DNA methylation is actively swept clean during human embryonic development, Reik & Kelsey (2014) re H. Guo *et al.* (2014) and Z. Smith *et al.* (2014).

Especially in eukaryotic organisms, where the DNA is sequestered in a nucleus and consists of long open ended strings rather than shorter prokaryotic rings, the protein-making machinery of the cell can only get at the DNA to process it into RNA transcriptions to act as a blueprint for the protein when the DNA is unwound from its chromatin packets, illustrated by Nestler (2011, 79). Epigenetic markers like histone acetyltransferase (HAT)—themselves coded by still other stretches of DNA—either keep the DNA wound tight around its histone spacers, preventing the automatic replication machinery from ever getting at it, or relax the spools so that the mechanism can move in to do its job and make active proteins. In that way the level of an active protein can vary in a cell.

Since the DNA doesn't signal directly whether to tighten or loosen the chromatin for its transcription, it was no shock to learn there were hitherto unknown additional layers involved, and researchers had been actively exploring that trail for some years by the time Marmorstein (2001) specified HAT structure. An extensive exploration of chromatin modification in plants commenced, such

as Pandey *et al.* (2002), and from the reviews by Carrozza *et al.* (2003) and K. Lee & Workman (2007) a tremendous range of functions were discovered for HATs (for instance, the same systems having taken on highly specialized roles in yeast, flies and humans). Far from isolated from the epigenetic chromatin-histone dance, though, coding variants in the DNA directly influence the epigenetic signaling, Furey & Sethupathy (2013) re Kasowski *et al.* (2013, Kilpenin *et al*. (2013) and McVicker *et al.* (2013). Some modifications to histones appear to be heritable, Ruth Williams (2014b) re Gaydos *et al.* (2014), Audergon *et al.* (2015) and Ragunathan *et al.* (2015).

New pieces of the epigenetic network puzzle are being uncovered regularly now, such as the discovery that methylation can modify adenine bases as well as cytosine, Pfeiffer (2016) re Wu *et al.* (2016), and the unifying principles that appear to govern chromatin regulation, Keung & Khalil (2016) re Bintu *et al.* (2016). Just how many factors remain to be discovered is unclear, but because those epigenetic methylation tags involve RNA as well as DNA, as reviewed by Dominissini *et al.* (2016), this is a clue that this dance has likely been going on for a long time.

The deep evolutionary roots of epigenetic regulation are suggested by the way noncoding RNA operates in the very ancient yeast, Stritch (2011) re Lardenois *et al.* (2011), reinforced since by the discovery of a common epigenetic methylation site in algae, nematode worms and fruit flies, Rood (2015a) re a trio of papers: Ye Fu *et al.* (2015), Greer *et al.* (2015) & G. Zhang *et al.* (2015). Evolutionary scientists have begun relating those processes to the broader ones of how the genetic novelties of life have come about since by these natural means. As Nina Fedoroff (2012a) summarized in a recent review in *Science*, the epigenetic system arose deep in the history of life to protect their DNA from external invaders: from bacteriophages to viral retrotransposons (packages of RNA with "copy me" instructions that allow their spectacular proliferation in eukaryotic genomes).

What we're seeing in living organisms today is that game, only billions of years down the playing field, the accumulated reactions to myriad mutations and interactions. While prokaryotic organisms tend to eventually delete transposons that venture into their closed-loop DNA rings, the long winding nucleated genomes of eukaryotes are less tidy and more vulnerable. The result is that some transposons linger on, shut down but present, accumulating what amounts to a genetic library of untapped possibilities. Should further mutations switch them back on again, they can cause anything from a diseased genetic wreck to sparking novel functions to appear (which we'll cover more in **Chapter 17** along with the antievolutionary spin put on such findings by the likes of the *Discovery Institute*'s Jonathan Wells).

Such an active level of "epigenomic programming" (where the regulatory system has adapted to flexibly permit favorable mutations to get their chance in the selectionist sun) has been identified regarding the F-Box protein superfamily in plants, Hua *et al.* (2013), where one branch with a high deleterious mutation rate has less epigenetic regulation (natural selection would weed those mutations out regularly without it) than other lines where innovative mutations are more likely to occur, and so benefit from an epigenomic layer that can dampen the expression of unfavorable mutations but relax when good ones emerge. And it is also the case that organisms can get by without epigenetic methylation at all, as explored by Bewick *et al.* (2016).

With all this coverage it's clear that the regular scientific community was neither unaware of the epigenetic phenomena (they defined and explored it) nor treated it as some antievolutionary news bulletin (as we'll be seeing in further examples to be covered in due course). And yet that is exactly how antievolutionists have approached epigenetics, when they address it at all. Thus *CreationWiki* (2011j) opined that epigenetics "has serious implications for creation biology, given the fact that major phenotypic changes can occur without the Darwinian process of genetic mutation and natural selection."

CreationWiki thinks epigenetic inheritance "provides a potential mechanism of the created kinds"—though without going into any details. Which is understandable, since creationists haven't actually

made much progress in working out just how many "created kinds" there were supposed to have been or to what extent they have been modified by natural speciation. To put the point more baldly, were someone to contend that epigenetic inheritance "provides a potential mechanism for the existence of unicorns" don't you have to show there actually were unicorns first, before being permitted to drag epigenetics (or any other natural system) into your argument?

More fundamentally, though, *CreationWiki* missed the lesson that the existing scientific research (none of which emanated from any creationist researcher) was already confirming: that these newfound mechanisms do not represent anything other than just more naturalistic and unguided processes operating in an evolving natural world, as reminded from the anticreationist camp by geneticist Jerry Coyne (2011l), or Jack Scanlon (2012a) commenting on the *Discovery Institute*'s *Evolution News & Views* (2012d). Indeed, there seems no reason to think that epigenetic signaling is any less prone to natural mutation and variation than the DNA it helps regulate, as evidenced by Becker *et al.* (2011), Schmitz *et al.* (2011), Schultz *et al.* (2015) and van der Graaf *et al.* (2015), or isolated from the genome doubling process that can lead to hybrid speciation, Paun et al. (2007). Regarding sexual reproduction and speciation, epigenetic factors are observed to play roles in the mate preference in mice and in the fairly prolific speciation rate seen in the famous Darwin's finches, Skinner *et al.* (2014) and Skinner & Nilsson *et al.* (2015).

This is the same problem for the Intelligent Design spin on epigenetics. Cornelius Hunter (2009c) claimed it "leaves evolutionists in an awkward position" because "such intelligent adaptation capabilities suggest design, not accident." Hunter's only documentation for this was a brief track back online to an entry in his own C. Hunter (2009a) and to the general published survey by Jablonka & Raz (2009), as though any of this buttressed epigenetics as an *intelligent* response to anything, rather than a totally blind mechanistic reaction to chemical markers that can function usefully or dangerously depending on circumstances. Hunter (2016g) continued to repeat his mantras on epigenetics, accusing Michael Skinner of engaging in a "Big Lie" by the scientist seeing epigenetics as an additional layer in the natural evolution story, not a refutation of it. That natural selection would continue to act on *both* the DNA and its epigenetic markers in fully natural ways was a point utterly lost on Hunter, who failed to comprehend even the content of his secondary source of Skinner (2016), a general survey of the work he'd been doing in the many technical papers Hunter was not any paying attention to.

The dangerous side of epigenetics isn't difficult to find: they've been implicated in a variety of cancers for some time, such as Lotem & Sachs (2002) and Nilsson *et al.* (2012), and this appears to be due to inherent instability in the genetic process. As explored by Francis (2011), the many factors that can affect the functionality of coding DNA (from demethylation of the chain at its source to changes in expression as other molecules modify the "control panel" parts of the gene) can easily end up as cancerous systems, an issue of "defective design" as troublesome for ID rationales as other peculiarities of complex biological systems. This is especially true of addictions, where humans can be ensnared in a destructive dependence by the epigenetic processes running *normally*, as described by Volkow (2011) re Levine *et al.* (2011) on nicotine addiction, or the more general review of epigenetic effects on cocaine addiction and depression by Nestler (2011). Similarly some cardiorespiratory complications like hypoxia appear to be aggravated by the epigenetic system doing its thing, Lagercrantz (2012) re Nanduri *et al.* (2012). Sometimes the tail wags the opposite way, with epigenetic variations triggered by the disease rather than the other way around, as cautioned by Birney *et al.* (2016).

The evolutionary nature of all this becomes even clearer the moment you recognize the **Map of Time** aspect of it. Some of the epigenetic systems in mammals occur because they have had to deal with invading retroelements for a very long time, roughly since the dinosaurs checked out. Sixty-five million years later Leonova *et al.* (2013) identified at least three layers involved: the p53 protein to suppress their transcription in the first place, epigenetic factors to prevent their translation into RNA if they do get transcribed, and finally a "suicidal interferon response" to kill the cell as a last ditch defense.

The reason why you have to take all this trouble is that the most likely effect of a buried retroelement turning on is cellular malfunction, such as cancerous tumors. From a "design" perspective, why put all that stuff in there to begin with, only to have to build moat after moat to keep the stuff accidentally turning back on and become dangerous? From an evolutionary perspective there is no such option, no neat designer editing device exists to prevent retroelements from intruding every now and then, or to detect them automatically once they are present. That leaves only one natural response: either further mutations enable your systems to manage the invader by a variety of *ad hoc* means, or in the long run your lineage ends up extinct—and thus excluded from any further analysis by the likes of Katerina Leonova *et al*.

But design advocates are not prone to explore these deeper issues. If something like epigenetics is "new" and hence not yet integrated into the bigger scientific picture, that's about as far as the ID treatment is prepared to go. Thus another possible epigenetic effect (this time in redwoods, where the genes appear to vary from bottom to top) drew the attention of *Uncommon Descent* (2011k) to a secondary account in *ScienceDaily* (2011g) regarding Christopher Cullis' experiment work on the possible environmentally induced inheritance of gene insertions in flax (that reliance on secondary coverage will prove to be a not uncommon feature of many antievolutionists). Though nothing in the main paper, C. Johnson *et al.* (2011), nor the earlier Cullis (1981), Schneeberger & Cullis (1991) and Y. Chen *et al.* (2009), suggested anything other than a natural process was going on here, *Uncommon Descent* discerned the hand of Design: "Some forward look must be built into the system in advance."

In a similar display of expectations derailing data, *Evolution News & Views* (2012b) waxed hyperbolic when they declared the epigenome to be "Evolution's Newest Nightmare." They took note of how their *Center For Science & Culture* Fellow Richard Sternberg was making epigenetics "the focus of his research lately"—though his concrete technical accomplishments in this area has yet to advance much beyond a general allusion to it in Sternberg (2002). But the bulk of the posting was directed at another target, a string of quotes from a trio of Harvard biologists sketching out approaches to integrate the pile of epigenetic findings into the regular evolutionary framework, Ben Hunter *et al.* (2012). Evidently Hunter's team was unaware they weren't supposed to be able to do that, and *EN&V* deemed their perfectly innocuous suggestions as trying to "look brave" in the face of a problem the scientists were supposedly stubbornly failing to acknowledge. "At this point evolutionists do not know which human instinct to follow: fight or flight," but *EN&V* peaked into their skulls *in absentia* to concede, "The look on their faces is curiosity instead of terror."

An excess of scientific curiosity is a defect Intelligent Design authors can seldom be accused of, for a couple of days later their doppelganger colleagues at *Uncommon Descent* (2012i) simply reprised the *EN&V* take on the Hunter paper, dismissing the scientists' work as one merely trying "to pretend that nothing much has happened." Sure.

As the scientific literature piles up, the ID cooptation machine ratchets up in response, so that *Evolution News & Views* (2013ab) declared "The lesson is clear: intelligent design is in the best position to promote scientific discovery, and to deliver the understanding sought by science." And their evidence for this amazing accomplishment by proxy: yet another parade of quotes from some recent epigenetic work in embryology and other areas, such as Pennisi (2013f), with sections in **bold** whenever the complexity or organizational structure of the regulatory systems were alluded to. No claim that any of the scientists responsible for this work either were ID advocates or paid the slightest attention to "design thinking" as ID conceives of it (non-evolutionary interventions in life), or that they imagined their work would ever have such implications. Pennisi's summary alluded to the XIST pseudogene, for example, which the anonymous *Evolution News & Views* called attention to, but *EN&V*'s curiosity stalled when it came to exploring any of the relevant background papers, such as Duret *et al.* (2006) or Chaumeil *et al.* (2011) on the natural origin and evolution of XIST.

Instead, *Evolution News & Views* proposed that "While evolutionists scramble to deal with the

unprecedented complexity, intelligent design is not surprised by it," and offered Stephen Meyer's 2009 book *Signature in the Cell* as exemplar, which displayed its deep prescience and utility in this department by omission: "epigenetics" didn't even show up as an index topic. Fortunately, Meyer (2013a, 271-287) has remedied this oversight retroactively in *Darwin's Doubt*.

The uses to which Meyer's book have been pressed in internet creationism showed up in a January 2016 exchange I had with Young Earth Creationist Otangelo Grasso regarding a post at Larry Moran's Facebook page. Grasso linked to his own Grasso (2015a) which authority quoted Meyer's *Darwin's Doubt* (2013a, 213)—but nothing from the epigenetic section of the book. Grasso's short piece cited only one technical paper, Watanabe *et al.* (2011) on methylation imprinting, which didn't affirm design either. Grasso may reflect a newer iteration of grassroots creationism, which freely (and superficially) recycles ID apologetics and rhetoric while concealing their YEC baggage unless prodded (which took some time).

Along with Meyer's *Darwin's Doubt*, *Evolution News & Views* (2013an) continued to ride the epigenetic hobbyhorse off the design cliff, grasping at increasingly peripheral straws in their campaign to undermine the Darwinian menace, this time contending that a paper on how exercise could alter the DNA methylation pattern in humans, Rönn *et al*. (2013), had "implications for whether or not evolution is the only guiding force in how man came to be as he is today. If genes are the focus of the Darwinian mechanism, then what does it mean that man can change his genetics by changing his behavior? Perhaps Darwinian evolution explains less than previously thought, particularly in the context of human evolution—as you know we've suspected all along."

The fundamental mistake in the design line of reasoning here is that it turns on a trick of definition: arbitrarily parsing "Darwinian evolution" so that it applies *only* to one narrow track of evidence (coding genes for example), thereby allowing any new discovery like epigenetic regulation to be seen as somehow contradicting a "Darwinian" dogma of their own contrivance. The issue is actually whether such epigenetic processes are any less *natural* and *mechanistic* as Darwin's natural selection, or have any lasting effect on the *genetic* structure in question, apart from a healthier body through exercise-stimulated methylation perhaps enhancing the likelihood of successfully getting a date and hence improving the odds of reproducing and thus passing on those epigenetically burnished but otherwise unchanged genes to one's progeny.

Nothing in the Rönn paper suggested anything design-friendly in this sense. Indeed, the exercise-stimulated methylation changes could only work their purely naturalistic magic on genes whose regulation was prone to methylation in the first place (the paper specifically noted the presence of "gene islands" where the absence of methylation precluded that) and no changes to the underlying genes themselves were ever indicated. This shell game of "aha, something non-Darwinian is happening!" will spool out repeatedly in the design campaign.

Judging by *Evolution News & Views* (2016w), which contends that epigenetics "lies beyond the reach of random genetic variation," the *Discovery Institute* intends to ride this hobbyhorse to the bitter end.

It should also be noted that more than just traditional antievolutionists can play the epigenetic revisionism game. Meloni (2016) noted the "quirky coalition of Russian right wingers, Stalinists, a few qualified scientists, and even the Orthodox Church" who were claiming the pseudogenetics of Stalin-era ideologue Trofim Lysenko (1898-1976) "has been vindicated by the latest findings in molecular epigenetics." The *Kulturkampf* with a fresh coat of red Soviet paint.

1.4 Section 3—Enter Charles Darwin, to make sense of so much the creationists of his time slipped past

Getting back to Lamarck, the important thing to remember about his contribution (or rather lack of it) to scientific thinking was that he wasn't some sort of proto-evolutionist in our modern sense of the

term. Indeed, he tended to think in terms of change only within separate fixed blocks of life, with any internal changes due to the tinkering of "the supreme author of all things," Quammen (2006, 70)—a view not unlike the gang at *CreationWiki*, though that may be ironically contrasted with the furious condemnation of Lamarck's "own bitter hatred of the Bible and Christianity" claimed (without documentary support) by fellow creationists Morris & Morris (1996c, 41). While the venerable old *Biographical Dictionary of Freethinkers* by Wheeler (1889, 196-197) had a listing for Lamarck, no examples of biblical animus were noted.

By the early 19th century, the progression of life through time no longer made much sense as a sequence of static regimes, and it was no coincidence that several halting steps towards an evolutionary perspective took place because of the evidence emerging from geology, Rudwick (2008). Lamarck tried to account for why the animals in the most recent layers of fossils he could see around him in the Paris Basin looked a lot more like what was currently alive than did the definitely extinct residents of deeper layers, as did Italian geologist Giambattista Brocchi (1771-1826) regarding even more recent deposits in Italy in which around half of the fossils seem to be still represented among living forms, Eldredge (2010, 493), with fuller discussion by Dominici (2010) and Dominici & Eldredge (2010).

Studying the past with one eye cocked on *current* life, though, Lamarck and Brocchi tended to marginalize the many extinct dead ends they found preceded them, and were also quite content not to speculate too much about what mysterious means a Creator or Nature might have used to accomplish this apparent succession of forms. Darwin was well aware of these churning speculations (his mentor, Robert Grant, leaned toward Lamarck's position), and by the time he sailed on HMS *Beagle* in the 1830s he was primed to test their competing predictions (whether species were arbitrary constructions as Lamarck thought, or more stable as Brocchi imagined) against this wider background, a **Deep Time** freed from the philosophical need to navigate by the limited filter of living forms, Eldredge (2009a).

The major difference between Darwin's thinking and that of Lamarck (or the poetic speculations of granddad Erasmus Darwin's *Zoonomia* forty years earlier, for that matter), as Darwin biographer Janet Browne (2002, 61) reminded, was that Darwin didn't suppose there had to be a *goal* to the evolution of life, that it necessarily had to be progressing *towards* whatever happened to be alive today (particularly *us*), rather than simply a surging sea of life changing as circumstances ebbed and flowed, with contemporary forms only that thin slice of time we happened to be around to look closely at. Contingency and opportunity, not teleology, governed the Darwinian view. As David Zeigler (2008) summarized it: "the evolution of life is not a story of progress but rather one of success of the very few and failure of the many," and not even a case of all the losers being "unfit," given the many mass extinctions that have slammed life on earth (as covered back in section **1.2**). This is a sobering **Deep Time** perspective guaranteed to be philosophically disquieting to many.

As for the content, this new "Darwinian" evolutionary theory can be summed up in a single sentence: all life is related by common natural descent. And that means *everything* … from aging singer Madonna to the mushroom residing on her dinner salad—though which one (fungus or pop star) ought to be more upset at this relation is anybody's guess. But since there has been such substantial and observable *change*, evolution means more than just genealogy. It signifies descent with *modification*, generated as a product of natural reproduction, and together with common descent that idea constitutes what might be called the General Theory of Evolution. Darwin's special contribution concerned supplying for the first time a plausible (and potentially observable) naturalistic candidate for the engine responsible for preserving and channeling all this modifying: the principle of "natural selection" whereby organisms whose inheritable features (gained by a variety of internal processes) improve their *reproductive* success (a critical distinction not to be confused with the more general idea of "fitness") will tend to be favored in the procreation business and get passed on to their descendants, and that the big changes of life (from multicellularity to eyes and wings and big brains) ultimately represented the acquisition of lots of incremental improvements.

There are many treatments of the history of evolutionary theory and Darwin's contribution to it: Edey & Johanson (1989), Mayr (1991), Schwartz (1999, 4-10), C. Zimmer (2001g, 3-55) or Gould (2002a, 503-591). Primary biographies of Darwin include Desmond & Moore (1991; 2009), Browne (2002), Eldredge (2005) and Quammen (2006). Van Wyhe (2008) aimed at a general readership for *National Geographic*, profusely illustrated with reproductions of documents and photographs to get a better sense of Darwin and his time. For a humorous aside, there is the *Flying Spaghetti Monster* take on Darwin's life in Henderson (2006, 84-88).

It took Darwin quite a while to come up with the double-barreled idea, though, and here the pivotal experience was his lengthy sea voyage as secondary naturalist aboard the *Beagle*, neatly summarized by Van Wyhe (2008, 16-31, 34-39) regarding the voyage and subsequent scientific publications. Having just been exposed to Lyell's new uniformitarian geology, it was the biogeographical epiphany he experienced en route that provided the first pieces of the puzzle. Unlike museum-bound experts like Cuvier, meticulously examining specimens submitted from afar, Darwin was bumping firsthand into life in the raw. The patterns of life came into sharpest focus on *islands*, particularly on the Galápagos in the Pacific, recounted by Grant & Estes (2009), where each featured inhabitants simultaneously distinctive, yet curiously restricted only to types that might have migrated there naturally. And these in turn were so suspiciously similar to those of nearby landmasses to further suggest not only where the newcomers had migrated from originally, but that, once arrived, they had evidently adapted to their special environments by somehow becoming separate species.

One of the things that set Darwin off on the road to evolutionary thinking involved the bird specimens he had brought back on the *Beagle*, Mayr (1991, 5, 18-19) and Shermer (2006, xiv-xvi), with Frank Sulloway (1982) for more detail. Darwin had collected a trio of what he took for varieties of mockingbirds, along with a host of specimens that he tried to identify as best he could, as *Fringilla* (true finches), *Icterus* (a broad bird family that includes blackbirds, meadowlarks and orioles), *Gross-beaks* and *Wrens*. The mockingbirds differed so much that Darwin thought they might undermine the fixity of species, but Darwin wasn't an ornithologist and knew his limits, so in March of 1837 he consulted a leading one: John Gould (1804-1881). Most ironically, Gould was a devout creationist, but what he told Darwin about his Galápagos birds helped set the evolutionary embers alight.

The mocking birds were the first to fly the "fixed type" coop when Gould readily identified them all as distinct *species*, beyond the varieties Darwin had initially thought. And then Gould began to marvel at how many *finches* Darwin had brought back. Darwin hadn't paid much attention to which of the islands he had found them on (an oversight he regretted later as he tried to reconstruct their provenance back in England, and which vexed subsequent scholars like Sulloway) because he hadn't realized at the time they *were* all "finches"—their highly variable beaks had thrown him off as plumage patterns were then deemed more relevant. Gould even called attention to how they resembled the finches seen in South America, which would set in motion an obvious biogeographical prospect (for Darwin and later evolutionists at least, if not for the creationist Gould): so many finches out in the middle of nowhere on the Galápagos would make sense if they had varied over time, island by island, from a common finch-like ancestor deriving from one of those mainland varieties. Fortuitously, the *Beagle*'s visit to this fairly recently formed islands had captured a living snapshot of an adaptive radiation:

> Through this four-part process of geographic isolation, speciation, recolonization, and ensuing adaptive radiation, the Geospizinae have evolved a remarkable disparity in the form of their beaks, from one as massive as that of a grosbeak to one as small as that of a warbler. There are three species of seed-eating ground finches with large, medium, and small beaks; another ground finch with a sharp, pointed beak; two species of ground finches that feed on cactus; a vegetarian tree finch; three species of insectivorous tree finches; a mangrove finch; a finch that closely resembles a warbler in

> both habits and morphology; and finally a 'tool-using' "woodpecker" finch, which employs twigs and cactus spines to extract its prey from crevices in tree trunks. *Sulloway (1982, 3).*

"Darwin's Finches" grew into a shorthand example of the whole evolutionary argument, "one of the most widely circulated legends in the history of the life sciences, ranking with the famous stories of Newton and the apple and of Galileo's experiments at the Leaning Tower of Pisa," Sulloway (1982, 39-40). Steven Spielberg's excellent *Lincoln* dangled the finches in this way in a hallway conversation involving Lincoln's bookworm son Tad, which Branch (2014c) chalked up as something of a technical error: although science buff and occasional inventor Abraham Lincoln had Darwin in his library along with a lot of heavy science tomes, he apparently hadn't read through it fully (rather a lot of activities on his plate at the time to devote too much attention to it, I would suggest). But even had he done so, *The Origin of Species* had not given the finches the evidential weight they would be accorded later on, though Branch (2015f) did find evidence that popular talk about evolution (especially monkey panic about how closely we were related to the primates) had made it to America by the Civil War.

As for the finches, Sulloway (1982, 3-5, 36-38) noted that by the second (1845) revised publication of his *Journal of Researches*, Darwin had come to realize some of their significance, but that Darwin hadn't dwelt on them at the time because he couldn't identify the adaptive reasons for their many beak variations. (As we'll see in **Chapter 11**, scientists' field work on the Galápagos a hundred years later would settle that side of things, drawing on a body of genetic discoveries that Darwin did not have at hand in the 19th century.)

Though much diversification and extinction has muddied the mainland record of the Darwin finches' cousins, progress has been made nonetheless. Morphological studies homed in on several genera within a group of seed-eating birds in the Emberizidae family, the tanagers and grassquits, such as the West Indian black finch *Melanospiza richardsonii* and the more common grassquit *Volatinia jacarina* of Central and South America, noted by Weiner (1994a, 221). Genetic analyses have further pressed the Darwin finch origins through to the yellow-faced grassquit genus *Tiaris* as closest living relatives, Freeland & Boag (1999), Sato *et al.* (1999; 2001) and Burns *et al.* (2002).

This scientific research may be compared to the indifference (and rationalizing) going on among antievolutionists on this topic. Phillip Johnson (1995a, 71) briefly alluded to Weiner's book, *The Beak of the Finch*, without stimulating detail ("Darwin himself did not seem to perceive their significance when he visited the islands"). Michael Behe (1996a, 14) touched in passing on *The Beak of the Finch* in a paragraph that appeared to accept Darwin's finches as physically related, but did not ponder whether those Galápagos birds might have been related to anything else beyond the island chain.

Over in YEC land, Morris & Morris (1996b, 238) cited Peter Grant (1981, 661) on the finches without ever mentioning any of the available relational suspects, even though this was a perfectly logical potential even for people enamored of fixed baramins. By the time we get down to Jean Lightner (2013) at *Answers in Genesis*' technical venue, the *Answers Research Journal*, trying to figure out how many living bird "kinds" there are today (196 in case you're wondering), Flood Geology literalists have functionally accepted the Darwin finch paternity suit by lumping the candidates into the "Sparrow/Finch Kind" that embraces over twelve hundred species! Lightner's analysis pointedly excluded fossil birds, thus avoiding the troubling issue of whether such pigeonholing falls apart once extinct taxa are included. And thus are added yet more blurry pages to the antievolutionary *Book of Bird Origins*.

Anyway, while the *Beagle* experience supplied a whole world of new observations for Darwin to mull over, he only started connecting the dots with a mechanism in mind after he encountered the gloomy views of a social critic, the Reverend Thomas Malthus (1766-1834), who argued more people (especially the "wrong sorts" that ended up in British poor houses) were born than could possibly survive. This got Darwin to thinking about the fate of variation generally among populations of animals.

Since more offspring are usually produced than can live long enough to successfully reproduce, wouldn't a factor in their making do have to include any inherited variations the individuals had? And just as human pigeon breeders use artificial selection to favor traits they like, wouldn't there have to be a "natural selection" playing a part in which individuals survived to pass on any advantageous features to their offspring? Supposing that carried on long enough, given the observable range of variation in natural populations, could anything in principle prevent the adapting descendants of that population from differing so much from their ancestors they might eventually be termed an entirely new species?

This was one of those deceptively simple conclusions with far-reaching consequences, as Darwin himself evidently recognized early on. For there was nothing in this line of reasoning that restricted the proposed method from naturally selecting traits in *any* population of organisms. Like *people*, for instance. In one fell conceptual swoop, Darwin had found a general mechanism for *a comprehensive* descent with modification, and the social implications of including the human species in the equation were not lost on the otherwise cautious Mr. Darwin.

The appearance of an anonymous book, *Vestiges of the Natural History of Creation*, in 1844 gave a clue how such ideas might be received, especially if it were not very well argued. *Vestiges* presented a breezy popular presentation of the idea that some form of theistic tinkering with life had led to transformations, Slotten (2004, 28-31), Eldredge (2005, 43-44) and Quammen (2006, 80-82). Very widely read (even by Abraham Lincoln away in America) it was also ferociously criticized by scientists for its loose evidential foundation (intermediates were imagined as simplistic chimeras, not unlike the way modern creationists approach the matter with things like crocoducks) and by social conservatives as a potential threat to the idea of a living world firmly fixed since creation—since if animals could transmute from their original station, so might people, no longer deferring to their betters.

These social and technical details lend an ironic twist to John West (2014a) at *Evolution News & Views* fervently distancing Lincoln from Darwin's god-free version of evolution. While Lincoln never got around to reading the heavier science writings of folks like Darwin (as noted above regarding Spielberg's *Lincoln*), he did appear to be warming to the general idea of evolution as reflected in *Vestiges of the Natural History of Creation*, which West strove to haul onto the antievolutionary landscape as a progenitor of Intelligent Design. By highlighting *Vestiges*' theistic teleology aspect over its technical limitation, though, West unintentionally reinforced the historical tendency for designer-focused speculations to turn on relatively superficial if not sloppy popular treatments appreciated more readily by politicians and lawyers (Lincoln was both) than the scientists more directly familiar with the factual difficulties.

The fuss over *Vestiges of the Natural History of Creation* grew so intense that its journalist author, Robert Chambers (1802-1871), never admitted to writing it (though Darwin guessed correctly it was his work), and possibly inspired the controversy-averse Darwin to imitate Copernicus (prudently sitting on heliocentrism, which openly challenged Aristotle's geocentric model of the solar system that the Catholic Church had embraced as gospel truth, until safely on his deathbed). Tucked away in his refuge of Down House outside London, surrounded by his growing family, the volumes of notes Darwin would collect in the years to come on his theory would help him withstand whatever storms of *Vestiges*-style reaction might rage in the event he ever got around to finishing the book version, which he had titled *Natural Selection*.

Though John West evidently missed it, the popular success of *Vestiges* reflected a gradual sea change in how transformism was being seen in Britain, filled as it was with an increasingly progressive urge for improvement in life as well as politics, coupled with a gradual decline in the acceptance of divine intervention as a default explanation for things better accounted for solely through the action of the "secondary causes" of natural processes—Charles Lyell's new uniformitarian geology was just as devoid of godly meddling as Darwin's evolution would be. So by the 1850s the British cultural milieu was a different place compared to when *Vestiges* had first appeared, Browne (2002, 19-22).

Add to that a giant detour: on the recommendation of his botanist friend Joseph Hooker (1817-1911), Darwin commenced a comprehensive monograph on the poorly known barnacles to better establish his scientific reputation. Considered perhaps some sort of snail (because of the shell), barnacles had been a contentious critter in natural classification. In centuries past they'd even been deemed the babies of *geese* (based on a 17th century observer noting their resemblance to embryonic birds). "So embedded was the notion that for a time the barnacle goose was counted as a fish and could be eaten by Catholics on Fridays," S. Jones (2011, 130).

Darwin's barnacle project soon ballooned into a massive taxonomical and analytical undertaking that kept him occupied for the next *eight years*, further delaying his resumption of the *Natural Selection* book. In the end, Darwin established barnacles to be highly modified arthropods, conclusions summarized by Desmond & Moore (2009, 229-230). Writing over a century after Darwin's pioneering work, Valentine (2004, 40) noted how the variety of adaptations in barnacles "have been achieved by rather tortuous modifications of ancestral morphology, as the organisms were not 'designed' from scratch for the new conditions."

Regarding the book writing chronology, Van Wyhe (2007) reminded that Darwin had worked out the main outlines of his theory of evolution before embarking on the barnacle project, and returned to it in earnest as soon as he'd completed that work, suggesting fear over critical reaction may not have been playing as significant a role in Darwin's supposed delay in publication than had been previously thought. In any event, it was true that Darwin's book-writing hand was directly forced by another younger naturalist, Alfred Russel Wallace (1823-1913), and thereby hangs a tale.

Perhaps because "Wallaceism" never caught on in the way the "Darwinism" term did (Wallace in fact was perfectly happy to let the elder figure be the point man here), Wallace's place in the early stages of evolutionary thinking fell into eclipse in the 20th century, Edey & Johanson (1989, 70-83). More recent reassessments by Endersby (2003), Slotten (2004), Quammen (2006, 122-152; 2008) and Milner (2009, 291, 375, 415-416, 434-440) have moved to redress this, especially on the 2013 centenary of his death, Lyons (2014). *Theory in Biosciences* devoted a special issue to Wallace: Kutschera & Hossfield (2013) re Costa (2013), Hossfeld & Olsson (2013), Ibrahim & Kutschera (2013), Kutschera & Kleinhans (2013), Kutschera & Niklas (2013), Levit & Polatayko (2013), Ruse (2013), C. Smith (2013).

More impressed by Chambers' *Vestiges* than Darwin or Thomas Huxley (1825-1895) ever were, Wallace was thinking of transmutation as a possibility as he launched his own fieldwork, first in South America (losing most of his specimens in a shipwreck on the way home), and later out past the Indian Ocean in the Malay Archipelago. Knocking about isolated islands on the opposite side of the world from the *Beagle* itinerary, Wallace independently ran into the same array of biogeographically distinctive plant and animal distributions, which led in 1855 to him formulating his "Sarawak Law" that new species are generated from existing models.

Though Darwin had not given much attention to Wallace's Sarawak paper, Lyell warned Darwin that Wallace was apparently hot on the same course and urged Darwin to get off his duff and start publishing his ideas before Wallace beat him to it. Meanwhile Darwin maintained a warm correspondence with Wallace in 1857, Quammen (2006, 144-147), by which time Wallace was explicitly applying Lyell's own concept of gradual uniformitarian change to the speciation issue, even though Lyell's three-volume *Principles of Geology* (1830-1833) had rejected Lamarck-style transmutation of species, Costa (2013). When a bout of malaria laid him low on the island of Ternate in 1858, Wallace made use of the recuperation time to rethink the problem and, just as Darwin had years earlier, realized the implication of Malthus to arrive at a natural selection mechanism for evolution. He then worked up a concise summary of his view and mailed the Ternate paper off to Darwin in the spring of 1858 with the request that the famed elder expert might pass it on to the even more renowned (and scientifically connected) Lyell for consideration and possible publication.

And thus was the jig up, leading Lyell to arrange for Darwin and Wallace's arguments to be

presented jointly to the Linnean Society later that year, which some editor at the Society's *Proceedings* subsequently misleadingly lumped together as one publication, Darwin & Wallace (1858). As an off-season meeting, just thirty people attended (less than 10% of the members) and neither author was present for the occasion. Wallace (technically not a member of the Linnean Society at all) was still half a world away, and Darwin was preoccupied with very personal matters: his youngest son Charles died from scarlet fever on June 28th, just as Wallace's manuscript arrived, and his daughter Henrietta (Etty) was down with diphtheria as well, Browne (2002, 33-37, 40-45), Slotten (2004, 155), Quammen (2006, 158-162), Desmond & Moore (2009, 305) and Van Wyhe & Rookmaaker (2012).

An aside on the long-distant nature of the Darwin-Wallace interaction: Darwin and Wallace appeared to have bumped into one another in person briefly at a museum sometime in 1853 or 1854, but first met formally face-to-face only in 1862, and thereafter only sporadically, Slotten (2004, 91, 191-194). The inveterate letter writer Darwin kept in touch with Wallace over the years, of course, and they actively read one another's publications. Of further note: in 1881 Wallace was in trouble financially, and Darwin and Huxley helped secure him a £200 annual civil pension (modest, though something like $50,000 in terms of today's purchasing power) of a type previously awarded to Michael Faraday (1791-1867) and James Joule (1818-1889), Slotten (2004, 361-364). Even Flannery (2011a, 74-76) couldn't find anything to say against Darwin on that matter.

The joint 1858 Darwin-Wallace paper caused no more of a stir than Wallace's Sarawak paper had in 1855. Wallace Arthur (2006, 114-117) suspects some of that was due to the dry title of the Linnean presentation: *On the Tendency of Species to Form Varieties; and on the Perpetuation of Varieties and Species by Natural Means of Selection*. Arthur suggests that had the meat of the argument not been buried under the tarp of stolid Victorian prose, but reversed instead to a simpler *On the Tendency of Varieties to Form Species*, the revolutionary implications of what Darwin and Wallace were aiming at might have been recognized sooner.

In any case, the forcing of Darwin's hand in this way meant he had to give up on the big evolution book he'd been working on for so many years, and cobble together instead a quickie summary of what he had in mind, shorn of all the documentary referencing. Darwin incorporated about a third of the original *Natural Selection* project in what he now titled (still Victorian wordy) *On the Origin of Species by Means of Natural Selection or the Preservation of Favored Races in the Struggle for Life* (and leaving the reworking of a lot of the remainder for his later books), Van Wyhe (2008, 52-53, 56-57) and Desmond & Moore (2009, 310). It's a measure of how Victorian science writing differs from today's Internet blogging (let alone twittering) that the hundreds of meticulously detailed pages of the *Origin* constituted for Darwin the dashed off *short* version!

The Origin of Species, along with Darwin's other books and journals, are readily accessible online these days (e.g. *darwin-online.org.uk*) though not always easily *used*, as Goldstein (2009) cautioned in his survey of three major online resources. For print versions, the new 2008 illustrated edition of Darwin (1859) with notes by David Quammen is most informative, and is the version I will be using for *Origin* citations.

Unlike the ho-hum response to the joint Linnean papers, the 1859 publication of the longer *Origin* was quite another matter. The reputation Darwin had as a careful and solid scientific thinker paid off, and the book not only became a hot seller, it quickly took hold in the sciences, Van Wyhe (2008, 48-49). For a fitting touch of turnabout irony, Robert Chambers was one of the earlier favorable reviewers, in his *Chambers' Edinburgh Journal* in 1860, Browne (2002, 101).

The effect of Darwinian thinking on the practical practice of science was profound, as Edward Larson (1985, 9-15) learned when he surveyed 19th century American science texts for his book on the legal tussle over evolution. Asa Gray (1810-1888) was the only American made aware of Darwin's theory before its publication, and was to become an early convert to it, offering a most perceptive review in Gray (1860). But before then, Gray's pre-evolutionary botany texts were mere catalogues of plant

types, reflecting his religious views more than the features of the flora. Until inspired by evolutionary thinking, Gray hadn't even noticed individual plant variations didn't invariably "revert to the original form of the species."

Once Darwinism appeared on the scene, though, plant characters began to be perceived as *clues* to relationships and functionality. Nothing about the plant was just because the divinity felt like doing it that way, but because its survival necessitated the feature. Bellon (2009) and Hoot (2009) surveyed Darwin's meticulous research into plants and its deep impact on subsequent scientific study, and Canadian biologist Daniel Brooks (2011c, 448) remarked on this clarifying nature of Darwin's evolutionary revolution:

> I recently spent a year in Europe, where a "sycamore" is a maple (*Acer pseudoplatanus*) and a "plane tree" (*Platanus orientalis*) is what I call "sycamore" (*Platanus occidentalis*). Darwin's metaphor of natural classification being a phylogeny enables us to understand why North American sycamores and European plane trees resemble each other so closely, why their ecological preferences are so similar, and why they are able to hybridize so readily.

More significantly, science popularizers who still didn't like evolution, like New York high school teacher J. Dorman Steele (1836-1886), nonetheless adopted the structure of the new evolutionary taxonomy for their books, even though the old creationist "natural theology" had nothing to do with developing it.

Carol Anelli has documented a similar revolution regarding the pioneering American entomologist Benjamin Dann Walsh (1808-1869), C. Sheppard (2004) and Anelli (2006). The old natural theology approach, epitomized by *An Introduction to Entomology* (first published in 1815 but reissued in 1860) by Reverend William Kirby (1759-1850) and William Spence (1773-1860), focused on illustrating "the great truths of religion" but offered only marginal insight into why specific insects were found where they were or why they acted as they did apart from it being by Divine Plan. This glee club approach to nature persisted in creationist apologetics, such as Harry Rimmer (1937, 48), asserting how "Flowers are common to all plant life, from grass to the tallest trees," thereby wiping out of his mental existence all the many non-angiosperm flowerless plants known to science.

It is interesting also to consider the historical context for Kirby and Spence: in a presage of today's *Kulturkampf* religious conservatism in service of tradition and the political status quo, the devout Kirby was unsettled enough in the tumultuous 1790s to help distribute pamphlets opposing the anticlerical Thomas Paine (1737-1809), Freeman (1852), and Kirby (1835) later affirmed "the Power and Wisdom and Goodness of God" in the animal world for the apologetic *Bridgewater Treatises*. Wearing his economist hat, Spence (1815) supported the British Corn Law that contributed to maintaining the landed aristocracy's lucrative agriculture monopoly, Smart (1909). Dao (2008a) illustrated the contemporary *Kulturkampf* myopia on such historical context in an article for the *ICR* that extoled Kirby's reverence for God's design of insects but stepped gingerly around the contentious political milieu by noting Kirby's application to be a botany professor at Cambridge "was denied due to his political views," which a footnote explained cursorily as "Kirby was a Tory, a party that supported the authority of the British monarchy."

Benjamin Walsh's application of Darwin's way of hypothesis formation affected American agricultural practice at the root by focusing on understanding insect pests as part of dynamic ecological networks and working tirelessly to spread the new way of thinking through education and farmer publications. In 1867 he even predicted the eventual spread of the apple maggot into the Pacific Northwest (which would indeed happen a century later) based on his understanding of what would ultimately be called sympatric speciation (which he termed Phytophagic Isolation).

For further contrast, back over in the Darwin-criticism camp, Windchy (2009, 27-28) decided *The Origin of Species* "was rejected immediately by virtually the entire scientific community" by quoting only the grumpy snap judgments of astronomer John Herschel (1792-1871) and geologists Adam Sedgwick (1785-1873) and Louis Agassiz—a gloss which may be compared to the similar approach taken by creationist Richard Peachey (2002). But scientists who worked in relevant fields (as Gray and Walsh did) quickly seized on the practical utility of the Darwinian approach to nature (quite independent of their own religious proclivities, Gray being a devout Christian and Walsh definitely not), and as the "shock of the new" wore off, the spreading groundswell of practical support meant that by 1869 there were so few notable thinkers who disagreed with the general principle that all life was indeed related by common evolutionary descent that the scrappy Alfred Wallace complained there were no good discussions anymore, Slotten (2004, 260-261).

Move on to the 1880s and even an academic backwater like the United States could barely scrape together a handful of practicing naturalists who didn't accept it, even if most couldn't quite yet swallow the Darwin-Wallace teleology-free "natural selection" mechanism for it. Presbyterian theologian and geologist James Woodrow (1827-1907) reflected the sea change, emerging from Louis Agassiz' antievolutionary shadow to regard natural evolution as a fact of nature that had to be accounted for theologically no less than the rock strata of geology, though it did rattle his position in the church for a time, Branch (2014f,h,j,l).

Many scientists of the time (especially ones with a strong religious motivation) were still hoping for some "progressive" form of evolution where animals would be aiming toward some adaptive goal, rather than a fully Darwinian model operating without plan or purpose (and which by implication would put us as just the latest and brightest of nature's various contingent wanderings). Still others either had trouble with the natural selection mechanism as the primary driver of evolutionary change, or went to the opposite extreme (especially the German and small cadre of French "Neo-Darwinists") to see natural selection as the *only* factor in generating adaptive change. Recalling that scientists at that time had no idea how genetic inheritance actually happened, by 1909 what we now think of as "Darwinism" had become only one position in a conflicting chorus of speculative science opinion about the nature of mutation and the inheritance of traits.

See Edey & Johanson (1989, 84-101) for 19th century scientific responses to Darwinism, Horenstein (2009) for some of the popular press reaction in the United States during Darwin's lifetime, Bowler (1983), Lustig *et al.* (2004), Eldredge (2005, 182-187) and Quammen (2006, 216-224) on the ups and downs of its scientific popularity, and Largent (2009) for a scholarly antidote to the later science writer trope that Darwinism proper was in "eclipse" during this period.

Given how entrenched religious antievolutionism appears today, it may come as a further surprise to learn that 19th century American evangelicals were not uniformly opposed to evolution, covered by Livingston (1987) or Numbers (2007)—and even today creationism remains a minority position at American theological schools, Witham (2002b, 190-191). There were some exceptions, of course: Vanderbilt University geologist Alexander Winchell (1824-1891) was fired in 1878 for accepting pre-Adamic man breaching the traditional Genesis boundaries, and in 1891 the Reverend Howard MacQueary "won the dubious distinction of being the first person to be tried for heresy in the Episcopal Church" partly for accommodating evolution, DelFattore (2007, 34). But two main players—the British religious establishment and the Catholic Church—never formally objected to Darwin's new book, which Kutschera (2009) suggested reflected Darwin's resolve not to make his evolution baby an intrinsically anti-religious one, however much it did have implications for people of faith.

Not that much of this history has filtered down to the antievolutionary basement, though. For example, Joe Renick (2011) of the *Intelligent Design Network New Mexico Division* (which while ostensibly ID-oriented nonetheless enthusiastically recommends the "excellent articles and resources" at *Creation Ministries International*) contended that "The paucity of evidence supporting his theory

greatly troubled Darwin but it served Huxley's purposes quiet [*sic*] well in that it provided a *blanket-of-ignorance* to cover some of the troubling facts," as though the fact-heavy exchanges Huxley and others engaged in with the likes of Richard Owen (1804-1892) over fossils and living forms never took place, such as primate brain features covered in **Chapter 5** of Downard (2004).

Evidently unaware that he might need to acquaint himself with who the players actually were when it came to how American science engaged the evidential issues of evolution, Renick offered instead this curious list of Darwinian supporters: "Things went very well for Darwin in Europe, but what about America? Not so good…at least not out in the heart land. Suffice it to say that the academic world and elite progressives like Margret [*sic*] Sanger, Sigmund Freud, John Dewey, Alfred Kinsey and Oliver Wendell Holmes were enamored with Darwinism for all the same reasons Thomas Huxley was…its role as a secular religion." All the ellipses and italics were Renick's.

What we have here (besides the unreliable spelling) is not a catalog of geologists, paleontologists, or biologists, and their sundry reactions to Darwin or Huxley—let alone a perceptive take on the role of secular thinking in the spread of Darwinism—but a cursory laundry list of more contemporary villains that repeatedly crop up in the *Kulturkampf* sights. Sigmund Freud (1856-1939), Margaret Sanger (1879-1966) and Alfred Kinsey (1894-1956) garner attention because of their connection to modern sensibilities on *sex* (AKA "begetting")—a topic that has been a lightning rod for antievolutionists for some time, such as the efforts to censor a 1931 pro-evolution film documentary over its footage of animals doing their thing, Glenn Branch (2014ap). Meanwhile, "natural law" jurist Oliver Wendell Holmes (1841-1935) and liberal educator John Dewey (1859-1952) appear as icons representing what Renick imagined that "heart land" supposedly did not want back then.

Like most thinkers in the late 19th century, Holmes paid attention to Darwin, to the approbation of Nancy Pearcey (2001, 499-504)—more on her curious antievolutionary pedigree in section **1.7**. Holmes' defense of individual rights under "natural law" and suggestion that religious concepts ought to compete for success in the market place of ideas along with everything else earned praise from *Freedom From Religion* (2013d) while his refusal to think you can decide the *oughts* of moral belief by reason raised the hackles of Intelligent Design advocate Robert George (2003). *Conservapedia* (2011b) was more apoplectic in assessing Holmes' impact, but like George tended to cherry pick quotes from Holmes for criticism rather than delving into the context of the cases he adjudicated in his long career.

One of "The Great Dissenter" Holmes' rulings does stand out as justifiably notorious: *Buck v. Bell* in 1927, when the Supreme Court of the United States (SCOTUS) upheld the forced sterilization of a supposedly "feeble minded" woman, covered in all its tragic context (some 70,000 were sterilized in America) by Cohen (2016). Akin (2009) suggests Holmes' chief failing here was neither callousness nor prejudice but an utterly misplaced confidence that the state of Georgia (and by inference the other states that would follow their precedent over the next twenty years) had established anything like the procedural safeguards necessary to protect the rights of the individual. More ironically, though, *Buck v. Bell* played a part in the 1973 *Roe v. Wade* abortion ruling that today's *Kulturkampf* warriors fret over, where the court rejected granting a woman an *unlimited* right over her own body in part based on the *Buck v. Bell* precedent.

Renick's use of the "elite progressives" tag was another loaded oversimplification that says much more about his own conceptions than it does the turbulent world of reformist politics a hundred years ago. No less an antievolutionist Christian fundamentalist as William Jennings Bryan (1860-1925) held populist progressive views, Kazin (2006, 146-147, 155-158, 223), such as government jointly owning the railroads, strenuously supporting organized labor, and favoring stiff income taxes on the rich—positions falling very far from the Tea Party or Freedom Caucus tree today (in this respect Bryan was atypical, where antievolutionists historically have tended to be on the politically conservative side because that's where the culturally conservative feel most at home). As for matters of faith, and trying to figure out where historical figures fall on today's issues, believers like *Conservapedia* tend to peg the Unitarian

Holmes as an atheist while the FFRF will not consider him truly "godless"—likewise even the strictly atheistic "naturalism" of evolutionist Dewey is not easily plotted on today's "spiritual but not religious" spectrum, as explored by Shook (2013).

Closer to the *Kulturkampf* target is Holmes' advocacy of eugenics, but even there, things are murkier than ideologues would like (more on that disreputable topic in section **1.6**). Lots of people in the pre-genetic era bought into the logic of trying to "improve" the species through scientific breeding, until the Nazis showed just how nasty that sort of reasoning could get when fueled by paranoid racism. Akin (2009, 3) noted leftist African-American rights pioneer W. E. B. Du Bois (1868-1963) supported eugenics, but so did Ronald Reagan's favorite conservative president, Calvin Coolidge (1872-1933). Panama Canal-building and trust-busting Republican Theodore Roosevelt (1858-1919) did too, along with progressive Democrat Woodrow Wilson (1856-1924), who along with starting up the income tax and Federal Reserve, tossed leftist radicals in jail during WWI and (still carrying the weighty baggage of his Southern heritage) thought D. W. Griffith's 1915 KKK love fest, *The Birth of a Nation*, was real history. This did not extend to rejecting evolution though, as Wilson (though less of a science buff than Lincoln) greatly admired his evolution-favoring uncle, James Woodrow. Wilson issued an explicitly pro-evolution statement in the early 1920s after one of his former students resigned as superintendent of schools in Santa Fe, New Mexico rather than succumb to the antievolutionist tide, a little known incident explored by Branch (2014f,h,j,l-m,p).

Given such a mixed historical bag, how exactly should one rank Holmes' eugenics beliefs or the *Buck v. Bell* ruling and its effects compared to the ethical spectacle of the Christian antievolutionist Ku Klux Klan brazenly marching down Pennsylvania Avenue in the 1920s or far too many racists lynching far too many blacks in the South all the way into the 1960s? It would have been instructive to see Renick try to detect even the slightest whiff of "Darwinism" or "secular religion" motivation in any of their escapades.