

Chapter Three

Responses by Christian Scholars to Extra-biblical Data on the Flood from 1500 to 1860

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Introduction

It can be argued that modern geology began through attempts to explain natural features of Earth's surface as consequences of a worldwide Flood. Montgomery notes that Niels Stenson (1638–1686), better known as Steno, and often viewed as the seventeenth-century forebear of modern geology, “invoked Noah's Flood to explain the origin of the landscape around Florence in his influential treatise on the nature of fossils”, published in 1669. In the same vein, Janet Browne discusses “the critical role played by Noah's Ark in the development of ideas about the geographical distribution of animals and plants”.¹

But the stratigraphic studies which Steno pioneered proved somewhat retributive in that they eventually sounded the death knell for the idea that the Flood was responsible for producing most of Earth's geological features. It transpires that this fate has attended most, if not all, of the historical investigations initially launched to support the idea of a worldwide Flood. This is ironic, given that most early geologists were men of strong Christian faith and a large proportion of them wore the cloth. Their scientific work was done in the expectation, even the certainty, that it would corroborate their understanding of Scripture, since they understood both the book of Nature and the Bible to have the same Author. Deciding whether modern attempts to restore the Flood to geological prominence are

enjoying more success than their antecedents is a matter of perspective. Certainly, the Flood is now one of the central features of an ongoing tension between science, particularly geology, and the beliefs of some Christians.

Extra-biblical data have influenced Christian perceptions of the Flood for at least a millennium. However, this has been particularly so from the sixteenth century, with its explosion of geographical, and scientific knowledge, a hundred years or so before Steno. A number of issues began to emerge: the capacity required for the Ark to accommodate all the animals; the problem of the movement of pairs of animal species located in remote places (e.g. Australia and the Americas) both to and from the Ark; the amount of water needed for a world-wide inundation; the height of mountains prior to the Flood; the degree of calmness or tempestuousness of the Flood; and whether or not a single Flood could explain all the observed features. The seventeenth century witnessed some of the first serious investigations into Earth's rocky surface, which in turn provided more grist for this mill. Over its decades various aspects of the Flood story moved into or out of primary focus as different discoveries came to light. Many of these issues came and went a number of times over the ensuing eighteenth and nineteenth centuries.

Several authors have already addressed aspects of this story in some detail; Davis Young, for example, has written more than one book on this subject.² I have drawn from these accounts in order to establish the context for our own Adventist encounter. I have attempted to synthesise an overarching account of these historical developments in order to present a concise story, told by calendar century, into which is woven the most significant issues, persons, discussions, controversies, models and publications. Table 3.1 presents a list of noteworthy individuals in order of the date of their decease. It serves as a useful guide to this narrative. Many peripheral aspects of the story, such as the proposed resting place(s) of the Ark, are not addressed.

Table 3.1

Historical sequence of individuals of significance to the development of geology and Flood understanding, fifteenth to nineteenth century (ordered by year of death)

1400 AD	1500 AD	1600 AD	1700 AD	1800 AD
Leonardo da Vinci (1452–1519)				
	Martin Luther (1483–1546)			
	John Calvin (1509–1564)			
	Johannes Buteo (1492–1572)			
	Bernard Palissy (1510–1590)			
	Walter Raleigh (1554–1618)			
	Abraham van der Myl (1563–1637)			
		John Wilkins (1614–1672)		
		Matthew Hale (1609–1676)		
		Matthew Poole (1624–1679)		
		Athanasius Kircher (1602–1680)		
		Niels Stenson (Steno) (1638–1686)		
		Isaac Voss (1618–1689)		
		Edward Stillingfleet (1635–1699)		
		Robert Hooke (1645–1703)		
		John Ray (1627–1705)		
		Martin Lister (1639–1712)		
		Matthew Henry (1662–1714)		
		Thomas Burnet (1635–1715)		
		Erasmus Warren (16??–1718)		
		John Keill (1671–1721)		
		Edmund Halley (1656–1722)		
		Isaac Newton (1642–1727)		
		John Woodward (1665–1728)		
		Antonio Vallisnieri (1661–1730)		
		Johann Scheuchzer (1672–1733)		
		John Arbuthnot (1667–1735)		
		John Hutchinson (1674–1737)		
		Beniot de Maillet (1656–1738)		
		John Strachey (1671–1743)		
		Fettiplace Bellers (1687–1750)		

1500 AD	1600 AD	1700 AD	1800 AD	1900 AD
		William Whiston (1667–1752)		
		Anton-Lazarro Moro (1687–1764)		
		Johann Lehmann (1719–1767)		
		John Gill (1697–1771)		
		Carl Linnaeus (1707–1778)		
		Torbern Bergmann (1735–1784)		
	Georges Leclerc, the Comte de Buffon (1707–1788)			
		John Wesley (1703–1791)		
		John Michell (1724–1793)		
		Giovanni Arduino (1714–1795)		
		James Hutton (1726–1797)		
		Alexander Catcott (1725–1799)		
		Richard Kirwan (1733–1812)		
		Abraham Werner (1749–1817)		
		John Playfair (1748–1819)		
		Thomas Scott (1747–1821)		
		William Phillips (1775–1828)		
		Georges Cuvier (1769–1832)		
		William Smith (1769–1839)		
		George Greenough (1778–1855)		
		Jean de Charpentier (1786–1855)		
		William Buckland (1784–1856)		
		William Conybeare (1787–1857)		
		John Fleming (1785–1857)		
		Ignaz Venetz (1788–1859)		
		Benjamin Silliman (1779–1864)		
		Charles Daubeny (1795–1867)		
		Roderick Murchison (1792–1871)		
		Louis Agassiz (1807–1873)		
		Adam Sedgwick (1785–1873)		
		Charles Lyell (1797–1875)		
		George Scrope (1797–1876)		

Essentially, there were three main Flood models proposed during these centuries. These were the **diluvial** schema of the seventeenth and early eighteenth centuries, the **neptunist** ideas of the late eighteenth century and the **diluvial catastrophism** of the early nineteenth century. For the most part these models were put forward by Christian scholars, many of whom were well known because of their significant contributions elsewhere.

Since the 1850s there have been no attempts on the part of those associated with the mainstream academic study of geology, Christian or otherwise, to explain any of Earth's features in terms of a world-wide Noachian Deluge. Such Flood models have not disappeared but since that time they have moved further and further away from accepted geological wisdom.

Although elements of this narrative were provided for Adventist audiences at least as far back as 1977 by Harold Clark it is a story which needs re-telling since there is a tendency for each generation to think that it is facing these issues for the first time.³

In his *History of Rome*, Barthold G. Niebuhr declared that, ““he who calls what has vanished back again into being, enjoys a bliss like that of creating””.⁴ If not exactly inducing bliss, the preparation of the following account has certainly heightened my appreciation of those honest, competent, and deeply Christian scholars who, over the centuries, have attempted to reconcile geological data with Scripture.

The Fifteenth and Sixteenth Centuries

More Species Discovered

It is generally thought that the epic land journey of Marco Polo (1254–1324) provided part of the inspiration for the great sea voyages by such famous sailors as Christopher Columbus (1451–1506), Ferdinand Magellan (1480–1521) and Tristan da Cunha (1460–1540). These voyages not only revealed a world of much greater extent than had been previously suspected but resulted in the discovery of a huge number of very different plants and animals up until then unknown to Europeans. This was particularly so of the Americas and the Pacific. By the mid-1500s the international menagerie had been expanded to include birds and beasts such as penguins, cockatoos, tapirs, armadillos, llamas, turkeys and bighorns, none of which had been known in the Old World.

Fossils

During this period the dawning awareness of fossils, or “formed stones” as they were initially known by some, also brought surprises. A number of theories concerning the origin and significance of these curiosities were advanced. There were those who regarded them as the works of evil or occult forces. Some took the view that fossils were petrified vapours, exhalations or plastic virtues (*vis plastica*), perhaps remnants of partly formed animals from the creation or discards which had “never made it to the surface”. Others felt that they were perfectly explicable as the remains of modern shellfish. But from their very earliest discoveries some took these artefacts to be remnants of ancient, once-living life forms.⁵ The French Huguenot, Bernard Palissy (1510–1590), a ceramist and self-taught scientist, was one of the first to advance this view. However, in contrast to most others who espoused it he argued vigorously that these fossils could not have been buried by the great biblical Flood.⁶ This discussion would generate more definite divisions of thought in the 1600s.

Geographical and scientific developments, such as the discovery of more living species and a greater diversity of fossil remains, were instrumental in opening up many Flood-related issues. These included the capacity of the Ark and the problem of the dispersal of animals over long distances. The fact that such questions were asked, calculations made and suggestions offered, reveals the desire in this age to support Christian belief by the use of rational argument.

Flood Issues Emerging

Capacity of the Ark

Discussion among Christians concerning the carrying capacity of the Ark goes back at least to Augustine (354–430) and it might have been expected that this aspect of the Flood story would have come under renewed scrutiny during this period because of the discovery of so many new species of animals. However, this appears not to have been so. Discussions during this era of the Ark’s carrying capacity were typically based on very conservative estimates of the number of species and did not reflect knowledge freely available at that time.

Representative of those during this period who expressed views on the capacity of the Ark was Johannes Buteo (1492–1572), a Roman Catholic mathematician. He chose three reference species— cow, sheep and wolf—and determined the equivalent volumes of all the

animals known to him in terms of the volume of one of these species. He estimated that the combined volume of the larger animals would have equated to some 91 cows, all the smaller animals would have been equivalent to 80 sheep and that, in total, the carnivores would have taken up the same space as approximately 80 wolves. Buteo calculated from the biblical dimensions given that the Ark would have had an internal volume of some 350,000 cubic cubits and he suggested a design which included room for waste at the bottom and two decks above for the animals and food respectively. Such a vessel was easily sufficient to contain the animals he had identified together with their food for one year. This would be particularly so if there was no need for aquariums, “as fish might be without sin and would therefore be spared”.⁷

At about this time other individuals also calculated the volume required for storage within the Ark. Some reduced the number of species needing to be housed by eliminating hybrids, such as mules, which could have been produced after the Flood.

The Problem of Animal Dispersal

The problem of how animals travelled to and from the Ark was just emerging and would later attract much more attention. One of the earliest to articulate this dilemma was Justus Lipsius (1547–1606), who suggested that a land bridge from Africa to America via Atlantis would have been necessary, since “no one would travel willingly with rattlesnakes and bears” to the New World!⁸

Other Voices from This Period

The great Protestant reformers Martin Luther (1483–1546) and John Calvin (1509–1564), while certainly commenting on the Flood, sometimes at length, gave no indication of any problems associated with the additional animals which had by then been found in distant lands. It was as if the New World, for example, had not yet been discovered!⁹

However, it is important to note that in other ways the influence of the Reformers on Flood discussions would be far-reaching. As pointed out by Peter Harrison, it was during the 1500s that influences associated with the Reformation began to encourage a more literal reading of the biblical text and a movement away from many of the allegorical interpretations which had characterised the earlier Christian period.¹⁰ This would in turn provide an impetus to verify biblical stories such as the Flood. We see this over the next few centuries.

The nature of the Flood itself, whether placid or otherwise, also excited little thought, although Sir Walter Raleigh (1554–1618) took the view that if the dove could have plucked an olive leaf the Flood must have been calm rather than violent. He felt that this opinion was further strengthened by a report that a pillar erected by Seth had been observed by Josephus.¹¹

One of the very few within the Renaissance period to express doubt about the Flood was the redoubtable Leonardo da Vinci (1452–1519). The difficulty of disposing of the huge amount of water required for complete coverage of Earth's terrestrial surface inclined Leonardo to question the worldwide extent of the Deluge. In fact, he questioned whether the fossil distributions found could be adequately explained by a flood, whether universal or not. Leonardo noted that fossil shells found at high elevations within the Italian Alps were often buried deep in stone. He felt that if these had been deposited by the Flood they would be found much closer to the surface or even on it.

Leonardo also noted that rivers swollen by rain would wash things into the seas, not from the seas far inland onto the mountains. He pointed out that, "the flood could not have carried shells so high up mountains because 'things heavier than water do not float upon the surface of the water.'" Furthermore, he wondered why certain objects having a high density would have been carried such long distances, even by turbulent flood waters, given that the base of a large ocean wave actually carries objects in the reverse direction to that in which the top of the wave is advancing.

In any case Leonardo doubted that the Flood had been very turbid, observing that, "if the shells had been in the turbid water of a deluge they would be found mixed up and separated one from another, amid the mud, and not in regular rows in layers as we see them in our own times". In addition, he took the view that the presence in the fossil record of oyster-shell pairs which were still joined together also spoke against the notion of a turbulent flood.¹²

However, it is clear that, despite the occasional outlier such as Leonardo, the great predominance of Christian opinion around the year 1600 favoured a world-wide Deluge in which any form of land-based life not preserved in the Ark must have perished.

The Seventeenth Century: The Rise and Zenith of Diluvial Cosmogonies

The seventeenth century was a time of both great religious ferment and scientific development. It witnessed the historic altercation between Galileo and the ecclesiastical and scholastic authorities. Following the restoration of the English monarchy it also saw the emergence of the Royal Society of London, which received its Royal Charter in 1662. Although religious and political issues were barred from consideration within this society many, if not most, of its members, including those of greatest influence, were sincere and practising Christians. They saw their science as being completely compatible with their faith. Furthermore, many saw their science as a means of strengthening that faith. In one of his letters Newton wrote, “‘When I wrote my Treatise about our System, I had an Eye upon such Principles as might work with considering Men, for the Belief of a Deity, and nothing can rejoice me more than to find it useful for that Purpose.’”¹³ Thus, it is no surprise that many of the most influential contributors to discussions concerning the Flood were members of the Royal Society.

Fossils

The discovery of many more fossils during the seventeenth century resulted in continued disagreement, even among experts, over their nature. There were many who denied that fossils represented organisms that had once lived. It is of interest to note that there was similar doubt about Egyptian mummies. Lyell presents this quaint view from the perspective of an adherent which, of course, he was not!

They may have been generated by some *plastic virtue* residing in the interior of the earth, or they may be abortions of Nature produced by her incipient efforts in the work of creation. For if deformed beings are sometimes born even now, when the scheme of the universe is fully developed, many more may have been “sent before their time, scarce half made up,” when the planet itself was in the embryo state.¹⁴

Athanasius Kircher (1602–1680), a German Jesuit polymath who has been described recently as “the last man who knew everything”, denied the biological origin of fossils, attributing them to a “lapidifying virtue diffused through the whole body of the geocosm”. Like many of his time, Kircher also took the unequivocal view that science was a vehicle for the proving of Christian faith.¹⁵

Within the Royal Society could be found proponents of each of the three major views on fossils. Competent student of natural history, Martin Lister (1639–1712), was one of the most ardent opponents of the notion of an organic origin for fossils. He felt that since fossils were sometimes found embedded deep in hard rock, and were themselves frequently rocky in nature, they could not be organically derived.¹⁶

Some opposed the idea of an organic origin because these apparent sports of nature were so manifestly different from those now living. Further to this point, if indeed fossils were of organic origin, then it was obvious that some life forms had become extinct. This violated the widely held principle of “plenitude”, according to which understanding it was thought that God had a necessary place for each of his creations and could not possibly have permitted some to disappear. Such casualness on the part of God towards his creation was unconscionable. “‘Is it likely’, asked Oxford Chemistry Professor and Keeper of the Ashmolean Museum, Robert Plot, in 1677, ‘that providence which took so much care to secure the works of Creation in Noah’s Flood, should, either then, or since, have been so unmindful of some shell-fish as to suffer any one species to be lost?’”¹⁷

Others thought differently. The Royal Society’s Curator of Experiments, Robert Hooke (1645–1703) denied that fossils were random sports of nature and, unworried by issues of plenitude, recognised them as the remains of extinct species. Lyell notes that when criticised on this account by contemporaries Hooke declared that his ideas:

were not repugnant to Holy Writ: for the Scriptures taught that our system was degenerating, and tending to its final dissolution; ‘and as, when that shall happen, all the species will be lost, why not some at one time and some at another?’¹⁸

However, Hooke did not agree that all fossils were laid down by the Flood, as was popularly conceived. The great systematist, John Ray (1627–1705), sometimes called the second Adam because he named all the animals, took a similar view. In contrast, leading naturalist, John Woodward (1665–1728), was persuaded that all fossils owed their origin to the Noachian Flood, being the remains of those harder parts of animals which had remained long enough to petrify.¹⁹ Some of these persons reappear in the subsequent discussion of emerging Flood models.

Flood Issues Emerging

Ark Capacity

John Wilkins (1614–1672), Bishop of Chester and Warden at Wadham College, Oxford, published in 1668 a comprehensive list of animals and plants known to him. In a digression on Noah's Ark he took the view that the number of animal species had been greatly overestimated and suggested that although "otherwise knowing and learned men" affirm that "there are so many hundreds of them, as could not be enumerated; ... upon a distinct enquiry into all such as are yet known, and have been described by credible Authors, it will appear that they are much fewer than is commonly imagined, not a hundred sorts of Beasts, nor two hundred of Birds". He took the view that some of Buteo's species needed updating: some were "fabulous", others were not distinct species at all, while other true species had been omitted. He followed Buteo's convention of beef [cow], sheep and wolf equivalency and even made allowance for the dietary needs of the 40 carnivores, which would amount to some 1,825 sheep. He concluded that 109,500 "solid" [cubic] cubits of hay would feed the ruminants, including the shrinking flock of sheep, for a year. Wilkins' estimate of the number of species for which accommodation would have been required certainly did not reflect adequately the knowledge available at that time.²⁰

Athanasius Kircher, already mentioned, made similar calculations but differed over the number of sheep required, determining that to be 4,562.5, more than twice the estimate of Wilkins. Once again, his approximation of the number of species involved did not reflect reality as it was then known. He spoke of only 130 types of animals (mostly mammals according to modern nomenclature), some 30 species of snakes and 150 kinds of birds. He also noted that most insects and reptiles need not have been on the Ark since they could have arisen from putrefaction after the Flood. He took the view that some other modern species resulted from post-flood crossbreeding. The giraffe (camelopard), for example was a camel-leopard cross, while the armadillo was an hybrid between turtles and porcupines!²¹

Even though inadequate, these detailed calculations deserve respect as serious attempts towards a rational response to growing criticism that the Ark was incapable of holding all the world's species.

Extent of the Flood

A major difficulty for diluvial theories which emerged at this time was to identify a source of water adequate to submerge the entire earth. This problem remained even if it was assumed that pre-flood mountains were not as high as those found on Earth today. This was the view of Lord Chief Justice Sir Matthew Hale (1609–1676), who postulated that the surface of the pre-Flood Earth “was ‘more even than now it is’”. Hale was one of Britain’s leading judges under both Cromwell and Charles II and presided over the regicide court which convicted and cruelly executed those responsible for the be-heading of Charles I. As well as being celebrated for his judicial impartiality he was widely regarded as one whose character was not only “improved and adorned by Christian graces and virtues” but one in which “Christianity was substantially exemplified”.²² Incidentally, it should be noted that the perception that the surface of the antediluvian Earth was essentially smooth was widely held at that time. Mountains were seen as “hideous blemishes upon the Earth’s fair skin” and as “cancerous growths of diluvial and post-diluvial age, ... striking evidence of nature’s degeneracy”.²³

Dutch-born Isaac Voss (1618–1689), later a canon in the English Church, solved the water-supply problem by questioning the universality of the Flood. He regarded *ad hoc* hypotheses by which God miraculously created the necessary water and eliminated it after the Flood as “pious fooleries” and felt that a universal Flood would have necessitated too many such miracles. Voss also questioned the need for a universal deluge, arguing that the “slow and sluggish” rate of breeding of the nine generations from Adam to Noah could hardly have resulted in humans spreading over the whole earth. Soon after, George Kirchmaier ventured that the Flood only affected that part of the world where Noah lived, pointing out that humanity was not widely dispersed until after the construction of the Tower of Babel.²⁴

Edward Stillingfleet (1635–1699) was another who favoured a local flood, although not too small, on the grounds of there being insufficient water to cover the globe. He, too, noted that human civilisation would not have spread out very far beyond Syria and Mesopotamia and that a localised flood could easily have destroyed “all Mankind”. He took the view that animals would have spread much further than humans but did not see any need for the total destruction of animal life on Earth. The animals taken on board the Ark would have been those of

importance to the daily life of humans, such as horses. These would have been needed to restore local populations after the flood.²⁵

More broadly-based investigations only exacerbated the water shortage problems. Calculations made possible from emerging meteorological knowledge revealed that a total collapse of the water in the world's clouds would cover the earth by a mere few inches. In order to solve this problem and restore the fortunes of a worldwide deluge it was argued by some (including Walter Raleigh, languishing in the Tower of London in 1614 and by Kircher in the 1660s) that springs coming out of the earth confirmed the existence of a vast aquifer within, often referred to as the "Abyss". Kircher claimed that vast quantities of this water were expelled to the world's surface.²⁶ The ensuing devastation would presumably have destroyed many of the existing land bridges.

Cambridge divine, Thomas Burnet (1635–1715), in his *The Theory of the Earth Containing an Account of the Original of the Earth, and of all the General Changes Which It Hath Already Undergone, or Is to Undergo Till the Consummation of All Things* was another who solved the hydration problem by hypothesising the existence of a subterranean abyss under the Earth's surface. This work appeared in Latin in the year 1681. It was later re-titled, *The Sacred Theory of the Earth*, the English translation of which appeared in 1684. Speaking of the Abyss Burnet wrote, "and no doubt in this lay the great mystery of the Deluge, as will appear when it comes to be rightly understood and explained". Burnet's model, which also reduced the amount of water required by assuming a relatively smooth surface for the Earth, is discussed in more detail in a later section of this chapter.²⁷

Matthew Poole (1624–1679), a well-regarded nonconformist minister in London, also spoke of water from the deep caverns in his influential work, *A Commentary of the Holy Bible*, published in 1679. Despite this subterranean water, Poole took the view that unless God had miraculously created additional water there would still have been insufficient for a world-wide Deluge. In his later *Synopsis* Poole argued even more strongly for a localised flood, noting that, "If we take this ground the difficulties which some have raised about the deluge fall away as inapplicable, and mere cavils; and irreligious persons have no reason left them for doubting the truth of the Holy Scriptures". Poole may have been the first author of an actual Bible commentary to make this concession. He was obviously aware of the huge number of

animal species revealed by the recent voyages of European navigators and of the difficulty in accommodating them in the Ark. He was also aware of the problems posed by the transfer both to and from the Ark of many of these animals that lived in remote places.²⁸

The Problem of Animal Dispersal

Awareness of the problem of getting the animals to and from the Ark in the event of a world-wide Flood was by this time beginning to dawn in earnest, as the many new species discovered through the exploration of new and distant places became better known. Abraham van der Myl (1563–1637) responded to this difficulty by opting for a restricted Deluge, noting that Noah’s descendants would hardly have “transported lions, tigers, bears, dragons and serpents to distant lands”. He thought that the Americas had retained all the original plants, birds and animal species whereas the Old World had only a remnant of the original creation, namely those that had survived the Flood.²⁹

Even in the context of a restricted Flood, Matthew Poole had speculated that the ocean separating Europe and Asia from the Americas was smaller in Noah’s day and this would have permitted many animals to swim across it. However, he left the question of transport open to the possibility of divine intervention, noting that the same God

... who made all these creatures and then caused them to come first to Adam and afterwards to Noah could afterwards both incline and empower them to go whither he pleased, without the advice of these vain men, who will believe nothing of God which themselves either do not see or cannot do.³⁰

Arguing in support of a universal Flood, Kircher suggested that the wild animals must have swum from island to island, while domestic species must have been conveyed in boats. Matthew Hale agreed that domestic animals might have been carried in boats, adding that waterfowl could have flown and swum. Other species could have crossed the frozen ocean wastes in northern winters. Once again, various land bridges were proposed. Hale suggested that these would be necessary because, after all, no one would be likely to provide transport for the ferocious beasts. Contrary to van der Myl, Hale took the view that animals currently endemic to America were adaptations of those species which had been in the Ark, produced by interbreeding, mutation and in response to environmental influences.³¹

A Succession of Flood Models

By the later 1600s the focus was shifting away from the capacity of the Ark and the problems of animal migration to the geological causes and effects of the Flood. Browne has suggested that this may have been due to the growing intractability of the overloaded Ark problem and the fortunate emergence of “more answerable” questions associated with the Flood itself.³² While Christian scholars had no wish to question the validity of a literal reading of the Genesis account they were fascinated by the possibility of discovering the secondary causation details concerning the creation and destruction of this world as they might be revealed through geological enquiry. These endeavours resulted in many diverse deluge theories in which terrestrial features such as valleys, mountains and rock formations were attributed in some way to creation and the Flood. These became known as **diluvial** models. The evidence suggests that, although sometimes slow to realise its import, Christian scholars took the incoming evidence seriously. Recognising the need to reconcile it with their understanding of Scripture, they were also driven to a more thorough study of the biblical text. It is significant that these attempts to explain a worldwide Flood increasingly invoked natural explanations rather than *ad hoc* miracles, the appetite for which was diminishing as more understanding of the natural order was revealed by science.

While there was clearly a mood at that time to view the world’s physical features as tangible evidence for biblical events there was some disagreement as to how this should be done. Some presented them as unmistakable evidence of the beneficent provisions of a wise and generous God, others as clear testimony to a world in decay.

Burnet’s *The Sacred Theory of the Earth* (1684) probably represented the first comprehensive deluge theory, at least in Britain. It was “writ with a sincere intention to justifie the Doctrines of the Universal Deluge, and of a Paradisiacal state, and protect them from the cavils of those who are no well-wishers to Sacred History; ...” Although essentially ignorant of science, the author also claimed a sound scientific basis, stating that, “We are not to suppose that any truth concerning the Natural World can be an enemy to religion”. He argued that after the release of huge quantities of water from the Abyss, gravitational forces acting on the original chaos of the earth’s surface resulted in the heavier particles sinking first and the lighter

ones settling more slowly afterwards. He drew support for this theory from Ps 24:2 “He founded the Earth upon the Seas and establish’d it upon the Floods”; and Ps 136:6: “He stretched out the Earth above the Waters”. According to Burnet’s scenario humans’ sin resulted in the Sun’s warming the globe, thereby causing expansion cracks in the crust, huge portions of which providentially gave way, releasing the water from below at just the right time to initiate Noah’s Flood, and ultimately settling as ocean basins and high mountains.

Burnet went on to explain that at the end of the Flood the waters settled into the newly formed ocean basins, ultimately draining back into the abyss through channels in the bottom of the ocean floor that were formed by the collapse of the crust. He did not attempt to discuss the formation of fossils. Burnet requested the opinion of Sir Isaac Newton (1642–1727). ““I think you have given the most plausible account,”” replied Newton, although other evidence suggests that he retained some scepticism over some parts of the work. Although controversial in its time, *The Sacred Theory* was widely acclaimed as a masterpiece. Burnet’s “stately prose” promoted a wide circulation and many reprints, the last as late as 1965!³³ Lyell disparagingly described *The Sacred Theory* as “most characteristic of the age” and went on to allege that “Even Milton had scarcely ventured in his poem to indulge his imagination so freely in painting scenes of the Creation and Deluge, Paradise and Chaos”.³⁴

Robert Hooke agreed with many of Burnet’s tenets but, while apparently happy with a world-wide Deluge, felt that the latter was too short to produce the effects observed. His initial papers on this topic were presented to the Royal Society in 1667. As earlier noted, he also argued that it was inadequate to account for all the fossil distributions and the rock strata. Hooke took the view that fossils now found in mountains far from the sea were indeed the remains of marine animals which had lived prior to the Flood but that these had been preserved as a result of successive earthquake activity during and after the Flood, causing the seabeds to be uplifted to their present positions. These ongoing earthquake disturbances had continued to counter the continual erosion, denudation and wearing down of these surface features by water action. Hooke also advanced the view that the Earth’s axis of rotation had shifted around, resulting in movement of the Earth’s centrifugal, equatorial bulge. This, together with enhanced geological activity around the time of the Flood, would have had the

effect of elevating some portions of Earth's primeval surface above sea level while submerging others, significantly reversing the land and sea floor.³⁵

Not all were appreciative of *The Sacred Theory*, even to the limited extent of Hooke. Davies notes that, "Herbert Croft, aged bishop of Hereford, branded the *Theory* as 'philosophik Romance', full of 'extravagant fancies', 'vain Fopperies' and 'Fabulous Inventions'".³⁶

Burnet was treated more severely in *Geologia* (1690), written by Erasmus Warren (birth-date not known–1718), the rector of Worlington, who felt that Genesis 1 clearly described a newly formed Earth which had both seas and mountains and that these were not all formed during the Flood. He also felt that Burnet had misused Ps 24:2 and Ps 136:6 in order to find biblical support for his abyss. Warren felt that these verses spoke more naturally of the juxtaposition of land and sea. Warren did, however, share Burnet's view that God had not created *ad-hoc* any water for the Flood. While criticising Burnet's exegesis for being insufficiently literal in places he went on to postulate that the Flood, while possibly worldwide, involved water levels "which were indeed but fifteen Cubits *high* in all, above the surface of the Earth", and did not cover the high mountains, such as the Swiss Alps, at all. Warren also felt that the Flood could not have been caused by the total destruction of the Earth's surface features, because if it had done so the Ark would have been "staved all to pieces" and all buildings, including the "Pillars of Seth", referred to by Josephus, would have been destroyed. Furthermore, the rivers of Eden would have been obliterated, in which case Moses would never have had occasion to refer to them.³⁷

And so we have good evidence that, the general Flood could not be the Effect of the earth's Dissolution. For if it were so, Moses's Description of Paradise must be false. Which, to affirm, would be horrid blasphemy, it being dictated by the HOLY GHOST.³⁸

The publishing in 1686 of Newton's *Principia* spurred many of those subsequently seeking to explain the Earth's surface features to formulate their models on the sound mathematical and physical principles generally recognised to be contained therein. The last few years of the seventeenth century saw a veritable explosion of publications on the Flood, most of which concentrated on possible mechanisms.

One very influential exception was *An Essay toward a Natural History of the Earth and Terrestrial Bodies* by the afore-mentioned John Woodward, FRS, which appeared in 1695. This was more concerned with the effects of the Flood than with mechanism. Although agreeing with many of Burnet's ideas, including the universality of the event, Woodward looked again at the fossils and the layered strata, wishing to be "'guided wholly by Matter of Fact' and observations 'carefully made and faithfully related'". He felt that the surface soils, rock particles and organic remains had been carried away by the floodwaters, from which they had settled out in layers before the water returned again to the abyss: "the present earth consists and was formed out of that promiscuous mass of Sand, Earth, Shells and the rest falling down again and subsiding with the Water". His thesis, boldly announced in the Preface to his book, was that the most-dense materials would have been deposited first and the lightest sediments last, leaving the earth covered with concentric deposits and strata, many containing organic remains; which were graded from top to bottom in increasing density: "... these marine bodies are now lodged in those strata according to the order of their (specific-LJR) gravity".³⁹

Interestingly, in Woodward's view the Deluge was sent to re-order the world for the ongoing benefit of mankind at least as much as it was sent to punish humanity in judgment:

So that upon the Whole 'tis very plain that the *Deluge* was not sent only as an *Executioner* to *Mankind*: but that its *prime Errand* was to *Re-form* and *New Mold* the *Earth*. ... For the *Destruction* of the *Earth* was not only an *Act* of the profoundest *Wisdom* and *Forecast*, but the most monumental *Proof*, that could ever have been given, of *Goodness*, *Compassion* and *Tenderness*, in the *Author* of our *Being* ...⁴⁰

Woodward's view aroused considerable opposition among the scientific community. Lyell quotes John Ray's negative reaction to Woodward's claim that

'... marine bodies are lodged in the strata according to the order of their gravity, the heavier shells in stone, the lighter in chalk, and so of the rest.' Ray noted that fossil bodies 'are often mingled, heavy with light, in the same stratum;' and he even went so far as to say that Woodward 'must have invented the phenomena for the sake of confirming his bold and strange hypothesis'.⁴¹

John Arbuthnot (1667–1735), a mathematician and experimental philosopher, urged in 1697 that Woodward’s efforts were not supported by the evidence. He, too, particularly homed in on Woodward’s very testable claim of a uniform gradient in rock density, claiming that

... it were endless to enumerate all the Particulars wherein the Doctor’s Rule is violated,

... I shall conclude with this general Remark; It is strange that the Laws of Gravity, which have been violated in so many Particulars, in raising the Water of the Abyss, and making a lighter Body, descend in its Room, in sustaining Minerals in Water, and stopping them in their descent before they reach’d the Centre; in placing the heaviest Solids in the upper Strata, etc. I say, it is strange the same Laws of Gravity should place a few shells with as much Nicety, as the Doctor does in his Collection, not transgressing so far as a fifteenth Part.⁴²

Despite these substantive objections Woodward’s view was comparatively long-lived and had considerable influence on subsequent Bible commentators.

In 1694 Edmund Halley (1656–1722) presented a Flood model to the Royal Society based on his up-to-the-minute knowledge of physical principles, in which he noted that God generally utilised natural means to accomplish His will. He defended the universality of the Flood, the evidence for which he found from the many fossil remains which are found “far and above the sea”. Perhaps not surprisingly, given his astronomical interests, Halley proposed that a comet that had passed close by Earth had initiated a catastrophic inundation of land by the oceans and may even have altered the orientation of Earth’s rotational axis. However, Halley delayed the publication of this address for three decades, “lest he incur the Censure of the Sacred Order”. He knew that politically powerful authorities in the English Church still widely accepted the dominant role of miracles in such events and resisted the new scientific explanations.⁴³

William Whiston (1667–1752), strongly influenced by Woodward, Newton and Halley, published his *New Theory of the Earth* in 1696. Whiston’s views represented another concerted attempt to mould a view based on the latest discoveries in physics. He believed that the Earth had initially been formed from a large comet and that the primitive, spherical Earth did not rotate about its axis. Rotation about Earth’s axis had commenced at the Fall and this motion had caused

the Earth to assume the shape of an oblate spheroid, stressing and cracking its surface in the process. The Flood was initiated by the Earth's passing through the tail of another great comet, during which time a huge quantity of water fell from the comet's atmosphere. Whiston believed that the proximity of the comet resulted in additional stresses at the Earth's surface as its strong gravitational attraction caused violent tidal movement of the waters beneath.

Its old Fissures were open'd and the Fountains of the Abyss (most naturally and emphatically so styl'd, according to Dr *Woodward's* Account of the Origin of Fountains) broken up; and sufficient Gaps made for a Communication between the Abyss below and the Surface of the Earth above the same ...

Accordingly, the waters of the abyss were released outwards in devastating quantities. The fossils and rock strata were deposited as the floodwater drained, in much the same manner as that outlined by Woodward.⁴⁴

Whiston's publication may have been the catalyst for the entry into the fray of Burnett's most able critic, Oxford's Savilian Professor of Astronomy, John Keill (1671–1721). Standing against the emerging mood of the age, Keill was generally disinclined to bring science into matters of religious faith and questioned the extent of science's explanatory power. Accusing science of unwarranted confidence, he wrote in 1698:

M Des Cartes, the great Master and Deliverer of Philosophers from the tyranny of Aristotle, is to be blamed for all this for he has encouraged so much this presumptuous pride in Philosophers that they think they can understand all the works of nature.

Despite this viewpoint Keill spoke as a scientist when he dismissed Burnet's earlier contribution as being poorly constrained by the data. He showed mathematically that the crust could not have formed as Burnet had claimed, since solid particles would have sunk the moment they coagulated. He took Whiston apart by challenging his physics. Keill also pointed out that Genesis speaks of humans using iron tools before the Flood, hence particles containing this metal must have been present and would have sunk more quickly than most. He condemned both Burnet and Whiston as “makers of imaginary worlds and losers of imaginary floods”. Davies noted a strange irony emerging from these accounts. Keill, the competent astronomer and scientist, sought to retain the role of supernatural interventions in the Flood, while

Burnet, who one hopes was a better cleric than scientist, was just as eager to demonstrate the all-sufficiency of natural law!⁴⁵

Other Voices from This Period

By the later decades of the seventeenth century, according to Davies, scientists

... were beginning to perceive dimly that the story of the Earth as revealed by nature is vastly longer than the story as told in the Bible. At this discovery they felt no elation, and quite unlike their successors in a much later generation, they certainly experienced no sense of science having triumphed over religious bigotry. Rather they were deeply religious men bewildered at the problem which they had unwittingly laid bare; a problem which they scarcely dared consider in their published works, but which appears time and time again in their correspondence with each other.⁴⁶

By the end of the seventeenth century, despite some lingering rear guard actions, “‘Experimental and Mechanical Knowledge’ was gaining ground over the ‘Philosophy of Discourse and Disputation.’” Speaking particularly of the Royal Society Fellows Bishop Sprat noted that, “‘their purpose is, in short, to make faithful Records of all the Works of Nature, or Art, which can come within their reach: ...’” and that, “‘they have indeavour’d to separate the knowledge of Nature, from the colours of Rhetorick, the devices of Fancy, or the delightful deceit of Fables...’” “These ‘Reformations in Philosophy’ were to be achieved, ‘not by a glorious pomp of Words; but by the silent, effectual and unanswerable Arguments of real Productions.’”⁴⁷

Although the Flood was clearly coming under strong scrutiny by that time, it seems that most British scholars still sought to account for geological phenomena in terms of a global Deluge, the idea of a localised flood still being widely considered to be heretical. The apparent success of the many diluvial models proposed was due in part to the fact that they did not take into account the huge number of new species which had by then been discovered and described. By the end of that century John Ray had listed about 500 species of birds, 150 different quadrupeds and some 10,000 invertebrates.⁴⁸ The success of these models also owed much to a poor understanding of ecology and of the interaction between individual species and their environments. The movements of animals over vast distances in connection with the Flood could thus be proposed with little recognition of the challenges and stresses these would represent.

Despite these necessary caveats, however, the amount of scholarly time expended, and the number of substantial books on various flood models produced by informed and respected Christian scholars of that age remains impressive.

The Eighteenth Century: the Decline of Diluvial Cosmogonies and the Rise of Neptunism

Fossils

Stokes notes that after 1699 no more articles were published in the Royal Society's *Philosophical Transactions* in favour of a non-organic origin for fossils. Scholarly opinion on fossils was clearly "hardening" into the conclusion that they were indeed of organic origin, although many felt that the Flood could not account for their distribution satisfactorily.⁴⁹

Although he had earlier thought that fossils were inanimate sports of nature, the Swiss polymath Johann Scheuchzer (1672–1733), who had been persuaded of diluvialism by Woodward, also changed his views on fossils. He wrote a rather clever piece entitled *Piscium Querelae et Vindiciae*—*The Fishes' Complaint and Vindication* (1708)—that contained some excellent plates and descriptions of fossil fish and in which he exposed his own earlier (non-organic) view of fossils, still accepted by some, to gentle ridicule. Scheuchzer's fish expressed their disappointment that they had been so widely discounted as inanimate freaks and begged due recognition by humans as having once lived.

We, the swimmers, voiceless though we are, herewith lay our claim before the throne of Truth. We would reclaim what is rightly ours... Our claim is for the glory springing from the death of our ancestors... that race which lived and was carried on the waves before the Flood... Moreover, we are defending an even greater cause: we bear irrefutable witness to the universal inundation.

The fish took the view that surely some dignity should be accorded to them since their death in the Flood and subsequent fossilisation had, after all, come about as a direct consequence of mankind's own sin!⁵⁰

Decline of Diluvial Models

In 1710, continuing the momentum of discussion concerning Woodward's model which had taken place during the 1690s, Fettiplace

Bellers (1687–1750), another Fellow of the Royal Society, published his study of 30 different rock strata from a coal pit in Dudley, Staffordshire. He found that “the Gravities of the several Strata are in no manner of Order; but purely casual, as if mixt by chance”.⁵¹

From 1724–1727 John Hutchinson (1674–1737) published his *Moses’ Principia*. Hutchinson had for a time assisted Woodward but he had become concerned that rationalistic explanations were in danger of displacing the authority of the Bible. This work was an attempt to establish a system of physics based on Scripture which would compete with Newton’s *magnum opus*. The Flood model he presented was similar in most features to Burnet’s and did not advance much new thought.⁵²

Young describes *A Treaty on the Deluge* (1761) by Alexander Catcott (1725–1799) as “perhaps the last competent treatment of the deluge as the principal causative agent for the world’s geological strata”. Drawing much of his inspiration from Hutchinson, Catcott argued for the universality of the Flood, partly on the basis of the many deluge traditions found in different cultures. He opposed the idea that fossiliferous sedimentary rocks were deposited by a series of smaller floods because the Egyptian pyramids, which he believed to date back to the time of Noah, were constructed of fossiliferous rocks. Catcott, however, was a competent field worker and his unpublished field notebooks indicate that he was aware of the fact that tilted rock layers and rock formations showed clear evidence of complex histories that were not easily fitted into his favoured scenario. He followed the earlier Lipsius and Hale in the view that it was unlikely that humans had transported noxious beasts such as rattlesnakes and lions around the world. In order to account for the human population in America he postulated that Africa and America were once more effectively joined and that about 300 years after the Flood an earthquake had resulted in the subsidence of the bridging land mass. He claimed biblical support from Genesis 10:25, which speaks of Peleg, in whose time “was the earth divided” (KJV).⁵³

It is interesting to observe that then, as now, there was a huge variety of diluvial models. Each represented a unique blend of biblical exegesis, natural theology, scientific philosophy, scientific and general knowledge, as well as speculation. They survived for a time mainly because there was some favourable evidence and because they ignored large bodies of unfavourable evidence. The increasing number of

recognised species also continued to haunt such attempts. By 1758 the 10th edition of Carl Linnaeus' (1707–1778) *Systema Naturae* listed some 7,700 species of plants and 4,400 animal species.⁵⁴ Many more were added in later editions. Expeditions such as James Cook's 1769 voyage to Tahiti in order to observe the transit of Venus and then on to find the great south land, *Terra Australis Incognita*, also resulted in the discovery of many more species than Ray had catalogued.

By the middle of the eighteenth century few competent exponents of diluvialism remained. Perhaps the last paper published in a serious scientific journal in support of Noah's Deluge was Edward King's "An Attempt to Account for the Universal Deluge", which appeared in the *Philosophical Transactions* in 1767. Not only did he not advance any significantly new ideas but he admitted that there were reasonable objections to the "many ingenious hypotheses" he did invoke. Ultimately, he justified his defence of a world-wide Flood on the basis of the extensive array of marine fossils. It is of interest that he also anticipated later uniformitarian ideas by suggesting that great changes could be wrought by the continued action of known processes.⁵⁵

In the end the old diluvial cosmogonies became casualties of their own earlier success. The genuine attitude of solid scientific enquiry that they engendered had encouraged the significant geological discoveries which undermined the very premise of diluvialism. Furthermore, the huge variety of models resulting from such attempts, and the equally diverse interpretations of scriptural allusions required to justify them, led many biblical scholars to question whether the Bible had been given in order to solve such questions of geological history. Montgomery notes that, "The floodgates of heaven and the fountains of the deep had been interpreted to refer to comets, a great vapour canopy, water from alpine caves, and a vast subterranean sea—just about everywhere one might imagine finding enough water to drown the world".⁵⁶ Scholars, most of whom were still profoundly Christian, started to abandon what were increasingly seen as speculative, biblically-based cosmogonies and to concentrate on the many exciting geological discoveries taking place by the mid-eighteenth century.

Bible Commentaries

The major Bible commentaries published during the first half of the eighteenth century varied considerably in their awareness of diluvial

models and geological developments generally. Non-conformist minister, Matthew Henry (1662–1714), in his devotional *Commentary on the Holy Bible*, (1706) did not question the world-wide nature of the Flood and gave little indication of an awareness of emerging Flood problems. He did, however, state that a great deal of water came from the abyss and this may reflect some recognition of the insufficiency of rainwater to overflow the mountains by 15 cubits. Henry claimed that God directly brought the animals to the Ark: “The same hand that at first brought them to Adam to be named now brought them to Noah to be preserved”. He also maintained that:

all enmities and hostilities between the creatures ceased for the present, and ravenous creatures were not only so mild and manageable as that the *wolf and the lamb lay down together*, but so strangely altered as that the *lion did eat straw like an ox*.

Such a convenient alteration of diet clearly solved Wilkin’s earlier problem of feeding the carnivores.⁵⁷

In his *Explanatory Notes Upon the Old Testament* (1745), John Wesley (1703–1791) also asserted the universality of the Flood and the destruction of all animals outside the Ark. In fact, the discussion of the Flood in the *Explanatory Notes* would appear to consist almost exclusively of selected quotations and adaptations of Henry’s earlier commentary. In his journal of 1770 Wesley endorsed Burnet’s *Sacred Theory*, claiming that its picture of the Flood was “highly probable”.⁵⁸

John Gill (1697–1771), a Baptist minister, gave evidence of much greater exposure to the current cosmogenic models and of some ability to reason scientifically through the emerging difficulties. In fact, his *An Exposition of the Old Testament* (1748–1763) comes close to being a cosmogony in its own right. Gill’s belief in the universality of the event was, he felt, supported by the widespread flood myths among the “heathen writers of all nations”, including the Chaldeans, Egyptians, Mexicans, Peruvians and the Bramines (Brahmins). His claims for the sufficiency of the Ark appear to be based on the work of Buteo and Wilkins. Going into the Ark were

... all sorts of beasts and cattle, reckoned 130 sorts, by some 150, including serpents; *and every creeping thing* ...; supposed to be scarce 30 sorts; not one sort of creature was left out, although ever so small and despicable: *every fowl after his kind*: Bishop Wilkins has divided them into nine sorts, and reckons them up to be 95 in the whole; *every bird of every sort*, or bird of every wing, let their wings

be what they will; some, as *Ainsworth* observes, are winged with feathers, others with skin, as bats.⁵⁹

He viewed the Ark's capacity as sufficient to allow some breeding on the part of the animals but took the view that "the marriage bed" was denied the humans accompanying them. Other interesting details are provided. Gill conjectured that the Ark was pitched on the inside as well as the outside "to take off the ill smell that might arise from the several creatures". He also suggested that the door "is reasonably supposed to be ten cubits high and eight broad, that there might be room enough for an elephant to enter in by it".⁶⁰

Gill took the view that a quantity of water easily sufficient to cover the earth could be found in subterranean cavities, such as that obviously associated with the Caspian Sea, into which drained huge amounts of water but which never overflowed. With impeccable mathematics he argued that if such subterranean waters were "pressed upwards", even at the rate of a quarter of a mile per hour, this would elevate all those within a depth of 240 miles during the forty days of inundation. These would add to the waters descending from above. He quoted an expert opinion to the effect that "thick air is easily turned into water" and felt that if the rain from such fell at 10 miles per hour for forty days this would deliver to the earth's surface all the water within almost 10,000 vertical miles. He also suspected that the antediluvian mountains were not as high as those now adorning the earth.⁶¹

In addition, Gill addressed the problem of animal dispersal.

It is a question with some, how the creatures which were only in Asia at the coming out of the Ark, could spread themselves all over the earth; particularly how they could get into islands, and especially into America: to which it may be answered, that this might be done by many of them, by swimming over narrow seas, for some wild creatures will swim whole days and nights, when they are forced to it, and by mens' carrying others in vessels to distant and different parts, ... , and especially, what is it the power and providence of God cannot do, who could not be at a loss for ways and means to replenish a world in all the parts of it he had made desolate, when it was his pleasure?⁶²

The Anglican, Thomas Scott (1747–1821), in his *Commentary on the Whole Bible* (1788–1791), although obviously aware of localised flood models, also argued for a world-wide Flood, noting that "traces of the deluge are found in all parts of the earth". He also affirmed

that “learned men have shewn” that the Ark’s “dimensions were far more than were necessary to contain all the animals to be preserved, and sufficient provision for them”. He did not, though, identify his learned authorities. He felt that, had any antediluvians repented, the Ark “would have been opened to as many as it could contain: and ... if others had in humble, penitent faith prepared arks they might also have been preserved”. Scott denigrated as presumptuous any attempts to explain the Flood in terms of secondary causes.⁶³

The Emergence of Stratigraphical and Geomorphological Studies and the Rise of Neptunism.

As we have seen, by the middle-to-late eighteenth century the diluvial models were struggling to accommodate the increasingly problematic stratigraphic data which were emerging. One reason for this bounty of new data was the beginning of the industrial revolution, with its extensive coal and ore mines, canal excavations and, later, railway cuttings. These were exposing much more of the upper layers of Earth’s surface, thus making them much more accessible to study. A new era in geology was emerging and it was coming fast. The emphasis quickly switched to accessing, classifying and explaining the complex rock strata of geological formations. The geological story from this point involves the appearance and interweaving of two subplots: the emergence of these stratigraphic studies and the rise of a new theory involving another vast, universal ocean. This was neptunism, the idea that most of Earth’s geological formations had resulted from slow chemical precipitation caused by the very gradual drying up of the ocean which had covered the globe at creation.

Stratigraphical Studies

Following the earlier work of Bellers, John Strachey (1671–1743) published papers on stratification in Somersetshire coal mines in 1719 and 1725. These appeared in the *Philosophical Transactions of the Royal Society of London*. In 1760 John Michell (1724–1793) published a paper in the same journal on earthquakes, in which he described a number of stratigraphic phenomena. Particularly in continental Europe the large-scale mapping and classification of rock strata were well advanced. It was also significant that continental scholars were much less constrained by theological and ecclesiological influences than were their peers in Britain. In 1721 Antonio Vallisneri (1661–1730), a Professor at the Padua University and also a Fellow of the Royal

Society, published a paper in which he argued that the proposed time period of the Flood would have been insufficient to have deposited the extensive marine strata he had studied in the Alps. He also took the view that they were too widespread to have been deposited by a Flood event such as that proposed by Woodward.⁶⁴

There quickly followed a flurry of important refinements in geological classification. In 1740 Catholic priest and naturalist, Anton-Lazarro Moro (1687–1764), classified mountains lacking stratified rock as “primary” and those having layers of stratified rocks on top of the un-stratified material as “secondary”. Giovanni Arduino (1714–1795), an Italian professor of mining, furthered Moro’s classification system by differentiating four different types of rocks based on lithostratigraphy. Stratigraphic studies were advanced by Johann Lehmann (1719–1767), a physician, copper-refiner and chemistry professor in St Petersburg, by Torbern Bergman (1735–1784), a Swedish chemist, and by Abraham G. Werner (1749–1817), a charismatic teacher at the Mining Academy in Freiburg, Saxony.⁶⁵

By 1795, when James Hutton (1726–1797) published his descriptions of the now famous angular unconformities at Siccar Point in Scotland, many new levels of classification had emerged. To Moro’s “primary” and “secondary” had been added “tertiary”, along with other classifications. We do not need to concern ourselves with the details of this classification system. Hutton’s studies revealed strong evidence for repeated uplifts, folds, slippage and distortions, as well as periods of erosion between periods of deposition. These were increasingly difficult to accommodate within a single Flood schema. The existence of very extensive but often very thinly striated rock formations, apparently speaking of slow deposition over long periods under quiet conditions, was also not easily reconciled with a turbulent Flood. Furthermore, a crude geological timescale was also beginning to emerge, with primitive rocks being the oldest. It was beginning to look as though the rocks were much more ancient than had earlier been suspected. This was less than 50 years after Moro’s initial stratigraphic work. Particularly during the mid-to-late 1700s stratigraphic studies revealed many European sequences that were hundreds to thousands of metres thick and which sometimes extended for hundreds of kilometres. Furthermore, many of these successions were characterised by great regularity and ordering. These features

were increasingly difficult to explain as the products of a worldwide Flood which had been conceived as chaotic and violent.⁶⁶

Over this period great advances were also being made in understanding the complex relationship between individual species and their environment. Linneaus had pointed out that species were exquisitely suited or adapted to specific environments and that they could not survive for long outside them. It was partly because of this difficulty in transporting species that the leading Swedish naturalist objected to the universality of the Flood. It would also have destroyed the habitats especially created by God, something he thought God would not do. It was also becoming obvious that movement over vast distances and through very different ecosystems was only possible for a very small number of species. These realisations confirmed the practical difficulties involved with getting the world's animals to and from the Ark, further threatening the idea of the Flood's universality.⁶⁷

The Rise of Neptunism

Named after the ancient Roman god of the sea, it is not surprising that the neptunist understanding of our planet's prehistory and of the origin of many of its surface rocks had to do with great waters. Benoît de Maillet (1656 – 1738) became convinced by evidence of former Mediterranean shorelines that rock layers had been deposited over millions of years by gradually shrinking ocean levels. However, being aware that this view would not endear him to religious authorities, he delayed publication. Some thirty years later, in 1748, his work was published posthumously by his editor. It was purported to be written by an Indian philosopher by the name of *Telliamed*. However, observant readers quickly noticed that this name was simply de Maillet spelt backwards.⁶⁸ This work not only encouraged more studies of European rock strata but also laid a foundation for neptunism.

Georges Louis Leclerc, the Comte de Buffon (1707–1788), extended this idea, linking the concept of the drying up of a vast ocean to his grand scheme that involved the cooling of the earth from an incandescent globe over a period of some 60,000 years. Lyell noted that following the publication of Buffon's *Natural History*, in which was included his *Theory of the Earth*, Buffon

received an official letter (dated January, 1751) from the Sorbonne, or Faculty of Theology in Paris, informing him that fourteen propositions in his works 'were reprehensible and contrary to the creed of the church'.

The only one of these propositions relating to geological theory was a claim that, by mechanisms of secondary causation, the oceans had not only produced the mountains and valleys of the land but would later eliminate and reform them. Lyell went on to recount that

Buffon was invited by the College, in very courteous terms, to send an explanation, or rather a recantation of his unorthodox opinions. To this he submitted; and a general assembly of the Faculty having approved his 'Declaration', he was required to publish it in his next work. The document begins with these words:— 'I declare that I had no intention to contradict the text of scripture; that I believe most firmly in all therein related about the creation, both as to order of time and matter of fact; and *I abandon everything in my book respecting the formation of the earth*, and, generally, all which may be contrary to the narration of Moses'.⁶⁹

The neptunist theory of the primeval ocean was advanced further in 1786 by Werner's publication of his *Brief Classification and Description of the Various Rocks*, in which he advanced the view that mineral veins within rocks, as well as primitive rocks such as granite, had precipitated out of the primeval ocean as its level lowered. By the late 1700s neptunism had substantially displaced the diluvial models of the previous century as an explanation for the extensive beds of stratified rocks which were by then known to geologists. However, the Flood would not go away. A variety of landscape features came under renewed scrutiny during this period and many questions arose. What could have carved out the many mountain valleys in Europe which contained no rivers at all or else had streams too small to carry away large amounts of rock? What mechanisms gave rise to those large surface deposits of sand and gravel sometimes found at great distances from river systems? These questions inspired a renewed interest in the Deluge, this time not as the means for depositing Earth's major geological features, but as an explanation for its surface topology. Particularly during the mid-to-late 1700s there were numerous and dramatic discoveries in many places of remains of large animals buried in peat bogs and beds of gravel. These discoveries also raised the possibility of burial by the Flood. Many of these animals, such as the mammoths found in northern latitudes, resembled species currently living in much warmer climes, which suggested movement over considerable distances.⁷⁰

Many, particularly in Britain, developed Flood models within the neptunist construct which sought to accommodate this evidence.

Richard Kirwan (1733–1812), was Inspector for Mines in Ireland and president of the Royal Irish Academy for a lengthy period. He was also an entrenched opponent of Hutton. Kirwan published his views in 1797. Like other neptunists he took the view that the primordial sea had gradually sunk beneath the surface crust, leaving the newly crystallised rocks to harden and also providing large volumes of water that remained in great crustal rifts. Much later, this water was released, producing the Noachan Flood. It was not world-wide, although very extensive, and had washed north from southern latitudes, carrying many life-forms, such as elephants and rhinoceros, along with marine species, from warmer places such as Africa and India to cold environments in high, northern latitudes. The fact, as it seemed to him, that no traces of northern species had been found in southern climes supported this idea of a northerly sweep for the floodwaters. These tempestuous waters had swept over mountains towards the North Pole, carving out features such as the Bay of Bengal, the Red Sea and the Caspian Sea, and depositing their detritus as they went. Like Stillingfleet, Kirwan proposed that only domestic animals would have been carried in the Ark since the “ravenous animals” would have posed a threat to the immediate survivors of the deluge’. Although he could claim no scriptural support, he took the view that God had re-created the carnivora after the Flood.⁷¹ Although somewhat speculative, Kirwan was very respectful of what he saw as well-based scientific opinions of his day. He noted that:

Some have imagined that the axis of the earth was originally parallel to that of the ecliptic, which would produce a perpetual spring in every latitude, and consequently that elephants might exist in all of them. But the ablest astronomers having demonstrated the impossibility of this parallelism it is unnecessary to examine its consequences ...⁷²

Despite Kirwan’s dismissal of it, the idea that the Earth’s axis was tilted at the time of the Flood has persisted in some quarters although there is no scientific evidence for such a recent and sudden change.⁷³

In summarising the scientific attitudes predominant at the end of this period, Young notes that:

The widespread opinion that the world’s stratified, fossiliferous rocks could be accounted for in terms of the action of a biblical global deluge had faded. Nonetheless, nearly a century later, orthodox Christian naturalists were still largely committed to a universal flood, a flood which accounted only for surficial phenomena, including

surface gravels, vast deposits of marine shells, and graveyards of vertebrates.⁷⁴

There is no doubt that by this time emerging scientific ideas were exerting a serious impact on Christian thought about the Flood, as on other matters. David Hempton lists several faith/science narratives which have been variously proposed as characteristic of the eighteenth century. He comments:

... scientific ideas were consolidated, assimilated and propagated more widely. In other words, this was the century in which science became in a sense “public knowledge” and this had to be reckoned with by educated elites including philosophers, administrators and theologians.

...Moreover, certain kinds of religious defence against the onslaught of new thought, especially the emphasis on natural theology and the argument from design, had the unintended effect of importing new thoughts of rationalism into theological discourse. In this way, Christian orthodoxy was as much eroded by its well-meaning defenders as by its sternest opponents.⁷⁵

Although noting that some elements of such generalisations require revision he concedes their explanatory power.

The Nineteenth Century: the Decline of Neptunist Flood Models and the Brief Reign of Diluvial Catastrophism

Geology Established as an Independent Scientific Discipline

The early 1800s saw the establishment of geology as an independent science and its elevation to an unprecedented level of social popularity and academic interest. The Geological Society of London was founded in 1807. In 1815 William Smith (1769–1839) published his *Delineation of the Strata of England*, an extensive geological survey of Britain, which did much to promote interest in geology. Lyell notes that “D’Aubuisson, a distinguished pupil of Werner” later paid tribute to Smith’s achievement of classifying so much of England’s geology while for the most part travelling around on foot. ““What many celebrated mineralogists had only accomplished for a small part of Germany in the course of half a century, had been effected by a single individual for the whole of England””.⁷⁶

The celebrated, although somewhat eccentric, Rev. William Buckland (1784–1856) was appointed in 1813 as Reader in Minerology at Oxford University and in 1819 as Reader in Geology at that institution. Following these appointments organised lectures and field studies began at Oxford, although it was not until 1888 that a separate School of Geology was established there.⁷⁷ In 1818 Adam Sedgwick (1785–1873), another churchman, was appointed Woodwardian Professor of Geology at Cambridge University, a chair he held until his death. The Woodwardian Chair had been founded in 1728 by John Woodward under the title “Professor of Fossils”. Under Sedgwick, regular lectures and geological fieldwork were commenced and Cambridge became a centre for the advancement of geology.⁷⁸

The Displacement of Neptunist Flood Models by Diluvial Catastrophism

The early 1800s also witnessed the replacement of neptunism by another Flood paradigm. Georges Cuvier (1769–1832), scientist, administrator and fossil expert who launched both the modern disciplines of vertebrate palaeontology and comparative anatomy, held an important position at the Muséum National d’Histoire Naturelle de Paris. He noted that terrestrial and marine fossils alternated in the sequence of strata found in the Paris basin. In 1812 he proposed that the secondary and tertiary strata had been formed by successive and violent catastrophic events, including repeated incursions and withdrawals of the sea. Such repeated cycles were different from the single drying process of neptunism and became known as diluvial catastrophism. This model enjoyed a brief period of ascendancy in the early nineteenth century. Cuvier argued that zoological evidence suggested that the latest such catastrophe was comparatively recent.

If there is any circumstance thoroughly established in geology, it is, that the crust of our globe has been subjected to a great and sudden revolution, the epoch of which cannot be dated much further back than five or six thousand years ago; that this revolution had buried all the countries which were before inhabited by men...

Nevertheless, Cuvier, though a nominal Protestant, did not explicitly link this last great catastrophe with the Noachian Flood.⁷⁹

George Greenough (1778–1855), who had earlier studied under Werner, was one of the founders of the Geological Society of London. In 1811, when this Society was more properly constituted, he became

its first president. Greenough also took the view that a major catastrophe must have been responsible for many of the sediments as well as for the “boulder-stones” (displaced boulders), many of them huge, which could be found in many European locations. In *A Critical Examination of the First Principles of Geology*, first published in 1819, he took the view that the slow-paced conventional causes for sedimentary phenomena, such as the drying of seas and rivers, the draining of lakes and the formation of sedimentary rocks by slow weathering and erosion of volcanic material were inadequate to produce the observed strata. Speaking of the plutonists, who believed that some rocks had been formed by the solidification of molten material, and with whom he clearly associated slow processes, he wrote:

Ye Gods! Perpetuate Time! says the Plutonist, and thinks his reasoning will be incontrovertible. But suppose the prayer granted; suppose the Plutonist to have at command whatever time he desires; Time graduating into eternity; nay Eternity itself; what use could he make of it? What profit can a man expect from putting Zeros out to interest? What increase in weight from a Fast sufficiently prolonged?

Greenough went on to assert that “the only remaining cause, to which these effects can be ascribed, is a Debacle or Deluge”.⁸⁰ The widespread distribution of these features suggested to him that all countries had been affected, and thus that the event was universal. Following Halley, he inclined towards a cometary or meteoritic cause. However, he questioned other earlier opinions, particularly the view that the deluge must have taken a northerly course. He noted that the bones of the “elephants”, which had supposedly been swept north by the waters, had mixed with them bones of clearly northern species, such as buffalos and elk. Additional doubts that these great beasts had, in fact, been transported such vast distances were suggested by his observation that the elephants would certainly have disintegrated by putrefaction along the way. He maintained that the direction of the flow could be more authoritatively established by examining the orientation of the geological features. But despite the prominence of flood elements in his model and its comparatively recent timing he, like Cuvier before him, did not explicitly identify this “Debacle or Deluge” with the biblical Flood. It is of interest that he noted the complete absence of human bones and implements in the deposits. This may have been a reason for his hesitation in identifying his deluge with Noah’s Flood.⁸¹

While diluvial catastrophism was well established by the early 1800s, it was Buckland who placed it more firmly on the geological map. In his inaugural lecture marking his appointment to the Readership at Oxford, given on May 15, 1819, Buckland, although not averse to non-literal interpretations of the Bible, did his best to demonstrate that the new science of geology was very compatible with Oxford's tradition of conservative theology. Clearly, he felt a need to justify his appointment by making such an assertion. While admitting that there remained some points of disharmony between geology and Christian faith, Buckland boldly claimed that the Flood was not among them, pointing out that:

The grand fact of *an universal deluge* at no very remote period is proved on grounds so decisive and incontrovertible, that, had we never heard of such an event from Scripture, or any other, authority, Geology of itself must have called in the assistance of some such catastrophe, to explain the phenomena of diluvian action which are universally presented to us, and which are unintelligible without recourse to a deluge exerting its ravages at a period not more ancient than that announced in the book of Genesis.⁸²

By this time the concept of the Flood was beginning to change considerably from the models upheld two centuries earlier. Buckland's Flood, while universal, was no longer responsible for the extensive layers of fossil-bearing strata, although in places it had eroded them. Nor was it sufficiently destructive or catastrophic to change the shape or position of the continents to any significant extent. Many geologists were impressed with Buckland's scenario. Among these were his friends and fellow Anglican ministers and geologists, Adam Sedgwick and William Conybeare (1787–1857), and William Phillips (1775–1828), a Quaker and a field geologist. Conybeare and Phillips were joint authors of *Outlines of the Geology of England and Wales*, published in 1822. They essentially adopted Buckland's position, appealing to many of the same geological features that had persuaded him.⁸³

Meanwhile, in 1821, a cave that contained a large quantity of bones was discovered in Kirkdale, Yorkshire. Similar remains had been discovered in small caves. Speaking of the Kirkdale bones and other remains discovered during this period, Greene notes that:

... some enthusiasts looking for geological evidence of the Deluge were happy to suppose that, in these remains, they had evidence

of a cataclysm so powerful that it had swept the bodies of tropical animals as far north as England. Others, bent on the same quest by a different path, asserted that the animals had been drowned in place by the Flood, and that England's former tropical climate had been permanently altered by this same giant event. In no case was the Deluge account of the Bible placed in doubt.⁸⁴

Greene points out that in fact, in opposition to this interpretation, Buckland's careful study of these bones convinced him that they did not constitute evidence for a Flood and were, for the most part, the remains of hyena dens. His lectures on this topic, delivered to the Royal Society in 1822, were so highly acclaimed that they resulted in his receiving the Copley medal, making him the first geologist to be so recognised. But Buckland still wanted to use geological evidence to bolster belief in the Flood and so he carefully incorporated the cave data into his *Reliquiae Diluvianae; or, Observations on the Organic Remains Contained in Caves, Fissures, and Diluvial Gravel, and on Other Geological Phenomena, Attesting to the Action of an Universal Deluge* (1823). In this definitive and influential work he attempted to assemble the various evidences in support of a recent global Flood. In connection with the caves, Buckland claimed that it was the thin layer of mud observed at the top of the remains which spoke of the Flood. Buckland also took the view that the Flood must have originated in the north rather than the south, since several large boulders as well as gravel deposits, appeared to have been transported south.⁸⁵

Diluvial catastrophism also gained a strong foothold across the Atlantic, particularly through the work of Benjamin Silliman (1779–1864) of Yale, who, in 1818, had founded the *American Journal of Science*.

The Decline of Diluvialism

But the persuasive power of the *Reliquiae* was to be short-lived. One geographical area from which problems quickly emerged was the Auvergne region of central France, where there are many extinct volcanic cones and associated basalt flows. This area had been extensively studied by the French in the eighteenth century. Naturalist, Jean-Etienne Guettard (1715–1786) had recognised the volcanic nature of the region's mountains and subsequent work by Nicolas Desmarest (1725–1815) and François Pasumot (1733–1804) produced additional evidence supporting this view.⁸⁶ However, these studies had not come to the notice of geologists across the English Channel.

Charles Daubeny (1795–1867), professor of chemistry at Oxford and a Buckland sympathiser, travelled through this area in 1819 and it was his *Letters on the Volcanos of Auvergne*, published in *The Edinburgh Philosophical Journal* in 1820 and 1821, which first drew this significant region to the attention of British geologists. It must be remembered that the origin of the basalt rocks was a most contentious issue at this time. These had been assumed by neptunists, such as Werner and his followers, to be the result of slow-forming chemical precipitates. On the other hand, the vulcanists, such as Hutton, Playfair and Lyell (all Scottish) associated basalt with volcanoes. As Daubeny studied the Auvergne rock forms he realised that they offered a conclusive answer to this question. He invited his readers “to determine in what degree the appearances there presented contribute to settle our belief as to the long-agitated question of the igneous or aqueous origin of trap-rock in general”. He distinguished between the older rocks which had been “cut through by the valleys which now exist”, perhaps by Buckland’s catastrophic inundation, and the “modern” basalts which “follow exactly the inequalities of the ground, so as to afford the most convincing proof that the strata in which they rest have experienced no important alteration since the period at which the lava was ejected”.⁸⁷ These observations not only argued strongly for the volcanic origin of basalt but identified features of Earth’s surface which had not been sculpted by the Flood.

As consensus built that the French basalts were indeed of volcanic origin the same was suspected of similar Scottish basalt outcrops. The publicity attending this discussion strengthened the hand of the Scottish vulcanists and at the same time sounded the death-knell for neptunism and weakened diluvialism. In an address delivered in 1901 Canon Bonney stated:

It is this episode in the history of Auvergne which has made it classical ground since the middle of the eighteenth century, for here especially the weapons were forged which early in the following one gave the deathblow to those Wernerian dogmas which had been so serious an impediment to progress in geology. Here Scrope and Lyell, Murchison and Sedgwick learned to read aright Nature’s book of hieroglyphics ...⁸⁸

During the 1820s the careful Scottish naturalist, John Fleming (1785–1857), fired off several high-calibre broadsides against diluvialism. Lamenting what he saw to be the misdirected efforts of the earlier Burnet, Woodward and Whiston, he stated:

Nature, misinterpreted, may amuse the cosmogonist, but can never befriend the Christian. That which is true in science can alone give useful support to revelation; and that which is true in science never can be found opposed to its interests.

He called repeatedly for clear thinking on these matters, pointing out that, for example, the Genesis account stated that two of every quadruped “were spared and preserved during the deluge” while nature, “as interpreted by the geologists” indicates that many species “were not spared, not preserved, but annihilated, by the catastrophe”. Furthermore, he identified geologically significant features of the Flood, such as suddenness, impetuosity and violence, which were espoused by Cuvier and Buckland, but which were not reflected in the biblical text at all.⁸⁹ Expressing a sentiment much against the prevailing view, Fleming wrote:

I am not prepared to witness in nature any remaining marks of the catastrophe, and I feel my respect for the authority of revelation heightened, when I see on the present surface no memorials of the event. On the other hand, had I witnessed every valley and gravel bed, nay, every fossil bone, attesting the ravages of the dreadful science, I would have been puzzled to account for the unexpected difficulties; and might have been induced to question the authority of Moses as an historian, or the claims of the book of Genesis to occupy its present place in the sacred record ... In other words, if the geological creeds of Baron Cuvier and Professor Buckland be established, as true in science, then must the Book of Genesis be blotted out of the records of Inspiration.⁹⁰

Fleming then went on to assert his belief in the veracity of Scripture! This was not the only time he warned against doing bad science and/or bad theology. On another occasion he stated that:

This indiscrete union of Geology and Revelation can scarcely fail to verify the censure of Bacon, by producing, “*Philosophia phantastica, religio haeretica*”.⁹¹

Fleming criticised Buckland’s interpretation of the data and his lack of precision in identifying many of the fossil remains which were central to his argument. He pointed out that many geologists failed to differentiate adequately the *species* from the *genus* and repudiated the common claim that many fossil remains that resembled living tropical species but which had been found in colder regions were in fact remains of tropical animals that had been transported by the Flood. He argued that the excellent skeletal articulation frequently

observed in such cases argued against transport over long distances under violent conditions and, furthermore, that evidence of heavy fur/hair sometimes found suggested that they were cold-climate species, which had been buried where they died. He also turned his attention to Buckland's prime exhibit, Kirkdale cave, questioning the declared diluvial origin of the red mud which had been found in that cave. Fleming's carefully argued criticisms proved devastating.

His opinions were also increasingly supported by other authority figures. The Auvergne volcanoes were all examined in the 1820s by three very able British geologists, George Scrope, (1797–1876), Charles Lyell (1797–1875) and Roderick Murchison (1792–1871). All agreed with Daubeny's earlier conclusions about the origin of basalt and, in contrast to Buckland, took the view that the deep valleys of the region could have been produced by the continual slow erosion of rivers over long periods, with no need for a catastrophic Flood.⁹²

The publication of Volume 1 of Lyell's *Principles of Geology* in 1830 put even greater pressure on catastrophism. By then, only seven years after the appearance of Buckland's *Reliquiae*, mainstream geologists were in retreat from diluvial catastrophism and, one by one, began to announce their change of heart. Most famously, Adam Sedgwick, a few months after the appearance of Lyell's *Principles* in a final presidential address to the Geological Society of London on February 18, 1831, just before handing over the presidency to Murchison, made the oft-cited (although mock-heroic, according to Rudwick⁹³) repudiation:

There is, I think, one great negative conclusion now incontestably established—that the vast masses of diluvial gravel, scattered almost over the surface of the earth, do not belong to one violent and transitory period. It was indeed a most unwarranted conclusion, when we assumed the contemporaneity of all the superficial gravel on the earth. We saw the clearest traces of diluvial action, and we had, in our sacred histories, the record of a general deluge. On this double testimony it was, that we gave unity to a vast succession of phaenomena, not one of which we perfectly comprehended, and under the name diluvium, classed them all together. To seek the light of physical truth by reasoning of this kind, is, in the language of Bacon, to seek the living among the dead, and will ever end in erroneous induction. Our errors were, however, natural, and of the same kind which led many excellent observers of a former century to refer to all the secondary formations of geology to the Noachian

Deluge. Having been myself a believer, and to the best of my power, a propagator of what I now regard as a philosophic heresy, and having more than once been quoted for opinions I do not now maintain, I think it right, as one of my last acts before I quit this Chair, thus publicly to read my recantation. We ought, indeed, to have paused before we first adopted the diluvian theory, and referred all our old superficial gravel to the action of the Mosaic Flood. For of man, and the works of his hands, we have not yet found a single trace among the remnants of a former world entombed in these deposits.⁹⁴

Colin Russell notes that:

Sedgwick did not deny the historicity of Noah's Flood; he most certainly did not abjure a deeply-held faith in Scripture and a commitment to biblical doctrines that realistically can be called evangelical. He simply abandoned an arbitrary determination that Genesis should be interpreted in certain specific ways.⁹⁵

The appearance of his third volume of *Principles* in 1833 saw Lyell's attack on diluvialism intensified. He homed in on the earlier-mentioned Auvergne region of France and the manner in which uncritical, if well-meaning, geologists had used these data in support of the Flood. In particular he scorned the confidence with which many had identified antediluvian and postdiluvian formations and the manner in which they saw "clear and unequivocal marks of the passage of a general flood over all parts of the surface of the globe". He noted that, "It had long been a question among the learned, even before the commencement of geological researches, whether the deluge of the Scriptures was universal with respect to the whole surface of the globe, or only so with respect to that portion of it which was then inhabited by man".⁹⁶ He clearly opted for a local event and agreed with Fleming that the biblical account does not require, or even suggest, a violent Flood.

In 1834, in the face of this onslaught, Greenough followed Sedgwick in repudiating his earlier diluvial stance. At the conclusion of his anniversary address to the Geological Society of London he stated in connection with the theory of diluvial action:

Some fourteen years ago I advanced an opinion, founded altogether upon physical and geological considerations, that the entire earth had, at an unknown period, (as far as that word implies any determinate portion of time,) had been covered by one general but temporary Deluge. The opinion was not hastily formed. My reasoning rested

on the facts which had then come before me. My acquaintance with physical and geological nature is now extended ... New data have flowed in, and with the frankness of one of my predecessors, I also now read my recantation ... To Mr Lyell is eminently due the merit of having awakened us to a sense of error in this respect. The vast mass of evidence which he has brought together ... convinces me that if, five thousand years ago, a Deluge did sweep over the entire globe, its traces can no longer be distinguished from more modern and local disturbances ... The Fossil Contents of these formations strongly confirm this argument. M. Deshayes has shown that they belong to a series unbroken by any great intervals, and that, if they be divided from the secondary strata, the chasm can have no relation to any such event as is called The Flood ...

Further, the elephants and other animals once supposed to be exclusively *Diluvial*, are now admitted to be referable to two or three different epochs; and it is highly probable that the blocks of the Jura Mountains, of the North of Germany, of the North of Italy, of Cumberland, Westmoreland, &c., are not the waifs and strays of one, but of several successive Inundations.⁹⁷

Finally, in *Geology and Minerology Considered with Reference to Natural Theology*, his Bridgewater Treatise of 1836 (the sixth Bridgewater Treatise), Buckland himself publicly disowned his earlier, well-publicised views on diluvialism, opting instead for a tranquil Flood which had done little to alter Earth's surface. He stated:

... as the rise and fall of the waters of the Mosaic deluge are described to have been gradual and of short duration, they would have produced comparatively little change on the surface of the country they overflowed.⁹⁸

In this document he urged restraint in the scientific use of Scripture:

The disappointment of those who look for a detailed account of geological phenomena in the Bible, rests on a gratuitous expectation of finding therein historical information, respecting all the operations of the Creator in times and places with which the human race has no concern; as reasonably might we object that the Mosaic history is imperfect, because it makes no specific mention of the satellites of Jupiter, or the rings of Saturn, as feel disappointment in not finding in it the history of geological phenomena, the details of which may be fit matter for an encyclopedia of science, but are foreign to the objects of a volume intended only to be a guide of religious belief and moral conduct.⁹⁹

Evidence that many fossil-bearing strata had been laid down over long periods of time persuaded Buckland that they could not have resulted from Noah's Flood. He came to recognise that even the surficial deposits were the results of more than one event. In fact, as earlier noted, the Kirkdale cave had perhaps begun Buckland's change of heart as early as 1822. Greene notes that his *Reliquae Diluvianae* had actually undermined traditional diluvianism in three identifiable ways: by reducing the proportion of the geological record which could be ascribed to the Flood: by reducing the power of the floodwaters to transport fossil material: and by denying that the Flood had resulted from the alternation of land and sea—the sinking of the land and the rising of the seabed.¹⁰⁰ Despite these changes of heart, however, it is important to note that Buckland remained a staunch Christian believer, one who now took the view that the scientific evidence did not give rise to questions of “the correctness of the Mosaic narrative, but of our interpretation of it”.¹⁰¹

Young points out that most of the principal contributors to this early-nineteenth-century discussion were orthodox Christian academics whose views had been overwhelmingly challenged by the data “and yet they felt no need to distort the evidence they encountered in order to sustain their belief in the biblical deluge”. He also notes that “One finds no appeal to miracle on the part of even the most ardent advocate of the deluge, William Buckland”.¹⁰²

The Glacial Coup de Grâce

Gordon Davies notes that “John Playfair's (1748–1819) classic *Illustrations of the Huttonian Theory of the Earth* (1802) is commonly regarded as the first work to expound the view that the Alps had undergone an extensive glacierization [glaciation] and that the swollen glaciers had been responsible for transporting erratics [boulders] into the Jura”. Davies goes on to point out that this theory did not originate with this volume since, after all, the whole purpose of Playfair's book was to popularise the work of his friend James Hutton.

While the first printed version of Hutton's *Theory of the Earth* (1788) did not mention glaciers the expanded version (1795) did allude to them and to their extensive action in the Alps.¹⁰³ Nonetheless, these early references to extensive glacial action appear to have gone largely unnoticed and unremarked until the 1840s.

During the 1820s and 1830s additional studies of the Swiss

glaciers were conducted by Ignaz Venetz (1788–1859), a Swiss engineer and glaciologist, and Jean de Charpentier (1786–1855), a German-Swiss geologist and mining engineer. In 1836 de Charpentier guided the young, though well-known, Swiss naturalist, Louis Agassiz (1807–1873), on a tour through the Alps during which they examined glacial phenomena. Agassiz, who had been a student of Cuvier and was at that time teaching at Neuchâtel, knew that his guide took the view that many of the alpine erratics and gravel deposits were of glacial origin. Initially he was wary and sceptical but as he examined the evidence for himself the logic of Charpentier's position became apparent and he changed his mind. This led him to conduct independent studies of glacial action elsewhere in Europe and in 1837 he gave a lecture to the Swiss Society of Natural History in which he presented evidence that much of Europe had at some time in the past been covered by extensive ice sheets. Not surprisingly, this presentation created a furore among geologists.

Buckland viewed this new ice-sheet theory with suspicion and, hoping to persuade Agassiz otherwise, went with him in 1838 on what Young describes as “one of the most significant field trips in history”. As Agassiz pointed out the “polished and striated bedrock and transported erratics [boulders] on the south-eastern slopes of the Jura mountains near Neuchâtel”, and as they together examined alpine glaciers, Buckland learnt, seemingly for the first time, of the immense power of slowly moving ice. Furthermore, as he examined these features he recognised that he had seen similar examples in England and Scotland. He realised that what he was seeing was much better explained as the result of erosion and transport by ice than by floodwaters. He was persuaded. Soon after, Lyell, who had originally resisted the idea of the existence of vast ice sheets on the basis of his uniformitarianism, also announced his change of heart. Agassiz's *Études sur les Glaciers* appeared in 1840 and also in that year he, Buckland and Lyell presented papers to the Geological Society of London in which they argued for extensive ice action on the basis of geological features found within Britain. Although these and other similar papers were not initially received with universal acclaim this situation soon changed. Within a decade serious opposition to the new glaciation theory had disappeared.¹⁰⁴ This collapse took with it most of the remaining historic arguments for the world-wide action of a Noachian Flood.

Harmonising and Scriptural Geologists

We have noted many European, particularly British, scientists who, after scrutiny, accepted the validity of the emerging scientific data and their implications for a global Flood whilst remaining devout Christians. This group included such prominent Anglican figures as Buckland, Sedgwick and Conybeare, as well as the Congregationalist, John Smith (1774–1851). These were practising geologists of unquestioned academic standing. Such individuals came to be known as “harmonising geologists”, since they were seen as attempting to bring together the Bible, particularly Genesis, and the new revelations of geology. This term was also later applied to those of similar mind across the Atlantic, such as Americans Benjamin Silliman (1779–1864), Edward Hitchcock (1779–1874), James Dana (1813–1895) and Canadian, Sir John Dawson (1820–1879).

On the other hand, those with strong Christian apologetic motives who preferred to submit the scientific data to a more literalistic and historical interpretation of Scripture became known as “scriptural geologists”. In Britain this group included George Fairholme (1789–1846), George Young (1777–1848), John Murray (c 1786–1851), Andrew Ure (1778–1857) and William Rhind (1797–1874). In America there were Eleazar Lord (1788–1871), his brother David Lord (1792–1880) and Martyn Paine (1794–1877). This group did not include many practising geologists.¹⁰⁵

However, the deep polarisation between modern biblical literalists and mainstream science makes it particularly difficult to achieve a fair balance when discussing those biblical literalists who participated in the nineteenth-century Flood and geology debates. Despite frequent characterisation of such as scientifically illiterate and reactionary “antigeologists”, scholarship has revealed that they were far from homogeneous in this respect. Many were recognised during their lifetime as having made significant scientific contributions. Andrew Ure, for example, was noted for his work in chemistry. Furthermore, as pointed out by O’Connor, in the early 1800s “geology was not yet securely established in the public eye as a discipline isolated from exegesis”. Care is clearly needed when describing this group today.¹⁰⁶

Conclusion

From this narrative spanning three centuries it is apparent that some sympathy should be extended to many of those whose stories are woven into this account. Their bold attempts to bolster up Christian faith by a series of confident appeals to the science of their day began well but later turned and rent them. This is particularly so of the neptunists and the later diluvialists. Indeed, so suddenly did the facts turn against the latter group that leading instigators such as Buckland and Sedgwick lived to experience their force and, indeed, to announce publicly their capitulation to them.

It is worth pointing out that the heroes of this account did their best to explain the data within a paradigm guided by their presuppositions. However, when this attempt failed they were able to outgrow those presuppositions. Most importantly, they were able to respect and accommodate the scientific data while at the same time retaining their Christian faith.

It is also of interest to note that these attempts by leading Christian thinkers to reconcile the emerging scientific data with a literal reading of Genesis 6–8 collapsed just around the time that a world-wide Flood was being urged by the young Ellen White and the fledgling Seventh-day Adventist Church. Clearly, there are many ways in which this juxtaposition could be interpreted.

Notes and References

- 1 David R. Montgomery, *The Rocks Don't Lie: A Geologist Investigates Noah's Flood* (New York, NY: W.W. Norton & Company, 2012), xiii, 56–63; Janet Browne, *The Secular Ark: Studies in the History of Biogeography* (New Haven, CT: Yale University Press, 1983), 2.
- 2 See Janet Browne, *The Secular Ark*; Norman Cohn, *Noah's Flood: The Genesis Story in Western Thought* (New Haven, CT: Yale University Press, 1996); Gordon L. Davies, *The Earth in Decay: A History of British Geomorphology, 1578–1878* (London, UK: MacDonald Technical and Scientific, 1968); David Montgomery, *The Rocks Don't Lie*; Martin S. Rudwick, *Earth's Deep History: How it was Discovered and Why it Matters* (Chicago, IL: University of Chicago Press, 2014); Davis A. Young, *The Biblical Flood: A Case Study of the Church's Response to Extrabiblical Evidence* (Grand Rapids, MI: Eerdmans, 1995).
- 3 Harold W. Clark, *The Battle Over Genesis* (Washington, DC: Review and Herald, 1977), 69–83.
- 4 Niebuhr, *History of Rome* vol (i), 5, cited in Charles Lyell, *Principles of Geology*, 9th ed. (London: John Murray, 1853), 61.
- 5 See Martin J. S. Rudwick, *The Meaning of Fossils* (New York, NY: Science Publications, 1976). See also Martin S. Rudwick, *Earth's Deep History*, 37–45; David R. Montgomery, *The Rocks Don't Lie*, 58–61; Evelyn Stokes, “The Six Days and the Deluge: Some Ideas on Earth History in the Royal Society of London 1660-1775”, *Earth Science Journal* 3:1 (1969): 16.
- 6 Bentley Glass, “The Admirable Discourses of Bernard Palissy. Aurele La Roque”, *The Quarterly Review of Biology* 34:4 (December, 1959): 297.
- 7 Johannes Buteo, *Opera Geometrica* (Lyons, France: Michaëlem Iovium, 1554). Cited in Don Allen, *The Legend of Noah* (Urbana, IL: University of Illinois Press, 1949), 78–79. Retrieved from <https://books.google.com.au/books?id=D8MNAQAAIAAJ&dq=editions%3AEOCLC1014> (August 16, 2019). Also cited in Norman Cohn, *Noah's Flood*, 40–41.
- 8 Janet Browne, *The Secular Ark*, 12; *The Correspondence of Charles Darwin*, vol 14: 1866 (Cambridge, UK: Cambridge University Press, 2004), 255. Retrieved from <https://books.google.com.au/books?id=jTON1MPaa61C&pg=PA255> (16 August, 2019); Richard Huggett, *Fundamentals of Biogeography* 2nd ed. (London, UK: Routledge, 2004), 294. Retrieved from <https://books.google.com.au/books?id=L6oZ0P-W9CYC&pg=PA294> (16 August, 2019).

- 9 Martin Luther, *Lectures on Genesis Chapters 6–14*, vol. 2 of *Luther's Works*, ed. Jaroslav Pelikan, trans. George V. Schick (St. Louis: Concordia, 1960), 3–186; John Calvin, *Commentaries on the First Book of Moses called Genesis*, vol 1, trans. John King (1847; reprint, Grand Rapids, MI: William Eerdmans, 1948); both cited in Davis Young, *The Biblical Flood*, 47–50.
- 10 Peter Harrison, “The Bible, Protestantism and the Rise of Natural Science: A Rejoinder”, *Science and Christian Belief*, 21 (2009): 155–162.
- 11 Walter Raleigh, *The Works of Sir Walter Raleigh*, vol.1, (New York, NY: Burt Franklin, 1829), 80, 81. Retrieved from https://books.google.com.au/books?id=3ro_AQAAMAAJ&pg=PA81&dq=Sir+Walter+Raleigh+Noah's+Flood+olive+leaf&hl=en&sa=X&ved (4 June, 2018).
- 12 Edward MacCurdy, *The Notebooks of Leonardo da Vinci: Arranged, Rendered into English and Introduced by Edward MacCurdy*, vol. 1 (London, UK: Jonathon Cape, 1938), 335–374.
- 13 Isaac Newton, Letter to Richard Bentley, 10 December, 1692, in John C. English, “John Hutchinson’s Critique of Newtonian Heterodoxy”, *Church History*, 68:3 (September 1999): 581–597.
- 14 Charles Lyell, *Principles of Geology*, 9th ed., 63.
- 15 Athanasius Kircher, cited in Martin J. S. Rudwick, *The Meaning of Fossils: Episodes in the History of Palaeontology* 2nd ed. (Chicago, IL: University of Chicago Press, 1976), 56. Retrieved from <https://books.google.com.au/books?id=TC5XAgAAQBAJ&pg=PA56&lpg=PA56&dq=lapidifying+virtue+diffused+through+the+whole> (7 April, 2018); Janet Browne, *The Secular Ark*, 3, 4; Paula Findlen, *Athenasius Kircher: The Last Man Who Knew Everything* (UK: Routledge, 2004).
- 16 Evelyn Stokes, “The Six Days and the Deluge”, 17.
- 17 Gordon L. Davies, *The Earth in Decay*, 22.
- 18 Charles Lyell, *Principles of Geology*, 9th ed., 28.
- 19 Davis A. Young and Ralph F. Stearley, *The Bible Rocks and Time: Geological Evidence for the Age of the Earth* (Downers Grove IL: IVP, 2008), 53, 61, 65.
- 20 John Wilkins, *An Essay Towards a Real Character and a Philosophical Language* (London, UK: Gellibrand, 1668), 162–168. Retrieved from http://ia800405.us.archive.org/20/items/AnEssayTowardsARealCharacterAndAPhilosophicalLanguage/An_Essay_Towards_a_Real_Character (4 June, 2018). Also James D. Fleming, *The Mirror of Information in Early Modern England: John Wilkins and the Universal Character* (Switzerland: Palgrave Macmillan, 2017), 258. Retrieved from <https://books.google.com.au/>

- books?id=t45jDQAAQBAJ&pg=PA258&lpg=PA258&dq=much+fewer+that+commonly+imagined,+not+a (7 April, 2018).
- 21 Janet Browne, *The Secular Ark*, 3–5; Also Olaf Breidbach and Michael T. Ghiselin, “Athenasius Kircher (1602–1680) on Noah’s Ark: Baroque ‘Intelligent Design’ Theory”. *Proc. Of the California Academy of Sciences, Fourth Series* 57:36 (Dec, 2006): 991–1002.
 - 22 T. Thirlwall, *The Works, Moral and Religious, of Sir Matthew Hale Knt. Lord Chief Justice of the Court of King’s Bench: The Whole Now Collected and Revised* (UK: R Wilks, 1805), viii, 39. Retrieved from https://www.google.com.au/books/edition/The_Works_Moral_and_Religious_of_Sir_Matthew_Hale (6 October, 2020).
 - 23 Gordon L. Davies, *The Earth in Decay*, 21, 21.
 - 24 Isaac Voss, *Dissertatio de Vera Aetate Mundi*, cited in Davis Young, *The Biblical Flood*, 52, 53. Also Norman Cohn, *Noah’s Flood*, 43–44.
 - 25 Edward Stillingfleet, *Origines Sacrae* 8th ed. (London, 1697), cited in David Montgomery, *The Rocks Don’t Lie*, 56.
 - 26 Norman Cohn, *Noah’s Flood*, 44–46.
 - 27 Thomas Burnet, *Telluris Theoria Sacra (The Sacred Theory of the Earth)* (1681) English translation (1684), 15–31. Retrieved from <https://www.amazon.com.au/sacred-Theory-Earth-Thomas-Burnett-ebook/dp/B007JCH63G> (5 Sept, 2020).
 - 28 Matthew Poole, *A Commentary on the Holy Bible, vol 1* (1679; reprint, London: Banner of Truth, 1979). Also Matthew Poole, *Synopsis criticorum aliorumque Sacrae Scripturae Interpretum et Commentatorum* (Ribbius, van der Water & Halma, 1684–1686).
 - 29 Davis Young, *The Biblical Flood*, 61.
 - 30 Matthew Poole, *Annotations Upon the Holy Bible* 3rd ed., vol I (London: Thomas Parkhurst, Jonathon Robinson, Thomas Cockerill Sen & Jun, Brabazon Aylmer, John Laurence and John Taylor, 1695), Gen 8:17. Retrieved from https://books.google.com.au/books?id=OUwjAQAAMAAJ&pg=RA1_PA3&lpg=RA1_PA3&dq=Matthew+Poole+who+will+believe+nothing (3 March, 2018).
 - 31 Davis Young, *The Biblical Flood*, 60, 61.
 - 32 Janet Browne, *The Secular Ark*, 9.
 - 33 Thomas Burnet, *Telluris Theoria Sacra (The Sacred Theory of the Earth)* (1681), 15, 16. Also Andrew Janiak, “The Unknown Newton: the Book of Nature, the Book of Scripture”, *The New Atlantis* (Winter 1995): 95. Retrieved from <https://www.thenewatlantis.com/docLib/20150715TNA44Janiak.pdf>. (5 September, 2020); Gordon L Davies, *The Earth in Decay*, 72, 73.

- 34 Charles Lyell, *Principles of Geology*, 9th ed., 31.
- 35 Evelyn Stokes, “The Six Days and the Deluge”, 24–26.
- 36 Gordon L Davies, *The Earth in Decay*, 73.
- 37 Erasmus Warren, *Geologia: or a Discourse Concerning the Earth before the Flood* (London, UK: R. Chiswell, 1690), 288, 292, 293, 300, 305–306. Retrieved from <https://books.google.com.au/books?id=g5xkAAAAcAAJ&pg=PA270&dq=Geologia> (August 23, 2019). Also Norman Cohn, *Noah’s Flood*, 134–135.
- 38 Erasmus Warren, *Geologia*, 286.
- 39 John Woodward, *An Essay Toward a Natural History of the Earth, and Terrestrial Bodies* 3rd ed. (London, UK: Bettesworth & Taylor, 1723), Preface. Retrieved from <https://books.google.com.au/books?id=prgQAAAAIAAJ&pg=PA265&source=gbs> (25 August, 2019); Gordon L. Davies, *The Earth in Decay*, 74–83; David Montgomery, *The Rocks Don’t Lie*, 69–73.
- 40 John Woodward, *Essay*, 105–106.
- 41 John Ray, *Consequences of the Deluge*, 165, cited in Charles Lyell, *Principles of Geology*, 9th ed., 31.
- 42 John Arbuthnot, *An Examination of Dr Woodward’s Account of the Deluge, etc. with a Comparison between Steno’s Philosophy and the Doctor’s, in the Case of Marine Bodies Dug out of the Earth* (London, 1697), cited in *The Miscellaneous Works of the Late Dr Arbuthnot The Second Volume* (UK: James Carlile, 1751), 213, 214. Retrieved from <https://books.google.com.au/books?id=qSEJAAAAQAAJ&pg=PA213&lpg=PA213&dq=It+is+strange+that+the+laws+of+gravity,+which+have+been+violated> (7 October, 2020).
- 43 Evelyn Stokes, “The Six Days and the Deluge”, 26. Also Gordon J. Davies, *The Earth in Decay*, 12.
- 44 William Whiston, *A New Theory of the Earth From its Original, to the Consummation of all Things* (London, UK: Mr Boyles Head for William Whiston, 1737), 372–400 (quote 377). Retrieved from <http://books.google.com.au/books?id=vZ15AAAAcAAJ&printsec=> (19 August, 2019). Also Norman Cohn, *Noah’s Flood*, 62–69; Gordon J. Davies, *The Earth in Decay*, 83–86.
- 45 David R. Montgomery, *The Rocks Don’t Lie*, 75–76. Also Peter Harrison, *The Bible, Protestantism, and the Rise of Natural Science* (Cambridge, UK: Cambridge University Press, 1998), 145–146; Gordon J. Davies, *The Earth in Decay*, 73; Evelyn Stokes, “The Six Days and the Deluge”, 13.
- 46 Gordon J. Davies, *The Earth in Decay*, 16.

- 47 Evelyn Stokes, “The Six Days and the Deluge”, 16.
- 48 Janet Browne, *The Secular Ark*, 5.
- 49 Evelyn Stokes, “The Six Days and the Deluge”, 19; Martin J. S. Rudwick, *The Meaning of Fossils: Episodes in the History of Palaeontology*, 2nd ed (Chicago, IL: University of Chicago Press, 1976), 82–89. Also Martin J. S. Rudwick, *Bursting the Limits of Time: Geohistory in the Age of Revolution* (Chicago, IL: University of Chicago Press, 1976), 63–65.
- 50 Norman Cohn, *Noah's Flood*, 88. Also Claudia Schweizer, “Scheutzer, von Haller and de Luc: Geological World-views and Religious Backgrounds in Opposition or Collaboration”, in *Geology and Religion: a History of Harmony and Hostility*, ed. Martina Kölbl-Ebert (London, UK: Geological Society, 2009), 95–98.
- 51 Fettiplace Bellers, “A Description of the Several Strata of Earth, Stone, Coal, &c Found in a Coal Pit at the West End of Dudley in Staffordshire”, *Philosophical Transactions of the Royal Society of London* 27 (1712): 541–544. Retrieved from <https://books.google.com.au/books?id=dfMyAQAAMAAJ&pg=RA1-PA541> (19 August, 2019).
- 52 John C. English, “John Hutchinson’s Critique of Newtonian Heterodoxy”, *Church History*, 68:3 (September 1999): 581–597.
- 53 Davis A. Young, *The Biblical Flood*, 77, 78.
- 54 Retrieved from https://en.wikipedia.org/wiki/Carl_Linnaeus (28 September, 2017).
- 55 Edward King, “An Attempt to Account for the Universal Deluge”, *Philosophical Transactions*, 57 (1767): 44–57; cited in Evelyn Stokes, “The Six Days and the Deluge”, 37, 38.
- 56 David Montgomery, *The Rocks Don't Lie*, 113.
- 57 Matthew Henry, *Commentary on the Whole Bible* vol 1 (Peabody, MA: Hendrickson, 1992), 48–51.
- 58 John Wesley, *Explanatory Notes Upon the Old Testament* vol 1 (1765), 33–36; Eighteenth Century Collections Online. Gale. State Library of NSW (21 August, 2019).
- 59 John Gill, *Explanatory Notes on the Old Testament*, vol 1 (1765), 47, 51. Retrieved from Eighteenth Century Collections Online. Gale. State Library of NSW, <https://gdc-gale-com.ezproxy.sl.nsw.gov.au/gdc/artemis/MonographsDetailsPage/MonographsDetailsWindow?disableHighlighting=&displayGroupN> (23 August, 2019).
- 60 *Ibid.*, 46, 48.
- 61 *Ibid.*, 50.

- 62 *Ibid.*, 56.
- 63 Thomas Scott, *The Holy Bible According to the Authorized Version with Explanatory Notes, Practical Observations, and Copious Marginal References* vol.1 (New York, NY: Samuel T. Armstrong, Crocker and Brewster, 1832), 52–55. Retrieved from <https://babel.hathitrust.org/cgi/pt?id=umn.31951002135157e&view=1up&seq=21> (24 October, 2020).
- 64 Evelyn Stokes, “The Six Days and the Deluge”, 28; John Mitchell, “Conjectures concerning the Cause, and Observations on the Phenomena of Earthquakes; particularly of that Great Earthquake of Nov. 1, 1755, which proved so fatal to the City of Lisbon, and whose Effects were felt as far as Africa, and more or less throughout almost all of Europe”. *Philosophical Transactions* (1760): 448–472. Retrieved from <https://books.google.com.au/books?id=DD5jAAAMAAMAJ&pg=PA472&lpg=PA472&dq> (12 September, 2020); Francesco Luzzini, “Antonio Vallisneri (1661–1730) and the Rise of Naturalistic Experimentalism. A European Debate”. Paper presented at the 25th International Congress of History of Science and Technology, Rio de Janeiro, Brazil, July 23–29, 2017. Retrieved from https://www.researchgate.net/publication/318503141_Antonio_Vallisneri_1661-1730_an (12 September, 2020).
- 65 Retrieved from <https://www.encyclopedia.com/people/science-and-technology/metallurgy-and-mining-biographies/giovanni-arduino> (19 September, 2020); Davis A. Young, *The Biblical Flood*, 85, 86.
- 66 David R. Montgomery, *The Rocks Don't Lie*, 93–96, 102–114.
- 67 Janet Browne, *The Secular Ark* 16–24.
- 68 Davis A. Young and Ralph F. Stearley, *The Bible Rocks and Time*, 80.
- 69 Charles Lyell, *Principles of Geology*, 9th ed., 39, 40.
- 70 Davis A. Young, *The Biblical Flood*, 88–92.
- 71 David R. Montgomery, *The Rocks Don't Lie*, 109–111.
- 72 Richard Kirwan, “On the Primitive State of the Globe and its subsequent Catastrophe”, *Transactions of the Royal Irish Academy* 6 (1797): 272, 273, 276. Retrieved from <https://books.google.com.au/books?id=NZnMAAAAMAJ&pg=PP14&lpg=PP14&dq=Richard+Kirwan+On+the+primitive+state&source=b> (29 September, 2017).
- 73 See Bible and Science. Retrieved from www.bibleandscience.info/re-creation-of-universe/universe-obeys-physical-law (10 February, 2018). Also Barry Setterfield. Retrieved from www.setterfield.org/NHCS/Flood/Noah/_and_the_Flood.html (10 February, 2018).
- 74 Davis A. Young, *The Biblical Flood*, 95.

- 75 David Hempton, *The Church in the Long Eighteenth Century* (London, UK: I B Taurus, 2011), 116.
- 76 Charles Lyell, *Principles of Geology*, 9th ed., 58.
- 77 University of Oxford Earth Sciences: History of the Department. Retrieved from <https://www.earth.ox.ac.uk/about/history-of-the-department/> (10 November, 2017).
- 78 Retrieved from <https://www.darwinproject.ac.uk/adam-sedgwick> (10 November, 2017). Also https://en.wikipedia.org/wiki/Woodwardian_Professor_of_Geology (10 November, 2017).
- 79 Georges Cuvier, *Essay on the Theory of the Earth, first published as a preliminary discourse to his Recherches sur les ossemens fossiles de quadrupeds ... (1812)*, cited in Davis Young, *The Biblical Flood*, 99–101.
- 80 George B. Greenough, *A Critical Examination of the First Principles of Geology* (London: Strahan & Spottiswoode, 1819), 147, 148, 149. Retrieved from <https://books.google.com.au/books?id=sNZgAAAACAAJ&pg=PA149&dq=he> (11 November, 2017).
- 81 *Ibid.*, 148–149.
- 82 William Buckland, *Vindiciae Geologicae or the Connexion of Geology with Religion Explained* (Oxford, UK: Oxford University Press, 1820), 23, 24. Retrieved from [shipseducation.net/glaciers/Buckland/Vindiciae Geologicae William Buckland](https://shipseducation.net/glaciers/Buckland/Vindiciae_Geologicae_William_Buckland) (20 August, 2019).
- 83 Davis Young, *The Biblical Flood*, 104, 113.
- 84 Mott T. Greene, “Genesis and Geology Revisited: The Order of Nature and the Nature of Order in Nineteenth-Century Britain”, in *When Science and Christianity Meet*, eds. David C. Lindberg and Ronald L. Numbers (Chicago, IL: University of Chicago Press, 2003), 143. Retrieved from <https://books.google.com.au/books?id=ViweK1jfi4C&pg=PA157&lpg=PA157&dq=The+disappointment+of+those+who+look+for> (2 February, 2018).
- 85 *Ibid.*, 141–148; Also see Davis Young, *The Biblical Flood*, 106, 107.
- 86 Kenneth Taylor, “New Light on Geological Mapping in Auvergne during the Eighteenth Century: The Pasumot-Desmarest Collaboration”, *Revue d’histoire des sciences* 47:1 (1994): 129–136. Retrieved from https://www.persee.fr/doc/rhs_0151-4105_1994_num_47_1_1195 (13 November, 2020).
- 87 Charles Daubeny, “On the Volcanoes of Auvergne: Letter to Professor Jameson”, *The Edinburgh Philosophical Journal*, III:VI (1 April to 1 October, 1820): 359–361. Retrieved from <https://books.google.com.au/books?id=wkhkAAAAMAAJ&pg=PA355&lpg=PA355&dq=Charles+Daubeny+On+the+Volcanoes+of+auvergne> (23 December, 2017).

- 88 Canon T. G. Bonney, "The Volcanic Region of Auvergne", *Proceedings of the Geologists' Association* 17:4 (1901): 191–212. Retrieved from <https://www.sciencedirect.com/science/article/abs/pii/S0016787801800808> (13 November, 2020).
- 89 John Fleming, "The Geological Deluge, as Interpreted by Baron Cuvier and Professor Buckland, Inconsistent with the Testimony of Moses and the Phenomena of Nature", *The Edinburgh Philosophical Journal*, XIV:XXVIII (April, 1826): 209, 212, 213. Retrieved from <https://books.google.com.au/books?id=yLE-AAAAYAAJ&pg=PA205&lpg=PA205&dq=John+Fleming+The+Geological+Delude+Edinburgh> (23 December, 2017).
- 90 *Ibid.*, 214.
- 91 John Fleming, "Remarks Illustrative of the Influence of Society on the Distribution of British Animals", *The Edinburgh Philosophical Journal*, XI (1824): 304, 305. Retrieved from <https://www.era.lib.ed.ac.uk/bitstream/1842/9860/1/Baxter1985.pdf> (23 December, 2017).
- 92 Davis Young, *The Biblical Flood*, 110–113.
- 93 Martin S. Rudwick, *Worlds Before Adam: The Reconstruction of Geohistory in the Age of Reform* (Chicago, IL: University of Chicago Press, 2008), 336.
- 94 Adam Sedgewick, "Address to the Geological Society", *Proceedings of the Geological Society of London*, 1 (1831): 313, 314.
- 95 Colin Russel; Cited in Michael Poole, *Beliefs and Values in Science Education* (Buckingham, UK: Open University Press, 1995), 122.
- 96 Charles Lyell, *Principles of Geology* vol. III (London, UK: John Murray, 1833). Cited in Charles Lyell, *Principles of Geology* (2 vols) vol. II (Philadelphia, PA: James Kay, Jun. & Brother, 1837), 391, 392. Retrieved from [urce=bl&ots=CIGhNh0U5M&sig=7CAa gNxDeqKybumxPPtIOFinio&hl=en&sa=X&ved=0ahUKEwjH_N3808LYAhVHa7wKHVdRCvIQ6AEIJzAA](https://www.google.com.au/books?id=bl&ots=CIGhNh0U5M&sig=7CAa gNxDeqKybumxPPtIOFinio&hl=en&sa=X&ved=0ahUKEwjH_N3808LYAhVHa7wKHVdRCvIQ6AEIJzAA) (6 January, 2018).
- 97 George B. Greenough, Address Delivered at the Anniversary Meeting of the Geological Society on the 21st February, 1834", *Proceedings of the Geological Society of London* 2:35 (1838): 69, 70. Retrieved from <https://books.google.com.au/books?id=raVGAAAACAAJ&pg=PA42&dq=George+Greenough+1834+Adress+Delivered+at+the+Anniversar y+Meeting> (6 January, 2018).
- 98 William Buckland, footnote in his *Bridgewater Treatise*; cited in Davis Young, *The Biblical Flood*, 107.
- 99 William Buckland *Bridgewater Treatise*, 1836, cited in Mott T. Greene, "Genesis and Geology Revisited", 157.

- 100 *Ibid.*, 147.
- 101 William Buckland Bridgwater Treatise, 1836, cited in David Montgomery, *The Rocks Don't Lie*, 128, 129.
- 102 Davis A. Young, *The Biblical Flood*, 116.
- 103 Gordon L. Davies, "Early Discoveries XXVI: Another Forgotten Pioneer of the Glacial Theory—James Hutton Journal of Glaciology 7:49 (1968):115. Retrieved from https://www.igsoc.org/journal/7/49/igs_journal_vol07_issue049_pg115-116.pdf (January 7, 2018).
- 104 Davis Young, *The Biblical Flood*, 118, 119.
- 105 Cornelis Bootsman, Kevin de Berg and Lynden J. Rogers, "A Study of the Christian Public's Engagement with the New Geology of the 19th Century and its Implications for the Succeeding Centuries". Paper presented at the *International History, Philosophy and Science Teaching Group Asian Regional Conference*, Taipei, Taiwan (December 4–7, 2014), "Michael B. Roberts, Geology and Genesis Unearthed", *Churchman* 112:3 (1998): 225–255. Retrieved from http://biblicalstudies.gospelstudies.org.uk/pdf/churchman/112-03_225 (13 November, 2020).
- 106 Ralph O'Connor, "Young-Earth Creationists in Early Nineteenth Century Britain? Towards a Reassessment of 'Scriptural Geology'", *History of Science* 45 (2007): 357–403. Retrieved from <https://www.abdn.ac.uk/staffpages/uploads/his221/young-earth-creationists.pdf> (13 November, 2020).

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