

BYRON AND CATASTROPHISM: A READING OF 'HEAVEN AND EARTH'

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ABSTRACT

Byron's poems and letters indicate that he drew inspiration from a vast array of literary and popular works. Although the literary echoes are fully documented, less attention has been given to the probable influence of contemporary and near-contemporary scientific publication, including the many articles in the great reviews (Edinburgh, Monthly, Blackwood's). This article makes reference to the kind of information Byron would have acquired in his reading and argues that certain of his works establish an acquaintance with contemporary hypotheses of natural historians and geologists, particularly Buffon. When this knowledge is applied to 'Heaven and Earth', we find an unorthodox, but revealing reading of a work that is frequently overlooked by critics.

Images of decay and dissolution in Lord Byron's works are expressions of a newly-enhanced fear, common amongst informed persons of his time that, concurrent with the supposed stability of western civilization, there existed a dark and powerful counterpart, a force which inevitably acted upon individuals, relationships, institutions, monuments, and worlds, causing them to dissolve into the vast undifferentiable abyss of time and space. Lord Byron's awareness of these destructive forces and their actions upon animate and inanimate objects is not remarkable in itself; empirical observation of the effect of waves upon sand, wind on trees, fire upon combustibles, volcanoes on land forms, is itself evidence for those who consider the relentless drive of such forces; but Byron's awareness is indebted to the new scientific discourse growing more convincing as it grows in volume near the end of the 18th century, particularly in the fields of geology and natural history.

To find the origins of the scientific attitudes and beliefs reflected in Byron's work would require

examining a vast array of texts, some dating as far back as the fourth century B.C. Ancient works which deal with 'degeneration' (1) theory as it relates to the surface of the earth, such as Lucretius on Heraclitean thought and Aristotle's Meteorologica, were doubtless known to Byron from Harrow and Cambridge. My concern, however, is with his interest in speculations on degeneration from geological and biological perspectives. Geology and biology were newly-distinguished areas of study, and discoveries therein attracted considerable interest during Byron's lifetime. Scientific works seem to have held a particular interest for Byron who rejected purely imaginative literature or wildly speculative philosophy in favour of "a poetry of fact, based on observation and experiment, tested by reason and claiming a purpose and function similar or equal to that of science." (2) His letters and poems reflect this bias for the verifiable and logical. In a letter of April 1817 to John Murray he wrote "I hate things all fiction....There should always be some foundation of fact for the most airy fabric -- and pure invention is but the talent of a liar."

Of particular interest are the works of Louis de Buffon and Georges Cuvier. Buffon's scientific and philosophical theories were well-known during Byron's time, and most of his works were translated throughout continental Europe and in England. The monumental Histoire Naturelle (1748-1788) was translated into English and appeared in 1791; the 1816 sale catalogue summarizing the contents of Byron's library indicates that he owned a copy of this work, which was "no doubt...willingly acquired to satisfy Byron's special interests." (3) He may have discussed Buffon's theories with Shelley, who alludes to La Theorie de la terre, the first volume of Buffon's work, in 1816 while describing the Mont Blanc glaciers: "I will not pursue Buffon's sublime but gloomy theory, that this earth which we inhabit will at some future period be changed into a mass of frost...." (4) Buffon's theories were not altogether new, but his diversity of interests, readable style, and respectable position in the scientific community made him an important influence:

His imaginative descriptions, going beyond possible scientific verification, of the geological catastrophes accompanying the formation of the earth, his suggestion that man's earliest ancestors lived in constant terror, witnessing the cataclysmic eruptions at the formation of mountains and at the loss of huge land masses under the deluge of rampaging seas, inflamed the preromantic imagination. (5)

Buffon is of further interest because there was a growing fear at the end of the century that the earth would be devastated by God, and "it seems most likely to the catastrophic imagination, nourished by eighteenth-century science, that collision with a comet will effect this disaster." (6) The basis of this theory may have been the long-standing belief that a comet had presaged the Noachian Deluge, but the scientific basis to which Majewski is here referring is most probably to be found in Buffon's Theorie de la Terre, where he argues that it was from just such a collision that the earth was created.

Cuvier is of central concern because he, too, was a highly respected and naturalist to whom Byron makes several references, most notably in the preface to Cain where he says he has "partly adopted in this poem the notion of Cuvier, that the world had been destroyed several times before the creation of man." In Don Juan Byron enlivens what will later be called "Catastrophism," (7) a view central to Cuvier's studies of the origin of the earth's crust:

But let it go: -- it will one day be found
With other relics of a `former world,'
When this world shall be former, underground,
Thrown topsy-turvy, twisted, crisped, and curled,

Baked, fried, or burnt, turned inside-out, or drowned,
Like all the worlds before, which have been hurled
First out of and then back again to Chaos,
The Superstratum which will overlay us.

So Cuvier says; -- and then shall come again
Unto the new Creation, rising out
From our old crash, some mystic, ancient strain
Of things destroyed and left in airy doubt:
Like to the notions we now entertain
Of Titans, Giants, fellows of about
Some hundred feet in height, not to say miles,
And Mammoths, and your wing{d Crocodiles.

(IX, 37-38)

A source of texts from the field of geology for Byron was his publisher, John Murray, who acted as "a kind of librarian for him, supplying him with books from his own shop or buying them for him elsewhere." (8) Murray published many important scientific texts, including the works of Sir Charles Lyell and William Buckland, and he clearly kept abreast of scientific and literary controversies:

In the year of its appearance (1802) John Murray was much concerned that Playfair's Apologia was so skilful that many readers might be wrongly persuaded `to the

Huttonian doctrines (which) whatever may be their ingenuity and novelty, appear visionary and inconsistent with the phenomena of geology.' (9)

Of all the sciences, geology is of particular interest because it was an emerging discipline which took as its subject matter issues that were of interest to a large portion of society. Charles Coulston Gillispie, in his "study in the relations of scientific thought, natural theology, and social opinion in Great Britain, 1790-1850" notes that "it was near the turn of the nineteenth century that geology put on a distinctively modern dress, the first of the descriptive sciences to do so. Old issues regarding the order of nature together with newer issues regarding the history of nature were then caught up in the development of geology." (10)

Biological and geological issues were of importance to a broad range of persons because they often provoked religious controversy. The debate stirred the various interest groups to argue against other theorists on the grounds that their work was anti-Christian; however what is particularly important for the reader of Byron is that new discoveries were upsetting conventional views of human nature and origin. Cataclysmic theory was, of course, no newcomer to the realm of religious controversy; the Noachian Deluge and the imminent Apocalypse had been debated for centuries. What elevated the clamour of geological discussion to unprecedented heights during Byron's time was the new link between catastrophist geology and old theories of cataclysm, bringing the prestige of inductive thought to this perennial debate. The modernity of Byron's vision rests in his combining the Heraclitean cycle (generation - degeneration - regeneration) with a later notion of degeneration, in which the ancient cyclical scheme became the means of explaining the process of deterioration, and contemporary scientific theory accounts for the existence of deterioration.

The late 18th and early 19th centuries saw a series of important discoveries (notably the

unearthing and cataloguing of fossils) which were sufficiently arresting in implication to attract a high level of public attention. From a scientific perspective, the discoveries had profound implications with regard to the age and origin of the earth, and to God's supposed role in the shaping of its surface. Although many scientists are thought to have influenced the tone and substance of popular discussion in the 18th and 19th centuries, for the reader of Byron the forefather of this controversy is Buffon.

Buffon is of particular interest because he pursued the concept of 'degeneration', a term which was to become a keyword for the 19th-century scientific community in its study of the origins of the earth:

Its power was the power that science claimed for both the objectivity and the analogical validity of its description of natural phenomena. From its first application in the sphere of biology the idea of degeneration was transferred to a variety of other areas, and derived much of its authority from the structure of scientific explanation. But like science itself, these explanations were metaphorical and used the concept of degeneration with all the metaphorical power of those metaphysical abstractions, such as the fall from grace, which they replaced. (11)

There are significant areas of overlap between Buffon's work and Cuvier's, and in some cases Byron's views seem to coincide more directly with those in the writings of Buffon. Buffon believed that a collision between a comet and the sun resulted in the splintering-off of a molten spheroid that upon cooling became the earth.

The scheme is historically important both as the first effective attempt to correlate actual observations bearing on the history of the earth, and also as an estimate of many geological formations as of very slow growth and of great antiquity. It provided a basis for inquiry. In common with most early schemes it laid great stress on volcanic activity, earthquakes, explosions, and other dramatic events. (12)

As the debate about the origins of the earth became more fervent at the end of the 18th century, Buffon's work gained new prominence. Byron's interest in natural history is most probably the result of the increased urgency of the discussions of the early 19th century when the battle lines were drawn between the so-called Vulcanists, who believed that heat was the element responsible for variations in the crust and the Neptunists who favoured water. The two schools had their respective ideological pundits; Werner postulated that "the ocean must have formerly covered the whole earth at the same time" (13) and that rock formations precipitated, either chemically or mechanically, with "the gradual diminution of the water from the surface of the earth;" (14) this theory was considered compatible with the biblical account that demanded the supervision of a providential agent. Hutton, author of the partially Vulcanist Theory of the Earth, with Proofs and Illustrations (1795) believed that the history of the earth was the history of constructive forces, heat and fusion, that built up continents, and of destructive agents, wind and water, that eroded them. If Byron knew of Hutton's works directly, it was probably through reading John Playfair's book Illustrations of the Huttonian Theory of the Earth (1802), based on a paper Hutton read to the Royal Society of Edinburgh in 1785. G. W. White suggests that the theory had a direct effect in the early years of the 19th century, and that "it is through these Illustrations and not through Hutton's original publications that Hutton's system has affected geological thinking for 150 years." (15)

A key figure in the general dissemination of Neptunist theories is Robert Jameson, a disciple of Werner. The fact that he enlarged Cuvier's Essay on the Theory of the Earth (translated by Robert Kerr and published in 1813) by adding mineralogical notes and an account of Cuvier's geological discoveries shows that Cuvier and other catastrophists were regularly associated with the Neptunist school. (16) Jameson's Elements of Geognosy is both an amplification and a defense of Werner's theories; it is the "true doctrine" of Neptunism, serving as the fundamental statement in English of Werner's theories. Jameson was also a teacher, and he founded the Edinburgh Philosophical Journal (1819), and the Edinburgh New Philosophical Journal (1824).

According to the Neptunist school, the central event was a major flood (the Noachian Deluge) which covered even the highest mountains. This flood was the precursor to a variety of events that led to the condition of the earth as we know it; first came the "transition strata," the chemical and mechanical precipitation of what Werner called "primitive" rocks (granite, gneiss, porphyry and so on) and the appearance of aquatic life, followed by the receding of the chemical solution and the subsequent emergence of terrestrial life. Then cataracts of the receding water produced winds which wore away at rocks, leaving clay, pebbles, sand -- the residue of erosion. In the last stage, volcanic activity left deposits and debris which mark the present continental areas.

The Vulcanist school posited no simple developmentalist view of how the earth's crust was formed except to say that they could see no mark indicating either a beginning or an end. This became a major area of contention between the two schools, with the Neptunists accusing Hutton of speaking against the scriptures. Erosive forces are an ongoing and central part of this theory, the only counterforce being heat, which fused the intermingled siliceous and bituminous materials. This same heat caused land forms to rise after the consolidation of the strata under the ocean floor. Hence volcanic activity must have played a central role in the formation of land masses, and the

local eruptions that occur now and again prevent massive reshaping of the continental strata. The importance of Hutton's theory lay in the implicit view that the earth was obviously very old, that changes were ongoing, and that each change could precipitate an unforeseen event or formation or life-form. In this sense, the Vulcanist view was forward-looking but somewhat bleak; the world is subject to uncontrollable forces of erosion which will ultimately lead to the destruction of all monuments, both natural and man-made.

Jameson's views were proliferated primarily via The Edinburgh Review, copies of which Byron read regularly, along with numerous other periodicals (see the 1816 Sale Catalogue). In a letter to John Murray, written from Ravenna on September 7, 1820, Byron says "Thanks for the books -- but as yet No "Monastery" of Walter Scott's the only book except Edinburgh and Quarterly which I desire to see;" (17) and on October 20 of the same year he reiterates his desire to receive only a select few of the periodicals:

You need never favour me with any periodical publications excepting the Edinburgh
-- Quarterly -- and an occasional Blackwood -- and now and then a Monthly Review
-- for the rest I do not feel curiosity enough to look beyond their covers. (18)

These monthly journals devoted a substantial amount of space to the newest geological theories, especially during the earlier part of the century. Important works in the fields of geology and natural history were reviewed or commented upon by the editors, and numerous letters indicating a particular position with respect to contemporary theories were frequently printed. In fact, by the 1820's public interest, combined with an on-going interest of physico-theologians in using "diluvial gravel" to justify their belief in the biblical account of the earth's history led the reviews to devote

"more space to keeping the educated reading public abreast of the progress of natural history than they did to all other sciences put together." (19)

The virtual bible of Catastrophism was Cuvier's Essay on the Theory of the Earth. The theory gained widespread prominence in England with the emergence of Buckland as the chief architect of the Catastrophist synthesis in the early 1820's, and with the belief amongst the British that Cuvier upheld the theory of perfect adaptation, a cornerstone of natural theology. (20) At the same time, the theories of Cuvier were being translated and made available to scientists and laymen throughout Europe. Although meant to be an introduction to a much longer work (Récherches sur les ossemens fossiles des quadrupèdes, published in 1812 and subsequently enlarged), the essay first appeared separately in the English translation by Robert Kerr (1813). During Cuvier's lifetime (1769-1832), this essay (which was published separately in 1825 as Discours sur les révolutions du globe, et sur les changemens qu'elles ont produit dans le regne animal) went into six editions, was translated into every major European language, and was revised and expanded numerous times by its author and in English by Robert Jameson. By the 1820's, the popular conception of geology had become virtually synonymous with Catastrophism, as naturalists like Conybeare, Sedgwick and Murchison published treatises which referred directly to the work of Cuvier in relation to catastrophist views. Thus if Byron hadn't already read the introduction to the Récherches, he probably would have read either the translation or a commentary or criticism thereon in one of the monthly journals or newspapers.

II. Echoes of Catastrophist Theory in 'Heaven and Earth'

The title of the dramatic poem Heaven and Earth is followed by the statement that it is "FOUNDED ON THE FOLLOWING PASSAGE IN GENESIS, CHAP. VI.: `AND IT CAME TO PASS...THAT THE SONS OF GOD SAW THE DAUGHTERS OF MEN THAT THEY WERE FAIR; AND THEY TOOK THEM WIVES OF ALL WHICH THEY CHOSE.'" Byron used this text as impetus, extrapolating basic details and adding his own expansive and complex vision of the set of events that led to the Flood. The descriptive passages dealing with a response to the imminent destruction of the earth are for the most part original to Byron, and his imagery indicates that he relied heavily upon his understanding of arguments from Cuvier and those scientists who adhered to the Neptunian conception of how the earth's crust was formed.

The scientific community -- those who had examined the earth's crust before and during Byron's time and found the remnants of beings once on earth, or those who looked at the stars and found that some were planets apparently similar to this -- had offered objective evidence that the world shares the dim destiny. Whereas decline and decay had always been identifiable through empirical observation, naturalists like Cuvier had shown that the world could also be subjected to sudden catastrophe. Destruction, whether through immediate devastation or on-going decay, was apparently imminent.

Characters in Byron's play seem to understand this; Japhet elucidates a fear similar to that expressed by Anah in scene I, a sense that "many signs and portents have proclaim'd / A change at hand, and an o'erwhelming doom / To perishable beings" (II, 66-68). His vision of the impending flood is the first of many descriptions of the submerging of the earth in the universal ocean. The description of the flood in the bible, upon which these visions are presumably based, is sketchy. In Genesis 6:17, God declares that "I, even I, do bring a flood of waters upon the earth, to destroy all

flesh, wherein is the breath of life, from under heaven; and every thing that is in the earth shall die."

In chapter 7 the flood is described:

17 And the flood was forty days upon the earth; and the waters increased, and bare up the ark, and it was lift up above the earth.

18 And the waters prevailed, and were increased greatly upon the earth; and the ark went upon the face of the waters.

19 And the waters prevailed exceedingly upon the earth; and all the high hills, that were under the whole heaven, were covered.

20 Fifteen cubits upward did the waters prevail; and the mountains were covered.

Except for his reference to "the leviathan, Lord of the shoreless sea and watery world," Japhet's description accords with the biblical passages. But his next description is not so orthodox:

Ye wilds, that look eternal; and thou cave,
Which seem'st unfathomable; and ye mountains,
So varied and so terrible in beauty;
Here, in your rugged majesty of rocks
And toppling trees that twine their roots with stone
In perpendicular places, where the foot
Of man would tremble, could he reach them -- yes,
Ye look eternal! Yet, in a few days,
Perhaps even hours, ye will be changed, rent, hurl'd

Before the mass of waters....

(III, 1-10)

Events in the biblical passage unfold over a relatively long period in a process where the earth is flooded and its creatures are drowned, and land emerges. Underlying this conception is a belief that changes to the earth are preordained, and their outcome is first degenerative and then restorative. But in Byron's dramatization there is a strong sense of violence and unpredictability; the entire crust is to suffer extensive change "in a few days, / Perhaps even hours." His treatment is in accord with Cuvier's vision of catastrophe:

Life, therefore, has been often disturbed on this earth by terrible events - calamities which, at their commencement, have perhaps moved and overturned to a great depth the entire outer crust of the globe, but which, since these first commotions, have uniformly acted at a less depth and less generally. Numberless living beings have been the victims of these catastrophes; some have been destroyed by sudden inundations, others have been laid dry in consequence of the bottom of the seas being instantaneously elevated. Their races even have become extinct, and have left no memorial of them except some small fragment which the naturalist can scarcely recognize. (21)

Cuvier and others who believed in this conception of the creation of the earth's crust sought to provide evidence that the world had been subjected to violent changes, and had suffered more than a rainstorm of forty days and nights.

In his description of the reappearance of land forms and life on the planet, Japhet again goes beyond the biblical. Verse three says that "the waters returned from off the earth continually," as though this area was a fixed one and had in no way been enlarged, reduced or changed in any way by the flood. The waters have therefore served only to cleanse the earth, to destroy the evil souls by destroying all life. No mention is made of any specific alterations to the surface of the earth; indeed, according to God's plan of redemption, such modification would serve no apparent purpose. Furthermore, the actual process leading to the ebb of the waters is described in simple terms; "God made a wind to pass over the earth," and the waters have receded to their former level.

Japhet's description is far more explicit; he imagines an "emerging world, / Reeking and dank from out the slime, whose ooze / Shall slumber o'er the wreck of this, until / The salt morass subside into a sphere / Beneath the sun" (III, 40-44). The references to the "slime" and the "salt morass" clearly restate the principles of Werner's theory regarding the primordial sea, in which all elements were suspended until the receding of the flood, when the process of chemical and mechanical precipitation formed the earth's crust. The concordance of the two ideas, the latter originally put forth in the 18th century, indicates the extent to which Byron has modernized the biblical story to accommodate new revelations about the formation of the crust. In this same speech, Japhet anthropomorphizes the earth, suggesting that it is subject to the same degenerative forces as are persons:

All beauteous world!

So young, so mark'd out for destruction, I

With a cleft heart look on thee day by day,

And night by night, thy number'd days and nights.

I cannot save thee, cannot save even her
Whose love had made me love thee more....

(III, 47-52)

The play indicates that people are ignorant of their inevitable plight; Japhet notes how peculiar it is for the earth to sleep "upon the very eve of death" (III, 71), and later on we learn that even Samiasa wasn't informed of the impending doom: "wherefore speak'st thou of destruction near?" (III, 530) he asks Raphael, who curtly replies that "Had Samiasa and Azazel been / In their true place, with the angelic choir, / Written in fire / They would have seen / Jehovah's late decree, / And not inquired their Maker's breath of me" (III, 531-536). The interchange between the mortals and the angels is Byron's fabrication, and performs the function of showing that even one closest to God could be ignorant of the impending doom of "this youngest star of his dominions" (526). Byron may have intended a parallel here between Samiasa and the authorities (particularly clerical) who preferred to be ignorant of contemporary scientific discoveries about the universe. The poem is markedly didactic on the subject of purposeful ignorance:

God hath proclaim'd the destiny of earth;
My father's ark of safety hath announced it;
The very demons shriek it from their caves;
The scroll of Enoch prophesied it long
In silent books, which, in their silence, say
More to the mind than thunder to the ear:
And yet men listen'd not, nor listen; but

Walk darkling to their doom....

(III, 272-279)

Throughout the scene there are references to the imminent catastrophe, as well as to the non-biblical notion that a race of giants inhabited the earth before Cain. These creatures, along with all of the earth, will submit to what the spirit calls "the world-dissolving wave" (III, 141), an 'anti-Creation' characterized by the dissolving of all elements into a primordial slime out of which the Neptunists imagined the precipitation of the present world. The spirit describes this event in terms similar to those of the Neptunist school, wherein "the subsiding deluge, from its slime, / When the hot sun hath baked the reeking soil / Into a world, shall give again to Time / New beings" (III, 187-191). The spirit also makes reference to the form that creatures will take after having been destroyed by this all-consuming flood -- "The creatures proud of their poor clay, / Shall perish, and their bleached bones shall lurk / In caves, in dens, in clefts of mountains, where / The deep shall follow to their latest lair" (III, 173-176), suggesting that the spirit has the foresight to envision the fossils unearthed and catalogued in the 18th century. The spirit also refers to the geological explanation for the discovery of bones and shells in regions where such lifeforms could never live -- "The wave shall break upon your cliffs; and shells, / The little shells, of ocean's least things be / Deposited where now the eagle's offspring dwells -- / How shall he shriek o'er the remorseless sea!" (III, 238-241). Cuvier's explanation of why shells are found at high altitudes may have served as impetus for Byron's writing this passage:

Similar strata, with the same kind of productions, compose the hills even to a great height. Sometimes the shells are so numerous as to constitute the entire body of the

stratum. They are almost everywhere in such a perfect state of preservation, that even the smallest of them retain their most delicate parts, their sharpest ridges, and their finest and tenderest processes. They are found in elevations far above the level of every part of the ocean, and in places to which the sea could not be conveyed by any existing cause. (22)

Byron is perhaps utilizing the postulations of the Neptunists with regard to the origin of fossils. Led by Cuvier, geologists had in a sense updated the biblical story; it is the Neptunist version that dominates this poem.

The play was never finished, but in Medwin's Conversations of Lord Byron the outline of Part II is set out. (23) Had it followed the schema provided there, the play would have contained numerous passages inspired by Byron's response to Cuvier's theories. The two angels, refusing to obey the summons of Michael, rise in the air with Adah and Aholibamah and go on an extra-terrestrial journey similar to that in Cain. There they were to observe a world in the throes of a catastrophe that Medwin reports (quoting Byron) is "a fate which, according to Cuvier, it has often undergone and will undergo again." (24) Heaven and Earth is based on Catastrophist theory; water is a devastating power whose force is exerted in sudden and violent ways; Hutton's view of it as an erosive force remains virtually absent in the play and in the projected part two.

It may be that the facts of human behaviour came in his last years to overshadow his earlier fascination with what Stephen Jay Gould calls "deep time" -- the immensity of the earth's age which we may briefly comprehend through analogy -- but it is certain that Byron's view of human nature was confirmed by his observation of our physical surroundings and his intermittent engagement with the burgeoning Earth Sciences of his day. (25)

Notes

1- J. Edward Chamberlin and Sander L. Gilman, eds, Degeneration: The Dark Side of Progress (New York: Columbia university Press, 1985) vii.

2- Heide N. Rohloff, "The Disturbing Challenge of Fact: Lord Byron and Romanticism." Romantic Reassessment. The Hannover Byron Symposium (1979). Ed. James Hogg. (Austria: Universitat Salzburg, 1981) 106.

3- Elizabeth French Boyd. Byron's Don Juan: A Critical Study. (New York: The Humanities Press, 1958) 91.

4- Percy Bysshe Shelley, The Complete Works, eds. Roger Ingpen and Walter E. Peck, 10 vols. (London: Ernest Benn, 1965) 9: 186.

5- Henry F. Majewski, "Mercier and the Preromantic Myth of the End of the World." Studies in Romanticism 7 (1967): 2.

6- Majewski 4.

7- The term was apparently coined by William Whewell (1794-1866) in his History of the Inductive

Sciences (1837). See Dictionary of the History of Science, ed. W. F. Bynum et al (Princeton: Princeton University Press, 1981) 53. For Cuvier and Catastrophism, see the entry under '1812' in Claire Parkinson, Breakthroughs (Boston: G. K. Hall and Co., 1985) 257.

8- Boyd 86.

9- Frank F. Cunningham, The Revolution in Landscape Science (Vancouver: Tantalus Research Ltd., 1977) 68.

10- Charles Coulston Gillispie, Genesis and Geology: A study in the relations of scientific thought, natural theology, and social opinion in Great Britain. 1790-1850. (Cambridge: Harvard University Press, 1951) ix.

11- Chamberlin 290.

12- Charles Singer, A Short History of Scientific Ideas to 1900 (Oxford: Clarendon Press, 1959) 328.

13- Robert Jameson. The Wernerian Theory of the Neptunian Origin of Rocks: A Facsimile Reprint of 'Elements of Geognosy,' 1808. Int. Jessie M. Sweet, foreword George W. White. Contributions to the History of Geology, 9. (New York: Hafner) 75.

14- Jameson 77.

15- John Playfair, Illustrations of the Huttonian Theory of the Earth (1802) (the foreword by George W. White) Facsimile Reprint (Urbana: University of Illinois Press, 1956). viii.

16- See Leroy E. Page, "Diluvialism and its Critics in Great Britain in the Early Nineteenth Century" in Toward a History of Geology, ed. C. J. Schneer (Cambridge, MA: MIT Press, 1967) 257 ff.

17- Byron, Letters and Journals. Ed. Leslie A. Marchand. 12 vols. (London: John Murray, 1973-1982) VII: 172.

18- *ibid* VII: 196.

19- Gillispie 115.

20- Dov Ospovat, Perfect Adaptation and Teleological Explanation: Approaches to the Problem of the History of Life in the Mid-Nineteenth Century," in William Coleman and Camille Limoges, eds., Studies in the History of Biology (Baltimore: The Johns Hopkins University Press, 1977) 2:33.

21- Georges Cuvier, Essay on the Theory of the Earth. Mineralogical notes and an account of Cuvier's geological discourse by Robert Jameson. Trans. Robert Kerr (Edinburgh: James Ballantyne and Co., 1817) 16-17.

22- Cuvier 8.

23- Ernest J. Lovell, Ed. (Princeton: Princeton University Press, 1966) 157.

24- Medwin 157.

25- S. J. Gould, Time's Arrow, Time's Cycle (Cambridge, MA: Harvard University Press, 1987).

