

CHAPTER 10

DARWIN'S STONE-HOUSE ANALOGY

In early 1860 Darwin began work on *The Variation of Plants and Animals Under Domestication*, the work that provided the documentary evidence on which *The Origin* rested. His "horrid little book" gave him no small amount of grief. Due to frequent interruptions from his own and family illnesses, as well as work on his several plant projects, he did not finish it until early 1867. Interminable and laborious proof corrections followed. It was finally published in January 1868. Natural history would be such a "splendid pursuit," he moaned, "if it was all observing and no writing!" He so despaired of the book making any contribution, that in jest he advised Hooker that the best way to read his book was to "skip the *whole* of Vol. 1, except the last chapter (and that need only be skimmed) and skip largely the 2nd volume; and then you will say it is a very good book." Despite Darwin's lament, Murray did not flinch at publishing the two thick volumes Darwin delivered, and with good reason: The English public was eagerly anticipating Darwin's next major publication. The entire first printing of 1500 copies sold out a week after it was published. That lifted Darwin's spirits.¹

¹Darwin, *Autobiography*, 126-127, 129-130; Darwin to Murray, 3 January 1867, *LLCD*, 2: 242-243; Darwin to Hooker, 17 November 1867, *LLCD*, 2: 257; Darwin to Hooker, 3 February 1868, *LLCD* 2: 258; Darwin to Hooker, 10 February 1868. *LLCD*, 2: 258-259.

The two most significant parts of the book, apart from the sheer mass of supporting material designed to overwhelm readers with evidence supporting his theory, were Darwin's theory of Pangenesis, a speculative understanding of the mechanism of inheritance, and his public repudiation of Gray's harmonizing of descent and design. Darwin and his critics agreed that one of the most serious weaknesses in his theory was an adequate understanding of how the traits of the parents were passed on to their offspring. He had been mulling this problem for over twenty-six years, trying to connect a disparate collection of facts.² In brief, Darwin hypothesized that each cell threw off microscopic "gemmules" that, when gathered together, parents passed on to their progeny via reproduction to shape their individual characteristics. He believed that "the characters of the parents are 'photographed' on the child, only by means of material atoms derived from each cell in both parents, and developed in the child." Granting that it was only a speculative hypothesis, it gave him "an infinite satisfaction . . . somehow to connect the various large group of facts, which I have long considered, by an intelligible thread." Even though it might be "stillborn" and a "mad dream" today, Darwin was confident that the concept would return some time in the future under another name.³

²M. J. S. Hodge has given exhaustive attention to the origin and structure of Darwin's theory of Pangenesis in "Darwin as a Lifelong Generation Theorist," in *The Darwinian Heritage*, ed. David Kohn, 207-244.

³Darwin to Gray, 16 October 1867, GHA; Darwin to Hooker, 17 November 1867, *LLCD*, 2: 256-257; Darwin to Fritz Muller, 30 January 1868, *LLCD* 2: 257; Darwin to Hooker, 3 February 1868, *LLCD*, 2: 258; Darwin to Hooker, 23 February 1868, *LLCD* 2: 259-261; Darwin to Wallace, 27 February 1868, *LLCD*, 2: 262-263.

It was not merely as a humorous aside that Darwin referred to his theory of Pangenesis as the "great god Pan." Pangenesis not only filled a theoretical gap in Darwin's theory, it also filled a crucial metaphysical or theological gap; it was a surrogate Deity. The natural theology tradition firmly believed that only God's supernatural power could "cause" the creation of new beings. Creation of life was the "mystery of mysteries" that lay far beyond the boundaries of science and natural laws. Darwin fought this dualistic understanding that divided nature between God's actions, conceived as capricious, external, and outside of law, and the immanent regularity and continuity of natural laws. He was committed to showing that the origin of new species was as much a "lawful" event as was the revolution of the planets; neither required an interfering Deity to "cause" their existence. Pangenesis filled this gap by showing how the generation of offspring, their inheritance of parental characteristics, and their inevitable variations were purely natural occurrences following regular laws of reproduction and inheritance. It would eliminate "such vague terms as spermatic force, the vivification of the ovule, sexual potentiality, and the diffusion of mysterious essences or properties from either parent, or from both, to the child."⁴ Once adopted, Pangenesis would eliminate the need for God's interference as much in the origin of variations and species as in the creation of individuals. Those proponents of design, like Asa Gray, who also applauded the extension of natural laws, would no longer be

⁴Darwin, "Author's Preface to the American Edition," *The Variation of Animals and Plants Under Domestication*, 2 vols. (New York: Orange Judd & Co., 1868).

able to call upon God to explain the mystery of mysteries.⁵

Ever since he first tangled with Gray in 1860 on the implications of his theory for the argument from design, Darwin had been turning over in his mind the best way to answer Gray's strategy of harmonizing descent and design. By June he had already sketched out the basic metaphor and its analogies that he would eventually use at the conclusion of *Variation* and passed it on to Hooker and Lyell for evaluation.

The following metaphor gives a good view of my notion of relative importance of Variability & Selection. -- Squared stones, bricks or timbers are indispensable for construction of a building; & their Nature will to certain extent influence character of building, but selection I look at, as the architect; & in admiring a well-contrived or splendid building one speaks of the architect alone & not of the brick-maker.⁶

Darwin was intent on shifting the focus away from the source of the building materials and their variations and concentrating instead on the uses to which those materials were put. Just as one praises the architect rather than the brick-maker, one should also concentrate on the role of Selection in working on existing variations rather than the source of the variations.

Lyell was unimpressed and disputed the validity of the analogy between the architect and Selection.

Your comparison of Selection to the Architect -- variations to the stones, is what I deduced from some passages but cannot accept. The architect who plans beforehand & executes his thoughts & invents the Corinthian & other styles of architecture & then by means of machinery, living & inanimate, cranes & horses & even sometimes intelligent men (foreman allowed some discretion & power of

⁵Darwin to Wallace, 27 February 1867, *LLCD*, 2: 262-263. I am indebted to Neil Gillespie for this basic insight, *Charles Darwin and the Problem of Creation*, 122-123.

⁶Darwin to Hooker, 12 June 1860, *CCD* 8: 251-252.

choosing) such an architect must not be confounded in his functions with the humble office of the most sagacious of breeders. As I have said all along it is the deification of Natural Selection.⁷

The more that Lyell delved into the multiple skills, flashes of insight, and inventive genius an architect needed to plan and execute his buildings, the more incongruous it seemed to him that an architect could in any way be "confounded in his functions with the humble office of the most sagacious of breeders."

Darwin shot back that Lyell had missed his main point. After all, "the very existence of the human architect shows the existence of more general laws; but no one in giving credit for a building to a human architect, thinks it necessary to refer to the laws by which man has appeared" any more than astronomers feel the need to refer gravity to God in describing the revolution of the planets. He simply could not see that God interfered any more in the "construction of species, than in the course of planets," despite the belief of "Paley & Co. . . . that this more special interference is thought necessary." It was perfectly legitimate, from Darwin's perspective, for God to be in the background, in the same way that the brick-maker was in the background, but God's presence was as irrelevant in discussing how Natural Selection used variations to construct an well-adapted organism as it was to bring in the brick-maker when determining how the architect used his materials to construct his house.⁸

Three years later Darwin tightened up the focus of his metaphor. He observed to Gray, almost in passing, that he was working on a metaphor for *Variation* that

⁷Darwin to Lyell, 14 June 1860, *CCD* 8: 254-255.

⁸Darwin to Lyell, 17 June 1860, *CCD* 8: 258.

compared "variation to the shapes of stones fallen from a cliff. & natural or artificial selection to the architect," though, in mock self-modesty, he doubted whether it would come to much since he lacked Gray's facility with metaphors.⁹ He gave it more color in writing to Patrick Matthew. "Fragments of rock fallen from a lofty precipice assume an infinitude of shapes -- these shapes being due to the nature of the rock, the law of gravity &c., -- by merely selecting the well-shaped stones & rejecting the ill-shaped an architect (called Nat. Selection) could make many and various noble buildings."¹⁰ Darwin wanted to make it clear that, though there were obviously many general laws that were involved in creating the various shapes of the fallen stones (variations), these laws were irrelevant in understanding the role that the architect (Selection) played in choosing only the "fittest" stones (adaptations) with which to build a house (organism).

As he put the finishing touches on the last chapter of *Variations* Darwin was ready to roll out the final version of his metaphor that would clarify his understanding of God's role in forming organisms. Though he dreaded discussing the topic, he "thought it shabby to evade the question" since so many had offered their own interpretations on what he meant and others had personally inquired about Darwin's thoughts. The impression of his orthodoxy that he had carefully orchestrated by advertising Gray's pamphlet in the *Origin's* third edition must finally and publicly be

⁹Darwin to Gray, 4 August 1863, GHA.

¹⁰Darwin to Matthew, 21 November 1863, de Beer, "Some Unpublished Letters of Charles Darwin,"

denied. "I finish my book," he informed Gray, "with the semi-theological paragraph, in which I quote and differ from you; what you will think of it, I know not."¹¹

Darwin had given the concluding section of *Variation* considerable thought over the past eight years. His inability to privately persuade Gray of the legitimacy of his objections to the harmony of descent and the received view of design compelled him to publicly clarify, as best as he could, his own "muddle" over the question. It was no longer possible to welcome the harmonizers into the Darwinian camp; they must choose one or the other. To do that with as much tact as possible, while still laying out his objections to the conventional understanding of God's role in forming new organisms, required far more than a "single paragraph" in a "little space."

He would tell his readers yet another compelling story. Just as he ended *Origin* with the myth of the "tangled bank" to summarize the creative power of the many organic laws he had discovered, so he would conclude *Variation* with a vision of the amazing power of natural selection working on simple variations to create the beautifully adapted organisms that surround us.

In accordance with the views maintained by me in this work and elsewhere, not only the various domestic races, but the most distinct genera and orders within the same great class, -- for instance, whales, mice, birds, and fishes -- are all the descendants of one common progenitor, and we must admit that the whole vast amount of difference between these forms of life has primarily arisen from simple variability. To consider the subject under this point of view is enough to strike one dumb with amazement. But our amazement ought to be lessened when we reflect that beings, almost infinite in number, during an almost infinite lapse of time, have often had their whole organization rendered in some degree plastic, and that each modification of structure which was in any way beneficial under

¹¹Darwin to Hooker, 8 February 1867, *LLCD*, 2: 245; Darwin to Gray, 16 October 1867, *GHA*.

excessively complex conditions of life, will have been preserved, whilst each which was in any way injurious will have been rigorously destroyed. And the long-continued accumulation of beneficial variations will infallibly lead to structures as diversified, as beautifully adapted for various purposes, and as excellently co-ordinated, as we see in the animals and plants all around us. Hence I have spoken of selection as the paramount power, whether applied by man to the formation of domestic breeds, or by nature to the production of species.¹²

Here was Darwin's final answer to Gray's attempt to harmonize descent and design. In his cosmic vision Natural Selection had "infallibly" created the most "diverse," "beautifully adapted" and "excellently co-ordinated" structures "in the animals and plants all around us." There was design in these breath-taking structures, but it was the *result* of "the long continued accumulation of beneficial variations," not preordained by God.

To drive home his point, Darwin introduced the stone-house metaphor he had been carefully crafting for the past eight years.¹³ Since it culminates his extensive consideration of descent and design, this metaphor bears careful study.

¹²Charles Darwin, *The Variation of Plants and Animals under Domestication* (New York: Orange Judd & Co., 1868), 2: 513-514.

¹³Few modern commentators seem to have recognized the importance of Darwin's metaphor and his commentary. James Moore declared that this metaphor is so "crucial . . . for understanding the difference between Darwin and the Christian Darwinians that we reproduce it at length." Apparently he believed that the extract would speak for itself for he offered no commentary on it. *The Post-Darwinian Controversies*, 275-276. Moore and Desmond devote two short paragraphs to it in *Darwin*, 543-544. L. E. Hicks examined this metaphor in *A Critique of Design Arguments*, 314-319, and concluded that the difference between Gray and Darwin on the role of design came down to an "infelicity of expression" in Gray's metaphor of "variation being led along beneficial lines." In truth, Darwin believed that *progress*, not variation, had been led along useful lines by natural selection. George F. Wright discussed it at great length in *Studies in Science and Religion* (Andover: Warren F. Draper, 1882), 196-205, though his confidence in Gray's perspective remained unshaken. Edward Manier briefly considers its relevance to Darwin's understanding of "chance" in *The Young Darwin and His Cultural Circle*, 117-118.

If an architect were to rear a noble and commodious edifice, without the use of cut stones, by selecting from the fragments at the base of a precipice wedge-formed stones for his arches, elongated stones for his lintels, and flat stones for his roof, we should admire his skill and regard him as the paramount power. Now, the fragments of stone, though indispensable to the architect, bear to the edifice built by him the same relation which the fluctuating variations of each organic being bear to the varied and admirable structures ultimately acquired by its modified descendants.¹⁴

Darwin built his metaphor on the analogy between the architect choosing stones to build a house and Selection choosing variations to ensure the survival of organisms. His basic analogy was architect : stones : house :: Natural Selection : variations : organic structure. This was but a minor variation of his original analogy between artificial and natural selection. What seemed so straight-forward was actually an intricate construction based on several important and debatable assumptions.

Throughout his long challenge to the design argument and the "ordinary" view of creation Darwin challenged the notion that God "interfered" in the process of speciation and stressed over and over again how new species arose from the operation of many organic processes. To establish this point Darwin turned to the much more familiar process of rocks fragmenting on the grounds that rocks fragmenting were analogous to organisms varying. The rock cliff fragmented, Darwin later maintained, as it was subjected to the operation of "a long sequence of events, all obeying natural laws; on the nature of the rock, on the lines of deposition or cleavage, on the form of the mountain, which depends on its upheaval and subsequent denudation, and lastly on the storm or earthquake which throws down the fragments." The fragments were not

¹⁴*Variation*, 514.

caused by God "interfering" in these processes by carving each individual stone in order that it was be used for a particular purpose by the architect; their fracturing and falling resulted from continuously operating natural forces and processes. So far, so good. He should have stayed with this important understanding of how the rock fragments were formed.

As it was, Darwin blundered badly in establishing his analogy between the architect and Selection. Passing by the difficulty of establishing a fruitful analogy between a living person and an admittedly metaphorical expression, there is a more substantive problem. Darwin had gone to great lengths in the third edition (1861) of the *Origin* to answer the frequent charge that he had deified Natural Selection. Recall that Lyell had curtly dismissed Darwin's initial draft of his stone-house analogy for precisely this reason. In the third edition Darwin argued that "every one knows what is meant and is implied by such metaphorical expressions; and they are almost necessary for brevity. So again it is difficult to avoid personifying the word Nature; *but I mean by Nature, only the aggregate action and product of many natural laws, and by laws the sequence of events as ascertained by us.*"¹⁵ How Darwin explained his meaning of "Nature" shows that he understood Nature, and by implication, Natural Selection, to be a shorthand term that covered all of the many natural processes and laws that shaped an organism's conditions of life. His subsequent imaginary scenario of how climatic changes dramatically altered the conditions of living things in the

¹⁵Peckham, 165; third edition, 14. Italics mine.

Origin made this clear. Thus, Darwin meant to say that those variations were preserved that enabled an organism to survive against the pressures of many natural processes that shaped its conditions of life. He had earlier admitted to Harvey that it might have been more accurate to speak of natural *preservation* rather than *selection*, since he was concerned with the *results* or effects, not *causes* at all, but the phrase was already let loose. Darwin should have made this substitution; it would have saved him from the fallacy of attributing agency to a metaphorical expression.

If Darwin meant by Natural Selection "the aggregate action and product of many natural laws," then the proper analogy would be between the natural processes and laws that were the occasion for the stones fragmenting and the natural processes and laws (i.e. Natural Selection) that were the occasion for preserving those variations that enabled an organism to survive. Natural Selection, then, answered not to the architect, but to the many natural processes and laws he had discovered that, in some way, shaped the conditions of organic life to which organisms responded. He should have said that knowing the operation of natural laws was as essential in explaining how stones fragmented as it was in explaining how adaptive variations were preserved. Few, certainly not Gray, would have found this a controversial claim.

With this more properly constructed analogy Darwin did not need his architect or the house at all to make his point. Or did he? He needed the exquisitely designed house to answer to the exquisitely constructed organism, and he needed agents to construct both. His problem was that there was not a straight causal line from the fragmenting stones to the house, without an intervening agent, as there supposedly

was from the varying organisms to their adaptive structures. There simply was no proper analogy between the "construction" of a house and the "construction" of an organism without begging the question of how organisms were "constructed." A more fitting analogy would have been for some of the numerous fractured rocks to have formed an exquisite house at the bottom of the cliff in the same way that only a few of the numerous variations enabled an organism to survive in its competition to live. This house would have to be far more beautiful than anything humans had constructed in the same way that organisms in the wild were more wondrously adapted, on Darwin's reading, than those that domestic breeders had created. He could then have shown the savage how the falling stones had formed a wonderful house for he and his family and encouraged him to compare the formation of the house to the formation of living organisms. No doubt the savage would have been impressed.

Without the beautiful house constructed of stone fragments Darwin's metaphor was doomed. While it is conceivable that some rocks at the base of the cliff could form some sort of habitation for humans, or more likely animals, there is a *prima facie* case against it being of the kind that humans would prefer. Only a human agent, with skill and foresight, could design and execute that kind of structure. But Darwin's explanation for the "almost perfect" adaptations in organisms could not be based on any agent, divine or metaphorical; the adaptations had to be formed only as organism's responded to countless and unyielding natural forces. All he really needed to say was that adaptive structures originated in response to its conditions of life in the same way that mountains originated in response to enormous pressures building up in

the earth's interior. In fact, looking for the "causes" of variation and adaptations led Darwin down the wrong track searching for agents responsible for initiating them. Darwin, it seems, tripped over his own anthropomorphic expression.

Darwin was misled at the beginning of his investigation of domestic breeding by taking the breeder himself as the base of the analogy and then searching for the analogue of the breeder in the state of nature. This compelled him to find some agent who "did" something to organisms in their natural state to adapt them to their conditions of life in the same way that breeders "did" something to modify plants and animals to suit their pleasure. This is what led him to construct the mythical Sagacious Being in his earlier essays who could, with unlimited time and unlimited resources, create new species *ad infinitum*. Darwin's attraction to an agent "doing" something in nature to "create" well-adapted creatures had a pernicious influence on his thinking. He should have been far more vigilant in resisting the temptation to attribute agency to natural forces, processes, and laws and describing them in the active voice.

Darwin was on the right track in specifying the innumerable forces and processes that comprised an organism's conditions of life. Those forces held universally for all creatures, whether wild or domestic, and were impressed on them continually in the same way that gravity is *continually* impressed on all objects in the universe. To say that an animal starved, for example, is to simply note that it failed to find food sufficient to sustain its life, for whatever reason. We do not search for an agent that "caused" the animal to starve; starvation is the term we give to the

failure of organisms to be properly fed. Natural Selection, even metaphorically, did not "cause" animals to die or adapt. Darwin's claim was that organisms were inescapably compelled to adapt themselves to their conditions of life or die.

What Darwin seemed to have missed was that breeders, in fact, *interfered* in the natural outworking of these forces and processes to shape and mold creatures; they *resisted* those forces and processes and *redirected* them to serve humanly contrived purposes rather than those that creatures naturally pursued. The breeders did not "cause" new varieties to exist; new varieties were the result of their using the practical wisdom on breeding that had been built up over centuries to modify existing species. Natural Selection was not a *vera causa* in the Herschelian meaning of the term. Darwin, thus, did not have to find a natural analogue of the domestic breeder; he simply needed to fully understand the myriad natural processes to which all organic phenomena were subject.

Though his metaphor was seriously weakened without an architect or house, Darwin continued to make a number of important points that bear more directly on God's relationship to variations. Natural theologians had claimed that God, as the true Efficient Cause, had initially brought each of the numerous organic variations Darwin had documented into existence and guided their roles in all facets of life. The cause of variation thus lay shrouded in the "mystery of mysteries," invisible to empirical inquiry and beyond the reach of natural law. Consequently, Darwin's theory of natural selection was redundant and explained nothing; God, after all, had designed and guided each variation, from origin to final adaptation in the organism's

life.

Darwin addressed these claims with a series of inter-related analogies to *illustrate* the explanatory role of natural selection.

Some authors have declared that natural selection explains nothing, unless the precise cause of each slight individual difference be made clear. If it were explained to a savage utterly ignorant of the art of building, how the edifice had been raised stone upon stone, and why wedge-formed fragments were used for the arches, flat stones for the roof, &c.; and if the use of each part and of the whole building were pointed out, it would be unreasonable if he declared that nothing had been made clear to him, because the precise cause of the shape of each fragment could not be told. But this is a nearly parallel case with the objection that selection explains nothing, because we know not the cause of each individual difference in the structure of each being.¹⁶

Darwin's defensiveness is palpable in this section. The point he made in his story is that praise for the architect's genius in picking and choosing just the right stones to construct his building was justified, even though he was not responsible for the shapes of the stones, in the same way that praise for the way that Selection picked and chose just the right variations that contributed to the survival of the organism was justified, even though Selection was not responsible for the variations themselves. This rested on the analogy between the countless unknown(able) "causes" of the numerous stone fragments and the countless unknown(able) "causes" of the numerous variations.

He was counting on the fact that people actually did praise architects for the *uses* they made of materials in their buildings, not their *manufacture*. Surely even a savage would understand something new when informed of the ways in which the architect had used those stones to build his house. In the same way, Darwin was

¹⁶*Ibid.*

saying that simply because he was unable to explain the origin of variations ought not detract from the worthwhile insight that Natural Selection gave into the ways in which certain variations were preserved. Even without his basic analogy between Selection and the architect, Gray and natural theologians would grant Darwin his point.

Darwin next tackled the enigma of the relationship between "accidental" and "law" in understanding natural selection. The natural theologians had laid great stress on the fact that there were only two ontological explanations possible for explaining events in the cosmos: either they were caused by chance or by Divine design. Darwin's theory of Natural Selection, they charged, resurrected the ancient Epicurean heresy of attributing all events to "mere" or "pure" chance. But such an explanation was absurd. The only rational alternative was Divine design, which was most clearly seen in the uniformity of natural laws. As we have seen, Darwin wrestled with this conundrum all of his adult life. On the one hand, he firmly believed that all events were subject to (or shaped by?--Darwin could never make up his mind which it was) natural laws, even the origin of variations. He could thus agree with the natural theologians on the importance of universal laws. On the other hand, he was equally committed to the belief that out of the countless variations that actually occurred only those that aided the organism's survival were preserved and perpetuated. Thus, there was some "chance" or "accidental" element involved. How, then, to reconcile "accidental" and "law"?

Darwin offered the following commentary on how we ought to understand the source of the rock fragments used in the building.

The shape of the fragments of stone at the base of our precipice may be called accidental, but this is not strictly correct; for the shape of each depends on a long sequence of events, all obeying natural laws; on the nature of the rock, on the lines of deposition or cleavage, on the form of the mountain, which depends on its upheaval and subsequent denudation, and lastly on the storm or earthquake which throws down the fragments. But in regard to the use to which the fragments may be put, their shape may be strictly said to be accidental.¹⁷

Here Darwin assumed that the fragments of stone bore the same "accidental" relationship to their subsequent uses by the architect in the finished building as the "accidental" variations bore to their uses by Natural Selection in the admirable organic structures. In what sense were the fragments "lawful" and in what sense were they "accidental"? Darwin contended that the fragmentation of the rocks was a lawful process, comprising innumerable physical forces. That the rocks fragmented was lawful; that *this* rock assumed *this* shape when it fragmented rather than another shape could not be predicted or determined beforehand and, thus, was accidental. The physical forces to which the rock cliff was subjected operated universally and uniformly; how the rock cliff would fracture when subjected to those forces could not be predicted or determined and, therefore, "accidental."

Darwin was struggling to break free from the false choice between "law" and "accident" and articulate the valid distinction between the universally prevailing physical forces to which the rock was subjected and the unique contingencies of how *this* rock face fractured. "Accidental" referred to the responses of the rock to the universal "law" of numerous physical forces. The inherited language of chance,

¹⁷*Variation*, 515.

accident, and law deprived Darwin of the ability to properly articulate this crucial distinction.

The rocks were "accidental" in a second important sense for Darwin. He said that the sizes and shapes of the rocks were "accidental" in terms of their subsequent architectural uses. By this he meant that the use of the rocks in building a house could not, in retrospect, be taken as the final cause or reason for the rocks fracturing and falling down the cliff. These were two independent questions. After all, the rocks could have been used for countless other purposes, from weapons of war to art objects to animal shelters. It was a fallacy, Darwin warned, to argue that the use to which an object were put must have been the cause or reason that it was formed in the first place. Thus, natural theologians could not use final causes, even if they could discover what they were, as an explanation for the current use to which variations were put by humans, plants, or animals. It was simply not meaningful, Darwin argued, for natural theologians to say that God *designed this* variation, out of an innumerable number, for *this* use in an organism's structure rather than *that* variation for *that* purpose. This simply reiterated the point he had made in his earlier discussion with Gray that pigeon breeders themselves chose particular variations, out of innumerable ones possible, in their birds to satisfy their own whims. Thus, it was meaningless to say that God had "designed" only those variations actually chosen.

How then did Darwin understand the role of God in the architect's subsequent use of those rocks in his building?

And here we are led to face a great difficulty, in alluding to which I am aware

that I am traveling beyond my proper province. An omniscient Creator must have foreseen every consequence which results from the laws imposed by Him. But can it be reasonably maintained that the Creator intentionally ordered, if we use the words in any ordinary sense, that certain fragments of rock should assume certain shapes so that the builder might erect his edifice?¹⁸

The architect discovered the rocks and found creative ways to use some of them in constructing his building and abandoned the others. But he would be wrong, Darwin maintained, in claiming that God had meticulously designed the size and shape of each rock fragment so that he could use it exclusively for building his house. Even if we granted him this explanation, Darwin wondered, would the architect also say that God had "designed" the mass of rocks that he did not use? This was the identical question he and Gray had first debated in 1860. It was just as foolish to declare that God had "designed" the death of this gnat by a hungry bird or that death of a person by lightening as it was to say that God had "intentionally ordered . . . that certain fragments of rock should assume certain shapes *so that* (italics mine) the builder might erect his edifice." God had established the universal physical conditions to which rocks were subjected. How *this* particular rock would react to those conditions was unknown *a priori*; its fracture was contingent on the intersection of innumerable physical forces, all operating lawfully. The architect who wanted to understand why these rocks had these particular sizes and shapes would do well to investigate those physical forces rather than declare that God had specially designed each stone for his use in the building.

¹⁸Ibid.

Darwin was pressing a valid point here. Presumably his natural theological readers would never think to say that God had specially designed each individual stone lying in a heap at the base of a cliff for the express use of an architect for building. They would not say that God personally cradled each fragment and gently placed it at the bottom of the cliff; they would more likely explain how the rocks got to the bottom of the cliff by appealing to various geological forces. Darwin maintained that even though "an omniscient Creator must have foreseen every consequence which results from the laws imposed by Him," such *foreknowledge* was not the *cause* of each contingency or the *uses* to which they would be put. God *foresaw* that the rockface would fracture when subjected to certain physical forces that were themselves created by Him, that fragments of various sizes would fall down into a heap, and that an architect would subsequently use them for his building, but we could not say that God *designed* each fragment for its subsequent use. Darwin was distinguishing between God's universal natural laws and the contingent characteristics of how organisms responded to them. On Darwin's reading, we could only say that God had *designed* each fragment through an anthropomorphic fallacy of attributing the same actions to God as we attribute to humans.

If his readers followed him thus far, Darwin contended, they surely understood God's relationship to variations and their subsequent use by organisms in the same way.

If the various laws which have determined the shape of each fragment were not predetermined for the builder's sake, can it be maintained with any greater probability that He specially ordained for the sake of the breeder each of the

innumerable variations in our domestic animals and plants; -- many of these variations being of no service to man, and not beneficial, far more often injurious, to the creatures themselves? Did He ordain that the crop and tail-feathers of the pigeon should vary in order that the fancier might make his grotesque pouter and fantail breeds? Did He cause the frame and mental qualities of the dog to vary in order that a breed might be formed of indomitable ferocity, with jaws fitted to pin down the bull for man's brutal sport?¹⁹

God's relationship to the fragments at the base of the precipice and their subsequent use by the architect was exactly parallel to God's relationship to variations and their subsequent use by the organism. God no more "intervened" in the natural conditions of life to chisel out each individual stone for the architect's use than God "intervened" in the natural conditions of life to create each individual variation for the organism's use. It demeaned God to say that He "specially ordained" every variation, whether those that were neither useful to humans nor beneficial to the creature, or those variations that pleased the capricious, and even brutal, whims of breeders. It was domestic breeders, not God, who used the variability of plants and animals for their own designs.

Here Darwin reached the crescendo of his argument against the "ordinary" view of creation. The "if, then" logic of his claims pressed his opponents to the wall of inconsistency.

But if we give up the principle in one case, -- if we do not admit that the variations of the primeval dog were intentionally guided in order that the greyhound, for instance, that perfect image of symmetry and vigour, might be formed, -- no shadow of reason can be assigned for the belief that variations, alike in nature and the result of the same general laws, which have been the groundwork through natural selection of the formation of the most perfectly

¹⁹Ibid.

adapted animals in the world, man included, were intentionally and specially guided.²⁰

The conclusion was inescapable: once cast doubt on whether God designed each and every variation that breeders had exploited for their own purposes, whether actually beneficial or harmful, there was no reason to believe that God designed each variation in nature.

It was finally time to dispute Gray's attempt to reconcile descent and design by saying that "variation had been led along certain beneficial lines." Darwin countered this claim by pressing Gray on its implications, ones that he knew Gray did not truly believe.

If we assume that each particular variation was from the beginning of all time preordained, then that plasticity of organisation, which leads to many injurious deviations of structure, as well as the redundant power of reproduction which inevitably leads to a struggle for existence, and, as a consequence, to the natural selection or survival of the fittest, must appear to us superfluous laws of nature.²¹

Gray faced a stark choice: abandon either the notion of "preordained variations" or the search for any natural laws that shaped organic life. The two were incompatible. For too long Gray had substituted God's design of each individual variation for a deeper and broader inquiry into the many laws of nature that governed organic life.

Yet not even Darwin was comfortable with this either/or choice. As much as he had tried to clarify his "muddle" over God's relationship to variations, he still felt the tug of belief that "an omnipotent and omniscient Creator ordains everything and

²⁰*Variation*, 515-16.

²¹*Variation*, 516.

forsees everything." How, finally, ought he to understand the Creator's relationship to the contingencies in the world? Echoing a remark he repeated in his earlier discussions with Gray, Darwin concluded that such a view "brought [us] face to face with a difficulty as insoluble as is that of free will and predestination."²²

By early fall 1867 E. L. Godkin had already requested Gray to review Darwin's forthcoming book in *The Nation*. Darwin was delighted that Gray would be reviewing it, but was somewhat apprehensive about it being reviewed in a "newspaper" rather than a proper scientific journal, but no matter. He was particularly curious about what Gray would think of his theory of Pangenesis and his "semi-theological" conclusion. He sent Gray the corrected sheets of *Variation* as soon as they were available. By the end of February Gray had plowed through both volumes and had even prepared a short talk on Pangenesis to the Cambridge Scientific Club to chide Bowen and Agassiz for their views on inheritance. While finishing his review Gray finalized plans for the New York firm of Orange Judd to publish an American edition of *Variation*.²³

Gray commended *Variation* as a treasure trove of facts concerning domesticated animals and cultivated plants that would particularly appeal to practical agricultural men. Though Darwin was well-known for his theory based on these

²²Ibid.

²³Gray to Darwin, 17 September 1867, APS; Darwin to Gray, 16 October 1867, GHA; Gray to Darwin, 18 November 1867, GHA typescript; Gray to Darwin, 14 January 1868, GHA typescript; Gray to Darwin, 24 February 1868, GHA typescript.

facts, Gray assured his readers that they could rely on Darwin's "rare ability, acuteness, and impartiality" in handling them regardless of their final verdict on the validity of his theory.²⁴ Gray concluded that after most readers had considered all of the facts Darwin brought forward in support of this theory of natural selection, they would still doubt whether natural selection could explain all of the facts bearing on the variation of domestic plants and animals. "Most naturalists--perhaps we should say most natural philosophers--appear to acknowledge natural selection as a *vera causa*, although few are convinced of its sufficiency, unaided, for the whole work which Mr. Darwin assigns it." Enlarging on a point he had made in his earlier review of De Candolle, Gray distinguished between the majority belief in some kind of derivative hypothesis, such as those believed by Pictet, Heer, De Candolle, and Owen, and Darwin's particular version of natural selection. Gray contended that this much larger group believed "that a species of the same genus, inhabiting the same or even more widely separated regions, are likely to have had a common origin, and, equally, that the plants and animals by which we are now surrounded are the modified representatives and descendants of those most like them in the last preceding geological age." Both were equally committed to speciation being a *natural* occurrence. The majority differed with Darwin merely over which "natural explanation of the process" of derivation best fit the facts.²⁵ Gray noted the

²⁴Gray, "Preface to the American Edition," *Variation*, iii-iv.

²⁵Hooker was greatly irritated that Gray, by attributing such "advanced views" on descent to the likes of conservatives like Heer and company, had demeaned the leadership of Darwin. It was an important strategic move on Gray's part to gain a fair hearing for Darwin's views, however, to show that his views on descent

enormous number of questions revolving around the question of heredity and succinctly summarized Darwin's hypothesis of Pangenesis.²⁶

Gray quoted liberally from Darwin's stone-house metaphor, though he did not note that the metaphor was directed against himself. Recall that Darwin had countered Gray's view that variations were providentially led along beneficial lines with the claim that, if every particular variation had been preordained, "the plasticity of organization which leads to many injurious deviations of structure, as well as that redundant power of reproduction which inevitably leads to a struggle for existence, and, as a consequence, to the natural selection or survival of the fittest, must appear to us superfluous laws of nature."

Gray's answer showed a penetrating insight into the complexity of the issues Darwin raised. He argued that these laws of nature would not be superfluous *if* "'survival of the fittest,' 'excellent co-ordination,' and all the harmonious adaptation and diversity we behold are to *result* (italics mine) from the operation of these very

were well in accord with those of the dominant paleontologists, comparative anatomists, and botanists and that they differed only on the minor point of the mechanism that accounted for speciation. Hooker to Gray, 20 April 1868, GHA.

²⁶[Gray], "Variation of Plants and Animals Under Domestication," *Nation* 6 (March 19, 1868): 234-236. It is instructive to compare Gray's rather bland review with the lengthy spirited anonymous review that William James, still emerging from the shadow of Louis Agassiz and sparring with Chauncey Wright, wrote for the *North American Review* (July 1868): 362-368. James concluded that "the one strong impression that affects the reader, after laying down these volumes, is that of the endless complication of the phenomena in question, and the (perhaps hopeless) subtlety and occultness of the immediate causes. At the first glance, the only 'law' under which the greater mass of the facts the author has brought together can be grouped seems to be that of Caprice, -- caprice in inheriting, caprice in transmitting, caprice everywhere, in turn. To look for laws at all in the chaos seems absurdly presumptuous." (366-367) Yet a beginning must be made, James counseled. The great value of Darwin's hypotheses, none of which remotely approached the status of law, is that they directed naturalists to search for additional facts and relationships, whether they will actually be confirmed or not.

laws." It was extremely difficult, Gray observed, to "draw the limits between the fixed and the contingent, either in the material or the moral world, in which both volition and established order play their mingled part." Gray was pointing out that many of Darwin's natural laws, like survival of the fittest and harmonious adaptation, were, in fact, the *results* of natural laws, not their *causes*. Darwin had been unable to clearly distinguish between those regularly occurring phenomena that were fixed laws and those that were accidental contingencies. Thus, on Gray's reading, survival of the fittest was not a natural law, as Darwin had thought, but a contingent consequence of some other universally fixed natural law.

At the same time, Gray's contrast between "volition" and "established order" showed that he was still trapped by the prevailing natural theological notion that "volition," as creative source, always lay at the foundation of new contingencies, i.e. that variations, as new creations, must be explained by some "cause," which was most likely divine. Whether or not Gray was correct about the status of survival of the fittest, his distinction between the fixed and contingent was an important advance in clarifying our understanding of the complexities of organic phenomena that Darwin had discovered.

Gray's last fillip challenged the consistency of Darwin's metaphor. On Darwin's own understanding, Gray argued, "not only the fragments of rock (answering to variation) should fall, but the edifice (answering to natural selection) should rise, irrespective of will and choice!" It is difficult to make out exactly what he meant here, for Darwin drew his analogy between natural selection and the

architect, not natural selection and the building, as Gray had it. It seemed that he was trying to make the same point we did earlier, namely, that falling rocks should form a beautiful house in the same way that variations, through natural selection, form adapted organisms, since, according to Darwin, organisms were not the result of forethought and planning.

Darwin was amused at Gray's "good slap at my concluding metaphor." He admitted that perhaps he should have drawn the contrast between artificial and natural selection more sharply, "but it seemed obvious to me that natural selection depended on contingencies even more complex than those which must have determined the shape of each fragment at the base of the precipice." Darwin is running amuck here. He seems to be drawing an analogy between the contingencies that shaped the rock fragments and the contingencies that shaped natural selection. On this telling, natural selection is the *result* of intersecting physical forces in the same way that stone fragments are the *result* of physical forces. In his original metaphor natural selection was an agent, a cause, able to do something with the variations it was given. Once we clear away the fog created by his confused analogies, Darwin is saying that adaptive organisms are the result of the interaction of numerous physical forces or natural laws, i.e. contingencies, and, thus, the particular variations found useful to the organism could not be preordained. "What I wanted to show was that in reference to preordainment whatever holds good in the function of a pouter pidgeon holds good in the formation of a natural species of Pidgeon. I cannot see that this is false. If the right variations occurred *and no others* natural selection would be superfluous."

(italics mine) Here again natural selection is an agent that picks and chooses the right variation or, perhaps more properly, a sifting process that filters out the harmful variations. Once Darwin clarified in his own mind just what sort of phenomena natural selection was, along the lines suggested by Gray, perhaps he would have a better idea of its relationship to preordainment.²⁷

Gray admitted that Darwin's metaphor threw him on the defensive so that he could offer only a feeble reply. "I found your stone-house argument unanswerable in substance . . . so all I could do was to find a vulnerable spot in the shaping of it, fire my little shot, and run away in the smoke. Of course I understand your argument perfectly, and feel the might of it." He was unable to "smash Darwin to pieces," as an Edinburgh reviewer of *Variations* chortled. Gray finally took refuge in the perspective that "design must after all rest mostly on faith, and on accumulation of adaptations, etc."²⁸

After all was said and done, this is finally what it came down to for Gray. He had spent his last shot in his longstanding dual with Darwin over descent and design and was weary of the fight. Design as an inescapable inductive inference from observation of organic structures must be given up. Both Darwin and Wright had relentlessly pressed him on this point. But rather than giving up his belief that the organic world was designed, Gray would hold on to it as a matter of faith. Perhaps that is how he had believed in it in the first place.

²⁷Darwin to Gray, 8 May 1868, *LLCD* 2: 266-67.

²⁸Gray to Darwin, 25 May 1868, *LAG* 2: 562.

At the end of his life Darwin recalled his argument against design in his *Autobiography* and reflected further on its significance. He observed that "[t]here seems to be no more design in the variability of organic beings and in the action of natural selection, than in the course which the wind blows. Everything in nature is the result of fixed laws. But I have discussed this subject at the end of my book on the *Variation of Domestic Animals and Plants*, and the argument there given has never, as far as I can see, been answered."²⁹ Why is there no design in the way the wind blows? Darwin does not deny that the blowing of the wind, any more than fragments breaking from a cliff, is subject to fixed laws, perhaps many of them interacting. But no one, not even God, has to "design" and guide the wind in its course; simply postulate certain conditions that are themselves subject to various meteorological laws and you have wind as a response to those laws. However, we simply lack the necessary knowledge by which we could determine those many climatic conditions and their fixed laws. For Darwin "design" thus stands in sharp contrast to fixed laws; "design" means doing anything that would interfere with the "natural" operation of fixed laws. Thus, there are as many complicated interacting fixed laws in the variations of plants and animals and the subsequent operation of natural selection, which defy our finding out, as there are in the way the wind blows. The fact that we cannot predict variations in advance, that they appear to occur suddenly, spontaneously without cause, does not mean that God has intervened in the

²⁹ *Autobiography*, 87-88.

organic processes to bring this variation into existence. It simply means we have yet to fully understand the laws to which variation and natural selection are subject. All sudden emergence of new life, e.g. variations and sports, are not miraculous, as the older natural theological tradition and Gray argued; they are all responses to unfathomable interactions of external conditions and fixed laws. Darwin got in the last word after all.

By the spring of 1868 Gray, nearing his 58th birthday, was feeling the full weight of enormous professional pressures. His good friend Hooker, already well under way on his *Genera Plantarum*, goaded him at every opportunity to get back to work on his *Flora of North America*, a work lying incomplete and dormant for the past two decades. There were still untold piles of unclassified specimens flowing in from numerous collectors. The new herbarium, only four years old, was already too cramped to house much-needed classroom and laboratory space. His ever-expanding botanical garden was costing time for its upkeep and money for its growth, neither of which he could spare. Even a new edition of *Field, Forest and Garden Botany* did not produce sufficient income to cover all of his mounting expenses. While his work was growing there seemed to be no qualified person available to share his growing burden. Through his twenty-six years at Harvard, Gray had trained only one professional botanist, Daniel Cady Eaton, then teaching at Yale. Gray had become a one-man botanical department at Harvard -- professor, researcher, curator, administrator, fund-raiser, and gardener. Even retirement appealed to him. He

lamented to Darwin that he was "half dead with drudgery, half of it at least for other people." The only escape was to "run over, with wife, who needs a change, to your side of the water for a good long while."³⁰

It was time for a sabbatical. Gray took little time to respond to Hooker's invitation to come over to England, "the sooner the better." In September he and Mrs. Gray set sail for England. He soon settled in alongside Hooker at Kew Gardens, happy to be immersed in plant taxonomy, his first love. There he was free at last from his wearing debates with Darwin on design and able to contemplate God's design of those exquisite plants under his microscope.³¹

³⁰*Gray*, 332-337; Gray to Darwin, 25 May 1868, *LAG* 2: 562; Gray to Darwin, 17 September 1868, GHA typescript.

³¹Hooker to Gray, 26 April 1868, GHA.