The Evolution of Darwin's Evolutionary Thinking

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Abstract

(1) Darwin inherited Lyell's methodology and applied it to the animate beings. This led him, eventually, to the principle of natural selection. This principle enabled him to expel God from biology.
(2) Darwin diverged from Lyell on Man and Morality, presumably because of his experience in Tierra del Fuego. This led him to the thesis of continuity of man and animals, and he noticed the function of morality.
(3) The process of Darwin's theory construction may be likened to gradual evolution. Each element of his theory, by itself, is not revolutionary. But taken together and combined, these elements produced a revolutionary change.

1. Darwin Indoctrinated by Lyell

All Darwin scholars agree that Darwin was profoundly influenced by Lyell's geology. But, more specifically, what, and how, does Darwin owe to Lyell? In order to answer this question, you have got to go through Lyell's three volumes of *Principles of Geology*. Fortunately, James Secord has done a great service for us, by editing these volumes into a compact one volume from Penguin Classics (1997). This is sufficient for our references.

As is well known, Darwin encountered Lyell's *Principles*, just when he started his voyage on the Beagle. Captain FitzRoy gave him the first volume of that book. By the time Darwin landed (Jan. 1832) on the Island of St. Jago (one of the Cape Verde group), he must have read a substantial portion of the first volume. He was fascinated by Lyell's methodology of geology, because it was quite in conformity with John

Herschel's scientific methodology, which impressed him in the last year of Cambridge. In order to practice good science, you've got to find a "vera causa" (true cause) which is known to exist in nature and can explain, systematically, various phenomena. Lyell insisted on the same methodology, and he seemed to have succeeded in explaining many past geological changes in terms of the causes that are in action *now*, on the present earth.

The Lyellian methodology consisted of three rules. (1) The laws of nature must be assumed to be *invariable over time*; they are the same in the past as in the present. (2) We must explain geological phenomena *only* in terms of the causes we can see *now acting*. (3) And these causes must be assumed to be invariable even in *degree*. This is the methodology of uniformitarianism, and it generally supports *gradualism* that geological changes are accumulated gradually during a long lapse of time.

More specifically, Lyell mentioned two kinds of causes, (1) Aqueous Causes (the power of water) and (2) Igneous Causes (the power of fire). Aqueous causes are actions by rivers, torrents, springs, currents, tides, and so on. Igneous causes can be seen in actions of volcanoes and earthquakes; these may uplift a portion of land, and sink another portion. And it must be emphasized that these two kinds of cause can be continually observed *now* on the earth. Lyell is saying that any past changes on the earth must be explained in terms of these causes, acting and accumulating for a long time.

With this doctrine in mind, Darwin landed on St. Jago, and he noticed an interesting feature of the land. He found a horizontal white band in the face of sea cliff, and it was running for several miles at the height of about 45 feet above the water (see the color plate 3 in Burkhardt 2008). When he examined this band, it was a stratum of numerous shells, and the same kinds of shells were found to be still living on the neighboring coast. What

does this mean?

Darwin found that the Lyell's method works beautifully in this case. These shells must have been lying on ancient volcanic rocks in the bottom of the sea. Then, at some time, these shells were covered by a stream of basalt by some volcanic action. Later, the bottom of the sea began to rise, according to some igneous causes. So far, igneous causes can provide a good explanation. Then, a long time elapsed, and the elevated stratum has been eroded by the actions of water, aqueous causes. Along the coast of the island, then, the cliffs show their structure in the face. Thus the white band can be perfectly explained in terms of the Lyellian causes, igneous and aqueous.

2. Darwin's Geological Accomplishments

Encouraged by this experience, Darwin began to geologize in terms of Lyell's method, throughout his voyage on the Beagle. The results were impressive. He examined the east coast of South America, in particular Patagonia, then the west coast of the South America, and finally the Andes, great chains of high mountains. In each of these examinations Lyell's method worked well.

In Patagonia, Darwin found the formation of Patagonia is geologically new, belonging to Tertiary period. A lot of shells contained in the deposit show this. The plains of Patagonia were made from thick deposits of round pebbles embedded in mud and sand, from the coast to the foot of the Andes. This means, according to Lyell's geology, that these pebbles were transported by rivers (action of water) from the mountains into the bottom of the sea, and they formed a thick bed there. Then, long after, this bed was gradually raised (action of fire, igneous cause). The formation is, geologically speaking, relatively new, but still it must have taken a long time.

In the west coast, Darwin saw a volcanic eruption, and afterward experienced a big earthquake. The Beagle visited the city of Conception, and Darwin saw that "the whole coast" was "strewed over with timber and furniture as if a thousand ships had been wrecked"; that was the effect of great waves caused by the earthquake. And Darwin witnessed not only the great destructive force of the earthquake, throwing down almost all buildings in Conception, but also the constructive force, raising the coast nearly one meter. Just as Lyell pointed out, the igneous cause related with earthquakes can raise the land, even to the height of Andes, if repeated many times in a long span of time. For Darwin observed that many shells were deposited at the height of 400 meters in the neighborhood of Valparaiso. Thus Darwin was convinced of the validity of Lyell's geology.

With this frame of mind, Darwin started his expedition across the Andes in the middle of March, 1835, from Santiago (Chile) to Mendoza (Argentina), and back again to Santiago. He observed that both sides of the Andes, the east side and the west side showed the similar structure. That is, the eroded face of the mountains on both sides, exhibited a number of strata consisting of pebbles and sand, which must have been formed at the bottom of the sea and then gradually raised up to the present height. The formation of the Andes must have been gradual, on this evidence.

And, finally, the highlight of the expedition appeared on Darwin's way from Mendoza back to Santiago. He followed the Uspallata pass, and noticed that the range on the way had a curious structure, various kinds of submarine lava alternating with volcanic sand and other deposits. Then, at the height of about 2100 meters, he found a small forest of petrified trees, shining white. After the moment of surprise, Darwin figured out the story how this forest appeared in the range. These trees were once alive on

the shore of Atlantic. But they sunk into the depth of the ocean, and gradually covered by thick sedimentary beds, and afterward covered again by enormous streams of submarine lava. Then the whole strata began to rise because of some igneous cause. In this process, the pile of the strata had been intersected by many wide valleys, the covering lava broken up, and the forest, now petrified, appeared again in the Uspallata range!

In this way, Darwin inherited Lyell's methodology of geology, and accumulated his own theorizing. He was thoroughly convinced that the Lyellian gradualism and uniformitarianism worked well. Darwin's later work on coral reefs also belong to this group, but we will skip it.

3. Lyell Raised the Question of Extinction and Origin of Species

Lyell's influence on Darwin is not confined to geology. In Chapter 9 of the first volume of *Principles of Geology*, Lyell stated his objections to the progressionism: the theory that asserts, on the evidence of geological records, that there was a progress in the organic beings, from lower to higher, from simpler to more complex. This doctrine does not mean transmutationism that lower animals changed into higher animals. It simply says that lower animals in one era were replaced by higher animals in later era, so that this doctrine can be consistent with the Design of God.

In addition, in the second volume of *Principles of Geology*, which Darwin obtained in 1832 in Monte Video, Lyell examined Lamarck's theory of transmutation (evolution), and forcefully argued against it, that we have no evidence for supposing indefinite variability of a species. Thus we may infer that Darwin became quite familiar with the standard objections to progressionism and to transmutationism, thanks to Lyell's books, while he was traveling South America.

Further, Lyell's second volume must have exerted a far more important

influence on Darwin's evolutionary thinking. For, from chapter 5 to chapter 7, Lyell consideres the laws which regulate geographical distribution of species. This is a quite natural step for extending his methodology to the problem of species, organic beings, in addition to inorganic changes on the surface of the earth.

Now, to make a long story very short, let me say this much about Lyell's consideration on the *extinction* of species. This subject is, of course, very closely related with Darwin's later evolutionary thinking. Lyell spends *four* chapters for this subject (chh.8 –11). He argues that geographical changes affect the organic beings living in a particular area; he also points out that the population of a species may be greatly affected by *other species* living in the same place or related places. These are the causal factors that we can observe on the present earth. He then concludes: "the successive extinction of animals and plants may be part of the constant and regular course of nature" (Secord 1997, 294). Thus Lyell was clearly aware of the implication of his geological uniformitarianism as regards the problem of extinction.

Lyell went even a step further than this. After this conclusion, he raises a new question: Is it also a part of the economy of nature that new species are introduced from time to time? (Secord 1997, 294) Lyell eventually evades this question by saying that to assume that our limited intelligence can handle such difficult problems should be out of question. However, we may suspect that Darwin was impressed by this implication of uniformitarianism as to the question of species. Lyell in effect suggested two kinds of the distribution of species: (1) the distribution over space (geographical), and (2) the distribution over time (extinction and replacement by other species). If the former can be handled according to uniformitarianism, why not the latter? Darwin may have felt this way.

4. Darwin's Most Impressive Experience in the Voyage

So far, we have examined Lyell's influence on Darwin. However, we also have to notice that as early as January 1832, Darwin's move began to diverge from Lyell's view in some points. By far the most important experience was, as many Darwin scholars point out, that Darwin saw the wild state of Fuegians, and realized how thick the clothes of civilization were. He wrote in *the Voyage of the Beagle*: "I could not have believed how wide the difference between savage and civilized man: it is greater than between savage and domesticated animal"(2nd, ed., ch. 10, 205). This statement must be understood in comparison with Lyell's view of man.

Lyell argued against progressionism, and against Lamarck's transmutationism. Although he dwells on various objections, the real roots of his objections seem to lie in the following view: "the superiority of man depends not on those faculties and attributes which he shares in common with the inferior animals, but on his reason by which he is distinguished from them" (Secord 1997, 93). Lyell continues the argument by saying that the *moral and intellectual faculties capable of indefinite improvement*, appeared for the first time in man, and united with the animal nature. Since we can find *no* such examples in lower animals, it is inconceivable that such a great gap be explained either by progressionism or by transmutationism.

Darwin already knew Lyell's view on this point, when he saw wild Fuegians. And , if Darwin had had any sympathy to such a view, it would have been shattered by his experience with the Fuegians. For, the Fuegians must have led the same wild life thousands of years, with no improvements whatsoever! Darwin must have felt a strong suspicion to the Lyellian view.

The importance of this experience was repeated many times by Darwin himself. For example, in his letter to Caroline Darwin, written on March 10,1835, he mentioned three most impressive experiences in South America, and his experience in Tierra del Fuego comes first!

5. Natural Selection and Morality

We will now focus on the crucial period for Darwin's development, i.e., October 1838. It is now an established fact that Darwin found the principle of natural selection by reading Robert Malthus's *Essay on the Principle of Population*. However, it is not so well known that he was studying moral philosophy also, around this period. Why did he study moral philosophy, in order to develop his theory of transmutation? The answer can be suggested, I believe, by seeing closely his relationship with Lyell. Lyell gave a special status to man, because he thought morality is peculiar to man, the most distinctive feature of man. Being a dedicated disciple of Lyell, Darwin must have been unable to ignore this aspect of Lyell's thinking. That was, at least, one of the reasons why Darwin was studying moral philosophy. This is not a mere speculation on my part. I have a good evidence for saying this.

On October 2, 1838, Darwin jotted down the following remark on morality:

> Two classes of moralists: one says our rule of life is what will produce the greatest happiness.——The other says we have a moral sense.——But my view unites both & shows them to be almost identical. What has produced the greatest good or rather what was necessary for good at all is the instinctive moral senses: (& this alone explains why our moral sense points to revenge). In judging of the rule of happiness we must look far forward & to the general action---certainly because it is the result of what has generally been best for our good far back. …

> Society could not go on except for the moral sense, any more than a hive of Bees without their instincts. (Old & Useless Notes 30, Barrett et al., 1987, 609.)

The crucial point of this remark is nicely summarized in the last sentence, i.e., "Society could not go on except for the moral sense, any more than a hive of Bees without their instincts". This is a remarkable insight, and Darwin obtained it together with the principle of natural selection, as the date clearly shows. Let me explain why it is so remarkable.

To Lyell, morality was the basis of human dignity. And as many scholars have already pointed out, he thought that if there should be continuity from animals to man, it would undermine human morality. Morality was a burden for him, the last fort for human dignity. But Darwin's insight can easily remove this obstacle. He changed the perspective, and "naturalized" morality, so to speak; he changed it from a burden to a subject of natural history. How was this possible? Simply by focusing on the *function* of morality (in the struggle for survival). I believe this change of perspective was made possible, mainly because of Darwin's experience in Tierra del Fuego. Thus Darwin could compare human morality with the instincts of bees. This insight was worked out and published as the *Descent of Man*, 34 years later, and the most impressive thesis of this book is the *continuity* of man and animals.

On the other hand, the principle of natural selection became the core of his theory of evolution. And as many writers, such as Richard Dawkins and Daniel Dennett point out, this principle enabled Darwin to expel God and Teleology from biology. It enabled him to talk about "design" and "function" without supposing the "designer". This was made quite explicit by his study on orchids, *the Various Contrivances by which Orchids are Fertilised by Insects* (1862). And what is important here is that these two insights are closely *interconnected*. The concept of "function" is the

connecting link.

These two insights are the basis of Darwin's evolutionary theory. And both were obtained in October, 1838. Although he needed more years to work out and publish these insights, I believe a *new species* of biological theory was born this year.

6. The Evolution of Darwin's Evolutionary Theory

In this paper, I have emphasized a comparison of Lyell and Darwin. Darwin owes a great deal to Lyell. But by diverging from Lyell, and taking in some other elements from other sources (such as embryology), Darwin's evolutionary theory was born as a *new species*, so to speak. Thus we can talk about the evolution of Darwin's theory.

Let me review my argument. Lyell's methodology of uniformitarianism was obviously essential, because Darwin extended it to the question of species. But, this methodology, by itself, is neither quite original nor revolutionary. Because Lyell himself was practicing it, and it was well known. Lyell himself applied it to the problem of geographical distribution of species, as well as to the problem of extinction. However, Darwin came to the principle of natural selection, by combining this methodology with the analogy of artificial selection, which was also well known to many breeders. And Wallace also came to the same conclusion independently, 20 years later. Then, what is *distinctively* Darwinian? I have to conclude that it is Darwin's insight on morality. This insight was attained because Darwin diverged from Lyell's view of man, and by throwing the morality back into the natural world. Darwin changed the perspective to see morality, and focused on its function in human society.

His insight was the result of this twist. Each step, by itself, does not seem to be revolutionary. But putting everything together, in a twisted

combination, the world of living creatures, including humans, began to look so differently from the former view. This is a revolution and the birth of a new species of biological theory. But like the origin of a new species advocated by Darwin's new theory, this revolution was the result of accumulating smaller changes. Darwin seems to have practiced his gradualism in his own evolution.

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