

CHAPTER 8

DARWIN, GRAY, AND THE CLASH OF PHILOSOPHICAL VISIONS

As soon as Darwin saw Gray's first review he immediately recognized how valuable it would be in securing a favorable opinion of his views. Virtually every letter he wrote to Gray in 1860 lavished praise on Gray's efforts. Early on, Hooker informed Darwin of Gray's initial comments after reading the *Origin*. In response Darwin wrote: "I cannot express how deeply it has gratified me. To receive the approval of a man, whom one has long most sincerely respected, and whose judgment and knowledge are universally admitted, is the highest reward an author can possibly wish for."¹ Darwin was thoroughly impressed with Gray's reviews. His *American Journal of Science* review was "by far the best the most able which has appeared, & you will have done the subject infinite service."²

As Hooker lately said in a note to me, you are more than any one else the thorough master of the subject. I declare that you know my book as well as I do myself; and bring to the question new lines of illustration and argument in a manner which excites my astonishment and almost envy! . . . Every single word seems weighed carefully, and tells like a 32-pound shot.³

Darwin could not "help feeling deeply obliged" to Gray. Without his help Darwin

¹Darwin to Gray, 28 January 1860, *CCD* 8: 53-54; Darwin to Gray, 8 February 1860, *CCD* 8: 74-76.

²Darwin to Gray, 18 February 1860, *CCD* 8: 91-92; Darwin to Gray, 24 February 1860, *CCD* 8: 106-107; Darwin to Gray, 8 March 1860, *CCD* 8: 124-125.

³Darwin to Gray, 22 July 1860, *CCD* 8: 298-300.

was sure, from the recent sharply critical reviews, "that I should have been fairly annihilated, had it not been for 4 or 5 men, including yourself." Darwin thought so highly of the *American Journal of Science* review that he tried very hard, though eventually unsuccessfully, to have it printed as a preface to the American edition.⁴

Darwin's inner circle hailed Gray's initial review for its effective handling of the subject and for quieting the theological fears of many. Lyell thought it was the best analysis of the subject that had yet appeared. Hooker deeply appreciated Gray's splendid analysis of the scientific and, especially, the theological aspects and reported that Gray's articles had "greatly mollified opposition" to Darwin's views.⁵

There were clouds on the horizon. Hooker and W. H. Harvey both pointed to strains in Gray's reviews which Darwin himself would stress more fully in his response to Gray. Hooker believed that "Darwin's work has made a deeper hole in your prejudices & preconceptions than you are yet aware of." As he had pointed out in their previous correspondence, Hooker discerned an "evident bias . . . to the old doctrine." Harvey also indicated that some of his friends thought that Gray "had not stated objections to the theory broadly enough, but had rather written an apology -- to show how far it was 'tolerable & not to be endured.'"⁶ Gray would soon learn the truth of their suspicions.

⁴Darwin to Gray, July 3, 1860, *CCD*: 8, 273-276; cf. Darwin to Gray, May 18, 1860. *CCD*: 8, 216-217.

⁵Darwin to Gray, 24 February 1860, *CCD* 8: 106-107; Hooker to Gray, 16 March 1860, *GHA*.

⁶Hooker to Gray, 16 March 1860, *GHA*; Harvey to Gray, 20 May 1860, *GHA*.

Darwin's Philosophical Vision

While Darwin was undoubtedly grateful for the important role that Gray's reviews played in securing a respectable hearing for his arguments, he quickly challenged the central premises of Gray's interpretation of his thought. Their frequent correspondence throughout 1860 and 1861 made it increasingly clear that Darwin no longer shared Gray's philosophical and theological assumptions. They were living in fundamentally conflicting universes of discourse, despite their friendship and similar language. Those first letters from Darwin in which he revealed the depth of his disagreement must have been poignant for Gray. He had been struggling to reconcile his theological and scientific assumptions with the plausibility of Darwin's theory since Darwin divulged the outline of his theory to him. He had implored Hooker at the conclusion of their long debate on these same issues the previous summer to explain how he could "connect the philosophy of religion with the philosophy of your science" if he adopted Darwin's theory of the origin of species. Even as he was reading Darwin's first letters he was striving valiantly to make the best case for the consistency of Darwin's theory with traditional philosophical principles of science and natural theology. Now Darwin was telling him, though couched in a gentle, evasive, yet firm manner, that his philosophical and theological framework of interpretation was fundamentally flawed. Yes, Darwin praised him as the one interpreter who knew his theory even better than he did himself. Yet sheathed in that praise was a rapier that threatened to cut out the heart of Gray's philosophical and theological convictions.

Little did Gray know that the questions he was struggling with now were the

same ones that Darwin had begun wrestling with over twenty years earlier. Just a year after Gray's religious conversion during the Second Great Awakening that flamed across upstate New York, Darwin opened the first of his secret notebooks in which he worked out the fundamental conceptual framework of his theory on the origin of species through natural selection. That new conceptual framework transformed the fundamental categories of the traditional understanding of science and natural theology.⁷

⁷Scholars are deeply indebted to Paul H. Barrett, Peter J. Gautrey, Sandra Herbert, David Kohn, and Sydney Smith, for their authoritative edition of *Charles Darwin's Notebooks, 1836-1844* (Ithaca, NY: Cornell University Press, 1987). Hereafter all references to these notebooks will follow the convention of notebook letter followed by the original page number, e.g. N69. The notebooks provide a unique glimpse into Darwin's frank, wide-ranging, radical, and secret reflections on every facet of his theory formation. Their publication has permanently dispelled the image of Darwin as a simple collector of facts who was innocent of any larger philosophical understanding or concerns. Donald J. Weinshank, Stephan J. Ozmanski, Paul Ruhlen, and Wilma M. Barrett have edited *A Concordance to Charles Darwin's Notebooks, 1836-1844* (Ithaca: Cornell University Press, 1990).

These notebooks have been intensively mined by numerous scholars in search of the sources and development of Darwin's theory. The following have most influenced my account, by date of publication: Michael Ghiselin, *The Triumph of the Darwinian Method* (Berkeley: University of California Press, 1969); Howard E. Gruber and Paul H. Barrett, *Darwin on Man, a Psychological Study of Scientific Creativity: Together with Darwin's Early and Unpublished Notebooks* (New York: E. P. Dutton & Co., 1974); Michael Ruse, "Darwin's Debt to Philosophy: An Examination of the Influence of John F. W. Herschel and William Whewell on the Development of Charles Darwin's Theory of Evolution," *Studies in the Philosophy of Science* 6 (1975): 159-181; W. Faye Cannon, "The Whewell-Darwin Controversy," *Journal of the Geological Society of London* 132 (1976): 377-384; Silvan S. Schweber, "The Origin of the Origin Revisited," *Journal of the History of Biology* 10 (Fall 1977): 229-316; Edward Manier, *The Young Darwin and His Cultural Circle* (Dordrecht: D. Reidel, 1978); Dov Ospovat, *The Development of Darwin's Theory: Natural History, Natural Theology, and Natural Selection, 1838-1859* (New York: Cambridge University Press, 1981); Ernst Mayr, *The Growth of Biological Thought* (Cambridge: Harvard University Press, 1982); Robert M. Young, *Darwin's Metaphor: Nature's Place in Victorian Culture* (Cambridge: Cambridge University Press, 1985); Phillip R. Sloan, "Darwin, Vital Matter, and the Transformism of Species," *Journal of the History of Biology* 19 (Fall 1986): 369-445; John F. Cornell, "'Newton of the Grassblade? Darwin and the Problem of Organic Teleology,'" *Isis* 77 (1986): 405-421; John F. Cornell, "God's Magnificent Law: The Bad Influence of Theistic Metaphysics on Darwin's Estimation of Natural Selection," *Journal of the History of Biology* 20 (Fall 1987): 381-412; Ernst Mayr, *Towards a New Philosophy of Biology* (Cambridge: Harvard University Press, 1988); David Kohn, "Darwin's Ambiguity: The Secularization of Biological Meaning," *British Journal for the History of Science* 22 (1989): 215-239; Adrian Desmond and James Moore, *Darwin: The Life of a Tormented Evolutionist* (New York: Warner Books, 1991); James G. Lennox, "Darwin Was a Teleologist," *Biology and Philosophy* 8 (1993): 409-421;

Historians agree that Darwin was engaged over these years in a massive overhaul of the philosophical framework in which natural theologians and scientists had thought about the weighty matters of origins, final purpose, design, God, will, cause, and many other crucial concepts. That seems to be the extent of scholarly agreement. They have had a difficult time identifying and agreeing on the strategic turning points when Darwin arrived at crucial components of his theory, the character of the many influences on his thought, and whether or when he became an agnostic or even an atheist. It seems that their portrait of Darwin's intellectual journey has become more complex, and even contradictory, the more intensive the inquiry into the extensive cache of Darwin documents has become. David Kohn has observed that "Darwin is well known for his wondrously ambiguous rhetoric. . . . Ambiguous positions, arguments that seem to fold in on themselves, vacillations, contradictions, and pluralities of explanation [that] suffuse Darwin's science and its constituent metascience."⁸ This is an accurate portrait of Darwin's tortuous path out of the natural theology paradigm in which he began his theorizing and into a yet-to-be-defined new paradigm of biology.

Continuity and Uniformity of Nature

The pole star that Darwin followed throughout the twists and turns of his theorizing was his radical commitment to the continuity and uniformity of nature.

Janet Browne, *Charles Darwin: Voyaging* (Princeton: Princeton University Press, 1995).

⁸Kohn, "Darwin's Ambiguity," 215. Kohn's article is an excellent bibliographical guide to the extensive literature on this issue.

Belief in the uniformity of nature was not itself unusual; virtually every natural scientist and even natural theologian in the Newtonian tradition would have said they were committed to the uniformity of nature.⁹ What was distinctive about Darwin's view was his steadfast refusal to acknowledge any areas of life and thought where it did not apply. He firmly believed that nature, which he viewed from the perspective of physics, formed a continuous whole with no gaps, barriers, or exceptions. Darwin was determined to expand the principle of the continuity and uniformity of nature so that it encompassed every aspect of the universe, whatever the consequences. Time and again, from his earliest reflections on transmutation, to his final letters, and across the broad spectrum of issues he studied and speculated on, Darwin's commitment to the uniformity of nature guided his theorizing, often in surprising and uncomfortable directions even for himself.

It was precisely the implications and powerful attraction of the continuity and uniformity of nature that made Gray so uncomfortable. On the one hand, as a scientist, he was committed to the uniformity of nature as an essential principle for understanding the natural world; on the other hand, as a Christian, he sensed the clash of the uniformity principle with his belief in God's immanent activity in that natural

⁹Robert Young's essay on "Darwin's Metaphor: Does Nature Select?" emphasizes the centrality of the uniformity of nature in Darwin's thought. R. J. Hooykaas has written an essential history of *Natural Law and Divine Miracle: The Principle of Uniformity in Geology, Biology and Theology* (Leiden: E. J. Brill, 1963) that elaborates on several ambiguities and permutations in the meaning of "uniformity" in geology, biology, and theology in the early nineteenth century and how Darwin took advantage of them in his own theorizing. The growing ambiguity of "uniformity" played a central role in shaping Darwin's understanding of this principle.

world. Following Darwin down the path of his theory formation will help us better understand the clash of paradigms manifest in the discussion between Gray and Darwin, which lay at the heart of the debates over the *Origin*.

Darwin was initially attracted to the principle of uniformity by reading the first volume of Charles Lyell's *Principles of Geology* while on board the *Beagle*.¹⁰ The *Principles* were a vigorous polemic against the Scriptural or Mosaic geologists who wedded a catastrophic and developmentalist interpretation of earth history with a literal reading of Genesis. Lyell claimed that geology could only become a true science, one that emulated the method and results of Newton's physics, by rigorously following the methodological principle of uniformity as outlined by John Herschel in his *A Preliminary Discourse on the Study of Natural Philosophy*. Lyell succinctly outlined how he intended to apply this principle in the *Principles* to his friend and colleague, Roderick Murchison:

My work . . . will not pretend to give even an abstract of all that is known in geology, but it will endeavour to establish the *principle of reasoning* in the science; and all my geology will come in as illustration of my views of those principles, and as evidence strengthening the system necessarily arising out of the admission of such principles, which, as you know, are neither more nor less than that *no causes whatever* have from the earliest time to which we can look back, to the present, ever acted, but those *now acting*; and that they never acted with different degrees of energy from that which they now exert.¹¹

Lyell understood the principle of uniformity to mean that the only acceptable *verae*

¹⁰Lyell's *Principles* bore the significant subtitle: *Being an Attempt to Explain the Former Changes of the Earth's Surface by Reference to Causes Now in Operation*.

¹¹Lyell to Murchison, 15 Jan. 1829, *Life, Letters and Journals of Sir Charles Lyell, Bart.*, ed. Mrs. Lyell (London: John Murray, 1881), vol. 1: 234.

causae of geological changes were those that existed in the present and had always been active to the same degree and in the same intensity as in the present. This understanding ruled out catastrophes, developmentalism, and miracles, three major assumptions of the Scriptural geologists.

Lyell applied this understanding of the uniformity of nature to every topic he discussed in his three-volume work, except the origin of species and man. Lyell believed that it was fruitless for geologists to speculate on the origin of species since it lay outside the boundary of what could be known. Besides, he was mainly concerned with what happened to species once they appeared. At the same time he rejected both Lamarck's theory of transmutation and the Scriptural geologists who argued that the Creator had intervened in nature to create new species. Lyell believed that species originated by completely natural, though currently unknown, causes that were providentially guided by the "Presiding Mind."¹² In common with his contemporaries, Lyell also exempted human moral and mental characteristics from the uniformity of nature and natural law. The principle of uniformity, which Lyell's popularity and influence did so much to advance, would soon bear fruit in these two areas that was even too bitter for Lyell to swallow.¹³

The *Principles* made an indelible impression on Darwin's young mind. He later reflected that he always felt "as if my books came half out of Lyell's brain. . . .

¹²Lyell to Herschel, 1 June 1836, *Life of Sir Charles Lyell*, 1: 468.

¹³Martin Rudwick provides a clear overview of the *Principles* and an essential bibliography of essential secondary works on Lyell's geology and philosophy of science in his "Introduction" to the facsimile of the first edition of *Principles of Geology* (Chicago: University of Chicago Press, 1990).

I have always thought that the great merit of the Principles, was that it altered the whole tone of one's mind."¹⁴ He acknowledged on Lyell's death "that almost everything which I have done in science I owe to the study of his great works."¹⁵ Lyell inspired Darwin to take up the basic biological problems that became his life's work and to adopt the methodological principle of the uniformity of nature.

Yet Darwin was not a slavish follower of Lyell. He rather teased, probed, and inverted Lyell's meaning of "uniformity" to conform to his own emerging research project. Darwin's primary concern, unlike Lyell's, was to plug all of the holes, cancel all of the exceptions, and eliminate all of the barriers to the uniform working of natural causes in forming both geological and biological phenomena. Darwin pushed himself first and later his opponents with the implications of a common commitment to the uniformity of natural causation. He assumed that if the uniformity of nature were true to any degree, it must be true for every problem that scientists confronted, including the origin of species and humankind. No room must be allowed for any mysterious, supra-natural cause, or any causality that could not ultimately be understood as kinds of physical causes.

Darwin thus transformed Lyell's methodological principle of uniformity into a metaphysical claim that he sought to apply in all areas of life and thought. Throughout his notebooks, letters, and writings Darwin broke down the traditional barriers

¹⁴Darwin to Leonard Horner, 29 Aug. 1844, *Charles Darwin's Letters: A Selection 1825-1859*. ed. Frederick Burkhardt (Cambridge: Cambridge University Press, 1996), 83.

¹⁵Darwin to Miss Buckley, 23 Feb. 1875, *Life and Letters*, 2: 374.

between origin and development, law and miracle, chance and design, variety and species, natural and artificial, analogy and identity, matter and mind, instinct and intellect, animal and human, creation and evolution, physics and biology, theory and hypothesis. Nothing seemed to inspire him more than to see wherever he looked those "infinitely fine gradations." Nature was uniform and continuous throughout, Darwin believed. He would spend his lifetime showing that it was.

Early in his reflections on transmutation Darwin realized that if evolution were true, there must be a material continuity between animal and human and a physical substratum for every human dimension, from unconscious behavior and emotions to morality and belief in God. It must be shown that there was no *hiatus* between animal and human.¹⁶ Every aspect of human existence must be shown to have a physical explanation. He set the stage for exploring the full extent of these continuities in early to mid-1838 when he reflected that

the believing that monkey would breed (if mankind destroyed) some intellectual being though not MAN -- is as difficult to understand as Lyell's doctrine of slow movements &c &c. This multiplication of little means & bringing the mind to grapple with great effect produced, is a most laborious, & painful effort of the mind (although this may be appear an absurd saying) & will never be conquered by anyone (if has any kind of prejudices) who just takes up & lay down the subject without long meditation. -- His best chance is to have profoundly over the enormous difficulty of reproductions of species & certainty of destruction; then he will choose & firmly believe in his new faith of the lesser of the difficulties. Once grant that species one genus may pass into each other. -- grant that one instinct to be acquired (if the medullary point in ovum. has such organization as to force in one man the development of a brain capable of producing more glowing imagining or more profound reasoning than other -- if this be granted!!) & whole fabric totters & falls. -- Look abroad, study

¹⁶C154, 157, 198, M151.

gradation. Study unity of type -- study geographical distribution. Study relation of fossil with recent. The fabric falls! But Man -- wonderful Man. "divino ore versus coelum attentus"¹⁷ is an exception. -- He is Mammalian. -- His origin has not been indefinite -- he is not a deity, his end under present form will come, (or how dreadfully we are deceived) then he is no exception. -- He possesses some of the same general instincts, & feelings as animals. -- They on the other hand can reason -- but Man has reasoning powers in excess, instead of definite instincts. -- This is a replacement in mental machinery -- so analogous to what we see in bodily that it does not stagger me. -- What circumstances may have been necessary to have made man! Seclusion, want &c & perhaps a train of animals of hundred generations of species to produce contingents proper. -- Present monkeys might not, -- but probably would. The world now being fit, for such an animal. -- Man, (rude, uncivilized man) might not have lived when certain other animals were alive, which have perished. -- Let man visit Ourang-outrang in domestication, hear expressive whine, see its intelligence when spoken: as if it understood every word said -- see its affection -- to those it knew. -- See its passion & rage, sulkiness, & very actions of despair; let him look at savage, roasting his parent, naked, artless, not improving yet improvable & then let him dare to boast of his proud preeminence. -- Not understanding language of Fuegian [indigenous people he met in Tierra del Fuego], puts on par with Monkeys.¹⁸

Every major continuity and theme that he subsequently elaborated is foreshadowed in this remarkable passage.

John Durant has brilliantly underscored Darwin's commitment to the continuity principle for understanding humankind's place in nature. Darwin directly challenged the prevailing belief that humans were so unique that they could not be properly understood by scientific methods. "Reason, will, consciousness, morality: these and other similar attributes were widely regarded as the distinguishing marks of man. But for Darwin they constituted a direct challenge to a naturalistic view of the world of life as a single domain, characterized by the possession of common properties and

¹⁷With divine face, turned toward heaven. C 77-1.

¹⁸C75-79.

powers, and subject to universal natural laws."¹⁹ Darwin transformed the prevailing anthropomorphic tendency of attributing human characteristics to non-human beings into the zoomorphic tendency of attributing non-human characteristics to humans.

Inspired by Positivist and Materialist Trends

Darwin's intellectual and social habits led him to a broad and eclectic reading, always searching for those books and ideas that he could use to bolster, illustrate, or advance his own thinking. This meant that he was far less concerned with accurately reading and representing an author's thought than he was with how he could use even the most incidental references for his own purposes. He was forever reshaping, twisting, even inverting, the ideas and assumptions of those he read to advance his underlying commitment to the continuity and uniformity of nature. It is for this reason that it is difficult to determine just how a particular author or idea influenced Darwin.²⁰

¹⁹See Darwin's Old & Useless Notes for his fullest statements on man's place in nature according to his theory just prior to *The Descent of Man* (1871). Despite his dismissive comments while sorting his notes for *Descent*, these notes were not "old and useless." Durant, "The Ascent of Nature," ed. David Kohn, *The Darwinian Heritage*, 288.

²⁰Edward Manier, chap. 4 on "Materialism" in *The Young Darwin*, and Simon Schweber, "The Origin of the Origin Revisited," illustrate this habit in their close study of the marginal notes Darwin made in the works he read by James Ferrier, John Abercrombie, John Barclay, Dugald Stewart, John Fleming, Benjamin Smart, Auguste Comte, William Lawrence, Thomas Malthus, and many others. Because of this habit, as Manier stresses, it is extremely difficult to know exactly how a certain author influenced Darwin since it was so often in ways very different from the author's own intention. This is most strikingly seen in the way that Darwin read Malthus and Smith.

Asa Gray was impressed by Abercrombie and Lawrence a full seven years before Darwin read them. Dr. Trowbridge, who was Gray's mentor and *au courant* with British medical philosophy, introduced Gray to these two authors early in his medical practice. Gray declared to his friend and medical school classmate, N. Wright Folwell, that "Lawrence is a grand fellow, -- a strong and agreeable writer. I wish you to read whenever you can obtain it. He is a materialist -- after my own fashion precisely--Don't attempt to form an opinion on such matters until you read it." Gray to

Darwin's maturing position was nourished and inspired by the broader philosophical currents of positivism, which broke down the epistemic barriers between knowledge purported to be obtained through revelation and so-called "positive" knowledge gained solely through empirical method, and materialism, which eroded the traditional barriers between mind and body.²¹ His intellectual habits and fascination with how Positivism could advance his agenda is vividly illustrated in the train of thoughts that were sparked by his reading of David Brewster's review of Auguste Comte's *Positive Philosophy* during the summer of 1838. Auguste Comte, an early nineteenth-century French thinker, using what he took to be Newton's philosophy of science as a paradigm for all science, formulated the philosophy of Positivism. Surveying the broad sweep of history, Comte claimed that mankind had passed through three stages of maturity in providing scientific explanations for phenomena. The first was the Theological stage that appealed to divine beings or agencies as the "first and final causes," not resting content until it had related the phenomena to origin and purpose. The second was the Metaphysical stage which explained the phenomena in terms of abstract forces or powers (e.g. Nature) that people considered inherent in the phenomena they studied. The third, and final, was the Positive stage. At this point people abandoned the vain and futile search for the origin, end, and

Folwell, 14 March 1831, 17 April 1831; quoted in Dupree, *Asa Gray*, 20. Perhaps it was the implications of Lawrence's strong materialism that were still percolating in the back of Gray's mind that so troubled him about the implications of Darwin's theory.

²¹Theodore Merz's four-volume *A History of European Thought in the Nineteenth Century* and Maurice Mandelbaum's *History, Man, & Reason* (Baltimore: The Johns Hopkins University Press, 1971) remain sure guides to the British and European philosophical background of Darwin's thought.

purposes of the universe and why things happen in the world. These searches accomplish nothing, Comte contended. The Positive stage was characterized by a scrupulous search for the "invariable relations" or laws which occur in experience.

Explanation in the Positive stage of knowledge no longer meant relating phenomena to such abstractions as origins, purposes, or final causes; henceforth it meant establishing connections between diverse phenomena and ideally one general law. Physics, under the guidance of Newton, according to Comte, was the first field of knowledge to have successfully passed through the Theological and Metaphysical stages of knowledge and emerged into the Positive stage. Comte called on all other fields of inquiry to follow the lead of Physics in its pursuit of Positive knowledge.

Brewster included a long extract from Comte which sharply criticized a theological interpretation of astronomical phenomena that grabbed Darwin's attention.

To minds unacquainted with the study of the heavenly bodies, though often otherwise well informed in other branches of natural philosophy, astronomy has still the reputation of being a science eminently religious, as if the famous verse . . . (the heavens declare the glory of God), had preserved all its force. (better informed minds, Comte added, understand that "the heavens declare no other glory than that of Hipparchus, Kepler, Newton, and all those who have contributed to the establishment of their laws.") It is, however, certain, as I have proved, that all real science stands in radical and necessary opposition to all theology; and this character is more strongly indicated than in any other, according to the comparisons already made. No science has given such terrible blows to the doctrine of final causes, generally regarded by the moderns as the indispensable basis of all religious systems, though it is in reality but the consequence of them. . . . The exact exploration of our solar system cannot fail to put an end essentially to that blind and boundless admiration which the general order of nature inspires, by showing in the distinctest manner, and under a great number of different aspects, that the elements of this system were certainly not arranged in the most advantageous manner, and that science allows us to conceive easily a better arrangement. In short, under another point of view, still more important, by the development of the true celestial mechanics since the time of

Newton, all theological philosophy, even the most perfect, has been henceforth deprived of its principal intellectual office; the most regular order being now conceived as necessarily established and kept up in our world, and even throughout the whole universe, by the simple mutual attraction of its different parts.²²

Comte's sharp challenge to "theological philosophy" and the doctrine of final causes strengthened Darwin's own earlier belief that "astronomers might formerly have said that God ordered, each planet to move in its particular destiny. -- In the same manner God orders each animal created with certain forms in certain country."²³ Astronomers *used to* make this appeal, but not anymore. Naturalists *used to* claim that God created each animal for a specific country, but Darwin was determined to follow the example of astronomy and banish this explanation from biology.

Darwin was not content merely to summarize Comte's rejection of the theological stage. He immediately struck out on new lines of thought that supported his own theorizing. He was particularly intrigued by Comte's notion that scientific explanations in the theological stage were always traced to the will of God.²⁴ This conformed perfectly with his own observations that the indigenous peoples he encountered in South America "attribute thunder & lightening to God's anger."²⁵ Even philosophers were quick to attribute causation to "imaginary beings, many

²²David Brewster, "M. Comte's *Course of Positive Philosophy*," *The Edinburgh Review* 136 (April 1838): 275.

²³B101. Darwin did not derive this objection from Comte; Comte rather confirmed his earlier rejection and gave him additional reasons for rejecting it.

²⁴N12.

²⁵M69, cf. M135.

vicarious, like ourselves."²⁶ He pressed this line of thinking in such a way that it overturned the Scottish argument for the existence of God.

The Scottish philosophy had grounded its argument for the existence of God on the assumption that "will" was the only causal agent in the universe. Everyone had the personal experience, the Scots maintained, of bringing to pass that which they had first willed. Since there were things and events that came into existence independent of human will, there must be a divine will that caused all things and events to come to pass. The Scots simply accepted the independent, non-material reality of "will." Darwin did not. He rather connected Comte's theological stage with his earlier speculation on the physiological foundation of mind in which the brain "secreted" thought. If this were true, Darwin mused, then our notion of human and divine "will" was itself the product of the "fixed laws of organization" in our brains. Both the divine and human "will" thus ceased to exist as metaphysical entities. Darwin thus subverted the traditional Scottish argument: people did not believe in God because of the unmistakable evidences of intelligence they saw in the universe; rather their belief in God was produced in them by the physiological structure and function of their brains. Even Comte had not drawn this implication. No wonder that Darwin rather self-mockingly exclaimed "Oh you Materialist!"²⁷

²⁶M136.

²⁷C166, M69-70. Darwin even commented that John Macculloch had a similar notion about the origin of our idea of a Deity: "Macculloch in his Chapter on the Existence of a Deity has an expression the very same as mine about our origin of a notion of a Deity." N35, cf. N4. Macculloch had said: "To proceed a further step, somewhat more rapidly than metaphysics do, the proof of the existence of a Supreme Creator depends therefore on our belief in a cause, or what has been termed

Darwin pressed this line of thought even further by connecting it with the puzzle of free will, chance, and design. If "will" were simply the name we gave to the results of necessary bodily processes and movements, then it typified the actions of all organic beings, plants, animals, and humans. "With respect to free will, seeing a puppy playing cannot doubt that they have free will, if so all animals., then an oyster has & a polype (& a plant in some senses). . . . Now free will of oyster, one can fancy to be direct effect of organization, by the capacities its senses give it of pain or pleasure." Even his own "wish to improve my temper, what does it arise from but organization. That organization may have been affected by circumstances & education, & by choice which at that time organization gave me to will." Darwin drew the inevitable conclusion that such a view "would make a man a predestinarian of a new kind, because he would tend to be an atheist "since it was no longer necessary to attribute desires, appetites, movements, or habits to either the human will or the will of God. Will, as conventionally understood by the Victorians, was an

causation." N35-1. Macculloch, of course, would have been scandalized to know Darwin believed they had "similar" notions about the origin of the idea of God since he was arguing for the traditional Scottish position.

Because Darwin pressed this line of thought so directly in his notebooks, I believe it is incontrovertible that by July 1838 when he opened his M Notebook Darwin had abandoned any conviction, whether Christian, theistic, or deistic, that a Deity existed independently of human consciousness. He was driven throughout the formation of his theory to make such a Deity epistemically irrelevant to science and to find natural mechanisms and processes that fulfilled all of the functions that natural theology had given to the Deity. It was but an "infinitely" short step to making such an epistemically irrelevant Deity ontologically non-existent. His continual use of traditional theological language was empty of any meaningful content. The extensive literature on Darwin's religious beliefs has most recently been summarized in Frank Burch Brown, *The Evolution of Darwin's Religious Views* (Macon, GA: Mercer University Press, 1986) and Kohn, "Darwin's Ambiguity."

illusion.²⁸

Perhaps, Darwin reasoned, this deterministic understanding of will also illuminated the meaning of chance: "free will is to mind, what chance is to matter."²⁹ In the same way that humans seem to be free, though actually guided by complex motives and environmental constraints, so natural processes only seem to be guided by chance because we cannot fully understand the "infinitely complex" constraints that determine them. "I verily believe free-will & chance are synonymous. Shake ten thousand grains of sand together & one will be uppermost: -- so in thoughts, one will rise according to law."³⁰ Free will merely expressed our ignorance of the underlying causes of our actions. Humans often believe that their actions are determined by free will when, in actuality, they are produced by "strong invariable passions. . . . The general delusion about free will obvious. -- Because man has power of action, & he can seldom analyze his motives (originally most INSTINCTIVE, & therefore now great effort of reason to discover them: this is important explanation) he thinks they have none." In the same way "a man may put himself in the way of Contingencies. -- But his desire to do so arises from motives. -- & his knowledge that it is good for him effect of Education & mental capabilities." Human motives, however complex they are and difficult to discover, are directly analogous to the role of force in physics: "every action whatever is the effect of a motive." Darwin agreed with John

²⁸M72-74.

²⁹M72.

³⁰M31.

Abercrombie, who maintained in his *Inquiries Concerning the Intellectual Powers and the Investigation of Truth*, that there was as strict a uniformity in explaining mental phenomena through appeal to motives as there was in explaining physical phenomena through appeal to material causes.³¹ No scientific theory could take refuge in either free will or chance. All exemptions to the continuity and uniformity of nature must be eliminated.³²

Darwin followed this same line of argument in deconstructing the major components of the traditional design argument of natural theology. During the critical summer and fall of 1838, tested his theory against John Macculloch's three-volume *Proofs and Illustrations of the Attributes of God*.³³ Darwin summarily dismissed all appeals to "the *will* of the deity, to create animals on certain plans" as "utterly useless" since "we know nothing of the will of the Deity. how it acts & whether constant or inconstant like that of Man. -- *The cause given we know not the effect*."³⁴ Furthermore, Darwin continued, if the intellect itself had a material origin, it would undermine the fundamental claim of the design argument that the analogy between the works of art and works of nature alike displayed evidence of intellect. He admitted

³¹OUN25-26, 25-2.

³²We will further explore Darwin's understanding of "chance" more fully below in our discussion of Darwin's stone-house analogy that he constructed in the conclusion to *Variation of Plants and Animals* to refute Gray's notion of providentially guided variation.

³³Darwin wrote a long abstract of volume one of Macculloch's *Proofs and Illustrations of God from the Facts and Laws of the Physical Universe, being the Foundation of Natural and Revealed Theology* (London, 1837) sometime during the fall of 1838. It is included in *Notebooks of Charles Darwin*; hereafter MAC.

³⁴MAC55r. Italics added.

that "the analogy between the works of art or intellect such as hinge & hinge of shell, works of laws of organization is remarkable" until we realize that intellect is nothing "but organization, with mysterious consciousness superadded." Darwin transformed the analogy between works of intellect and works of the laws of organization into an identity: they were both formed by the same laws of organization; neither were formed by an external Deity. True, "an adaptation made by intellect" would take a shorter period of time, yet no savage, supposedly endowed with intellect, "ever made a perfect hinge." The obvious implication was that no one could infer, simply by examining the myriad types of hinges in the universe, that some were "perfect" and therefore must have been created by a divine intelligence.³⁵

Darwin could not contain his contempt for Macculloch's many weak illustrations of designed adaptations in plants. He had already shown that "will", whether human or divine, was not an independently existing metaphysical phenomena: it was simply the name given to a particular physiological process of the brain. This being the case, Darwin summarily dismissed all appeals to "the *will* of the deity, to create animals on certain plans" or to adapt them to certain conditions of life as being "utterly useless" since "we know nothing of the will of the Deity."³⁶ How could Macculloch seriously maintain that plants being fertilized by insects illustrated intelligent design when the reality was that without the insects there would have been

³⁵MAC58v.

³⁶MAC55r.

no plants in the first place?³⁷ How could he possibly believe that baby chicks were endowed with hard beaks to break out of their shells when the reality was that those with weak beaks were "sifted away" in the struggle for existence?³⁸ It was silly to argue that the long bills of the Grallae were specifically designed to enable them to dig their food out of the ground when it was much simpler to say that they being able to dig out their food as "a simple consequence" of their bills becoming longer step by step.³⁹ How could he possibly believe that the Deity created plants specifically to arrest mud flow at deltas?

If we once venture to say created to prevent the valuable soil in its seaward course, -- we sink into such contemptible queries, as why should the earth have drifted; why should plants require earth, why not created to live on alpine pinnacle? if we once to presume that god created plants to arrest the earth, . . . we do lower the creator to the standard of one his weak creations.⁴⁰

How could Macculloch declare that the woodpecker was "perfectly adapted" when the "*ground* Woodpecker" lived its entire life on the ground without benefit of trees?⁴¹

Darwin concluded that the design argument, based on adaptations designed by a divine will, was "exhausted & abandoned."⁴²

All of the adaptations that Macculloch appealed to as proof of design by a

³⁷MAC56v.

³⁸MAC58r.

³⁹MAC28v.

⁴⁰MAC54r.

⁴¹MAC57r.

⁴²MAC54v.

divine intelligence Darwin explained as the "direct consequences of still higher laws" that were themselves "grand & simple."⁴³ Darwin maintained that his theory made all organic beings "perfectly adapted to all situations, where in accordance to certain laws they can live."⁴⁴ He looked "at every adaptation, as the surviving one of ten, thousand trials. -- each step being perfect or nearly so."⁴⁵ When adaptations were understood in this way, Darwin argued, it became clear that all the Bridgewater Treatises simply stated the "laws of adaptation."⁴⁶ Simple "laws of fixed organization," not divine purpose, explained all adaptations and insured the unbroken continuity and uniformity of nature.

The design argument had invoked the Deity as the only sufficient explanation for the wonder, order, stability, life, and design observed throughout the world. These phenomena, so the argument ran, were simply too marvelous to have arisen by chance or without external guidance; their existence in the universe could only be explained by the existence of a superintending God. As we have seen, Darwin raised numerous objections to the assumptions and conclusions of this argument in his transmutation notebooks. It was plainly inconsistent with his commitment to the principle of the continuity and uniformity of nature. At the same time he recognized that if his critique of the design argument and final causes as inadequate explanations

⁴³MAC53r, 54r.

⁴⁴MAC54r.

⁴⁵MAC58v.

⁴⁶MAC57v.

of the origin of species was to be successful, he needed a plausible alternative to the Deity. He needed a completely natural mechanism or process that was fully sufficient to explain the *appearance* of design. Three prominent, though conceptually distinct, sources for Darwin's emerging concept of natural selection to fill this role were Adam Smith's vision of a self-regulating Liberal social order, Thomas Malthus's polemic against political efforts to interfere with the laws of population, and German vitalistic understandings of natural purpose in nature.⁴⁷

Searching for Self-Regulating Biological Systems

The leading thinkers of the Scottish Enlightenment, David Hume, Adam Smith, Adam Ferguson, and Dugald Stewart, led the revolution to liberate British society from the centuries-old cultural belief that an active, even aggressive, centralized authority was essential for good order in society, politics, and economics.⁴⁸ They fashioned a new answer to the ancient question of how order and stability could

⁴⁷These were not the only influences on Darwin's theorizing; they are only illustrative of his search for an explanatory framework that was consistent with the continuity and uniformity of nature. Manier, *The Young Darwin*, Schweber, "The Origin of the *Origin* Revisited," and Moore and Desmond, *The Life of a Tormented Evolutionist* explore the multiple sources of influence in much greater depth.

⁴⁸Darwin was led to the Scottish moralists through his interest in the origin of social morality and a stable social order. In late August 1838 he read Dugald Stewart's influential *Account of the Life and Writings of Adam Smith, Account of the Life and Writings of Thomas Reid* (1829), though he was undoubtedly familiar with the broad outlines of Smith's moral and economic theory. Simon Schweber gives a succinct summary of Darwin's reflections on his reading Stewart's memoir in "The Origin of the *Origin* Revisited," 274-283. It is likely that Darwin discovered Smith because of his primary interest in Dugald Stewart. His Old & Useless Notes, 14-21, contain notes on reading Stewart's essays, "On the Beautiful" and "On Taste," entered sometime prior to 6 Sept. 1838. Edward Manier contends that Stewart's realist theory of language provided Darwin with the resources, contrary to Stewart's intention, for developing a materialistic understanding of how human language evolved from primate ancestors. Manier, *The Young Darwin*, 40.

be maintained in society. Intellectuals at the beginning of the eighteenth century began to speculate that dynamic systems existed or could be created that were capable of maintaining equilibrium and stability without any external interference; they could be self-regulating. Such a self-regulating system suggested a completely new understanding of social order that was ideally suited to be the foundation of a liberal social theory; social, political, economic, even religious balance could best be achieved by granting individuals maximum personal liberty.⁴⁹ The Scottish moralists contended that a complex and stable social order arose spontaneously from the reflexive, habitual, and instinctive actions of individuals pursuing their own short-term interests rather than from individual foresight and calculation or the guiding hand of either legislators or God. They were confident that law ruled the spontaneous ordering of society in the same way that Newton's law of gravity ruled the heavens and the earth.⁵⁰

⁴⁹Otto Mayr, *Authority, Liberty & Automatic Machinery in Early Modern Europe* (Baltimore: The Johns Hopkins University Press, 1986), 155. Mayr does not claim there was a causal connection between the invention of self-regulating technological systems, e.g. regulators and governors of various sorts, and the liberal conception of a self-regulating social order. "Quite firmly established, however, is the fact of the simultaneous appearance in Britain of these two phenomena, which in itself is forceful evidence of the interdependence of the socio-intellectual with the technological activities of a culture." 199. Ronald Hamowy has surveyed *The Scottish Enlightenment and the Theory of Spontaneous Order* (Carbondale, IL: Southern Illinois University Press for the Journal of the History of Philosophy, 1987).

⁵⁰D. D. Raphael and A. L. Macfie underscore Smith's significant reliance on the ancient Stoic doctrine of the natural law of social harmony. Smith succinctly summarized his understanding of this doctrine in *A Theory of Moral Sentiments*: "The ancient stoics were of opinion, that as the world was governed by the all-ruling providence of a wise, powerful, and good God, every single event ought to be regarded, as making a necessary part of the plan of the universe, and as tending to promote the general order and happiness of the whole: that the vices and follies of mankind, therefore, made as necessary part of this plan as their wisdom or their virtue; and by that eternal art which educes good from ill, were made to tend equally to the prosperity and perfection of the great system of nature." Part 1, Section 2, Chap. 3. D. D. Raphael and A. L. Macfie, eds., *Adam Smith: A Theory of Moral Sentiments* (Oxford: Clarendon Press, 1976), 5-10.

Adam Smith gave this bold social theory based on "natural liberty" its most extensive analysis in *Wealth of Nations* (1776). Natural liberty was the original condition of mankind, according to Smith. Harmonious social order would emerge spontaneously once oppressive and intrusive government was eliminated from society. Governments, Smith argued, had been deluded into believing that only they had the necessary wisdom to "superintend the industry of private people and of directing it towards the employments most suitable to the interests of society." History had amply shown that they did not. Under the system of natural liberty the interests of society were best served when government assumed the minimal roles of protecting its citizens against foreign invasion, administering justice for every member of society, and maintaining those public institutions that individuals would not find profitable to maintain themselves. Released from governmental bondage, "every man, as long as he does not violate the laws of justice, is left perfectly free to pursue his own interests in his own way." The great insight of the Scottish moralists that Smith codified into social law was that self-love was the engine that drove the economy and incidentally stabilized the society. "It is not from the benevolence of the butcher, the brewer or the baker, that we expect our dinner, but from their regard to their own self-interest." Granted that the baker serves us because of his own self-interest, how was it possible that the interests and stability of the society were served through his narrow self-interest?

Smith maintained that the great social ends of stability, harmony, peace, and prosperity were simply the unintended consequences of the self-serving activities of thousands of individuals. The social goals that everyone desired spontaneously developed out of the complex interactions of myriads of persons acting for their own immediate purposes. As has become so well-known, Smith illustrated this principle with the market, the ideal self-adjusting economic mechanism. The market was the largely invisible space in which free individuals exchanged goods and services for numerous reasons, from the most contemptible to the most benevolent motives. Fair and equitable prices for those goods and services were automatically controlled by the law of supply and demand, not by the government or even the Scholastic notion of a "just" price. He invoked the famous metaphor of the Invisible Hand to illustrate this self-regulating system.

Every individual necessarily labours to render the annual revenue of the society as great as he can. He generally, indeed, neither intends to promote the public interest, nor knows how much he is promoting it. By preferring the support of domestic to that of foreign industry, he intends only his own security; and by directing that industry in such a manner as its produce may be of the greatest value, he intends only his own gain, and he is in this, as in many other cases, led by an invisible hand to promote an end which was not part of his intention. Nor is it always the worse for the society that it was no part of it. By pursuing his own interest he frequently promotes that of the society more effectually than when he really intends to promote it. I have never known much good done by those who affected to trade for the public good. ⁵¹

Smith's self-regulating society seemed to have made the medieval technological dream of a perpetual motion machine, a machine that would run of its own accord without

⁵¹*Wealth of Nations*, Bk 4, chap. 2.

external interference or aid, a reality at last.

The metaphor of the "invisible hand" is as beguiling as its meaning is elusive.⁵² What exactly were his readers supposed to infer from Smith's use of this expression? There seems little doubt that Smith was trading on the public's temptation to treat it as a synonym for God's providential guidance.⁵³ After all, he was a professor of moral philosophy at the Moderate Presbyterian University of Glasgow, the successor of the prominent moral philosopher, Thomas Reid. At the same time it is clear that Smith did not seriously consider appealing to the Deity to salvage social order. The purpose of his moral theory was to find an immanent process that would fill all of the Deity's former roles. The "invisible hand" was a substitute, not a synonym, for the Deity in Smith's lexicon. No longer must people appeal to the guiding hand of God to explain the wonder and marvels of a smoothly-running society and economy.⁵⁴ Such a society may seem to have been designed by a transcendent intelligence and guided by final causes, but Smith had laid bare the reality that public order and social benefit had

⁵²Incisive critiques of the way the metaphor of the "invisible hand" has been historically misunderstood and invoked for ideological purposes are offered in Stephen Copley and Kathryn Sutherland, eds. *Adam Smith's Wealth of Nations: New Interdisciplinary Essays* (New York: Manchester University Press, 1995). The intrinsic ambiguity of the metaphor raises challenging questions concerning Darwin's own interpretation and use of the concept to advance his own philosophical agenda.

⁵³Smith first used "invisible hand of Jupiter" in an early essay on astronomy that showed marked sympathy with ancient materialism and polytheism. Richard Olson, *Science Deified & Science Defied: the Historical Significance of Science in Western Culture* (Berkeley: University of California, 1990), 2: 222.

⁵⁴Bob Goudzwaard, the prominent Dutch economist, has laid bare the profound way in which Smith transformed the Christian understanding of "providence" into a natural law that served as the guarantor of social harmony. Bob Goudzwaard, *Capitalism and Progress: A Diagnosis of Western Society* (Grand Rapids, MI: William B. Eerdmans Publishing Co., 1979), 21-27.

arisen spontaneously and unintentionally from the way persons interacted as they pursued their own private ends. There was simply no need or place for God in Smith's liberal social order. Smith's "invisible hand" turns out to have been nothing more a synonym for the highly abstract, though still mysterious, immanent law of self-regulation.⁵⁵

The Scottish moralists and Adam Smith inspired Darwin and confirmed his own search for the biological analog of Smith's law of unintended consequences and

⁵⁵There are numerous intriguing links between Scottish moral philosophy's emphasis on the law of unintended consequences and Darwin's search for the immanent laws of the origin of species. Consider the following two quotations from Adam Ferguson's *An Essay on the History of Civil Society* (1767). Ferguson taught moral philosophy at the University of Edinburgh. "The artifices of the beaver, the ant, and the bee, are ascribed to the wisdom of nature. Those of polished nations are ascribed to themselves, and are supposed to indicate a capacity superior to that of rude minds. But the establishments of men, like those of every animal, are suggested by nature, and are the result of instinct, directed by the variety of situations in which mankind are placed. Those establishments arose from successive improvements that were made, without any sense of their general effect; and they bring human affairs to a state of complication, which the greatest reach of capacity with which human nature was ever adorned, could not have projected; nor even when the whole is carried into execution, can it be comprehended in its full extent." Quoted in Ronald Hamowy, *The Scottish Enlightenment and the Theory of Spontaneous Order*, 22.

"Mankind, in following the present sense of their minds, in striving to remove inconveniences, or to gain apparent and contiguous advantages, arrive at ends which even their imagination could not anticipate, and pass on, like other animals, in the track of their nature, without perceiving its end. . . . He who first ranged himself under a leader did not perceive that he was setting the example of a permanent subordination, under the pretense of which the rapacious were to seize his possessions and the arrogant to lay claim to his service.

Like the winds that come we know not whence and blow whithersoever they list, the forces of society are derived from an obscure and distant origin. They arise, long before the date of philosophy, from the instincts, not from the speculations of men. The crowd of mankind are directed, in their establishments and measures, by the circumstances in which they are placed; and seldom are turned from their way to follow the plan of any single projector.

Every step and every movement of the multitude, even in what are termed enlightened ages, are made with equal blindness to the future, and nations stumble upon establishments, which are indeed the result of human action, but not the execution of any human design." Quoted in Louis Schneider, ed., *The Scottish Moralists*, 108-109.

self-regulating social systems.⁵⁶ Both Smith and Darwin were part of a much broader cultural search for ways of understanding society and nature that accounted for order, design, and purpose without appealing to miracles, final purposes, or an intervening God. That they should hit upon similar ideas of self-regulating systems is not surprising.⁵⁷ Ironically, Darwin's appropriation of the law of unintended consequences to serve his own purposes had the troubling consequence of undermining the Scottish philosophy's arguments for design.⁵⁸

Darwin's search for immanent laws that would lead to self-regulating biological systems also led him to Thomas Malthus's *Essay on the Principle of Population*, a most surprising source. The reverend Malthus had written his book in 1798 at the height of the French Revolution as a polemic against the utopian dream of the atheist William Godwin who taught that abolishing social inequalities would usher in universal happiness and human perfection. Malthus claimed that God had designed

⁵⁶ Silvan Schweber is more confident that "the fact that variations are chance elements . . . made Darwin look at Adam Smith and other Scottish economists and moral philosophers to see how a theory . . . with random elements can account for the stability of the social and economic order." "The Origin of the *Origin* Revisited," 282.

⁵⁷ It is a most intriguing question, which we cannot explore in this context, whether Smith's theory accurately captured the complexity of society, whether Darwin accurately understood Smith's theory and metaphors, and then to ask what warrant he had for using social phenomena to illuminate the activity of all organic phenomena. What does this analogy capture in their similarities and what does it distort? Darwin does appear to be constantly tempted to forget the fragility of this and numerous other analogies he drew and run them into identities. In this case, it seems clear that Darwin was more inspired than influenced by Smith's theory.

⁵⁸ There is an intriguing parallel between Smith's "invisible hand" and Darwin's "Master Breeder," as well as Maxwell's "demon," that merits further exploration. See Silvan S. Schweber, "Aspects of Probabilistic Thought in Great Britain During the Nineteenth Century: Darwin and Maxwell," in *Probability Since 1800: Interdisciplinary Studies of Scientific Development* (Bielfeld: Universitat Bielfeld, 1983), 41-96.

the fundamental laws of political economy and established firm limits to social progress that radicals ignored at society's peril. The most significant law of nature that Malthus claimed to have discovered was that populations grew geometrically while available food supply grew only arithmetically. God had established this law, Malthus observed, to goad the promiscuous into exercising sexual restraint and the indolent into improving their material conditions. Personal discipline, industry, even emigration, were the only way that individuals could improve their lives. The sober reality, Malthus warned, was that without these moral virtues population growth could only be checked by the external pressures of starvation, disease, war, and death. Since this was a natural law even charity and governmental assistance to the downtrodden, however well-meaning, only aggravated the consequences. He concluded that "this natural inequality of the two great powers of population and of production in the earth, and that great law of our nature which must constantly keep their efforts equal, form the great difficulty that to me appears insurmountable in the way to the perfectibility of society. . . I see no way by which man can escape from the weight of this law which pervades all animated nature."⁵⁹ No wonder political economy after Malthus became known as the "dismal science."

Malthus was the center of explosive political turmoil throughout England in the late 1830s. His doctrines shaped the nation's New Poor Law of 1834. The severe restrictions on charity for the poor that it called for, coupled with the severe

⁵⁹Quoted in Roger Smith, *The Norton History of the Human Sciences* (New York: W. W. Norton & Co., 1997), 333.

depression created by the Corn Laws, fueled a groundswell of protest and rioting among the poor and unemployed throughout England. Malthus's doctrines were roundly denounced as the root of the people's troubles and hailed by the Whigs as the source of the nation's prosperity. By 1838 a mass movement emerged that demanded a People's Charter of reform; a dramatically new principle of charity headed the list. The abstract Malthus Darwin first encountered while reading Paley as a student at Cambridge was now the center of controversy within his social and intellectual circle and the periodicals he regularly read at the Athenaeum Club.⁶⁰

Malthus's influence on Darwin is as well-known as it is ambiguous and controversial. The crucial entries from his D Notebook on 28 September 1838 captured the rush of implications and sketches of half-formed thoughts that he found in Malthus.

I do not doubt, every one till he thinks deeply has assumed that increase of animals exactly proportional to the number that can live. We ought to be far from wondering of changes in number of species, from small changes in nature of locality. Even the energetic language of Decandoelle does not convey the warring of the species as inference from Malthus. -- in Nature production does not increase, whilst no checks prevail, but the positive check of famine & consequent death.

Population in increase at geometrical ratio in FAR SHORTER time than 25 years -- yet until the one sentence of Malthus no one clearly perceived the great check amongst men. -- Even a *few* years plenty, makes population in Men increase, & an *ordinary* crop causes a dearth then in Spring, like food used for other purposes as wheat in making brandy. -- take Europe on an average, every species must have same number killed, year with year, by hawks, by cold &c -- even one species of hawk decreasing in number must effect instantaneously all the rest. -- One may say there is a force, like a hundred thousand wedges trying force into every kind of adapted structure into the gaps of the oeconomy of Nature, or

⁶⁰James Moore and Adrian Desmond have deepened our understanding of the broader social and political context of Darwin's reading of Malthus in *Tormented Evolutionist*, 264-268.

rather forming gaps by thrusting out weaker ones. The final cause of all this wedgings, must be to sort out proper structure & adapt it to change.-- to do that, for form, which Malthus shows, is the final effect, (by means however of volition) of this populousness, on the energy of Man.⁶¹

Darwin reflected in his autobiography that after reading Malthus "for amusement" and reflecting on his prior appreciation for the struggle for existence, he soon realized that he "had at last got a theory by which to work."⁶²

What did Malthus contribute to Darwin's search for a natural law that would give the appearance of design and final cause? It is tempting to answer that Darwin simply accepted the Malthusian thesis and extended it to include the non-human world. Close study, however, reveals only a superficial similarity between Malthus's thesis and the theory that Darwin claimed to have gotten from him.⁶³ Darwin was already familiar with De Candolle's emphasis on the "war" between plants in the same locale. He was struck by what appeared to be a remarkable parallel between the fierce competitive struggles among individuals in the crush of both non-human and human populations. Malthus had portrayed the dreary immediate consequences of this struggle among individuals for limited resources; he justified these consequences by showing how God used them to instill the social virtues essential for individual and social well-being. Darwin had no interest in Malthus's static system and theodicy; he

⁶¹D135-36.

⁶²*Autobiography*, 120.

⁶³Two of the most revealing analyses of the ambiguous Malthusian influence are given in Edward Manier, *The Young Darwin*, 75-85, and Elizabeth Wolgast, "The Invisible Paw," *Monist* 67 (1984): 229-250.

was much more interested in the creative theoretical potential of the struggle in forming new species. Malthus's descriptive competitive struggle became Darwin's creative agent with the "force, like a hundred thousand wedges" that was actively "thrusting out weaker" adaptations. He transformed the transcendent "final cause" of natural theology into the immanent "final cause of all this wedgings," the sorting out of proper structures and adapting them to changed living conditions. Such was the natural law that Darwin discovered in Malthus.

By early October, while finishing Malthus's *Essay*, Darwin exulted in the omnipotence of this immanent law by inverting Malthus's argument for the divine character of the law of population. He copied out the following section in his notebook:

'It accords with the most *liberal!* spirit of philosophy to believe that no stone can fall, or plant rise, without the immediate agency of the deity. But we know from *experience!* that these operations of what we call nature, have been conducted *almost!* invariably according to fixed laws: And since the world began, the causes of population & depopulation have been probably as constant as any of the laws of nature with which we are acquainted.'⁶⁴

He had encountered the same statements *ad nauseam* in so many of the natural theology texts he had studied; he was already adept at showing how their claims for design and purpose could be countered with completely natural explanations. Darwin observed that Malthus had a narrow view of the extent of his law. He, on the other hand, "would apply it not only to population & depopulation, but extermination &

⁶⁴E3. The italics and exclamation points are Darwin's. They clearly show that Darwin was acutely aware of the ironic twist he was giving to what Malthus intended to be a pious affirmation that the Deity's laws extended even to the laws of population. Who had the "liberal" spirit? What had "experience" really shown? Were the laws only "almost" invariable?

production of new forms. -- their number & correlations." He had found an immanent creative law that filled all of the functions previously filled by the Deity of natural theology: it explained every essential dimension of organic life through the working of a natural process while yet appearing to be designed and guided by final causes. It would shortly be incarnated as "Natural Selection."

A third strand in Darwin's efforts to devise a naturalistic alternative to intelligent design of organic phenomena was his immersion in the revival underway since the early eighteenth century to conceive of nature as itself dynamic, active, and vital.⁶⁵ The British natural theologians of the seventeenth century had rather uncritically adopted the framework of the ancient Stoics in their debate with the Epicureans on the question of order, design, and purpose in the universe. Their strong commitment to the mechanical or corpuscular philosophy meant that they conceived of nature as being composed of passive, inert, and invisible atoms or corpuscles. Since nature was composed of material incapable of moving and shaping itself into intelligible patterns, an external source had to be found for their evident order. Would that external source be the Epicurean appeal to spontaneous order arising by chance, or the Stoic appeal to the providential design of "Nature," chance or design? Natural theologians in the Newtonian tradition overwhelmingly answered

⁶⁵Phillip Sloan has illuminated this significant and often overlooked background in Darwin's thought in three essays, "The Question of Natural Purpose," in Ernan McMullin, ed., *Evolution and Creation* (Notre Dame: University of Notre Dame Press, 1985), 121-152, "Darwin, Vital Matter, and the Transformism of Species," *Jour. Hist. Bio.* 19 (Fall 1986): 369-445, and "Introductory Essay: On the Edge of Evolution" in Phillip Reid Sloan, ed. *The Hunterian Lectures in Comparative Anatomy, May-June 1837: Richard Owen* (Chicago: University of Chicago Press, 1992), 1-72. My account leans heavily on Sloan's insights.

that since order arising in inert matter from chance was inconceivable, the only rational alternative was God, now subtly substituted for the "Nature" of Stoicism.

The increasing inability of Newtonian mechanics fully to explain unique and complex biological functioning encouraged medical writers in the early eighteenth century to revive earlier Aristotelian conceptions of immanent teleology and Renaissance notions of nature as an active power in the origin, development, function, and structure of organisms. This dynamic and vitalistic concept of nature was a radical alternative to the passive and inert material universe of the Newtonians. It also posed a serious threat to the traditional argument for design by offering a third alternative to chance or design. Nature could be seen as possessing its own independent powers, while subordinate to the Divine Will, that eliminated the need for God's constant interference or, more radically, Nature could be given sufficient inherent creative powers that God simply became unnecessary to explain the source of activity and order.

By the time Darwin opened his first transmutation notebook he was already familiar with this vitalistic perspective of nature through John Henslow's botany lectures at Cambridge, the writings of Augustin-Pyramus de Candolle, the prominent Swiss botanist, and the influence of Richard Owen, the respected comparative anatomist who worked through the mammalian fossils from the Beagle voyage. Darwin was early attracted to an essay by C. G. Carus on "The Kingdoms of Nature, their Life and Affinity" published in *Scientific Memoirs* for 1837 that echoed this vitalistic perspective. The following excerpts caught his particular attention:

As it follows . . . that life is not a single isolated reality, we shall be obliged to define it generally as the constant manifestation of an ideal unity through a real multiplicity, that is, the manifestation of an internal principle or law through outward forms. . . . Thus we find in fact the idea of life, that is, the constant manifestation of unity through multiplicity, exhibited by universal nature; and are therefore bound to consider nature collectively as one vast and infinite life, in which, through the extinction of any one of its various modifications, or the merging of a single external form or life in the universal life, is possible, an absolute and proper death is inconceivable

.....
 Now it is clear that the idea of life and that of an organism are essentially the same; . . . Universal nature is consequently to be considered as the highest, the most complete, the original organism.

.....
 As the plant may be considered a crystal continually developing itself in a constant change of its matter, in like manner the living animal body so nearly represents a plant which has reached a higher unity and faculty of self-determination, that although the animal still remains a part of a higher unity . . . yet this hold . . . is even less in degree than that which we observe in the plant as compared with the unorganized body. For this very reason, the animal presents, among natural bodies, the most perfect idea of an organism.⁶⁶

Darwin was struck by Carus's claim that "there is one living spirit, prevalent over this world . . . which assumes a multitude of forms each having acting principle according to subordinate laws. There is one thinking sensible principle . . . which is modified into endless forms, bearing a close relation in degree & kind to the endless forms of living beings."⁶⁷ Darwin reflected that Carus was especially strong in showing that life itself was under a law, just like the rest of the universe, and should be consulted for any future "metaphysical speculations" on life.⁶⁸ This sympathetic treatment of an

⁶⁶Excerpts quoted from footnotes 103-2, 103-3, and 103-4 in *Darwin's Notebooks*, 270.

⁶⁷C210. His summary of what he had gleaned from Carus, immediately prompted Darwin to speculate on how the "various shades of separation" of rationality, emotion, and habit unified all living things, from polyp to humans.

⁶⁸C104.

immanent teleology in nature resonated throughout the transmutation notebooks and subsequent thought.⁶⁹

During the spring of 1839 Darwin reread his grandfather's *Zoonomia*, a speculative understanding of the evolution of life, which he greatly admired.⁷⁰ In the context of developing his own speculative understanding of evolution, Erasmus Darwin summarized what he took to be Hume's central philosophical understanding of nature in which nature became a dynamic, life-giving, immanently guided process. Now both his grandfather and David Hume confirmed his assumption that nature was a self-regulating system.

The influence and transmutation of this vitalist perspective can be traced through four well-known passages from Darwin's "Sketch of 1842," the "Essay of 1844," his "Big Book on Species" from which the *Origin* was abstracted, and, finally, the *Origin* itself. Darwin gradually transformed his brief reflection on the power of a "sagacious being" in the "Sketch" into a fully complete dynamic natural process in the *Origin*. "If every part of a plant or animal was to vary . . . , and if a being infinitely more sagacious than man (not an omniscient creator) during thousands and thousands of years were to select all the variations which tended toward certain ends," there is no limit to what could be produced. "Who, seeing how plants vary in garden, what

⁶⁹James G. Lennox has argued convincingly that Darwin retained a teleological dimension in his theory, though he abandoned the conventional theological and philosophical framework, in "Darwin Was a Teleologist." David Kohn underscores how Darwin secularized the teleology of natural theology in "Darwin's Ambiguity," 232-239.

⁷⁰Darwin first read his grandfather's book, under a good deal of pressure from his father, while a medical student at the University of Edinburgh.

blind foolish man has done in a few years, will deny an all-seeing being in thousands of years could effect (if the Creator chose to do so), either by his own direct foresight or by intermediate means, -- which will represent (?) the creator of this universe."⁷¹

Darwin elaborated on the superior power and penetrating insight of his "imaginary Being" to produce the most intricate and adaptive transformations of organisms in the "Essay of 1844."

Let us suppose a Being with penetration sufficient to perceive differences in the outer and innermost organization quite imperceptible to man, and with forethought extending over future centuries to watch with unerring care and select for any object the offspring of an organism produced under the foregoing circumstances; I can see no conceivable reason why he could not form a new race . . . adapted to new ends. As we assume his discrimination, and his forethought, and his steadiness of object, to be incomparably greater than those qualities in man, so we may suppose the beauty and complications of the adaptations of the new races and their differences from the original stock to be greater than in the domestic races produced by man's agency . . . with time enough, such a Being might rationally (without some unknown law opposed him) aim at almost any result.

Seeing what blind capricious man has actually effected by selection during the few last years, and what in a ruder state he has probably effected without any systematic plan during the last few thousand years, he will be bold person who will positively put limits to what the supposed Being could effect during whole geological periods" with secondary means of selection.⁷²

By 1854 Darwin dropped his focus on an imaginary "sagacious Being" to emphasize that Nature itself possessed incomparably superior selecting powers to those of humans.

See how differently Nature acts! By nature, I mean the laws ordained by God to govern the universe. She cares not for mere external appearance; she may be said to scrutinise with a severe eye, every nerve, vessel & muscle; every habit, instinct, shade of constitution, -- the whole machinery of the organisation. There

⁷¹*Foundations of the Origin of Species*, "Sketch of 1842," 6.

⁷²*Foundations of the Origin of Species*, "Essay of 1844," 85-87.

will be here no caprice, no favouring: the good will be preserved & the bad rigidly destroyed, for good & bad are all exposed during some period of growth or during some generation, to a severe struggle for life. Each being will live its full term & procreate its kind, according to its capacity to obtain food and escape danger. Nature will *never* select any modification without it gives some advantage to the selected being over its progenitors under the conditions to which it is exposed.

Can we wonder then, that nature's productions bear the stamp of a far higher perfection than man's product by artificial selection. With nature the most gradual, steady, unerring, deep-sighted selection, -- perfect adaptation to the conditions of existence, -- the direct action of such conditions -- the long-continued effects of habit & perfect training, all concur during thousands of generations. . . . If we admit, as we must admit, that some few organic beings were originally created, which were endowed with a high power of generation, & with the capacity for some slight inheritable variability, then I can see no limit to the wondrous & harmonious results which in the course of time can be perfected through natural selection.⁷³

Darwin finally transferred all of the attributes that natural theology had traditionally ascribed to the Deity on the basis of its inductive examination of nature to Nature itself; *she* now was fully omniscient, omnipotent, and omnipresent.

The transformation became complete in the *Origin*. There Darwin dropped all pretense to identifying natural selection as the mode of the Deity's operation in Nature. The *Creator* of the "Sketch" was fully transformed into the "Nature" of "natural selection."

As man can produce and certainly has produced a great result by his methodical and unconscious means of selection, what may not nature effect? Man can act only on external and visible characters: nature cares nothing for appearances, except in so far as they may be useful to any being. She can act on every internal organ, on every shade of constitutional difference, on the whole machinery of life. Man selects only for his own good; Nature only for that of the being which she tends. Every selected character is fully exercised by her; and the being is

⁷³Robert C. Stauffer, ed., *Charles Darwin's Natural Selection: Being the Second Part of His Big Species Book Written from 1856 to 1858* (Cambridge: Cambridge University Press, 1975), 224-225.

placed under well-suited conditions of life. . . . How fleeting are the wishes and efforts of man! how short his time! and consequently how poor will his products be, compared with those accumulated by nature during whole geological periods. Can we wonder, then, that nature's productions should be far 'truer' in character than man's productions; that they should be infinitely better adapted to the most complex conditions of life, and should bear plainly the stamp of far higher workmanship?

It may be said that natural selection is daily and hourly scrutinising, throughout the world, every variation, even the slightest; rejecting that which is bad, preserving and adding up all that is good; silently and insensibly working, whenever and wherever opportunity offers, at the improvement of each organic being in relation to its organic and inorganic condition of life.⁷⁴

Darwin had succeeded in endowing natural selection with the *appearance* of providential design. The vitalist tradition legitimized, though in a way different from its intention, Darwin's effort to find a fully natural mechanism that would insure the complete continuity and uniformity of nature.

By the time Darwin first responded to Gray's reviews he had reflected long and deeply on his central philosophical and methodological commitment to the continuity and uniformity of nature. He had probed and tested its implications for explaining a broad range of physiological, biological, social, and even religious phenomena. Finally, he had found in his theory of natural selection a naturalistic mechanism, a *vera causa* that he believed conformed to Herschel's criteria, that explained the transmutation of species far better than the creationist alternative. Nothing that Asa Gray, or any others of his most astute critics could say, would be able to successfully challenge Darwin's deepest philosophical commitment to the continuity and uniformity of nature.

⁷⁴*Origin*, 83-84.

Darwin's Firm Rejection of Gray's *Apologia*

Darwin was sincerely grateful for Gray's reviews. Through his impartial reviews Gray had gained a respectable hearing for Darwin's views, something that would have been much more difficult without them. At the same time, Darwin, slowly at first, and then building, challenged the central premises of Gray's interpretation of his thought and Gray's effort to portray Darwin's views as at least not inconsistent with scientific and theological orthodoxy.

The commonly-accepted distinction between theory and hypothesis was an essential element of Gray's philosophy of science and of his strategy for securing a fair hearing for Darwin. Following the empiricist tradition, Gray maintained that what we could claim to know with certainty was limited to the physical; observation and experiment guaranteed that it was, indeed, knowledge. High-level generalizations about the physical world that had been "physically demonstrated" were theories.

Hypotheses, on the other hand, were statements about the physical world and its causal relationships which lacked, whether inherently or because of insufficient experimental evidence, the required physical demonstration to class it as a theory. They were warranted by their power to explain the causal relationships, generally through a comprehensive explanation. Thus, in Gray's understanding, Darwin's claim was a *hypothesis* since, by the nature of the case, it was inherently impossible to offer physical demonstration. But, as Gray said, that did not mean Darwin's claim could be so easily dismissed. Hypotheses which demonstrated their superiority over their rivals by explaining the phenomena were useful to the naturalist. On these grounds, Gray

claimed that Darwin had presented a useful hypothesis, not a theory, on the origin of species.

In addition, Gray had stressed that both theories and hypotheses could only be about proximate or secondary causes which lay within the boundaries of the physical world. They could not, in principle, be about the Efficient or Final Cause since they could never provide an ultimate explanation of causality. While the Efficient Cause necessarily lay outside the boundaries of the physical world, its existence as a necessary ground for secondary causes could be known by inference, with 'moral certainty,' from the study of the secondary causes and effects. This was the epistemological foundation which warranted the natural theology tradition to infer the existence of a Designer from empirical observation of the natural world.

This was the reason Gray advised Darwin to speak of his views as a "tentative" or "tenable" hypothesis. It would save him unnecessary grief from empirical critics who would dismiss his suppositions because he offered no physical demonstration of descent. It would also protect him against the charge that he had eliminated design and Final and Efficient Causes. The assumptions on which these distinctions were built had been such a solid part of the natural theology tradition and its understanding of how to gain knowledge about the world that Gray felt fully warranted in explaining and interpreting what he considered to be Darwin's epistemological lapses and careless statements. In his mind, he was only doing what Darwin would have done or would do in the future, if given the opportunity. Gray did not have to wait long for Darwin's response.

During his last year as a student at Cambridge Darwin was smitten with Herschel's *A Preliminary Discourse on the Study of Natural Philosophy* (1830). He later reflected in his *Autobiography* that this book, along with Humboldt's *Personal Narrative*, were the two of the most influential books he had read. They both "stirred up in me a burning zeal to add even the most humble contribution to the noble structure of Natural Science."⁷⁵ During the critical two years between July 1837 and July 1839 when Darwin was formulating his theory and actively involved with both Herschel and William Whewell in the Geological Society, Darwin read it more attentively.⁷⁶ His earlier close reading of Lyell's *Principles* strengthened his resolve to study Herschel.

Herschel, already knighted for his work in astronomy, articulated the prevailing view that physics and astronomy were the model sciences. Their astounding advances were made possible by following faithfully in Newton's methodological footsteps. The goal of all physical theories, according to Herschel, was to discover the "actual structure or mechanism of the universe and its parts, through which, and by which, those processes [of nature] are executed; and of the *agents* which are concerned in their performance."⁷⁷ Scientific *theories* were statements that identified those agents, the *verae causae*, of the phenomenon on the

⁷⁵ *Autobiography*, 67-68.

⁷⁶ Darwin kept a list of books he read in working out his theory at the end of his C Notebook. On the basis of his comments in N49, it is most likely that Darwin read and annotated *Preliminary Discourse* in late October or November 1839. *Charles Darwin's Notebooks*, C269-275.

⁷⁷ *Preliminary Discourse*, 191. Italics added.

basis of rigorous induction from their observed effects.

These agents are not to be arbitrarily assumed; they must be such as we have good inductive grounds to believe do exist in nature, and do perform a part in phenomena analogous to those we would render an account of; or such, whose presence in the actual case can be demonstrated by unequivocal signs. They must be *verae causae*, in short, which we can not only show to exist and to act, but the laws of whose action we can derive independently, by direct induction, from experiments purposely instituted; or at least make such suppositions respecting them as shall not be contrary to our experience, and which will remain to be verified by the coincidence of the conclusions we shall deduce from them, with facts.⁷⁸

The theory of gravity was the ideal theory. The agent was a force which acted on all material bodies to draw them toward each other, as the moon was drawn to the earth by an observable and verifiable force. Gravity, though invisible, was a physical *vera causa*.

Darwin was painfully aware that his "theory" lacked a *vera causa*; he could not identify any agent that was responsible for the effect of transmuted species. Herschel, however, inspired him to continue in his quest by endorsing the "bold hypothesis." "Hypotheses . . . afford us motives for searching into analogies; grounds of citation to bring before us all the cases which seem to bear upon them, for examination. A well imagined hypothesis, if it have been suggested by a fair inductive consideration of general laws, can hardly fail at least of enabling us to generalize a step further, and group together several such laws under a more universal expression." It may well be the case, Herschel continued, that

such a weight of analogy and probability may become accumulated on the side of

⁷⁸*Preliminary Discourse*, 197.

an hypothesis, that we are compelled to admit one of two things: either that it is an actual statement of what really passes in nature, or that the reality, whatever it be, must run so close a parallel with it, as to admit of some mode of expression common to both. . . . Now, this is a very great step, not only for its own sake, as leading us to a high point in philosophical speculation, but for its applications; because whatever conclusions we deduce from an hypothesis so supported must have at least a strong presumption in their favour: and we may be thus led to the trial of many curious experiments, and to the imagining of many useful and important contrivances.⁷⁹

Scientists can use hypotheses, Herschel cautioned, as long as they realize that their role is to lead to the *vera causa* of the phenomena and must be freely abandoned or modified when new facts come to light. Hypotheses were thus instrumental, provisional, and heuristic. Darwin exploited this opening.

Throughout his early correspondence with Gray and others Darwin vigorously defended his "theory" of natural selection against the prevailing view that only those generalized scientific statements that offered a *vera causa* were entitled to be called theories. Darwin was acutely aware that natural selection was not a *vera causa* in the Herschelian sense since there was no way possible to offer demonstrative proof of transmutation. He appreciated it when others understood that as well. But why should the lack of demonstrative proof prevent him and others from regarding it as a reasonable theory to be tested against the facts?

Over and over again he contended that his theory of natural selection was analogous with that of the theory of gravity and the undulatory theory of light. Darwin happily reported that Newton had countered Leibnitz's charge that gravity

⁷⁹*Preliminary Discourse*, 196-197.

was an occult quality, not a *vera causa*, with the claim that his only responsibility as a natural philosopher was to explain the motion of the planets whatever the cause of their motion. The "attractive power" of the "*theory* of gravitation" is inferred only from being able to explain the phenomena of motion, Darwin explained.⁸⁰

Furthermore, "everyone now speaks of the undulatory *theory* of light; yet the ether is itself hypothetical & the undulations are inferred only from explaining the phenomena of light." Darwin wondered whether Sedgwick, who had severely criticized him for abandoning "the spirit of inductive philosophy," believed that "it was not allowable (& a great step) to invent the undulatory theory of light -- i.e. hypothetical undulations in a hypothetical substance the ether." If virtually all naturalists accepted the theory of light based on the hypothetical existence of the ether, Darwin believed that they must also accept his theory of the origin of species based on the hypothetical existence of natural selection.⁸¹

⁸⁰Darwin to Gray, 18 February 1860, *CCD* 8: 91-92; Darwin to Lyell, 23 February 1860, *CCD* 8: 102-103; Darwin to Gray, 24 February 1860, *CCD* 8: 106-107. Darwin is being disingenuous here. That it came to be known as the *theory* of gravity is testimony more to the prestige of Newton than to the fact that it had satisfied all of the elaborate criteria of induction in order to be elevated to the advanced rank of *theory*. Furthermore, despite Newton's prickly defense of "gravity" as an induction from the phenomena, the sober reality was that "gravity" was a hypothetical entity brought in to explain the phenomena of planetary motion. Newton was unable to make good his claim that "gravity" was a *vera causa*. Darwin, like Newton, wanted the prestige of having discovered a *vera causa* without all of the stringent inductive requirements.

⁸¹Darwin to Gray, 18 February 1860, *CCD* 8: 91-92; Darwin to Gray, 24 February 1860, *CCD* 8: 106-107; Darwin to Henslow, 18 May 1860, *CCD* 8: 194-196; Darwin to Hutton, 20 April 1861, *CCD* 9: 96.

Darwin was stretching his analogy between natural selection and gravity and the ether. He was acutely sensitive to the common criticisms, coming especially from Lyell and Gray, that he tended to personify or deify "Natural selection," a criticism his often confused phrasing encouraged. At the same time he strongly insisted that "natural selection" was not an active agent that was in principle capable of being discovered. If this was Darwin's fundamental understanding, then "natural selection"

Darwin was equally delighted to bask in the glow of what he took to be John Stuart Mill's endorsement of his "inductive" method. Henry Fawcett informed Darwin that Mill had personally told him that Darwin's "reasoning throughout is in the most exact accordance with the strict principles of logic" and that he had followed the only method of investigation available to him.⁸² He quickly informed Gray that, after being repeatedly criticized for violating the standards of induction, he was extremely pleased to have the support of England's "highest authority on such subjects." Perhaps Emma's remark that C.D. knew nothing about logic was close to the mark, since Mill's support was not as strong as Darwin took it to be.⁸³ Mill had actually said that Darwin's "remarkable speculation" was a "legitimate hypothesis." Since Darwin had never presented his hypothesis as proved, he was bound only by the rules of hypothesis, which required only probability, not induction, which required demonstrable physical proof. This was exactly the point Gray had labored so hard to make only to have Darwin reject it. But, no matter. Darwin accepted any support, however tempered with reservations, that soothed the constant stings of rebuke from

could not be a *vera causa* in the Newtonian-Herschelian tradition. It was not in any way analogous to Newton's postulation of "gravity" as the *vera causa* of planetary motion. The analogy with the hypothetical medium of the ether in the undulatory theory of light served his purpose even less well. He surely did not believe that his theory of "natural selection" had only heuristic value, that it was merely a useful fiction to guide scientific research. He, like Copernicus, strongly resisted this effort to "save the appearances." He believed "natural selection" was a real phenomena, however riddled with inconsistencies and unsolved problems. That Darwin should compare "natural selection" with the ether is especially ironic since physicists subsequently abandoned the hypothetical ether as unnecessary.

⁸²Henry Fawcett to Darwin, 16 July 1861, CCD 9: 204-205.

⁸³Darwin to Gray, 21 July 1861, CCD 9: 213-216.

his enemies.⁸⁴

The true test of any scientific statement, in Darwin's view, was finally whether it explained a host of widely differing phenomena, not whether it met the strict tests of induction. He explained to several correspondents that

The fair way to view the argument of my book, I think, is to look at Natural Selection as a mere hypothesis (though rendered in some degree probable by the analogy of method of production of domestic races; & by what we know of the struggle for existence) & then to judge whether the mere hypothesis explains a large body of facts in Geographical Distribution, Geological Succession, & more especially in Classification, Homology, Embryology, Rudimentary Organs [.] The hypothesis to me does seem to explain several independent large classes of facts; & this being so, I view the hypothesis as a theory having a high degree of probability of truth. All turns on whether the above classes of facts seem to you satisfactorily explained or not.⁸⁵

Darwin returned time and again to this criteria for the validity and truthfulness of natural selection, even when isolated difficulties seemed to count most strongly against it. He did not believe in natural selection because he could "prove in any single case that it has changed one species into another, but because it groups &

⁸⁴ CCD 9: 205 for the relevant citations from Mill.

⁸⁵ Darwin to Samuel Pickworth Woodward, 6 March 1860, 122-124; cf. Darwin to C. J. F. Bunbury, 9 February 1860, CCD 8: 76-77; Darwin to Huxley, 5 December 1860, CCD 8: 595.

Darwin could also have appealed to the authority of Herschel for this view. Herschel maintained that "when a theory will bear the test of such extensive comparison, it matters little how it has been originally framed. However strange and, at first sight, inadmissible its postulates may appear, or however singular it may seem that such postulates should have been fixed upon, -- if they only lead us, by legitimate reasonings, to conclusions in exact accordance with numerous observations purposely made under such a variety of circumstances as fairly to embrace the whole range of the phenomena which the theory is intended to account for, we cannot refuse to admit them; or if we still hesitate to regard them as demonstrated truths, we cannot, at least, object to receive them as temporary substitutes for such truths, until the latter shall become known. If they suffice to explain all the phenomena known, it becomes highly improbable that they will not explain more; and if all their conclusions we have tried have proved correct, it is probable that others yet untried will be found so too; so that in rejecting them altogether, we should reject all the discoveries to which they may lead." *Preliminary Discourse*, 208-209.

explains well (as it seems to me) a host of facts in classification, embryology, morphology, rudimentary organs, geological succession & Distribution."⁸⁶ On this basis, Darwin maintained that "It seems to me that an hypothesis is developed into a theory solely by explaining an ample lot of facts."⁸⁷ His view on the origin of species was already, or approaching, the status of theory. Darwin privately scuttled Gray's elaborate public efforts to save the appearance of his methodological orthodoxy.

Darwin's Muddle Over Design and Natural Selection

The third major plank of Gray's *apologia* for Darwin's orthodoxy rested on his claim that natural selection could be made compatible with theism and the traditional design argument for the existence of God. Gray had contended that design by a Supreme Intelligence was the only rational explanation for the order in the universe and that the existence of an Efficient Cause could and must be inferred with "moral certainty" from the evidence of wonderfully designed adaptations. Understood in this way natural selection, so Gray argued, was not incompatible with traditional natural theology. Darwin was impressed with Gray's ingenuity and rhetorical skill in

⁸⁶Darwin to Cuthbert Collingwood, 14 March 1861, *CCD* 9: 53-55; cf. Darwin to Leonard Jenyns, 7 January 1860, *CCD* 8: 24-25; Darwin to G. H. K. Thwaites, 21 March 1860, *CCD* 8: 131-132; Darwin to Herschel, 23 May 1861, *CCD* 9: 135-136.

⁸⁷Darwin to Gray, 18 February 1860, *CCD* 8: 91-92.

Darwin's perspective in these statements demonstrate that, for him, the truth of his theory did not rely on discovering the *vera causa* of transmutation at all. At some level he understood that there simply was no analogue in his theory of natural selection with either gravity or the ether. It rather relied on what Whewell had termed a "consilience of inductions," the claim that the probable truth of a hypothesis increased as it was confirmed by several independent lines of inductive arguments. That was the bedrock of Darwin's belief that a theory that explained so many distinctive realms of natural history could not be totally false, whether or not it had discovered the *vera causa*. That also explains his view that a hypothesis *becomes* a theory as its explanatory range is extended and deepened.

shielding him against the charge that his views were atheistic and undermined the design argument. At the same time he was deeply ambivalent about the fundamental premises of Gray's argument.⁸⁸

By 1859, as we have already traced in some detail, Darwin had already spent more than twenty years probing and puzzling over the implications of Paley's utilitarian design argument for understanding the origin of species. Darwin, contrary to Paley's intentions, was interested in the "ordinary" view of creation and the design argument as a research program in unraveling the mysteries of Nature, not in whether it provided inescapable proof for God's existence and attributes. As he told Gray and others, he had no intent to write atheistically.⁸⁹ Rather he had gradually become convinced that the "ordinary" view was completely incapable of providing any effective guidance for the rigorous study of the complex issues touching on the origin of species; he believed it was empirically and theoretically bankrupt. Throughout the *Origin* Darwin brooded and puzzled over genuine empirical and theoretical dilemmas that the received versions of the paradigms of science and natural theology could not

⁸⁸The following discussion of Darwin's "muddle" over design extends and deepens Neil Gillespie's suggestive comment in *Charles Darwin and the Problem of Creation* that "Darwin's relationship to the idea of intelligent design in the world was consistently ambivalent," 86.

⁸⁹Darwin's claim that he had "no intention to write atheistically" must be carefully interpreted. The truth is that by 1859 he had lost any significant philosophical or religious concern for the existence of God and the natural theology project of demonstrating his existence and attributes by appeals to the world's design. Darwin's theological understanding of the Christian faith, the Bible, and theology was superficial at best. The "theism" he claimed for himself in his *Autobiography* when he wrote the *Origin* had lost contact with the Trinitarian confession of Christianity and the Creed of the Church of England; it had long since been evacuated of any meaningful content. It remained only as a badge of respectability for a country squire. While he flirted with the radical views of his brother's London friends, Darwin was too shy to openly avow atheism. With this context in mind, to argue whether Darwin was a "theist" or not in 1859 is to juggle labels.

answer. The *Origin* was "one long argument" against the weak and vacuous answers the "ordinary" view of creation offered to Darwin's pressing questions about the origin of species. He believed his alternative explanation of modification by descent through natural selection was a more reasonable explanation of the known phenomena. Yet he was not completely satisfied with his own answers.

Throughout his correspondence with Gray and others during 1860-61 Darwin confessed that he was still in a "deep muddle" over the meaning of design and its bearing on his theory of natural selection in the origin of species.⁹⁰ Contrary to the widely held perception that Darwin focused on criticizing Paley's utilitarian design argument, we discover that Darwin had other, more substantive, philosophical and

⁹⁰Scholars have surprisingly given little deepened attention to Darwin's wide-ranging reflections on the design argument. In addition to the sources cited in note 21, the following are useful in tracing not only Darwin's own thinking on design, but in illustrating how scholars have exploited what they have taken to be Darwin's conclusions: John Dewey, "The Influence of Darwin on Philosophy," in *Darwin on Philosophy and Other Essays in Contemporary Thought* (New York: Holt, 1910), 1-19; Alvar Ellegard, "The Darwinian Theory and the Argument from Design," *Lychnos* (1956): 173-192; James Collins, "Darwin's Impact on Philosophy," *Thought* 34 (1959): 185-248; Ernst Mayr, "Accident or Design, the Paradox of Evolution," in *The Evolution of Living Organisms*, ed. G. W. Leper (Melbourne: Melbourne University Press, 1962), 1-14; H. Bartov, "A Fortiori Arguments in the Bible, in Paley's Writings and in the 'Origin of Species,'" *Janus* 64 (1977): 131-145; Peter J. Bowler, "Darwinism and the Argument from Design: Suggestions for a Reevaluation," *Jour. Hist. Bio.* 10 (Spring 1977): 29-43; Dov Ospovat, "God and Natural Selection: The Darwinian Idea of Design," *Jour. Hist. Bio.* 13 (Fall 1980): 169-194; Phil Diamond, "The Natural Theologians and Darwin: A Case of Divergent Evolution in the History of Ideas," *Australian Journal of Politics and History* (26 (1980): 204-211; David N. Livingstone, "The Idea of Design: The Vicissitudes of a Key Concept in the Princeton Response to Darwin," *Scottish Journal of Theology* 37 (1984): 329-357; John F. Cornell, "Newton of the Grassblade? Darwin and the Problem of Organic Teleology," *Isis* 77 (1986): 405-421; Richard Dawkins, *The Blind Watchmaker* (New York: W. W. Norton, 1986); John F. Cornell, "God's Magnificent Law: The Bad Influence of Theistic Metaphysics on Darwin's Estimation of Natural Selection," *Jour. Hist. Bio.* 20 (Fall 1987): 381-412; James A. Sadowsky, "Did Darwin Destroy the Design Argument?," *International Philosophical Quarterly* 28 (March 1988): 96-104; David N. Livingstone, "The Darwinian Diffusion, Darwin and Darwinism, Divinity and Design," *Christian Scholar's Review* 19 (1989): 186-199; Dennis Dennett, *Darwin's Dangerous Idea: Evolution and the Meanings of Life* (New York: Simon & Schuster, 1995); Michael J. Behe, *Darwin's Black Box: The Biochemical Challenge to Evolution* (New York: Simon & Schuster, 1996).

theological issues in mind. He raised nuanced objections, unsolved puzzles, and contradictory views that, on his understanding, weakened the "ordinary" view of creation and design. The issues he raised underscored several key philosophical and theological problems that compromised the reigning paradigms of science and natural theology and hung as a dark cloud over the debate on the *Origin*. As we unravel his "muddle" we come to appreciate that Darwin understood the complexities of the issues posed by these paradigms better than did his critics who blithely believed that all was well in the houses of science and natural theology. Perhaps Darwin was close to the truth when he blurted out that trying to understand these dilemmas was like a dog trying to understand Newton or trying to teach Euclidian geometry to a gorilla.⁹¹

By the spring of 1860, after showering fulsome praise on Gray for his *American Journal of Science* review, Darwin confessed his bewilderment on the issue.

With respect to the theological view of the question; this is always painful to me. -- I am bewildered. -- I had no intention to write atheistically. But I own that I cannot see, as plainly as others do, & as I sh[oul]d wish to do, evidence of design & beneficence on all sides of us. There seems to me too much misery in the world. I cannot persuade myself that a beneficent & omnipotent God would have designedly created the Ichneumonidae with the express intention of their feeding within the living bodies of caterpillars, or that a cat should play with mice. Not believing this, I see no necessity in the belief that the eye was expressly designed. On the other hand I cannot anyhow be contented to view this wonderful universe & especially the nature of man, & to conclude that everything is the result of brute force. I am inclined to look at everything as resulting from designed laws, with the details, whether good or bad, left to the working out of what we may call chance. Not that this notion at all satisfies me. I feel most deeply that the whole subject is too profound for the human intellect. A dog might as well speculate on the mind of Newton. -- Let each man hope & believe what he can.

Certainly I agree with you that my views are not at all necessarily atheistical.

⁹¹Darwin to Gray, 22 May 1860, *CCD* 8: 223-226; Darwin to Gray, 11 December 1861, *CCD* 9: 368-370.

The lightning kills a man, whether a good one or bad one, owing to the excessively complex action of natural laws, -- a child (who may turn out to an idiot) is born by action of even more complex laws, -- and I can see no reason, why a man, or other animal, may not have been aboriginally produced by other laws; & that all these laws may have been expressly designed by an omniscient Creator, who foresaw every future event & consequence. But the more I think the more bewildered I become; as indeed I have probably shown by this letter.⁹²

This letter outlines all of the major issues and unsettling dilemmas that troubled Darwin about the traditional design argument for the existence and attributes of God and the origin of species on the "ordinary" view of creation. He simply had too many unanswered or poorly answered questions to allow him to assent to traditional beliefs in God based on the design of the natural world.

The great irony was that Darwin was just the kind of person whom the proponents of the design argument believed would and should be convinced by the empirical and logical cogency of their arguments. But if Darwin was not persuaded by the premises and claims of the design argument, where did the fault lie? The reality was that Darwin's "muddle" was rooted in the grave weaknesses of the design argument itself, its allegiance to post-Newtonian physics as the model of "science," its superficial understanding of God's relationship to the world, his own inability to break through the mechanistic and deterministic character of post-Newtonian philosophy of science, and his commitment to the continuity and uniformity of nature. Darwin explored the many facets of his "muddle" over design in his correspondence during those critical first years of the debate.

⁹²Darwin to Gray, 22 May 1860, *CCD* 8: 223-226.

The design argument had rather breezily assumed that the goodness of God was wonderfully revealed in every aspect and functioning of Nature. Proponents often went to bold lengths to "save the appearance" of God's goodness in the face of embarrassing realities to the contrary. But Darwin knew too much about the misery and evil in the natural world -- as well as in his personal life -- to be persuaded by these shallow arguments. He was, in fact, repulsed by the notion that such a God could have "designedly created" the many obvious evils of Nature. Did Gray really believe that God intentionally created the Ichneumonidae to feed "within the living bodies of caterpillars" or cats to play with mice? Darwin pressed Gray with further questions about the relationship between design and evil:

I see a bird which I want for food , take my gun & kill it, I do this *designedly* -- An innocent & good man stands under a tree & is killed by flash of lightning. Do you believe (& I shd like to hear) that God *designedly* killed this man? Many or most persons do believe this; I can't and don't. -- If you believe so, do you believe that when a swallow snaps up a gnat that God designed that particular swallow shd snap up that particular gnat world.⁹³

How odd: Darwin's protest against making God responsible for evil was fully in line with what orthodox Christian theologians had historically taught. This essential Christian insight had been clouded by the uncritical zeal of many natural theologians who were determined to see design everywhere and in everything in the world.

Not only did Darwin question whether God had "designed" the evils in the natural world, he questioned whether God had "designed" the innumerable contingencies that were so obvious to him in the natural world. Here he got to the

⁹³Darwin to Gray, 22 May 1860, *CCD* 8: 223-226; Darwin to Gray, 3 July 1860, *CCD* 8: 273-275; cf. Darwin to Hensleigh Wedgewood, 10 September 1860, *CCD* 8: 349-51.

heart of his criticisms of the "ordinary" view of creation in which God intervened in the world to bring about "designed" results or interfered with the "natural" laws already in place. Without fully understanding their import, Darwin was raising fundamental questions about God's relationship to the world, an understanding that was severely strained by the received Newtonian world picture. What his questions lacked in philosophical sophistication was more than compensated by his precise empirical knowledge of the world.

Darwin relentlessly pressed Gray and Lyell with the *reductio absurdum* of the "ordinary" view that God had designed each and every contingency that occurred. His study of domestic variation had persuaded him that there was "an enormous field of undesigned variability . . . ready for natural selection to appropriate for any purpose useful to each creature."⁹⁴ Darwin wondered whether Lyell actually believed that the "endless variations of domestic production which man accumulates for his mere fancy or use" were ordained.⁹⁵ Did Gray, Lyell, or Herschel actually believe "that God designed the feathers in the tail of the rock-pigeon to vary in a highly peculiar manner in order that man might select such variations & make a Fan-tail?"⁹⁶ Surely, neither Lyell nor Gray, Darwin wondered, believed that the exact shape of his

⁹⁴Darwin to Gray, 5 June 1861, *CCD* 9: 162-164.

⁹⁵Darwin to Lyell, 3 August 1861, *CCD* 9: 234-235.

⁹⁶Darwin to Gray, 26 November 1860, *CCD* 8: 496-498; Darwin to Herschel, 23 May 1861, *CCD* 9: 135-36; Darwin to Lyell, 1 August 1861, *CCD* 9: 225-227. Darwin could even imagine that if a wild pigeon were found that had used its abnormal fan-tail as a sail, everyone would extol it as a "beautiful & designed adaptation" to the laws of hydrostatics.

"cream-jug nose" was ordained "by an intelligent cause on a preconceived & definite plan."⁹⁷ Darwin contended that saying that God designed every contingency, every movement of the planets, every one of the endless variations that occurred in nature, was "mere verbiage" and "theological pedantry." It explained nothing and would surely spell the doom of all scientific inquiry.⁹⁸

Darwin believed that if Gray and Lyell failed to affirm design in each and every instance, they had no grounds for claiming that God had "designed" the variations that had been preserved by natural selection. If God did not design the evil events that daily occurred in nature, then Darwin saw "no necessity in the belief that the eye was expressly designed."⁹⁹ If God did not design the deaths of men and gnats, Darwin saw no good reason to believe that their "FIRST birth or production should be necessarily designed."¹⁰⁰ If God did not design the variation of the feathers of the rock-pigeon to please the whimsy of domestic breeders, Darwin could not "see design in the variations of structure in animals in a state of nature.--those variations which were useful to the animal being preserved & those useless or injurious being destroyed."¹⁰¹ Hence, his muddle: how was it possible to empirically determine which

⁹⁷Darwin to Lyell, 21 August 1861, *CCD* 9: 237-240; Darwin to Gray, 17 September 1861, *CCD* 9: 266-268; Darwin to Gray, 11 October 1861, *CCD* 9: 301-302.

⁹⁸Darwin to Lyell, 3 August 1861, *CCD* 9:234-235.

⁹⁹Darwin to Gray, 22 May 1860, *CCD* 8: 223-226.

¹⁰⁰Darwin to Gray, 3 July 1860, *CCD* 8: 273-75.

¹⁰¹Darwin to Herschel, 23 May 1861, *CCD* 9: 135-36; cf. Darwin to Lyell, 1 April 1860, *CCD* 8: 160-61; Darwin to Lyell, 1 August 1860, *CCD* 8: 225-227; Darwin to Lyell, 13 August 1861, *CCD* 9: 234-35; Darwin to Gray, 17 September 1861, *CCD* 9: 266-68.

things, systems, and processes of Nature were designed by a beneficent God and which things were not? Neither Gray, Lyell, nor any of the natural theologians could answer that legitimate question. If they could not answer that question, why, Darwin wondered, should he assent to their claims that natural events and processes were designed?

What finally seemed to clinch Darwin's fading belief in the design of each unique part of an animal was his discovery of an alternative way for the same result to have been produced. Darwin admitted to Gray that he had formerly believed that each part of the animal had been uniquely designed. That belief evaporated, however, when he discovered "a way of its being formed without design, & *at the same time* saw in its whole structure (as in homologies, embryology, rudimentary organs, distribution &c) evidence. of its having been produced in a quite distinctive manner, i.e. by descent. . . ." He traced out this alternative route to adaptation most fully in his meticulous study of orchids. Darwin exclaimed to Gray that it now seemed "incredibly monstrous to look at an orchid as created as we now see it," since "every part reveals modification on modification."¹⁰²

Darwin used this same framework to show how natural selection could have formed the eye. Yes, he confessed that the part on the eye may have been weak; the eye had once made him "cold all over, but I have got over this stage of the complaint. . . ." He recovered by thinking about the "fine known gradations," a phrase repeated

¹⁰²Darwin to Gray, 11 October 1861, *CCD* 9: 301-302.

many times in his correspondence with Gray and others. Those gradations, like those between the swim-bladder and the lung, persuaded him that Natural Selection could originate even such a "wondrous organ" as the eye. Reason convinced Darwin that he could conquer the chill he might feel in contemplating how Natural Selection formed the eye by steadily gazing at the numerous "fine gradations." Perhaps, he implied, if Gray gazed intently at the gradations he, too, could see individuality melt into a continuum of being. These early comments must have only confirmed the urgency of Gray's question to Hooker and driven him to discuss this significant issue in greater depth in his Atlantic reviews.¹⁰³

Despite his repeated challenges to the "ordinary" view of design, Darwin confessed that it still held an irresistible attraction to him at some visceral level. He could not resist the strong impression that the grand scheme of nature was designed, *but*. . . . "All your arguments about Design," he admitted to Gray, "seem to me excellent. . . . I have a feeling that the existence of the multitude of Stars & the motion of the planetary system &c are equally good with living beings to prove a First Cause; & yet if there were no living things, there could hardly be design."¹⁰⁴ Perhaps the belief in design was less the product of our reflection on the world than it was the result of our being immersed in the world. Then again, he conceded to Herschel that "One cannot look at this Universe with all living productions & man without believing

¹⁰³Darwin to Gray, 8/9 February 1860, *CCD* 8: 74-76; Darwin to Gray, 24 February 1860, *CCD* 8: 106-107; Darwin to Gray, 3 April 1860, *CCD* 8: 140-142; Darwin to Gray, 3 July 1860, *CCD* 8: 273-74; Darwin to Gray, 11 August 1860, *CCD* 8: 317-319.

¹⁰⁴Darwin to Gray, 26 September 1860, *CCD* 8: 388-391.

that all has been intelligently designed; yet when I look to each individual organism, I can see no evidence of this."¹⁰⁵ He summed up his dilemma to Gray: "If anything is designed, certainly man must be; one's 'inner consciousness' (though a false guide) tells one so; yet I cannot admit that man's rudimentary mammae bladder drained as if he went on all four legs; and pug-nose were designed."¹⁰⁶ He was in a profound muddle over how he could maintain these two seemingly irreconcilable views. Such dilemmas, he lamented on numerous occasions, were as deep as those surrounding free will vs. necessity, the origin of evil, predestination, and foreordination.¹⁰⁷ Darwin took some small comfort from Kant who argued that directly opposite conclusions could be reached on the basis of the same evidence.¹⁰⁸

Kant does provide an important clue to the sources of the muddle that so

¹⁰⁵Darwin to Herschel, 23 May 1861, *CCD* 9: 135-36; cf. Darwin to Gray, 3 July 1860, *CCD* 8: 273-275; Darwin to Gray, 26 November 1860, *CCD* 8: 496-98.

¹⁰⁶Darwin to Gray, 11 December 1861, *CCD* 9: 368-70. Perhaps Darwin's inability to see "design" in the individual organism while being persuaded that it existed throughout the universe was parallel with his belief that his theory could not be proven at the level of the organism but must be inferred from its ability to group a host of independent facts.

¹⁰⁷Darwin to Gray, 24 February 1860, *CCD* 8: 106-107; Darwin to Lyell, 15 April 1860, *CCD* 8: 160-161; Darwin to Lyell, 1 August 1861, *CCD* 9: 225-227; Darwin to Gray, 17 September 1861, *CCD* 9: 266-68.

¹⁰⁸Darwin to Gray, 3 July 1860, *CCD* 8: 273-275. Darwin had caught the general drift of the four fundamental antinomies of pure reason that Kant outlined in the *Critique of Pure Reason* (1781), book II, chap. II. Kant argued that when pure reason, in its arrogance and pride, soared above and beyond the limits of experience, it fell prey to four pairs of contradictory claims about the nature of reality, each of which could claim empirical support and neither of which could be dismissed as unreasonable: 1) the world has a beginning/the world is eternal; 2) everything that exists coheres in a fundamental unity/ everything that exists is divisible and transitory; 3) humans are free agents/ humans are "bound in the chains of nature and fate;" 4) thought can know that an Ultimate Cause of the world exists/thought can never escape the order of nature. Thesis and Antithesis were inescapably bound together in a dialectical tension that reason was powerless to break. Darwin no doubt gained his passing knowledge of Kant from Whewell's *The Philosophy of the Inductive Sciences* (1840).

exasperated Darwin about the relation of the design argument and his theory of natural selection.

A central characteristic of Darwin's thought was its relentless drive to pursue the logical implications of ideas wherever they led, erode all boundaries of thought and nature, extend continuities *ad infinitum*, reduce all complexities to the simple, level all limits. We observed above that this characteristic was most fully developed in Darwin's commitment to the uniformity of nature and its laws. He showed the same tenacious insistence in turning the logic of the design argument inside out. The result in both cases was the same: he found himself mired in contradictory positions that became worse the more he struggled to conform them to a single principle of thought. The more he tried to reason his way out of his various dilemmas, the more he found himself committed to apparently irrational positions. No wonder Darwin felt bewildered, overwhelmed, and perhaps even sickened by the consequences of his thought. He had, without fully understanding them, stumbled into the antinomies, contradictions, and inconsistencies that were the legacies of the post-Newtonian understanding of God's relationship to the world.

One of the central tensions that trapped Darwin was how to understand "law" when applied to organic phenomena. By the mid-nineteenth century, under the towering influence of Newton, physics had become the paradigm science through its search for the uniform laws of matter in motion throughout the universe. The Newtonian model of "law" and "lawfulness" was the solar system. Newton had elegantly demonstrated how stars, planets, and all earthly physical objects invariably

obeyed the simplest mathematical laws. It was this exalted view of the uniformity of law that gripped Darwin's imagination and drove his quest for the laws of organic change. He was firmly committed to the belief that the uniform reign of Law must cover the entirety of Nature, including the origin and functioning of all living beings, systems, and processes. Just as there were no breaks in the lawfulness of the solar system and all physical objects, so, too, Darwin believed, there must be no breaks in the lawfulness of all organic phenomena. Where others drew a sharp boundary between the lawfulness of inorganic phenomena and the realm of divine, organic, and all human activity, Darwin strove to draw a continuum. The origin of species must come under the rule of law.

The "god" that Darwin resisted, and the "god" that was most often hailed by the natural theologians, interfered with, intervened in, or in some way disrupted the lawful causal nexus in the world. What room could there possibly be for both "god" and "law" in the Newtonian universe? The most influential answer to this question was framed by Kant who sought refuge from the antinomies of pure reason in a world he compartmentalized into the realm of freedom (occupied by personal morality and belief in God) and the realm of necessity (occupied by empirical reality under deterministic law) which he hoped would establish peace between these two realms. Darwin's commitment to "law" compelled him to reject this solution. He would choose for "law" whatever the consequences for "god."

At the same time Darwin had to fight for contingencies in the world, which seemed to defy lawfulness, against the claims of the advocates of design that all events

and processes in the world were divinely ordered, i.e. under law. He understood that innumerable contingencies played an important role in the organic realm, especially the variations which triggered his "law" of natural selection. That's why he resisted the notion that these contingencies were designed. Law and contingency seemed to be opposed to each other, yet he needed both to make sense of the world he knew. How could he have law without "god" while having contingencies without design?

Darwin intuitively understood that the "law" for the origin of species was of a distinctly different kind than the "law" for the revolution of the planets, though he (in common with his peers) lacked a vocabulary with which to articulate the crucial differences. He had no way of distinguishing the complex and regular patterns of the behavior of organic phenomena from the "laws" to which they were subject. It was easy and inconsequential for physicists to fail to distinguish between planetary laws and the uniform responses of the planets to those laws. This confusion was, however, of paramount importance when dealing with organic phenomena that had far broader ranges of possible behaviors than planets and rocks.

The best that Darwin could do to make sense of his muddle was "to look at everything as resulting from designed laws, with the details, whether good or bad, left to the working of what we may call chance."¹⁰⁹ Lightning occurs from the complex

¹⁰⁹Recent scholars have drawn a compelling relationship between Darwin's thinking about chance and law and the emergence of a new form of probability thinking shaped by Quetelet's statistical analyses of social phenomena. While it is no doubt true that Darwin's theorizing encouraged what Ernst Mayr called "population thinking" about the origin of species, it is still an open question how much Darwin understood and applied the statistical techniques of Quetelet or Maxwell in his own thinking. My study leads me to suggest that it was not important. If it had been, Darwin would have approached his discussion of design, chance, and law in a very different way. Outstanding essays on

interaction of natural laws; it is in that sense "designed." At the same time, Darwin maintained, lightning strikes both good and bad men by "chance," not through God's design. That lightning strikes is under law and God's design; who or what it strikes is purely by chance, not under any known law or God's design. In the same way, Darwin suggested, that an animal was generated by its parents comes under law; that this or that animal was generated resulted from chance, not God's design. At the same time he did not want to rule out the possibility that an "omniscient Creator . . . foresaw every future event & consequence."¹¹⁰ No wonder he was bewildered. How could the Creator, in this perspective, foresee every future contingency and yet not design them?

Darwin summed up the implications of this crude metaphysical position in his

probablism in the nineteenth century are found in Michael Heidelberger, Lorenz Kruger, and Rosemarie Rheinwald, eds. *Probability Since 1800: Interdisciplinary Studies of Scientific Development* (Bielefeld: Universitat Bielefeld, 1983) and Lorenz Kruger, Gerd Gigerenzer, and Mary S. Morgan, eds. *The Probabilistic Revolution* (Cambridge: MIT Press, 1987), 2 vols.

¹¹⁰Darwin to Gray, 22 May 1860, CCD 8: 223-226. Advocates of the design argument had posed the choice between "design" or "chance." This false choice simply carried forward the ancient debate between the Epicureans, who saw the order of the universe arising out of the random collision of atoms, and the Stoics, who countered that every detail of the universe was under the providential control of the Divine. Unfortunately, orthodox Christianity and post-Newtonian natural theology uncritically adopted the Stoic position as most compatible with an orthodox understanding of God's providential relationship to the world.

It seems clear that Darwin understood "chance," not as the Epicureans did, but much more like Aristotle and the classical Christian understanding in which an event happened by "chance" or "accident" when two independent lines of causation intersected, e.g. as when a person "accidentally" discovers buried treasure while digging a grave, as Aristotle explained. This is the sense he had in saying that a variation by "chance" is useful to the survival of an organism. The origin and the usefulness of the variation are two independent lines of causality. Being created it was subsequently found to be useful to the organism's survival; it was not created in order that it would subsequently be found useful. Darwin was resisting the notion that all events and processes in nature necessarily occur as a result of God's design or providence. Aquinas and the classical Christian tradition fought that same battle centuries earlier. Unfortunately, post-Newtonian natural theology overturned that victory and entangled orthodoxy once again in the false choice between "design" and "chance."

sharp criticism of Gray's streams analogy. Gray had offered his analogy of streams being led along their channels by gravity as a way to interpret the relationship between natural selection and design: God guided variations in the same way that gravity guided a falling stream. Darwin spared Gray his harshest criticism by including it in a letter to Lyell in late summer 1861. Darwin admitted that he had received a good deal of mail on the issue of providential guidance and natural selection. He had also just seen Herschel's new edition of *Physical Geography*, which cautioned that "the higher law of Providential Arrangement should always be stated." Darwin found this distasteful. He then delivered his brutally frank assessment of Gray's analogy:

The view that each variation has been providentially arranged seems to me to make natural selection entirely superfluous, & indeed takes the whole case of appearances of new species out of the range of science. . . . It seems to me that variations in the domestic & wild conditions are due to unknown causes & are without purpose & in so far accidental; & that they become purposeful only when they are selected by man for his pleasure, or by what we call natural selection in the struggle for life & under changing conditions. . . . I doubt whether I have made what I think clear; but certainly A. Gray's notion of the courses of variation having been led like a stream of water by Gravity, seems to me to smash the whole affair. ¹¹¹

On Darwin's understanding the particular variations were contingencies; nothing compelled or necessitated these particular variations to occur or be useful to this particular organism. They "were due to unknown causes & are without purpose & in so far accidental." Since Darwin and his critics believed that a choice must be made between God/ design/providence and contingencies/ accidents/ chance events, Darwin felt compelled to give up God, design, and providence in order to save

¹¹¹Darwin to Lyell, 1 August 1861, CCD 9: 225-227.

variations.¹¹² At the same time he flinched from the unbearable tension this false choice created. "I do not wish to say that God did not foresee everything which would ensue; but here comes nearly the same sort of wretched embroglio as between free-will & preordained necessity."¹¹³ Indeed, it was. Unfortunately, neither Darwin, Gray, Lyell, nor Herschel had the intellectual resources to quiet this storm. Darwin concluded that Gray and Herschel's understanding of the subject was still "in Comte's theological stage of science."¹¹⁴

Darwin's "muddle" over design and natural selection graphically exemplified the disintegration of post-Newtonian natural theology. Orthodox Christianity had been so beguiled by the breath-taking world picture sketched by Newton that it uncritically adopted it as the framework for articulating its understanding of God's relationship to the world and defending its truth claims. By the time of the *Origin* many of the inadequate premises of the design argument and natural theology had been exposed by

¹¹²The natural theology tradition, from which Darwin learned his lessons on providence and contingency, by the mid-nineteenth century had departed significantly from the views of medieval theologians who had focused considerable attention on contingency and necessity in God's relationship to the world. Aquinas used his Aristotelian-Christian synthesis to summarize the nuances of these matters with depth and sophistication; c.f. *Summa Contra Gentiles*, Book 3: Providence, chaps. 71-77. The fracture of the Thomist synthesis created the dialectic between voluntarism, which emphasized God's freedom in the world and the subsequent contingency of events in the world, and rationalism, which emphasized the necessitarian character of God's relationship to the world and its subsequent deterministic structure. Margaret Osler illumines the centrality of this complex of issues in the seventeenth-century debate on Christianity and the mechanical philosophy in *Divine Will and the Mechanical Philosophy: Gassendi and Descartes on Contingency and Necessity in the Created World* (Cambridge: Cambridge University Press, 1994). Tragically, Darwin mistook his being trapped in the antinomies created by a superficial understanding of these issues for the deeper harmony that the classical Christian tradition had forged in the preceding centuries.

¹¹³Darwin to Lyell, 1 August 1861, *CCD* 9: 225-227.

¹¹⁴Darwin to Lyell, August, 1861, *CCD* 9: 226; cf. Darwin to Gray, September 17, 1861, *CCD* 9: 266-269 for Darwin's more gentle rejection.

its sternest critics and many of its most sympathetic friends. Darwin exposed many of those inadequacies in his debate with Gray, Lyell, and Herschel during the years 1860-61. Unfortunately, Darwin confused the "god" whose unworthiness he exposed with the God of classical orthodox Christianity.

Natural Selection not Inconsistent with Natural Theology

Darwin's rejection of Gray's efforts to "save the appearances" of his methodological and theological orthodoxy was filled with irony.¹¹⁵ While he was privately repudiating the major premises of Gray's *apologia* for his scientific and theological orthodoxy, Darwin yet keenly sensed how persuasive Gray's *Atlantic* articles could be in strengthening the public's perception of his orthodoxy. He desperately craved social respectability. From the time he opened his first transmutation notebooks he carefully cultivated the habit of hiding his private radical views under the mantle of Victorian respectability. Gray's reviews gave Darwin the perfect cover he needed to preserve his public image: he could *appear* orthodox without actually *being* orthodox.

By late October 1860 Darwin had decided to lobby Gray to publish his three *Atlantic* articles as a pamphlet and then visibly promote it among the most prominent

¹¹⁵John Angus Campbell has published a number of perceptive articles on Darwin's various rhetorical strategies: "Darwin and the *Origin of Species*: The Rhetorical Ancestry of an Idea," *Speech Monographs* 37 (March 1970): 2-14; "The Polemical Mr. Darwin," *The Quarterly Journal of Speech* 61 (December 1975): 375-390; "The Invisible Rhetorician: Charles Darwin's 'Third Party' Strategy," *Rhetorica* 7 (Winter 1989): 55-85; and "Charles Darwin: Rhetorician of Science," in *The Rhetoric of the Human Sciences: Language and Argument in Scholarship and Public Affairs*, ed. John S. Nelson, Allan Megill, Donald McCloskey (Madison: Univ. of Wisconsin, 1987), 69-86.

men of English science as a most able presentation of his theory. After sending the August article off to the *Annals and Magazine of Natural History* to be reprinted under Gray's name as author, Darwin announced his "larger scheme . . . to get the whole three published with (as you permit) your name."¹¹⁶ Gray's articles were just too potentially useful to languish in an American popular periodical, Darwin lamented. They would do "his side" a world of good in the face of numerous hostile reviews, books, and pamphlets. Lyell agreed that "it would be well worth while if a little Book could be got up by Asa Gray for the theological part is so admirable & would surely have many readers."¹¹⁷

Darwin counseled Gray that "it would be indispensable to have your name & title on Title-page; & very advisable to have some remark on Title, showing its bearing on Natural Theology or Design."¹¹⁸ Only then would the scientific men in England be compelled to read it out of respect for Gray's sterling reputation for scientific and theological orthodoxy.¹¹⁹ Gray succumbed to Darwin's flattering request to publish his *Atlantic* articles as a pamphlet, arranged for its publication by Ticknor and Fields in Boston, and even paid half the cost of publication. It was

¹¹⁶Darwin to Gray, 26 September 1860, *CCD* 8: 388-391; Darwin to Gray, 19 October 1860, 438-439. Gray had published his articles anonymously.

¹¹⁷Darwin to Gray, 24 October 1860, *CCD* 8: 443-444. Lyell declared to George Ticknor that Gray's discussion of the issues was "the ablest, and on the whole grappling with the subject, both as a naturalist and metaphysician, better than anyone else on either side of the Atlantic." Lyell to Ticknor, 29 November 1860, *Life, Letters and Journals of Charles Lyell, Bart.*, 2: 341.

¹¹⁸Darwin to Gray, 19 October 1860, *CCD* 8: 438-439; Darwin to Gray, 31 October 1860, *CCD* 8: 451-454.

¹¹⁹Darwin to Gray, 31 October 1860, *CCD* 8: 451-454.

published in early 1861 under the revealing title of *Natural Selection not Inconsistent with Natural Theology. A Free Examination of Darwin's Origin of Species, and of its American Reviewers.*

Darwin quickly took the lead as his own most effective publicist. He drew up a list of thirteen influential popular and scientific periodicals and approximately 100 prominent scientists within the Royal Society, the Geological Society, and the Linnean Society to whom to send presentation copies.¹²⁰ He had earlier sent a majority of these men presentation copies of the *Origin*. Darwin employed his considerable diplomatic skills and persuasive powers in seeking the pamphlet's notice. He was, of course, careful not let his presentees know that he had orchestrated the pamphlet's publication or that he believed natural selection *was* inconsistent with natural theology. As far as they knew, he was simply doing a favor for his friend, Asa Gray. Hooker and Huxley were his first targets. Would Hooker please persuade John Lindley, the editor of the *Gardners' Chronicle*, to review it. He would also appreciate it if Hooker would review it for some other botanical journal. "I shd much like for Asa Gray's sake (& indeed for my own) if I could get some sold."¹²¹ He called on Huxley, the editor of the new *Natural History Review*, to review it. "A. Gray has republished his Reviews as a pamphlet; I have directed a copy & advertisement to be sent to Nat. Hist. Review. For Asa Gray's sake (& my own) could you insert notice *literally* only

¹²⁰The list of those to whom he gave presentation copies is given in CCD 9: 395-398.

¹²¹Darwin to Hooker, 20 February 1861, CCD 9: 32-33. Lindley published a complimentary page-long review in *Gardners' Chronicle* (9 March 1861): 219.

of two or three length?? His Reviews have struck others besides myself as very able."¹²² Venturing into hostile territory, he deferentially requested Andrew Murray, the Scottish entomologist who had already written a severe review of the *Origin*, to write a short notice.

I send by this Post, a pamphlet by Prof. Asa Gray on my "Origin," which several good judges think very well written. Although the author praises me he does not fully concur, & I have thought that you might possibly look at it. Could you get it noticed, in 2 or 3 lines, in any Nat. Hist. periodical in Edinburgh? I shd be very glad to have it a little known for Prof. A. Gray's sake, as well as my own. -- I hope this request is not very indelicate; I am far from meaning that I want to see it praised, only just noticed.¹²³

The notices and presentation copies had the intended effect. Several scientists thanked him for sending them copies and complimented Gray on his efforts; many others were significantly mollified by Gray's arguments.¹²⁴

Gray's pamphlet opportunely arrived just as Darwin was putting the finishing touches on the third edition of the *Origin*. What better way to promote Gray's pamphlet -- and not incidentally promote the illusion of his own endorsement of its views -- than to advertise it in the book itself? Prominently appearing in the front of the third edition was the following notice:

An admirable, and, to a certain extent, favourable Review of this work, including an able discussion on the Theological bearing of the belief in the

¹²²Darwin to Huxley, 17 Feb. 1861, *CCD* 9: 31-32. Huxley did refer briefly to it in his anonymous review of Agassiz's *Contributions* which appeared in *Natural History Review* 1 (1861): 433-434.

¹²³Darwin to Andrew Murray, 23 Feb. 1861, *CCD* 9: 34-35. Evidently Murray was not persuaded; no review of the pamphlet appeared in the *Edinburgh New Philosophical Journal*.

¹²⁴Darwin to George Rolleston, 2 March 1861, *CCD* 9: 42; Darwin to P. L. Sclater, 12 March 1861, *CCD* 9: 53; Darwin to Edward Cressy, 28 May 1861, *CCD* 9: 146-147.

descent of species, has now been separately published by Professor Asa Gray as a pamphlet, about 60 pages in length.¹²⁵

Together with the well-chosen quotations from Bacon, Butler, and Whewell at the front of the book, notice of Gray's pamphlet served the continued function of at least blunting the attacks of his most outspoken critics on his orthodoxy.

Darwin was immensely gratified by the impact of Gray's pamphlet in England.¹²⁶ His strategy had worked out exceptionally well; it had accomplished exactly what he anticipated and planned.

I have had many letters about it; all full of praise -- "truly admirable" says one, "& am lending my copy to one person after another". Another says, "has read nothing on the subject with anything like the satisfaction" -- Another says he (ie you) "is a cunning fencer & believes in you entirely".¹²⁷

He had successfully cast the illusion that he accepted Gray's *apologia*. He was content to allow that public perception to linger for seven more years. Darwin did not

¹²⁵Morse Peckham, ed., *The Origin of Species, by Charles Darwin. A Variorum Text* (Philadelphia: University of Pennsylvania Press, 1959), 57.

¹²⁶The 250 copies of Gray's pamphlet which remained with Ticknor & Fields were never distributed in America. Shortly after the pamphlet was published James Fields, a champion of Agassiz and his causes, assumed editorial control of the *Atlantic*. Thereafter its pages were closed to Gray and opened for Agassiz. It may have been economically unwise not to sell Gray's pamphlet; it was politically astute. Consequently, Gray was much better known in England than he was in America for his philosophical and theological efforts on Darwin's behalf. Americans did not learn that Gray was the author of the *Atlantic* articles until they were reprinted in 1876 in *Darwiniana*. Dupree, *Asa Gray*, 299. In May 1862 Gray sent Darwin a package of unsold pamphlets, wryly explaining that he could send him as many more as he wanted. He had foolishly failed to follow up with Ticknor & Fields on the progress of their sale; consequently, none were sold. Gray to Darwin, 18 May 1862, *CCD* 10: 206-208.

¹²⁷Darwin to Gray, 12 March 1861, *CCD* 9: 51-53. In March 1862 Darwin reported that Trubner only had 38 copies of the pamphlet left. "I believe that your pamphlet has done my book *great* good; & I thank you from my heart for myself; & believing that the views are in large part true, I must think that you have done natural science a good turn." Darwin to Gray, 15 March 1862, *CCD* 10: 117-119.

divulge the extent of his public disagreement with Gray until 1868 in the conclusion to *Variation of Plants and Animals Under Domestication*.

Conclusion

By the fall of 1861 Gray, apparently exasperated with Darwin's refusal to accept his evidence for design, asked Darwin what it would take to convince him of design in the world. Darwin's answer illuminates the great gulf fixed between Gray's natural theological perspective and Darwin's positivist perspective. Darwin answered that Gray's question was a "real poser."

If I saw an angel come down to teach us good, & I was convinced, from others seeing him, that I was not mad, I shd believe in design. -- If I could be convinced thoroughly that life & mind was in an unknown way a function of other imponderable forces, I shd be convinced. -- If man was made of brass or iron & no way connected with any other organism which had ever lived, I should perhaps be convinced.¹²⁸

How distant this perspective was from the natural theology tradition which Gray had so eloquently defended and tried to reconcile with Darwin's views. Darwin's total lack of sympathy, his virtual incomprehension of Gray's question, verges on the point of mockery. He made no appeal whatsoever to the traditional scientific and theological categories of inference, purpose, final cause, or adaptation as evidence to convince him of design.

The natural theological tradition in which Gray stood had confidently assumed that the design was there in the universe as an inescapable and undeniable empirical

¹²⁸Darwin to Gray, 17 September 1861, *CCD* 9: 266-269. It is a pity that we do not have Gray's letter in which he asked Darwin this central question.

phenomena. All people had to do was open their eyes to comprehend the beauty, beneficence, and loving care of God that was evident in the exquisite adaptations that were carefully prepared for each creature.

Darwin looked, but saw nothing to warrant such a conclusion. He thoroughly rejected Gray's epistemological framework and criteria for understanding the natural world and for discovering the evidence for its grand design. In Darwin's positivist worldview no knowledge of transcendent purpose or presence in the world was possible. Not being possible it could serve no role in grounding or gaining knowledge of empirical reality. The only epistemic possibility was to seal off human understanding of the physical world from "theological" and "metaphysical" claims to knowledge, as Comte had counseled. Knowledge, thus redefined, could now only be discovered in the lawful interaction of physical phenomena in the final "positive" stage of mankind's maturity.

Gray was intuitively aware that Darwin's derivation hypothesis harbored implications which, if followed out, would destroy natural theology. But he was caught on the horns of the dilemma bequeathed to him by the natural theology tradition, one which he so eloquently spelled out to Hooker in the fall of 1859: how was it possible to accept the premises of empirical science and yet retain the affirmations of design so central to the natural theology tradition?

Darwin's answer to his question was clear: it was impossible. He would remain faithful to the full implications of positivism for the whole of life, refusing to flinch at any minor discomfort it created or to accept any superficial accommodation

of his views with the discredited natural theology tradition. Gray was, however, determined to resist the tug of Darwin's philosophical stance and forge a reconciliation between design and descent, no matter how strenuously Darwin objected.