Walter Cannon

THE PROBLEM OF MIRACLES IN THE 1830'S

THE PROBLEM of miracles was revived in theological discussions in the 1830's, as some Christians (many of them scientists as well) set for themselves the task of defining the miraculous so that it could be related rather than opposed to natural science proper. These men were not yet ready to accept that modern dogmatism which, on the one hand, makes Providence totally unrelated to the laws of nature, and, on the other hand, arbitrarily limits the areas of rational explanation. At the same time these Christians wished to revise William Paley's natural theology so that it would demonstrate a progressively developing world, would present, that is, a world-view or cosmography opposed to that of Charles Lyell's *Principles of Geology* of 1830-33.[1] It was the quest for such a developmental philosophy of nature that gave William Whewell (scientist, philosopher, moralist, and eventually Master of Trinity College, Cambridge) his method of defining a miracle – a method which in the 1860's finally permitted John Tyndall to present an even more fatalistic view of the cosmos than the one Whewell was trying to refute in the 1830's.

[1] Vol. I was first published in the summer (not, as is stated in later editions, in January) of 1830, Vol. II in 1832, and Vol. III in 1833. Vol. I, 2nd ed. (1832), plus the original editions of Vols. II and III were thereafter called the "2nd edition" of the entire work. Hence, according to the official nomenclature the "1st edition" consists simply of the original Vol. I.

Opposite: portrait of William Whewell (in his forties?) from *Popular Science Monthly*, VII (1875), frontispiece.

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The debate began over the question as to whether miracles occur in the natural world (specifically in the origin of new biological species), and there were sincere Christians on both sides of this argument. But soon a logically more basic problem became apparent: what should we consider a miracle to be, how should we describe one so that we would be able to categorize any particular event as miraculous? Some of the authors we shall discuss did not consider this second problem and did not know just what they wanted to mean by "miracle" or how emphatically they wanted to assert the existence of the miraculous in nature. We shall have to interpret their words carefully in the light of contemporary usage. For example, the geologist William Buckland had asserted in 1819 that, since geological forces have operated "with a direction to beneficial ends, we see at once proofs of an overruling Intelligence continuing to superintend, direct, modify, and control the operations of the agents, which he originally ordained."[2] Except for one word, to be noted in a moment, Buckland's statement is an orthodox assertion of Providential control: God the Creator, who is of course God the Designer, is also God the Director. We may say that God as originator of the laws of nature not only designed the system to run perfectly, as a watch runs perfectly, but has also insured that it will move in a particular direction, as a railroad engine moves. As God the Sustainer, he is even now in ultimate control of the secondary causes which carry out his plan. All of this is logically quite compatible with a belief in the possibility of relating the observable phenomena to a continuous network of secondary causes.

With the word "modify," however, Buckland casually introduced, without insisting on it, the notion that God is also God the Interferer, who has acted to re-direct his own secondary causes. In general, then, we may use the appearance of the concept of "creative interference" in a man's writings as a sign that he has allied himself with the miraculous. When, however, such men as Charles Babbage and William Whewell set themselves the task of producing a detailed and precise definition (see below, sections IV and V), this vague criterion can be abandoned.

I

The possibility of re-opening science to the miraculous came

[2] *Vindiciae Geologicae* (Oxford, 1820), p. 19; delivered as a lecture the year before.

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from the particular state of the linked sciences of geology and biology in 1830. Charles Lyell's geological system was dubbed "Uniformitarianism" by Whewell because it asserted absolute uniformity in the natural forces which produce geological and fossil remains. Not only have the same laws of nature ruled the past as the present, but also, Lyell asserted, the same particular natural agencies (rain and rivers, earthquakes and volcanoes) have been at work in the past at about the same intensities as are observable at present. And these agencies have produced the same kinds of phenomena over and over again. Continents have risen and been washed down and have risen again; species have come into being and flourished and become extinct and new species have come into being; and the whole system has come from no unique initial state and has led to no particular new status.[3]

Lyell's scientific opponents (whom Whewell named the "Catastrophists"), including such excellent geologists as Adam Sedgwick and Roderick Murchison, opposed to this system their own experience based on observation. As Sedgwick, one of the best field geologists of all time, said in his presidential address to the Geological Society of London in 1831, "If the principles I am combatting be true, the earth's surface ought to present an indefinite succession of similar phenomena. But as far as I have consulted the book of nature, I would . . . affirm, that the earth's surface presents a definite succession of dissimilar phenomena." The Catastrophists emphasized two points in particular. First, it seemed from appearances that there had been a "progressive development of organic structure" from the simple organisms of lower strata to the highly complex organisms of today. Second, this progress seemed to have taken place in giant steps: one geological environment contained a fossil world adapted to it, yet the next stratum showed a different fossil world, adapted to its own environment but not obviously derivable from the previous fossil world.[4]

[3] On Uniformitarianism in general see the excellent article by R. Hooykaas, "The Principle of Uniformity in Geology, Biology, and Theology," *Journal of the Transactions of The Victoria Institute*, LXXXVIII (1956), 101-116. I would only object that the Catastrophists were more "biblical" and less simply "theistic" than Professor Hooykaas believes, and *were* concerned with God's care for "unimportant" things; and I would add that what Hooykaas calls the "biblical view" seems to be nicely expressed in John Herschel's letter to Lyell quoted in section IV, below; yet Herschel was more Uniformitarian than Catastrophist.

[4] *Proceedings of the Geological Society of London*, I (1826-33), 304-306; for Murchison, who is sometimes incorrectly classified as a Uniformitarian, see his *The Silurian System* (London, 1839), I, 164, 428, 437, 522, 545, 561, 574, 576. These passages may be compared to the assertion of Charles Gillispie, *Genesis and Geology* (Cambridge, Mass., 1951), p. 135, that in this treatise Murchison "seldom even alludes to the Uniformi-

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Since Lyell made no attempt in the *Principles* to explain how new species originate, Whewell was able, in his review of the first volume, to emphasize this weakness in the Uniformitarian explanation of the evidence: "We see in the transition from an earth peopled by one set of animals, to the same earth swarming with entirely new forms of organic life, a distinct manifestation of creative power, transcending the known laws of nature." Since in contemporary scientific usage the term "creative power" merely meant whatever unknown power has produced species and did not imply the supernatural, Whewell had not as yet allied himself with the miraculous. That the origin of species was not explicable by the *known* laws of nature was quite apparent to everyone.[5] Whewell soon modified his position, however, in his review of Lyell's Volume II, a volume devoted in considerable part to refuting Lamarck's theory of the transmutation of species. By asserting in the pages of the *Quarterly Review* that new groups of organisms appear "*as if* they were placed there, each by an express act of the Creator," Whewell committed the Catastrophists to the task of furnishing at least a description of what a miracle *looks like* to a scientist.[6] Otherwise Catastrophism, which prided itself on its ability to describe the evidence, would be postulating indescribable events and hence would be as incomplete as Uniformitarianism, which postulated (in the origin of species) inexplicable events.

If they were to be more thorough-going than Lyell, the Catastrophists needed to present a scientific world-view which was as rational as Uniformitarianism, yet was both discontinuous and historical (using the word "historical" to mean "uniquely developing in time"). Lyell's geology, with its randomly occurring cycles, allowed no serious meaning for the concept "historical," yet for Christians an obvious fact about the world is that it *is* historical, moving irreversibly from Creation to Judgment. Natural theology could never be a satisfactorily complete theology

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tarian-Catastrophist debate or to any theoretical controversies." Also cf. the rather odd presentation of Sedgwick's position by Loren Eiseley, *Darwin's Century* (New York, 1958), pp. 149-150: Sedgwick did not "come to the very verge of the evolutionary abyss and then draw back" — he flatly asserted progressive change and as flatly denied Lyell's ecological mechanisms.

[5] "Lyell — *Principles of Geology*," *British Critic*, 3rd ser., IX (1831), 194. Gillispie, (p. 146) asserts that this passage has "clearly stated" the Catastrophists' "lust" for the miraculous. Actually the passage is technically correct even from the Uniformitarian point of view. Both Charles Lyell and Charles Darwin regularly used the term "creation" and variants of it.

[6] "Lyell's *Geology*, Vol. 2," *Quarterly Review*, XLVII (1832), 117. It is in this article that Whewell, so far as I know, introduced the proper names "Uniformitarian" and "Catastrophist" (p. 126). Whewell's authorship of this article and the one listed in note 5 was well known; Lyell was so pleased with the first that he was willing to ask Whewell to write the second: see his *Life, Letters and Journals*, ed. K. Lyell (London, 1881), I, 351, 355, 359.

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so long as it described a static world, and by 1830 the Christian geologists were sure that it could not be satisfactory scientifically either. The development which had taken place in only thirty years is dramatically indicated in the 1836 edition of William Paley's *Natural Theology*, first published in 1802. The first sentence in Paley's famous book is: "In crossing a heath, suppose I pitched my foot against a *stone*, and were asked how the stone came to be there, I might answer, that, for anything I knew to the contrary, it had lain there for ever; nor would it, perhaps, be very easy to show the absurdity of this answer." In the 1830's the eternal existence of a stone was becoming as absurd as the eternal existence of a watch; and the editors (Henry Brougham and Charles Bell) added a long footnote which occupied the rest of the page and most of the next one, beginning:

> The argument is here put very naturally. But a considerable change has taken place of late years in the knowledge attained even by common readers, and there are few who would be without reflection "how the stone came to be there." The changes which the earth's surface has undergone, and the preparation for its present condition, have become a subject of high interest; and there is hardly any one who now would, for an instant, believe that the stone was formed where it lay. . . .
>
> So true is the observation of Sir John Herschel, "that the situation of a pebble may afford him [an ordinary observer] evidence of the state of the globe he inhabits myriads of ages ago, before his species became its denizens."[7]

Yet Whewell could not depend on the new geology alone to supply evidence for his cosmography, for it was precisely in the outstanding geological treatise of the time that the historical vision of the world was refuted at great length. Instead he turned to the high authority of physical astronomy. His commission as author of one of the Bridgewater Treatises gave him an opportunity to present his case.

II

The Bridgewater Treatises, eight valuable if not very exciting revelations of the nearly-Victorian mind, where a somewhat unexpected result of the will of the eccentric eighth Earl of Bridgewater, a relative of the famous canal-building Duke. The Earl, dying in 1829, left a bequest for a work in natural theology, "illustrating such work by all reasonable arguments, as for instance the variety and formation of God's creatures in the animal, vegetable, and mineral kingdoms; the effect of digestion,

[7] (London, 1836), I, 1-2. Herschel's observation is from his *Preliminary Discourse on the Study of Natural Philosophy* (London, 1831), p. 14.

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and thereby of conversion; the construction of the hand of man; and an infinite variety of other arguments." The President of the Royal Society, who was named as administrator, called to his aid the Archbishop of Canterbury and the Bishop of London; and this committee decided that it would be wisest to divide up the "infinite variety" of arguments among eight authors. The distribution produced a quite uncoordinated series, and reviewers found it rather absurd to have Dr. William Prout write on *Chemistry, Meteorology, and the Function of Digestion* as his contribution to theology. The books were reasonably popular with the reading public, however, and continued to be re-issued at intervals throughout the following half-century. The authors were selected in 1830, the first four treatises came out in 1833, and the last, that of William Buckland on geology, in 1836. William Whewell's *Astronomy and General Physics Considered with Reference to Natural Theology* was the first in order of publication, one of the best, and possibly the most popular of the treatises, and it first made him known to the general reading public, since his review articles had been anonymous.[8]

Large parts of Whewell's book simply rehearsed the standard arguments in natural theology, for example, that both the simplicity of natural law and the size or arbitrary magnitudes in the solar system show the beneficence of the Creator. The first makes it possible for us to discover the laws of nature, which might, after all, have been of indecipherable complexity. The second is essential so that, for example, the cycle of the sun may be nicely suited to the cycle of internal functions in vegetables, without which happy coincidence "the working of the botanical world would be thrown into utter disorder" (*Astronomy*, p. 23). Whewell rejected the notion that a selective principle at work here could merely weed out such vegetables as did not conform to the solar cycle: "A watch could not go, except there were the most exact adjustment in the forms and positions of its wheels; yet no one would accept it as an explanation of the origins of such forms and positions, that the watch would not go if these were other than they are" (*Astronomy*, pp. 29-30). There must be an efficient cause to produce proper construction and not merely a selective agent to suppress failures in construction.

This position in natural theology, which may seem to cry out for Darwin,[9] is worth noting as an example of the role played by theology in insisting on the unity and rationality of the cosmos. Natural theologians

[8] D. W. Gundry, "The Bridgewater Treatises and Their Authors," *History*, n.s. XXXI (1946), 140-152, is a brief introduction, not correct in all details.

[9] Cf. Gillispie, p. 131: "with benefit of hindsight, uniformitarianism in geology seems almost to cry out for evolutionism in biology."

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refused to accept arguments implying chance or incoherence in nature. It was, for example, one of the objections to Lamarck's theories that his concept of an innate tendency towards change in organisms seemed to lead to a denial of the close correlation between organisms and their environments. An organism that is continually changing its form by means of its own inner forces would be perfectly adapted to the environment only at one point (or at a limited number of points, if the environment were independently changing) in its development.[10] Yet the tendency of science at this time was to demonstrate ever more radically the closeness of the connection between all parts of nature, and in the hands of such comparative anatomists as Georges Cuvier and William Buckland the Argument from Design had been turned into a powerful tool of scientific research. It was by reasoning on the necessary construction of an animal designed to live and flourish in a particular environment that they were able to carry out their masterpieces of reconstruction from fossil bone fragments.[11]

For humanitarian tastes this close interconnection could be insisted on too much, as when Paley, and after him Buckland, pointed out that carnivores keep their prey from starving to death. Similarly the astronomer John Herschel repeated Lyell's justification of earthquakes because of their usefulness in bringing about geological change and added that one should not object too much to their incidental destructiveness. It is no doubt harsh that twenty thousand lives should be taken at one blow, but "sooner or later every one of those lives must be called for, and it is by no means the most sudden end that is the most afflictive" – which, by Christian standards, is undeniable.[12] This ecological vision, as it may be called, eventually furnished the mechanism for Darwin's hypothesis of natural selection, which also offended some humanitarian tastes. Yet neither this vision nor Darwin's hypothesis furnished a causal agent for the origin of structure. In the absence of any such causal agent, God the Designer was for Whewell the connecting link that rendered intelligible the existence of correlations which seemed to have no other causal connection. God was a necessary postulate for a rational system.

We may note, further, that the fundamental assumption underlying the Argument from Design (that is, that randomness is natural and hence probable, whereas local concentration of organization is un-

[10] William Whewell, *History of the Inductive Sciences* (London, 1837), III, 574.

[11] Cf. Buckland's lecture on the megatherium, described in Anna Gordon, *The Life and Correspondence of William Buckland* (New York, 1894), pp. 129-133.

[12] "About Volcanoes and Earthquakes," *Familiar Lectures on Scientific Subjects* (London, 1867), p. 19.

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natural and improbable and hence needs to be explained whenever it occurs) was soon to be used as a method for interpreting the Second Law of Thermodynamics. It would be interesting to track down the origin of this assumption, but for now it is sufficient to note that it is embodied in Protestant Christianity in the notion of the radical contingency and instability of the natural world without the preserving power of God,[13] a notion that Charles Lyell, with his system of nicely balanced forces, was (in effect) eager to refute.

In his second and more original section Whewell could cite the recent work of the great French mathematicians Laplace and Lagrange, which established the beneficent stability of the solar system, a stability which Laplace had shown to be highly improbable. Laplace, however, had notoriously *not* drawn the conclusion that an intelligent Creator had set the system up, but instead had propounded his Nebular Hypothesis. This hypothesis was that a huge revolving primitive solar mass had cooled and contracted and in doing so had left portions of its original mass revolving in their original orbits, all ready to contract in their turn and form planets. To minimize Laplace's importance, Whewell pointed out that the hypothesis was only a conjecture, as indeed it was, Laplace having presented it at the end of his popular book on astronomy and having made only passing reference to it in his great *Mécanique céleste*.[14] Furthermore, Whewell argued, it did not account for animate life: "Was man, with his thoughts and feeling, his powers and hopes, his will and conscience, also produced as an ultimate result of the condensation of the solar atmosphere?" (*Astronomy*, p. 185). Whewell thus posed the question that John Tyndall was willing to answer in the late 1860's with a firm, if somewhat qualified, "Yes." But it seemed almost a rhetorical question in 1833, and Whewell hardly felt it necessary to argue the point. Regarding the inorganic world, however, he was eager to speculate as far as the Law of Continuity (see below, section V) could take him. We can, he said, think back even beyond Laplace's revolving solar mass to a primitive nebulous matter diffused throughout space, as postulated by the English astronomer William Herschel.[15] But any assumed

[13] Contrast St. Thomas Aquinas, *Summa Theologica*, Part One, Question II, Article 3. The first three of St. Thomas' five proofs of the existence of God essentially prove the stability of the cosmos, but by the nineteenth century only his fifth proof, that things act towards an end, remained acceptable to Protestants. Buckland's attack on the fourth proof, that taken from the gradation of beings in goodness, is described in section IV, below.

[14] *Oeuvres complètes* (Paris, 1884), V, 322-323; VI, 498-509.

[15] Laplace's hypothesis concerning the origin of the solar system should always be distinguished from that of William Herschel concerning the origin of the entire starry

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initial distribution of any assumed primitive substance demonstrates the beneficence of the Contriver, since the initial state has necessarily (and hence by plan) led to our present beneficently contrived state. And still reason will not let us stop. Where did the nebulosity itself come from? "If we can establish by physical proofs, that the first fact which can be traced in the history of the world, is that 'there was light;' we shall still be led, even by our natural reason, to suppose that before this could occur, 'God said, let there be light'" (*Astronomy*, p. 191).

Moreover Whewell had something new to add to this familiar argument: Encke's comet. Encke has shown in the 1820's that one of the comets is gradually decreasing its periodic time, and this decrease was often ascribed to the effect of some resisting medium in space. This medium, if genuine, must act as a frictional brake on the planets as well as on comets. Therefore, said Whewell, the movements of the solar system cannot go on forever; they are imperceptibly decaying, and the planets must eventually fall into the sun. And as in the future, so in the past; the system cannot have been going on indefinitely, or its motions would already have been deranged: "the watch is still going, and therefore it must have been wound up within a limited time" (*Astronomy*, p. 206). While the system lasts, its stability assures its fitness for life, but astronomy agrees with the fossils of geology in showing the universality of finite duration; perpetual change is the universal law of creation. Whewell dwelt on this topic in such language that the very minor poet J. E. Reade was moved to translate the passage into blank verse to show, as Reade said, "that a simple relation of the operations of Nature forms Poetry of the highest order." Reade's rendition is not exact, but it is quite close to the original:

> Say not man only perishes: he shares
> The lot decreed to all save God himself
> The oak endures for centuries, and falls;
> The crumbling Mountains change, and earthquakes cast them
> From their foundations: even the sea retires,
> And the emerging green field smiles above
> The roar of weltering waves: the starry worlds
> Fall, and their place in heaven is known no more.
> The Sun and Moon have written on their foreheads
> The lines of age; that they must end; they have

heavens from nebulous matter diffused throughout the universe. It is the latter hypothesis which is present in the deleted stanzas of Tennyson's *"The Palace of Art"* (1833) cited by Basil Willey in *More Nineteenth Century Studies* (London, 1956), p. 83, as an example of Laplace's influence. The lines quoted by Professor Willey from *The Princess*, Canto II, seem to be derived from Whewell's presentation, not directly from Laplace or Herschel.

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> Only a longer respite given than man.
> Th' ephemerae live their hour, man threescore years;
> Empires, too, have their centuries, their rise,
> Their spring and autumn: and volcanic fires
> Hurl the fixed Island from his Ocean throne!
> The very revolutions of the sky
> Which make our time, will languish, and stand still.[16]

In his conclusion Whewell emphasized that God is above all a law-abiding governor. Although there is no observable necessity in things themselves and, for all we can determine of essences, the world could just as easily be a chaos as a cosmos, we can empirically observe that "events are brought about, not by insulated interpositions of divine power exerted in each particular case, but by the establishment of general laws. . . . God is the author and governor of the universe through the laws which he has given to its parts, the properties which he has impressed upon its constituent elements: these laws and properties are, as we have already said, the instruments with which he works" (*Astronomy*, p. 356). This, said Whewell, was not only the view of Francis Bacon but also of John Herschel in his currently fashionable *Discourse on the Study of Natural Philosophy* (London, 1830). (It was also, as it turned out, the view of Charles Darwin, who, perhaps a bit cruelly, quoted the first sentence from this passage over Whewell's name opposite the title page of *On the Origin of Species.*)

Even in the moral world, Whewell said, there are laws, though altogether different in nature from those of the physical world. Relatively, our investigation of moral laws has only just begun, but

> if, in endeavouring to trace the tendencies of the vast labyrinth of laws by which the universe is governed, we are sometimes lost and bewildered, and scarce, or not at all, discern the line by which pain, and sorrow, and vice fall in with a scheme directed to the strictest right and greatest good, we yet find no room to faint or falter; knowing that these are the darkest and most tangled recesses of our knowledge; that into them science has as yet caught sight of no general law by which we may securely hold: while, in those regions where we can see clearly, where science has thrown her strongest illumination upon the scheme of creation; where we have had displayed to us the general laws which give rise to all the multifarious variety of particular facts; — we find all full of wisdom, and harmony, and beauty.[17]

[16] Quoted in Isaac Todhunter, *William Whewell* (London, 1876), I, 69; cf. Whewell, *Astronomy*, pp. 202-203. Unfortunately for Whewell's particular proof, it was discovered in 1884-85 that Encke's comet had ceased to be retarded properly, and the idea of a resisting medium had to be given up. By that time, however, a new generation of Catastrophists had already prepared new physical proofs of the finite duration of the world, largely based on the laws of heat radiation. See esp. William Thomson (Lord Kelvin), "On Geological Time," an address to the Geological Society of Glasgow in 1868, reprinted in *Popular Lectures and Addresses* (London, 1889-94), II, 10 ff.

[17] *Astronomy*, pp. 380-381. Two stanzas from LIV of Tennyson's *In Memoriam* are an answer to Whewell's affirmation:

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III

The God of Whewell's *Astronomy* was the God of Paley's *Natural Theology,* and a comparison of the two books shows first of all the rhetorical blight which had crept into English prose style, perhaps partly from the pulpit, in the intervening thirty years. Nevertheless, Whewell was able to represent Paley's omnipresent but law-abiding Deity as presiding over a natural world which, however well adjusted to the purposes of life at present, was working its way towards an inevitable finish (except, as Whewell pointed out in his sermons, that God had promised to intervene and end the affair before it proceeded that far).[18] Yet it was still necessary to show how such a rational Deity was as much the God of Catastrophist geology as he was of evolutionary astronomy, and to do it before the Catastrophist position was lost to the Bibliolaters. The publications of two writers of different intellectual allegiance showed the danger. They were Thomas Chalmers, the evangelical Scotsman, and Nicholas Wiseman, later Cardinal-Archbishop of Westminster but at this time special English preacher and rector of the English College at Rome.

Chalmers, once the most spectacular visitor to the London preaching circuit and later reforming minister in Glasgow, at this time professor at Edinburgh, and soon to be leader in the establishment of the Scots Free Church, clearly indicated his fundamental position on miracles in *his* Bridgewater Treatise, *On the Power, Wisdom and Goodness of God as Manifested in the Adaptation of External Nature to the Moral and Intellectual Constitution of Man* (1833), with a few bitter remarks about people who try to explain the whole natural world, even the transitions between strata, by secondary causes ([London, 1839], I, 41, 43). In his own *Natural Theology* (Glasgow, 1836) he still did not trust geologists, or at least some geologists, although he felt that Granville Penn was dif-

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I falter where I firmly trod,
And falling with my weight of cares
Upon the great world's altar-stairs
That slope through darkness up to God,
I stretch lame hands of faith, and grope,
And gather dust and chaff, and call
To what I feel is Lord of all,
And faintly trust the larger hope.

Tennyson has picked up the two words "faint" and "falter" but has used them without Whewell's negative. Since Tennyson was Whewell's pupil at Cambridge and was even then keenly interested in natural theology and its relation to moral questions, it seems certain that he read Whewell's Bridgewater Treatise with care.

[18] Todhunter, I, 328 and 344: a sermon delivered in 1827, and the relevant passage as repeated in a sermon of 1866.

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ferent: "We earnestly recommend, however, the perusal of his mineral and Mosaical geologies – not because of our great confidence in his skill or science as a naturalist, but because of a certain admirable soundness in many of those views which are purely theological. If he have erred in the one science, there is a redeeming force in the worth and stability of certain weighty aphorisms that he has given forth in relation to the other science" (I, 252). Penn, in his *Comparative Estimate of the Mineral and Mosaical Geologies* (London, 1822), had not trusted any scientific geologists. All of them, he believed, represented the world as passing from an imperfect chaotic state through a slow progression to a tranquil maturity, thus maligning God by saying that he had created something that was initially less than perfect. Penn argued for an instantaneous creation of the entire world in full working order (pp. 59, 86-89).

This was going too far, Chalmers felt; Penn had been a bit too touchy on the subject of the Mosaic record, and, unfortunately, like others of "our Scriptural geologists," he had exposed his position to ridicule by not knowing enough about the science he was discussing. Chalmers, although he relied overmuch on the already dated work of Georges Cuvier, was more modern than Penn and said quite correctly what Whewell had already said: science knows no way in which species can be generated by secondary causes, and transmutation is refuted by all known facts. Therefore, said Chalmers, just as God originally created the world, so God has been at work in the interval between one system of life and the next. And Chalmers made it quite clear that when he used the term "Creative Interposition" he did not mean God the Designer, or God the Sustainer, or God acting through law or decree or secondary causes: he meant the direct interference of an "ever watchful Deity" whom he conceived, it seems, as a workman who personally constructed the machine of the present world-order with his own hands, as, possibly, he had done several times before. Scientifically speaking, Chalmers admitted, the case was proved only for the organic creation, but he himself felt that the Bible meant more than that, and was confident that science would in time agree with the Bible. It was, he said, perhaps possible to interpolate the stretches of geological time into the Bible at the very beginning without violating a strictly literal reading of Genesis, but

> we should not tamper with the record by allegorizing any of its passages or phrases. We should not for example protract the six days into so many geological periods – as if by means of a lengthened and natural process to veil over the fiat of a God, that phenomenon, if we may so term it, which of all others seems the most offensive

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to the taste of some philosophers, and which they are most anxious to get rid of. We hold the week of the first chapter of Genesis to have been literally a week of miracles — the period of a great creative interposition, during which by so many successive evolutions, the present economy was raised out of the wreck and materials of the one which had gone before it. (*Natural Theology*, I, 229-230)

Chalmers' desire to keep the Bible intact and his commitment to the possibility of miraculous interference received what may have been undesired support from Rome. Nicholas Wiseman's *Twelve Lectures on the Connexion Between Science and Revealed Religion* (2nd ed. [London, 1842]) were originally intended for an introductory course in the study of theology at the English College but at the request of friends he delivered them to a large audience in the drawing-room of Cardinal Thomas Weld in 1835. Slightly revised so as to include references to modern English books, they were published in England in 1836 and republished without textual change in 1842 and 1849. The lectures were a survey of all the sciences to show how well they supported the "unassailable veracity" of Scripture against the attacks of eighteenth-century scepticism. For example, Wiseman said, the study of ancient China and India has shown that their native chronologies are wildly exaggerated, and that their history is confined to some such dates as 2400 or 2600 B.C., well within the time-span indicated by the Mosaic narrative. Medical science has described the particular ways in which crucifixion is especially painful, and it shows that Christ's suffering was far more acute than would have been that of a physically stronger man. Ethnography refutes Voltaire's contention that the various nations of men are actually separate races; there is only one race of men, and hence all could be descended from Adam. As for Lamarck's hypothesis that man originated by a successive development from lower animals, Wiseman felt that he hardly had to argue the point and simply referred his readers to the second volume of Lyell's *Principles* for a full refutation.

In geology Wiseman was somewhat more severe with Granville Penn than Chalmers was: "I am unwilling to say any thing of living authors, where blame must almost seem to be cast upon labours directed by a zealous lover of religion, and for the most disinterested purposes. But I am sure that the cause of religion is no way served by crude theories or the rejection of facts repeatedly demonstrated" (2nd ed. [1842], p. 183). Penn had attacked geology for its method of explaining the Mosaic Deluge as only one of a series of catastrophes, but Wiseman welcomed William Buckland's demonstration in his *Reliquiae diluvianae* (London, 1823) of the geological actuality of the Flood. Should this last Catastrophe turn out not to have been universal, however, or not of the

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correct date to have been the Flood of Moses, it would be of little importance. Wiseman approved of Catastrophism in general and dismissed Lyell's geological dynamics in brief compass, giving copious reference to the writings of Cuvier and the even more outmoded work of Deluc. The principle of gradual development, if geology should show it to be true, is a very fine one, he said, and as Scripture tells us nothing about it, it cannot clash with God's sacred word. The attribution of all such progressive changes to a single cause (the central heat of the earth) is a theory of beautiful simplicity, worthy of Divine Providence and, said Wiseman (somewhat contradicting himself), in harmony with the express declarations of God's word.

In Wiseman's discussion there was, of course, no real problem about miracles to be considered. It was simply a matter to be determined in each individual case:

> in the intermediate space between creation and the present arrangement of the earth, some longer period may be required than a day, if we suppose the laws of nature to have been left to their ordinary course; for then, some longer interval would have been requisite for the plants produced to be decked out as we must suppose them, with flower and fruit, and grown to their complete perfection, when man was placed among them. But it might please God to bring them forth at once, in all their grandeur and beauty, from the first instant of their production. (p. 206)

All in all, Wiseman's was a very confident and relaxed performance in the growing enlightenment of the Catholic Revival. He remarked with pleasure on the contributions that French scientists were once more making to the advance of true knowledge. It was gratifying, he said, to see geology returning, "with a bosom of well-earned gifts, to pile upon [religion's] sacred hearth. For it was religion which . . . gave geology birth, and to the sanctuary she hath once more returned" (p. 210). He called attention to the able and learned Bridgewater Treatises for those interested in natural theology, and in particular noted William Buckland's expected work, which, he said, would throw more light on the topics he had treated. And so as he had put on his title-page the quotation, "Science should be dedicated to the service of religion," Wiseman closed with what "I trust I may consider as the summary and epilogue of these my Lectures; 'RELIGIO, VICISTI.' Religion, thou hast conquered!" Voltaire had been answered at last.

IV

Buckland, the Catastrophist and lively eccentric who had been England's best-known geologist in the 1820's, was in the meantime

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taking his task very seriously. As a Canon of Christ Church and also the most prominent representative of science in the suspicious Oxford of John Keble, his was a central and unenviable position. He labored over his treatise night after night, but when *Geology and Mineralogy Considered with Reference to Natural Theology* was published in 1836, it satisfied almost no one. Buckland was in no way a systematic thinker, and his treatise was filled with paleontological descriptions so detailed as actually to be a major contribution to monographic research. In the space that was left for theory he was concerned to emphasize Paley's assertion that man is not the sole object of the Creator's care. This, although Buckland did not say so overtly, was becoming an increasingly important theological argument. John Wesley, as late at 1770, had been able to present the age-old scientific verity that, "If Death is permitted to cut down Individuals . . . it is never permitted to destroy the most inconsiderable Species;" the total system of life has remained the same.[19] But by the grimmer 1830's men had learned from the new paleontology that species are not immortal. In large part through the deliberate publicity efforts of Buckland himself and then through the success of Lyell's *Principles,* the English imagination was radically altered; it became populated by grinning monsters from the slimy swamps, and by a haunting realization that the earth is a great charnel-house of bones testifying to the transience of life-forms and is itself changing, melting away as in a dream:

> The hills are shadows, and they flow
> From form to form, and nothing stands;
> They melt like mist, the solid lands,
> Like clouds they shape themselves and go.
> (*In Memoriam,* CXXII)

Buckland was, therefore, concerned to point out that each species, fossil or living, had been assigned its own portion of enjoyment. Each plays its role "in the maintenance of the general system of co-ordinate relations, whereby all families of living beings are reciprocally subservient to the use and benefit of one another" (*Geology and Mineralogy,* 2nd ed. [London, 1837], I, 101). Man is but one element in the latest of these

[19] *Survey of the Wisdom of God in the Creation,* 2nd ed. (Bristol, 1770), I, 225; cf. John Calvin, *Institutes of the Christian Religion,* tr. John Allen, 7th Am. Ed. (Philadelphia, 1936), I, 198. Keats, in his statement, "Thou wast not born for death, immortal Bird," was simply using this well-known scientific truth; he was not "romantically" defying the facts of life, as some critics have thought. He is of course referring to the *species* nightingale and not the individual, as the context shows. Herbert McLuhan, "Aesthetic Patterns in Keats's Odes," *University of Toronto Quarterly,* XII (1943), 175, has pointed out that the primary allusion in this passage is to Malthus' population theory.

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interrelated systems of life. Fossil remains, said Buckland, demonstrate an increasing complexity of organization as we approach modern times, but if we judge perfection rather by the relation of the organization to the objective to be attained rather than by complexity, "a Polype, or an Oyster, are as perfectly adapted to their functions at the bottom of the sea, as the wings of the Eagle are perfect, as organs of rapid passage through the air."[20] This insight of natural theology could also be turned into classic rhetoric by Tennyson,[21] and was basic to Darwin's explanation, in Chapter Four of the *Origin of Species,* of why in his system, unlike that of Lamarck, there is no necessary tendency for simple forms to become more highly organized.

Buckland asserted the futility of trying to reconcile geology and Genesis, thus reaffirming a position he had upheld against Thomas Chalmers as early as 1819.[22] The Bible was not designed to give scientific information, and the Biblical account of the creation had as its object "not to state *in what manner,* but *by whom* the world was made." The sequence of events narrated does not accord with the geological sequence, said Buckland, who thus did some of Thomas Huxley's work for him thirty years in advance. The geological sequence may have taken place between the first and second verses; subsequent verses then describe how "the earth was to be fitted up, and peopled in a manner fit for the reception of mankind," its status at the time of the first verse being "geologically considered . . . the wreck and ruin of a former world." In pointing out that the "creation" of Genesis need not mean "creation out of nothing," Buckland was able to include in support of

[20] (I, 208). Hence an oyster is as good as an eagle, and St. Thomas's gradation according to goodness (see above, note 13) does not apply. An oyster is chosen, presumably, because in the Renaissance scale of being it was customarily assigned the lowest rank in the animal kingdom. Contrast these statements of Buckland to the assertion of Eiseley, p. 177, that for Paley and the Bridgewater authors "man stood at the center of all things and the entire universe had been created for his edification and instruction." Furthermore the Bridgewater authors did not try to demonstrate the "final intention of the Creator in respect to each structure" (Eiseley, p. 178) — such could be known only by revelation (cf. Whewell, *Astronomy,* p. vi) — but merely his local beneficence. The Catastrophists did not assume that each *species* was a new special creation (Eiseley, p. 178) but only that each paleontological *era* was. And, finally, natural theology was not as unimportant before "about the latter half of the seventeenth century" as one might gather from Eiseley (p. 176); it is satisfactorily present in Calvin's *Institutes,* and indeed in Psalms 8 and 19 and the Book of Job. (As Professor Eiseley's is the most accurate and useful book on his subject that I know, it seems worthwhile to point out its occasional shortcomings.)

[21] *In Memoriam,* LIII, especially: "That not a moth with vain desire/ Is shrivell'd in a fruitless fire,/ Or but subserves another's gain."

[22] See his *Vindiciae Geologicae,* a reply to Chalmers' *The Evidence and Authority of the Christian Revelation,* 2nd ed. (Edinburgh, 1815). By emphasizing Buckland's abandonment of the Mosaic Deluge in geology, recent writers have tended to obscure the fact that Buckland's basic position remained unchanged in all important respects from 1819 to 1836.

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this interpretation of the Hebrew text a long footnote from his Oxford friend Edward Pusey, the learned professor of Hebrew, one of the mainstays of the Oxford Movement and later the decisive voice in support of Henry Acland's program for giving natural science a reasonable place in the Oxford curriculum (I, 33, 24, 26, 22-25).

Buckland felt that he had proved three points, over and above the central and basic demonstration of benevolent design. The most important of these was that "polytheism" is wrong: the Deity is one; though who the polytheists were in England in the 1830's is a little hard to determine. Perhaps this could be construed as an answer to those who asked: "Are God and Nature then at strife,/ That Nature lends such evil dreams?" Buckland was next most proud of having shown that the world's history can be traced back to a very hot starting-point before which all life on earth was impossible. This refuted the Atheist, who denied original creation. Finally, the study of fossil remains showed that "the doctrines of the derivation of living species either by *Development and Transmutation* from other species [as upheld by Lamarck], or by an *Eternal Succession* from preceding individuals of the same species [are equally incorrect]. . . . we have found abundant proofs, both of the Beginning and End of several successive systems of animal and vegetable life; each compelling us to refer its origin to the direct agency of Creative Interference" (I, 585-586). And having thus slipped gently over to the side of miracles, Buckland referred the matter back to Whewell by quoting the latter's original review of Lyell to support his conclusion. Nothing had been resolved.

Buckland's treatise satisfied no one, neither Uniformitarians nor Catastrophists, and especially not the old and new Bibliolaters, from whom it called forth several agonized protests. Charles Lyell, on the other hand, was much surprised at the mildness of its theoretical position (with which of course he disagreed) and thought that on the whole the treatise would do much good. Adam Sedgwick felt that it made the argument of good emerging from apparent evil seem almost grotesque, while Roderick Murchison, perhaps noting that Buckland had quietly omitted his earlier assertion of the geological actuality of the Mosaic Deluge, called it "Bridge-over-the-water."[23] But Dean William Cockburn of York was so aroused — for if a reverend professor at Oxford would not defend the Bible, who would? — that he launched a pamphlet attack on

[23] Gordon, p. 136; W. Tuckwell, *Reminiscences of Oxford,* 2nd ed. (London, 1907), p. 37; Lyell, *Life,* I, 473, which also gives the remarks of Murchison; J. W. Clark and T. M. Hughes, *The Life and Letters of the Reverend Adam Sedgwick* (Cambridge, 1890), I, 470.

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Buckland in 1838 and continued his offensive by invading the geological section of the British Association for the Advancement of Science in 1844 to present his own (Mosaic) theory of the earth's early history. Repulsed by a severe speech from Sedgwick in reply, Cockburn published his paper as *The Bible defended against the British Association* (a pamphlet which went through five editions within the year), thus joining *The Times* and Charles Dickens in obscurantism directed against that most successful of Victorian societies.[24] These goings-on caused only mild embarrassment when Buckland and other geologists visited at Tamworth, the home of the Dean's brother-in-law, Sir Robert Peel, but the 1838 pamphlets called forth an often-cited statement to the effect that science should be welcomed, not feared, by lovers of God's truth. As the statement was made by the Reverend William Vernon Harcourt in his presidential address to the British Association in 1839, and as Vernon Harcourt was the son of the Archbishop of York, the moral of the affair, we may conclude, is that the clergy could handle their own problems — or perhaps that Trollope is the best introduction to understanding such affairs.[25]

At the stage in the discussion of miracles marked by Buckland's Bridgewater Treatise, two of William Whewell's personal friends from college days attached themselves to the Uniformitarian side, with qualifications. In February 1836 John Herschel (astronomer, physicist, Christian, and, as the son of the great William Herschel, a semi-divine hero to early Victorian public opinion) wrote a long letter from the Cape of Good Hope to Charles Lyell, setting forth his speculations as to a basic geological mechanism. Part of the first paragraph is especially relevant here. Herschel wrote:

> Of course I allude to that mystery of mysteries the replacement of extinct species by others. Many will doubtless think your speculations too bold — but it is as well to face the difficulty at once. For my own part — I cannot but think it an inadequate conception of the Creator, to assume it as granted that his combinations are exhausted upon any one of the theatres of their former exercise — though in this, as in all his other works we are led by all analogy to suppose that he operates through a series of intermediate causes & that in consequence, the origination of fresh species, could it ever come under our cognizance would be found to be a natural in

[24] John W. Dodds, *The Age of Paradox* (New York, 1952), p. 189, incorrectly calls these incidents a battle between theologians and scientists. But both of the scientists, Buckland and Sedgwick, were clergymen, and Cockburn was neither scientist nor theologian. The affair was a quarrel between obscurantism and rationality within the church.

[25] Clark and Hughes, II, 76-78; Lyell, *Life*, II, 51; Vernon Harcourt, in *British Association Report*, IX (1839), 16-22. The science writer Mary Somerville reports in her *Personal Recollections*, ed. Martha Somerville (Boston, 1874), p. 129, that she was "preached against by name in York Cathedral" — presumably by the same Dean.

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contradistinction to a miraculous process — although we perceive no indications of any process actually in progress which is likely to issue in such a result.[26]

Herschel's letter put pressure on his Catastrophist friends. Lyell referred to it when writing to Whewell to defend himself against the charge of inconsistency in not asserting the naturalistic origin of species in his *Principles*: "If I had stated as plainly as he [Herschel] has done, the possibility of the introduction or origination of fresh species by a natural, in contradistinction to a miraculous process, I should have raised a host of prejudices against me." And the quoted passage became public property in 1837 when Charles Babbage published large parts of the letter in his *Ninth Bridgewater Treatise* to establish his own priority in proposing the geological mechanism which Herschel had described. Lyell (as always, quite nervous about public opinion) agreed to publishing the letter reluctantly, fearing it to be too unorthodox, though Babbage omitted the most unorthodox parts (Lyell, *Life*, II, 5, 11).

Babbage's treatise was a strictly unofficial contribution to the Bridgewater series, and a not especially welcome one, even though it had been censored by the Reverend Adam Sedgwick (with Babbage's consent) before publication. Babbage had been annoyed by a section of Whewell's treatise which showed that the pursuit of deductive science might lead men to trust too much in their own ability to explain the universe and hence lead them away from God. On the other hand, Whewell had suggested, the pursuit of inductive science accustomed them to the search for more and more general laws and causes, hence leading them up to the consideration of a First Cause. Whewell had apparently been trying to discredit the testimony in natural theology of such eminent deductive scientists as the eminently atheistic Laplace; but Babbage, as "an ardent but not an exclusive cultivator of some of the more abstract branches of mathematical science" (and, incidentally, as Lucasian professor of mathematics at Cambridge), took it as a personal affront.[27]

Babbage defended his pursuits as offering particularly striking new examples of the power and foresight of the Creator. He used Laplace's work in the theory of probability to show the error of Hume's statement that it is always more probable that the testimony that a miracle has occurred is incorrect than that the uniformity of nature has been broken. This was a particularly good ploy, since Laplace had used

[26] John Herschel to Charles Lyell, 20 Feb. 1836, Lyell Collection, American Philosophical Society Library, Philadelphia.

[27] Whewell, *Astronomy*, Book 3, chs. v and vi; Babbage, *Ninth Bridgewater Treatise*, 2nd ed. (London, 1838), p. xvi.

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his theories for precisely the opposite purpose.[28] Babbage argued that if we estimate that in the assumed six thousand years of human existence one trillion individuals have died, then it is one trillion to one against a dead man having been restored to life. But if we assume that each witness to such an event tells, on the average, one falsehood to every ten truths, then calculations show it to be still more improbable that the concurring evidence of twenty-five independent witnesses should be wrong. Or, in general, since the uniformity of the laws of nature is known only by human experience and hence is only finitely probable, not certain, then "(provided only that there are persons whose statements are more frequently correct than incorrect, and who give their testimony in favour of it without collusion,) a certain number *n* can ALWAYS be found; so that *it shall be a greater improbability that their unanimous statement shall be a falsehood, than that the miracle shall have occurred*" (*Ninth Bridgewater,* p. 198).

Babbage was able to illustrate his position from the calculating engine which he had devoted himself to building. This engine, he pointed out, could be so set up that an observer could make *one hundred million* observations and conclude that the invariable law of the machine was to produce a sequence of numbers each of which was greater than the last by one: 1, 2, 3, 4, . . . "Now, reader, let me ask how long you will have counted before you are firmly convinced that the engine, supposing its adjustments to remain unaltered, will continue, while its motion is maintained, to produce the same series of natural numbers? . . . after the fifty-thousandth term the propensity to believe that the succeeding term will be fifty thousand and one, will be almost irresistible" (p. 35). Yet the term following one hundred million and one turns out to be one hundred million *ten thousand* and two, and the next one is one hundred million *thirty thousand* and three. A new law has been added to the old one. But this combination of laws itself fails at the 2762nd term; and a new combination takes over for 1430 terms; and so on.

Up to this point in his illustration Babbage was merely making the same point that Herschel had expressed with his statement that there is no reason to assume that God's "combinations are exhausted upon any one of the theatres of their former exercise," and Lyell could agree with that. It is, said Babbage, "more consistent to look upon miracles not as deviations from the laws assigned by the Almighty for the government of matter and of mind; but as the exact fulfillment of much more extensive laws than those we suppose to exist" (p. 92). That the

[28] Cf. Pierre de Laplace, *A Philosophical Essay on Probabilities,* tr. F. Truscott and F. Emory, from 6th French ed. (New York, 1951), pp. 118-124.

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origin of new species is not explicable by known laws, he suggested, only demonstrates the wisdom of a God who could so arrange his original laws as to bring about these new events in the course of time.

Babbage went even further, however. He could set up his engine, he said, so as to produce *one* discontinuity in an otherwise perfectly uniform sequence. After the machine had produced a uniform sequence of square numbers for any specified length of time, it would be possible for the maker to say: " 'I impressed on it a law, which should coincide with that of square numbers in every case, *except* the one which is now to appear; after which no future exception can ever occur, but the unvarying law of the squares shall be pursued until the machine itself perishes from decay' " (p. 95). Even more to the point with respect to the origin of species, said Babbage, was that the engine could be arranged to present any number of such isolated discontinuous deviations from the uniform law, occurring at any period however remote, each deviation to be of a different kind. The study of mathematics teaches us how such discontinuities can fulfill a more general law, in particular the study of discontinuous curves: "It is to these *singular points*, which really fulfill the law of the curve, but which present to those who judge of them only by the organ of sight an apparent discontinuity, that I wish to call the attention, as offering an illustration of the doctrine here explained respecting miracles" (p. 100).

Babbage's conclusions were cold comfort for Uniformitarians, who had no desire to be shown how discontinuities in the course of nature were possible, even as a part of a higher natural law; that was too close to what Buckland had been saying about his catastrophes for years.[29] But Babbage's explanation of miracles was also not of a kind to appeal to Catastrophists, who equally with Uniformitarians were committed to the belief that the solid material world is rational in itself and not merely in some mathematical formula or idea that can, several stages removed, be applied to it. Expressed in Aristotelian terminology, the Catastrophist desire was not for an explanation of God's activities as formal cause, but for some way of explaining God's miraculous powers as somehow acting as efficient cause, without however subverting the integrity of the continuous network of secondary efficient causes which science investigates. To follow Babbage would have been to follow the road of post-Kantian Idealistic philosophy, and for Cantabrigians like Whewell and Sedgwick that was hardly a possible alternative. Hegel had, after all, attacked Newton; he had also asserted that

[29] Lyell, *Life*, II, 10; and also his letter to Sedgwick in Clark and Hughes, I, 488.

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nature has no history. The Catastrophists waged their own war on such heresy. Whewell, although in some ways a post-Kantian himself, rebuffed Hegel and Schelling (without, however, rejecting all of their particular insights), and Sedgwick wrote a fine denunciation of the *Naturphilosophie* of Lorenz Oken, which he called "ideal lunacy."[30] So Babbage's suggestions had little effect – except, as it turned out, on the anonymous author of the disreputable *Vestiges of the Natural History of Creation*.[31]

V

The task of making Catastrophism rational, of finding a *via media* between Charles Lyell and Thomas Chalmers, was thus left to William Whewell. He presented his solution briefly in his *History of the Inductive Sciences* (London, 1837) and more fully in his *Philosophy of the Inductive Sciences* (London, 1840). We may conveniently reconstruct his argument from the latter treatise, especially from the section entitled "The Philosophy of Palætiology." Whewell was an inveterate word-coiner, and he supplied his contemporaries with scientific nomenclature: "eocene," "miocene," and "pliocene" for Lyell; "anode" and "cathode," "paramagnetic" and "diamagnetic" for Michael Faraday; "biometry" for John Lubbock; "photistics" and "thermotics" (the theories of light and heat) for John Herschel.[32] He created "palaetiology" by combining "palaeontology" and "aetiology" to provide a name for the study of the causes of historical events, that is, the theoretical side of such sciences as geology, archaeology, and comparative philology. His purpose was to have terminology with which to distinguish historical causes from instantaneously interacting "mechanical" causes: "we consider the events which we contemplate, of whatever order they be, as forming a chain which is extended from the beginning of things down to the present time; and the causes of which we now speak are those which connect the successive links of this chain. . . . The problem in the Palætiological Sciences with which we are here concerned, is, to determine the manner in which each term is derived from the preceding, and thus, if possible, to calculate backwards to the origin of the

[30] Whewell, *History*, II, 181; Whewell, *The Philosophy of the Inductive Sciences* (London, 1840), I, 258-259; Sedgwick, *A Discourse on the Studies of the University*, 5th ed. (Cambridge, 1850), p. cci.

[31] Cf. [Robert Chambers], *Vestiges* (New York, 1845), pp. 155-160.

[32] Todhunter, I, 88, II, 132, 135, 364; Whewell, *Philosophy*, I, lxxi, cxiii.

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series" (*Philosophy*, II, 112-113). In doing this we are bound by the Law of Continuity, just as we are in the mechanical sciences, and this law, stated in aphoristic form (Whewell was attempting to bring Bacon's *Novum Organum* up to date) is "that a quantity cannot pass from one amount to another by any change of conditions, without passing through all intermediate magnitudes according to the intermediate conditions" (I, xlvi).

Now it is possible to imagine all historical causes taken together as forming one great progression which will explain the entire history of the earth and solar system, from the condensation of a primitive nebula through the origin of life on earth and the entire series of past forms of animal and vegetable life to the origin of man and his subsequent history: "And thus we are led by a close and natural connexion, through a series of causes, from those which regulate the imperceptible changes of the remotest nebulae in the heavens, to those which determine the diversities of language, the mutations of art, and even the progress of civilization, polity, and literature" (II, 115). This hypothetical series is our standard of comparison of the universal efficacy of natural causes. For it may turn out "that such occurrences as these are quite inexplicable by the aid of any natural causes with which we are acquainted; and thus the result of our investigations, conducted with strict regard to scientific principles, may be, that we must either contemplate supernatural influences as part of the past series of events, or declare ourselves altogether unable to form this series into a connected whole" (II, 116). Whewell maintained, in other words, that a continuous historical sequence took rational priority over the supposed universal efficacy of secondary causes and therefore that a miracle would be scientific if it were needed to maintain historical continuity. Any lack of continuity is unacceptable, but secondary causes, where they do not seem to be continuous with other secondary causes, may turn out to be continuous with First Causes.

By measuring it against this hypothetical historical chain, Whewell was able to maintain that Uniformitarianism taken on a cosmic scale was inconsistent. For example, if the Uniformitarian seizes on the nebular hypothesis to explain that planetary systems are constantly and uniformly forming and hence that no creative origin of the solar system need be postulated, then he is asserting an origin of our earth and hence a progression from incandescence to our present stable and populated world. If the heavens have been progressive, the earth, since it is a heavenly body, cannot have been static. Yet in geology it is this progression which the Uniformitarian denies. Likewise, if the Uniformitarian

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tries to explain the existence of deep-seated heat in the earth not by original incandescence but by the chemical combination of materials in the earth's crust, this also leads to a finite duration for the present state of things, for such chemical supplies cannot be inexhaustible. The only possible Uniformitarian solution to such problems is steadfastly to refuse to speculate beyond the end of the geological strata.

Whewell did not maintain that Catastrophism was, as yet, a complete explanation of the changes of the earth's surface; but then neither was Uniformitarianism. But Catastrophism was the more satisfactory approach to the hypothetical history of the world:

> to assume the introduction of new species as a part of the order of nature, without pointing out any natural fact with which such an event can be classed, would be to reject creation by an arbitrary act. Hence, even on natural grounds, the most intelligible view of the history of the animal and vegetable kingdoms seems to be, that each period which is marked by a distinct collection of species forms a cycle; and that at the beginning of each such cycle a creative power was exerted, of a kind to which there was nothing at all analogous in the succeeding part of the same cycle. . . . We are necessarily driven to assume, as the beginning of the present cycle of organic nature, an event not included in the course of nature. (II, 134)

Likewise the nebular hypothesis, even if true, explains only the origin of the material world, not the addition of life to this material system. With man, still another discontinuity is introduced, for the gradations in physical form between man and man-like animals such as monkeys are small, said Whewell; the real differences are in civilization, internal wants, intellectual and moral constitution. These human qualities are not continuous with any development in the animal world. And to take an even more detailed example, language has evolved non-uniformly, according to the expert Dr. James Prichard, and the origin of language is quite inexplicable as yet by any theory of natural causation. (Whewell, we may note, had thus in 1840 casually accepted for Christians the point that Thomas Huxley made with great fervor and *éclat* against Richard Owen in his *Man's Place in Nature* of 1863: that man is not in essentials physically different from the monkeys. And Huxley too fixed upon language as a distinguishing characteristic of humanity.)

It is thus a feature of the palaetiological sciences that in none of them are we able "to arrive at a beginning that is homogenous with the known course of events." Although we can see back very far indeed, often near to the origin, we "probably never will be able to demonstrate, what was that primitive state of things from which the progressive course of the world took its first departure" (II, 137). Science, therefore, can tell us nothing concerning the act of creation itself; she can neither contradict nor confirm the Biblical account. The mystery of

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creation finds its place in the providential, not the natural, history of the world. The Bible tells us of this providential history, not in scientific terms but in words which the original hearers could understand: "If the Divine Speaker, instead of saying that he would set his bow in the clouds, had been made to declare that he would give to water the property of refracting different colours at different angles, how utterly unmeaning to the hearers would it have been!" (II, 144). The Biblical story is that of the moral government of the world by a Power which directs its course "to the unfolding and perfecting of man's moral nature . . . by its transit through a world full of moral evil" (II, 140). This moral growth (and here again Thomas Huxley was to agree in his *Evolution and Ethics* of 1893) is not provided for and perhaps is opposed in the ordinary economy of nature. As a directed process it has its own beginning and its own evidence, and we should not confuse it with the natural history of the world, as is done, for example, by suggesting that the nebular hypothesis shows how there could be light from luminous matter before the sun itself existed.

Yet, Whewell concluded, there is a connection between the providential and the natural series of events. The sciences do not lead directly to but only point towards a First Cause. But they all point towards the same First Cause, as their interdependence shows. "And this point, thus indicated by the natural course of things, can be no other than that which is disclosed to us as the starting point of the providential course of the world; for we are persuaded by such reasons [as are given in the Bridgewater Treatises] that the Creator of the natural world can be no other than the Author and Governor and Judge of the moral and spiritual world" (II, 164).

This assertion suggests the comment that the alternative position, after all, *is* polytheism; for even if man may be assumed to have made his own moral history, he has not made the actualities of nature.

VI

Whewell's defense of miracles by means of observable discontinuities in the natural history of the world is, we may admit, quite reasonable, and his claim to be scientific is as well-founded as that of Lyell. Both the historical sequence, he felt, and the instantaneously interacting system of secondary or "mechanical" causes have claims on continuity. Where we meet a discontinuity in trying to think *back* along a chain of temporal causes to the "First Cause in Order of Succession,"

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we need not despair of thinking at all. We may at such points think *up* along the chain of logical causes leading from the ordinary set of secondary causes towards the "Supreme Cause in Order of Causation" (I, xlvii). To refuse to follow this procedure would be "to reject creation by an arbitrary act" of refusing to think. If we accept John Herschel's dictum that the sure criterion of dogmatism is the placing of a limit on inquiry, it is apparent that Whewell's explanation of miracles does not fall into this class; it does not require that a rhinoceros spring from nothingness into heavy-footed half-ton being, as Thomas Huxley later supposed. Nor does it permit one to leap discontinuously from ordinary secondary causes to an idea or Plan laid up in Heaven, as a Platonist might wish to do and as Hugh Miller and Louis Agassiz sometimes did. On the contrary, Whewell invites thinking "up" a continuous chain of more and more general causes, and warns the investigator not to believe that he has already reached an ultimate explanation or the true First Cause. Charles Lyell himself was pleased to point out this feature of the definition.[33]

Whewell himself was rather touchy on the subject of man's moral and intellectual nature, but, as is usual in such cases, it was his logic and not his attitudes that counted. Although he did not like attempts to explain morals naturalistically, he did not remove such subjects from the field of rational investigation. Rather he insisted on the possibility of discovering laws in the realm of mental and spiritual truth that were different from those of material nature, that were rational but in all probability non-numerical, non-mathematical. In the jargon of modern philosophy of science, he denied the validity of the reduction hypothesis as applied to such subjects. This was a perhaps wholesome bearing of witness amid the swelling ledgers of Benthamite calculus. When in the 1840's Whewell himself, as Professor of Moral Philosophy at Cambridge, began the task of reducing pietistic morality to scientific form, it is not too surprising that his attempts were received without enthusiasm by his more conscience-guided Christian contemporaries, even the natural scientists among them. What is more interesting is that John Stuart Mill objected that his scheme was not deductive enough![34]

[33] Herschel, *Preliminary Discourse*, p. 111; Huxley, "On the Reception of the *Origin of Species*," in Charles Darwin, *Life and Letters*, ed. Francis Darwin (New York, 1887), I, 548; Lyell, *Life*, II, 37. The rhinoceros image originated with Darwin, in his 1842 sketch: Charles Darwin and Alfred Russel Wallace, *Evolution by Natural Selection*, ed. Gavin de Beer (Cambridge, 1958), p. 84.

[34] See, for example, Whewell's *Lectures on Systematic Morality* (London, 1846), p. 21; John Herschel to Mrs. Somerville, November 21, 1845, in Somerville, p. 280; and John Stuart Mill, "Dr. Whewell on Moral Philosophy," *Dissertations and Discussions* (Boston, 1864), III, 169-172, 179-181.

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Whewell's belief that God has acted as Creator not once but several times in succession, hence not arbitrarily but in a law-abiding sequence, was logically based, like Lyell's belief in the fixity of species, on the scientific evidence available in the 1830's. Like Lyell's belief, Whewell's position became less tenable as scientific theory changed. We may note, however, that with his hypothetical sketch of the natural history of the world Whewell supplied exact specifications for determining when the notion of a limited number of creative acts should rationally be abandoned: that is, when creation was no longer needed to maintain historical continuity. As a good scientist should, he presented his theory in a form in which it could be buttressed or refuted by future research. This hypothetical historical sketch is perhaps the most interesting feature of Whewell's presentation, and the fact that it was presented by a Christian philosopher and not (as with Buffon) by someone philosophically suspect is equally interesting. It was an outline which Victorian science filled in, and once a naturalistic explanation for all parts of the sequence could be made merely plausible (not proven), the Law of Continuity made its acceptance compelling to the Victorian mentality. Indeed, as the popularity of Robert Chambers' *Vestiges of the Natural History of Creation* (1844) showed, it was attractive to many people even when it was not plausible.

In the 1860's John Tyndall was able to present a complete naturalistic alternative to the orthodox Christian history of the world, entrapping man completely, so it seemed, in two necessitarian (that is to say, causal) sequences, corresponding to Whewell's historical and mechanical chains of causes. In the first of these sequences, man was the historical result of forces inherent in the primitive solar nebula. In the other, the doctrine of the conservation of energy as applied in particular to the brain and nervous system closed the last escape from what was earlier known as "mechanical" determinism; it made "unscientific," that is, the argument that man's will or vitality conferred on him powers dissimilar from those of blind molecular forces. As Thomas Huxley reported of his friend, "A favorite problem of his is – Given the molecular forces in a mutton chop, deduce Hamlet or Faust therefrom. He is confident that the Physics of the future will solve this easily."[35] It seemed that man was an automaton once more; but this time fully so. So long as scientific explanation did not become historical, Christians could if

[35] Tyndall, "Scientific Materialism" and "Scientific Use of the Imagination," *Fragments of Science* (New York, 1904), II, 75-90 and 101-134; Leonard Huxley, *Life and Letters of Thomas Huxley* (London, 1900), I, 231.

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they wished ignore its implications. A scientifically based world-view was simply incomplete if it could not explain the obvious truth about the world, that it *is* a historical place. No really scientific description of the cosmos was possible as long as no really scientific theory of its origin and development was available.

William Whewell, then, outlined the divisions along which cosmographic debate was to proceed. In opposition to the indefinitely long but randomly cyclic outlook of Lyell, he codified a combination of this approach with the progressive or historical approach of Catastrophism, which, as Lyell had shown in the historical introduction to his *Principles*, was the geological embodiment of Christian ideas. With this codification Whewell bridged the gap that forty years before had separated the followers of Lyell's scientific godfather James Hutton from historically-minded Christians, and in the 1830's might have threatened to separate scientists from an Evangelical society. Scientific thought was kept in contact with the pressure of Christian historicism, and Christian belief was kept under the discipline of scientific rationality and exactitude.[36] This achievement made it possible for the later, more intense, Darwinian debates to be conducted with the same respect for evidence and reason on both sides, at least among the intellectually reputable leaders; basic disagreements led to the discussion of basic differences in the philosophy of science still worth considering today, not simply to denunciation.[37] With their stubborn insistence on the historical nature of the cosmos (an insistence which can be documented from the geological monographs of the period 1830-60 as well as from the philosophic works here considered),[38] the Catastrophists forced speculation away from Lyell's unprogressive position and kept a developmental view of the world alive, so that today we popularly describe the history of the world as Whewell saw it (but without his miracles), not as Lyell saw it. Eventually it was Lyell's closest scientific friend and disciple who was able to bring forward a case for development so convincing that even Lyell abandoned the position he had vehemently defended for thirty years. The geological parsons, under attack from both sides, stood their ground and (ironically enough) through the work of Charles Darwin won the day.

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[36] Cf. John Baillie, *Natural Science and the Spiritual Life* (New York, 1952), p. 32.
[37] Alvar Ellegård, *Darwin and the General Reader* (Göteborg, Sweden, 1958), p. 175.
[38] Cf. my article, "The Uniformitarian-Catastrophist Debate," *Isis*, LI (1960), 38-55.

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