

The idiom of a six day creation and global depictions in Theories of the Earth

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Abstract: During the 17th century, in a new contested tradition known as Theories of the Earth, conventions for the visual representation of the Earth as a whole developed alongside the expression of biblical idiom. Global depictions carried embedded biblical idiom that shaped the formulation of questions, the development of theories, and the exchange of discoveries and ideas. In several examples I contrast the varying ways in which biblical idiom was expressed within global depictions, particularly hexameral idiom (i.e. the language of the six day creation in Genesis 1). I discuss the Jesuit mathematician Gabriele Beati and meteorological and cosmic sections; the cosmogonic sections and hexameral idiom of Robert Fludd; the geogonic sections and hexameral idiom of René Descartes; the apocalyptic idiom of Thomas Burnet; and the global depictions and hexameral idiom of William Whiston in the controversy over Burnet. Biblical and particularly hexameral idiom proved durable and versatile for more than a century after Fludd, and facilitated the development of a directionalist sense of Earth history. The continuities of visual conventions, the durability of hexameral idiom, and the contrasts of disciplinary perspectives and local contexts observed in the examples considered here conform well to the characterization of Theories of the Earth as a contested print tradition.

This paper explores the relations between biblical idiom and global depictions in 17th-century Theories of the Earth as a sequel to an earlier examination of the development of the global depictions (Magruder 2006). Shared conventions for visual representations provided a common ground for the exchange of novel ideas. In a similar way, shared biblical idiom provided a linguistic common ground for the exchange and comparative assessment of rival theories. This paper and Magruder (2006) show how biblical idiom and global depictions each facilitated the establishment of 17th-century Theories of the Earth as a contested print tradition. The relations between early Theories of the Earth and biblical idiom are rich and complex. However, this paper will focus specifically upon the biblical idiom that was embedded within global depictions with emphasis on the embedded hexameral idiom; that is, the language of the six days of creation as narrated in the first chapter of Genesis.

Georges Cuvier (1769–1832) stated that early Theorists of the Earth tried to explain all of the Earth's history by reference to only two events, the creation and the biblical Flood (Cuvier 1812, p. 4). There was truth in his argument, although there were major Theorists of the Earth, for example, Benoît de Maillet (1656–1738) and James Hutton (1726–1797), who did not seek to relate their writings to traditions of biblical interpretation. For others such as Georges-Louis

Leclerc, Comte de Buffon (1707–1788), biblical idiom served more as a rhetorical flourish than a substantive resource. However, for many, the use of biblical idiom did signal the continuing importance of a widespread mode of interdisciplinary communication.

To understand the significance of the biblical Flood for Theories of the Earth we may turn to a variety of insightful studies (Rappaport 1978; Young 1995). Less has been written about the tradition of hexameral commentaries and their significance for thinking about the Earth (Williams 1948). Some writers regard Theorists of the Earth as preoccupied with the Flood, as many were indeed. Yet the prolific hexameral commentary tradition was one of the most important textual traditions for discussing the formation of the Earth before such discussions acquired a more interdisciplinary character in the contested print tradition known as Theories of the Earth. To understand Theories of the Earth, therefore, it is essential to take into account the role of hexameral idiom.

'Idiom' refers to nontechnical language that nevertheless shaped how investigators articulated questions, formulated concepts, and appropriated novel ideas by transposing them into a familiar linguistic context. 'Hexameral idiom' refers to the development, presentation and exchange of ideas using the linguistic resources of Genesis 1. Instances of hexameral idiom ranged from the vocabulary of the biblical text, which offered a source of proto-terminology such as 'the firmament' that carried

Table 1. *Global visions and hexameral idiom*

	Field or discipline	Natural philosophy	Image character	Image type	Biblical idiom
Beati	Astronomy	Jesuit	Didactic and contemplative	Cosmic section	Hexameral
Fludd	Chymistry	Hermeticism	Emblematic	Cosmogonic sections	Hexameral
Descartes	Meteorology	Mechanical	Didactic abstractions	Geogonic sections	Hexameral
Burnet	Classics	Cambridge Platonism	Evidential representations	Global sections and views	Apocalyptic
Whiston	Physics	Newtonian	Didactic abstractions	Geogonic sections	Hexameral

affiliated conceptual resources, to turns of phrase such as ‘the gathering of the waters’ on the third day, to larger linguistic structures such as the pattern of a gradual cumulation of events over a succession of six days. This range of idiom provided a scaffolding for the development and communication of ideas about the history of the Earth regardless of the specific content of the theories or a writer’s area of technical expertise (Magruder 2008).

The earlier paper (Magruder 2006) compared the global depictions of Johann Kepler (1571–1630), Robert Fludd (1574–1637), René Descartes (1596–1650) and Thomas Burnet (*c.* 1635–1715), examining their varied disciplinary and technical contexts, their diverse natural philosophies, and the different roles played by images in their works (see Table 1). This paper will superimpose upon that analysis a consideration of biblical idiom (see Table 1, rightmost column). Because of the incidental role of images in Kepler’s thinking about the Earth, this paper will adopt a different starting point; namely, a brief look at the precedents provided by meteorological sections and cosmic sections for

visually depicting hexameral idiom. The resulting survey portrays Theories of the Earth as a ‘hermeneutical conversation’ (Gadamer 1996, pp. 383–405) in which a shared biblical idiom enabled writers to engage in a common critical debate. In early Theories of the Earth, biblical idiom helped to convey a directionalist sense of Earth history, and facilitated the interaction and exchange of new theories between investigators adhering to diverse natural philosophies, methodologies and technical contexts.

Gabriele Beati: hexameral idiom and cosmic sections

Meteorological sections and views depict the relations of the elements of the Earth. Frequently meteorological sections showing concentric regions of earth, water, air and fire were incorporated into cosmic sections representing the second day of creation, when the waters covered the face of the Earth, as in the *Nuremberg Chronicle* of 1493 (Fig. 1a and b; Schedel 1493). Meteorological

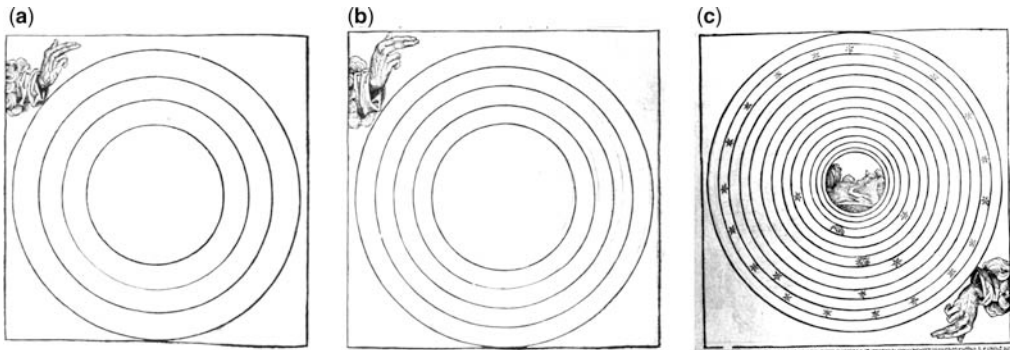


Fig. 1. *Nuremberg Chronicle* (Schedel 1493). (a) Meteorological section, second day of creation. (b) Meteorological section, third day. (c) Meteorological view, fourth day.

views, combining the land and the sea in a single region, depicted the Earth after the third day when the dry land appeared and the waters withdrew into the ocean basins (Fig. 1c). That the meteorological regions, taken together, constituted a coherent body or interrelated functional system is confirmed by the way meteorological depictions could be placed in the heavens, as in Thomas Digges' 'globe of mortality' (Digges & Digges 1576, p. 43).

Gabriele Beati (1607–1673) published a cosmic section in 1662 for contemplation by his mathematics students at the Collegio Romano (Fig. 2; Beati 1662). Far above the meteorological section in the centre, in the higher spheres of the cosmos, lie additional structures inferred from the hexamerical account. For mid-17th-century Jesuits such as Beati, three regions were established during the creation week: the meteorological, the celestial and the empyrean. Each of the three regions was composed of a fiery solid that would erupt in conflagration were it not for the cooling effect of fluid waters above.

In the celestial region the solid firmament supported the waters above the heavens just as the solid crust supports the oceans on the Earth. Because the firmament was igneous in nature, the waters above the firmament tempered the heat of the firmament and its fiery stars. The heavens continued to exist only because of this precarious balance between water and fire. In addition, the lower solid part of the empyrean heaven was fiery, supporting a fluid region above. The empyrean thus completed an exact three-way parallel to the Earth's solid but igneous crust underlying the

ocean basins, and to the solid igneous firmament underlying the super-celestial waters. A similar precarious balance between water and fire characterized the well-known global sections of Athanasius Kircher, a Jesuit contemporary of Beati in Rome (Kircher 1665; Waddell 2006). The Jesuit understanding of the Earth manifest in Kircher's global sections, with their dramatic depictions of the balance of fire and water, was made more plausible to readers accustomed to the hexamerical idiom embedded within such cosmic sections, including Kircher's own (Kircher 1657).

The didactic, contemplative cosmic section of Beati provides one example of how hexamerical idiom became embedded within mid-17th-century cosmic sections. Hexamerical idiom pervaded many cosmic sections regardless of religious tradition, disciplinary context or natural philosophy. Both meteorological and cosmic sections, each associated with hexamerical idiom, provided important precedents and resources for depictions of the Earth in the 17th century.

Robert Fludd: hexamerical idiom and cosmogonic sections

The London physician and chymical philosopher Robert Fludd used images as emblems representing the mysteries of hermeticism that he would interpret for the reader (Fludd 1617; Debus 1966; Godwin 1979; Westman 1984). Fludd's rich use of cosmogonic sections established important visual conventions for subsequent representations of the Earth, including the quarter section and double hemisections explored by Magruder (2006). That paper did not emphasize Fludd's hexamerical orientation, however, although it was of central importance to his use of images. For example, Fludd used rotation to suggest the passage of time in the first three days of creation (Fig. 3a).

Fludd's work opened with a sustained cosmogonic series organized explicitly according to the hexamerical account, the earliest important series of cosmogonic sections of the 17th century. In this sequence, layers gradually separated as creation proceeded from chaos (Fig. 3). The details of the diagrams do not matter so much as the directional framework of the hexamerical idiom. Because of the hexamerical context, the diagrams attributed the origin of the Earth to a meaningful sequence of temporal events. That is, Fludd explained the Earth and cosmos by detailed expository references to cosmogonic sections which because of their embedded hexamerical idiom attributed a directionalist pattern to the origin of the Earth. (For a careful discussion of directionalism see Rudwick (1971) and Magruder (2000, pp. 6–43).)

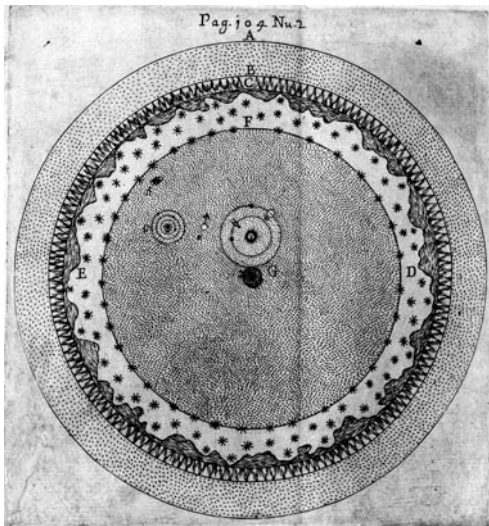
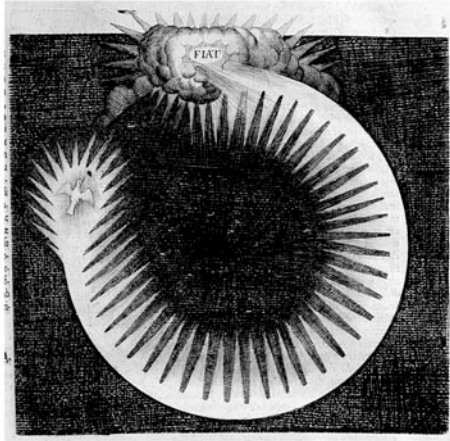
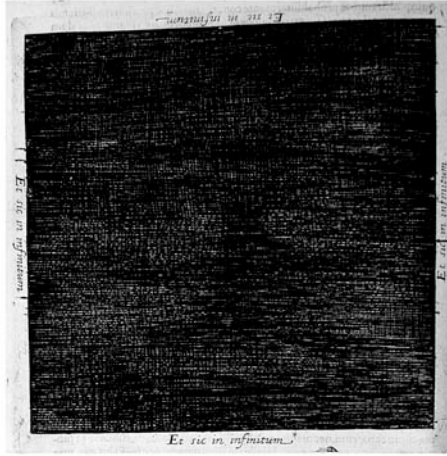


Fig. 2. *Sphaera Triplex* (Beati 1662). Cosmic section. G, meteorological regions; F, firmament; C, empyrean (solid); E, empyrean (fluid).

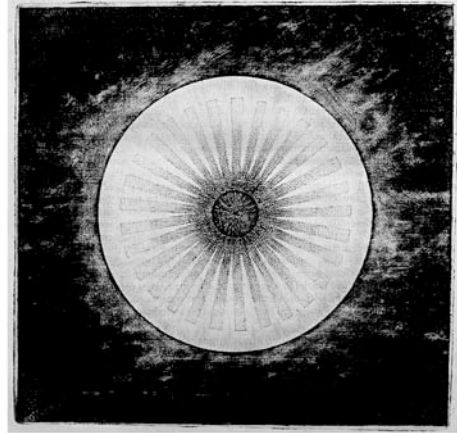
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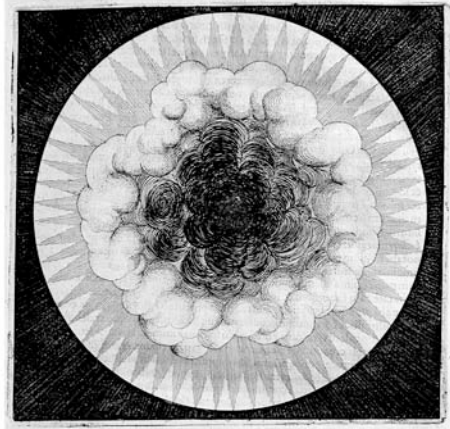
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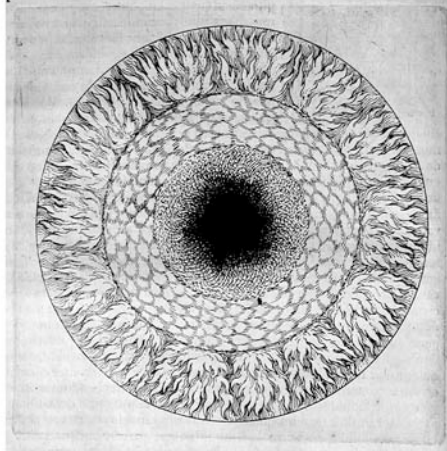
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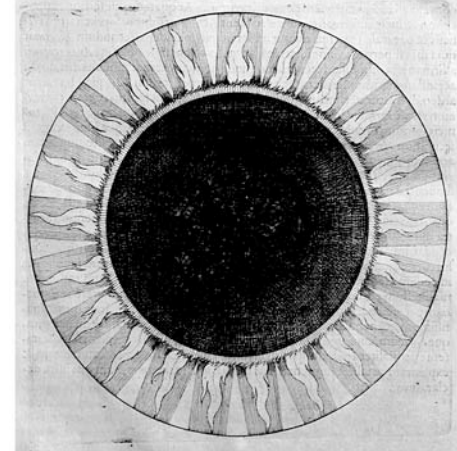


Fig. 3. Cosmogonic sections (Fludd 1617, Vol. 1). (a) Rotating figure, p. 49. (b) p. 26. (c) p. 29. (d) p. 37. (e) p. 46. (f) p. 55.

René Descartes: hexameral idiom and cosmic and geogonic sections

In the *Principia philosophiae* (1644), René Descartes offered a comprehensive mechanical vision of the development of Earth-like planets (Descartes 1644). This mechanical account broke with Fludd and the chymical philosophers in many ways, yet Descartes, too, employed hexameral idiom. While writing the *Principia*, Descartes wrote to Mersenne that he would have no trouble showing the compatibility of his account of the formation of the Earth with Genesis 1 (Descartes 1965, III, pp. 295–296). Compatibility with Genesis 1 was just as important for legitimizing Cartesianism as the often-cited issues of the motion of the Earth and the physics of the eucharist (Nadler 1988). When the *Principia* appeared, however, Descartes trod cautiously, as interpreting the Bible was the prerogative of the theologian rather than the Catholic natural philosopher. Nevertheless, hexameral idiom is present in Question 131 of the *Principia*, for example, where Descartes identified the firmament with the refracting surface of the Sun's vortex. The waters above the firmament were the vortices of other stars, whereas the Sun's fluid planetary heavens comprised the waters below the firmament (Fig. 4a). In this case, hexameral idiom was explicit. The familiar idiom translated novel features of Descartes' cosmology into a familiar and accessible linguistic common ground.

Descartes' idiom was not lost on readers who appreciated the cognitive resources it provided for interpreting the second day of creation. For example, Théodore Barin organized his account of

Descartes' natural philosophy in the form of a hexameral narrative, and embedded Cartesian visual representations within that sequential hexameral account (Barin 1686). One cosmic section (Fig. 4b) shows Barin's philosophical interpretation of the second day when the creation of the firmament divided the waters. Barin developed an explicit concordism, drawing highly specific inferences from the hexameral text: neither the stars nor the Sun and planets yet exist, although their vortices are present. The vortices created by the division of the heavens on the second day were then filled with the planets and stars on the fourth day. Barin's second cosmic section (Fig. 4c) depicted the stars and planets as they appeared within their respective vortices on the fourth day. While Descartes drew back from such detailed and highly specific concordism between cosmology and hexameral exegesis, Barin's interpretation did follow the lead of Descartes' hexameral idiom, which explicitly identified the firmament and the super-celestial waters within Cartesian cosmology.

Descartes prepared a singular sequence of geogonic images to show the development of an Earth-like planet over time. In a striking rotating figure, Descartes combined four geogonic sections into one diagram (Fig. 5a; Magruder 2006). Descartes regarded the settling out of the planetary layers to this point as a gradual process, but in Question 39 he asserted that it would not have required a long time. His description allowed readers such as Barin to assign these events to the creation week. In two subsequent geogonic hemisections, a dried solid layer has fractured and tilted, creating

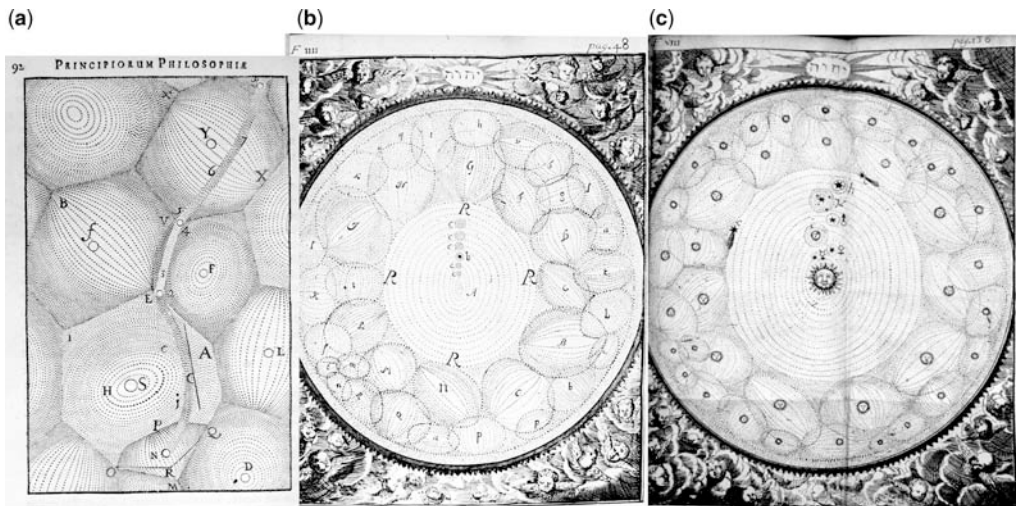


Fig. 4. (a) Cosmic section (Descartes 1644, p. 92). (b) Théodore Barin, cosmic section, second day (Barin 1686, p. 48). (c) Théodore Barin, cosmic section, fourth day (Barin 1686, p. 136).

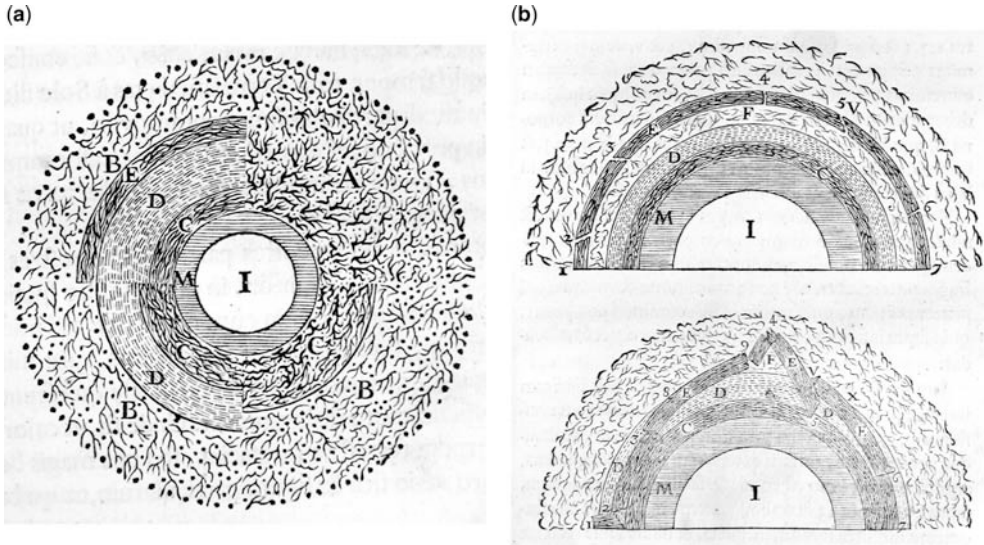


Fig. 5. Geogonic sections (Descartes 1644). (a) Geogonic quarter-sections (Descartes 1644, p. 206). (b) Geogonic hemisections, (Descartes 1644, p. 215).

mountains and ocean beds (Fig. 5b). In the hexameral tradition, the formation of mountains and ocean beds would have been assigned to the third day, the separation of the dry land and the sea.

Indeed, consistent with hexameral idiom, Barin assigned a Cartesian geogonic section to the beginning of the third day (Fig. 6a) and another to the end of the third day, after the separation of the

dry land and the sea (Fig. 6b). Barin saw this as a straightforward reading of Descartes' *Principia*. However, Descartes implied that the crustal collapse would not have been possible in two or three 24 hour days. Barin was willing to interpret the length of the days figuratively, while maintaining the pattern of the six days as a directionalist framework consisting of a temporal sequence of events.

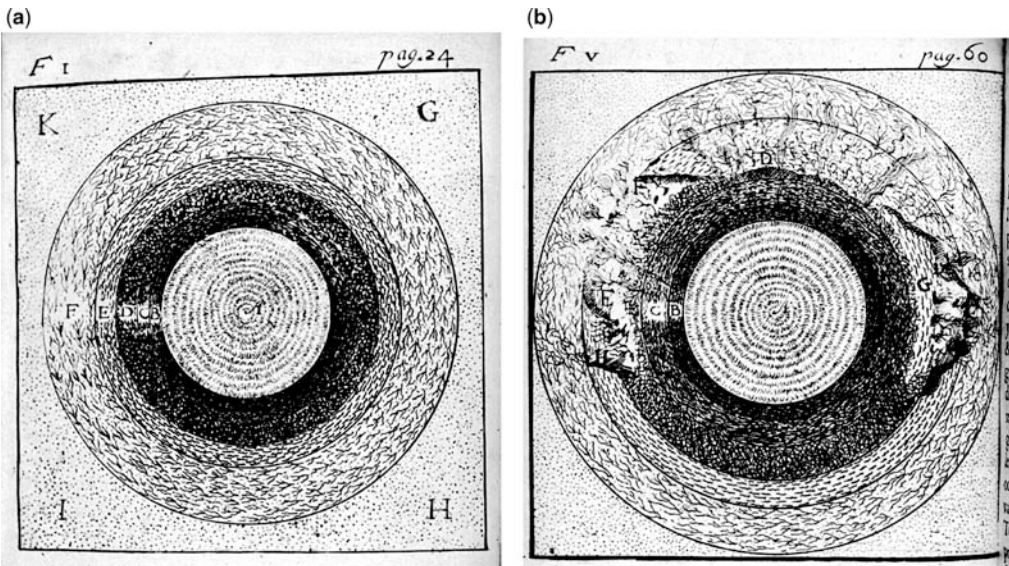


Fig. 6. Geogonic sections (Barin 1686). (a) Before the third day (Barin 1686, p. 24). (b) After the third day (Barin 1686, p. 60).

Despite the contrasting natural philosophies of Fludd and Descartes, there was a continuity of visual representation, as Fludd provided the visual precedents for Descartes' rotating wheel and hemisections (Magruder 2006). As with visual rhetoric so with biblical idiom: Fludd and Descartes also shared the deployment of hexameral idiom within a directionalist framework of creation. Descartes' cosmic sections and his geogonic sections were presented in terms of the hexameral idiom of the firmament and the waters above and below the firmament, and were consistent with the separation of dry land on the third day. Descartes himself affirmed that he had compatibility with the hexameral account in mind as he was writing the *Principia*. Readers such as Barin who elaborated concordist interpretations regarded this compatibility as legitimizing Cartesian natural philosophy.

Thomas Burnet: biblical idiom and global sections and views

The classical scholar Thomas Burnet substituted apocalyptic idiom for the hexameral tradition. That Burnet's theory owed at least as much to the apostle Peter as to Descartes may be seen in the apocalyptic cycle of Earth history depicted in the frontispiece to his *Theory of the Earth* (Burnet 1684; Fig. 7). Christ's left foot rests upon a ball of chaos under the caption *Apò kataboles kosmou*, 'From the Foundation of the World'. This biblical idiom resonates with apocalyptic overtones, evoking one of the most quoted passages in the New Testament regarding the destiny of the Earth, 2 Peter 3: 3–13, the primary allusion behind Burnet's caption. The epistle of 2 Peter admonished readers that in the last days scoffers would assert nothing but continuities from the beginning of the creation. Believers should rather look for a new Earth by remembering that the former Earth had perished. The epistle spoke of three utterly different worlds: the 'world that then was'; the 'earth that [is] now'; and 'a new earth' that is to come. Burnet described his *Theory of the Earth* as nothing more than a commentary on this text (Burnet 1690, p. 385).

Because Peter established apocalyptic discontinuities between past, present and future Earths, Peter was of greater importance than Moses for deciphering the 'whole Circle of Time and Providence' (Burnet 1684, p. 24). Thus Burnet sought to transplant discussion of the origin and fate of the Earth away from the hexameral tradition, which emphasized continuities of the Earth, into a new apocalyptic discourse that would emphasize discontinuities (for a detailed study of Burnet's apocalyptic idiom, see Magruder 2008). In the

controversy that followed the publication of his book, Burnet's argument largely failed because his antediluvian globe, with neither mountains nor oceans, contradicted established hexameral idiom. For Burnet there was no third day of creation, no gathering of the waters into the sea to form the dry land. Wherever one finds mountains in maps of Eden or biblical illustrations of the creation week, the hexameral idiom of the third day implied that mountains were older than Adam (Fig. 8).

Burnet's emphasis on the biblical Flood at the expense of the creation week was reflected not only in his frontispiece but also in his citations of the Bible. In *The Theory of the Earth* (1684), Burnet cited four biblical books nine or more times. It does not take a reference count to suggest that Genesis will be the most quoted biblical book in a work about the natural causes of the Flood and Paradise, and Burnet cited it 40 times. Similarly, nine references to Job and 12 to the Psalms are not surprising, considering the large number of nature passages, often poetical, contained in these books. What would be surprising, were it not for the frontispiece, are the 14 references to the second epistle of Peter, second in frequency only to Genesis. Burnet's references to Genesis also reflect his radical departure from hexameral interpretation. Most importantly, over half (21) of the 40 Genesis references refer to the Flood. Only five references occur to the creation week, and none of these refer to what Burnet's contemporaries would have regarded as the chief hexameral event responsible for the formation of the Earth, the division of dry land and sea on the third day. As Burnet explained, 'Those places of Scripture which we have cited, I think, are all truly appli'd; and I have not mention'd Moses's *Cosmopoëia*, because I thought it deliver'd by him as a Lawgiver, not as a Philosopher; which I intend to show at large in another Treatise, not thinking that discussion proper for the *Vulgar Tongue*' (Burnet 1684, pp. 288–289). The other treatise would be the *Archaeologiae Philosophicae*, published in Latin rather than the vernacular in a failed attempt to contain the developing controversy (Burnet 1692).

Hexameral idiom and the global depictions of the Burnet controversy

Hexameral idiom played a critical role in the controversy over Burnet's Theory of the Earth. After Descartes and Burnet established visual conventions for depicting the development of the Earth, global depictions became a common currency of debate as critics from a variety of technical contexts proposed arguments to defend the continuities

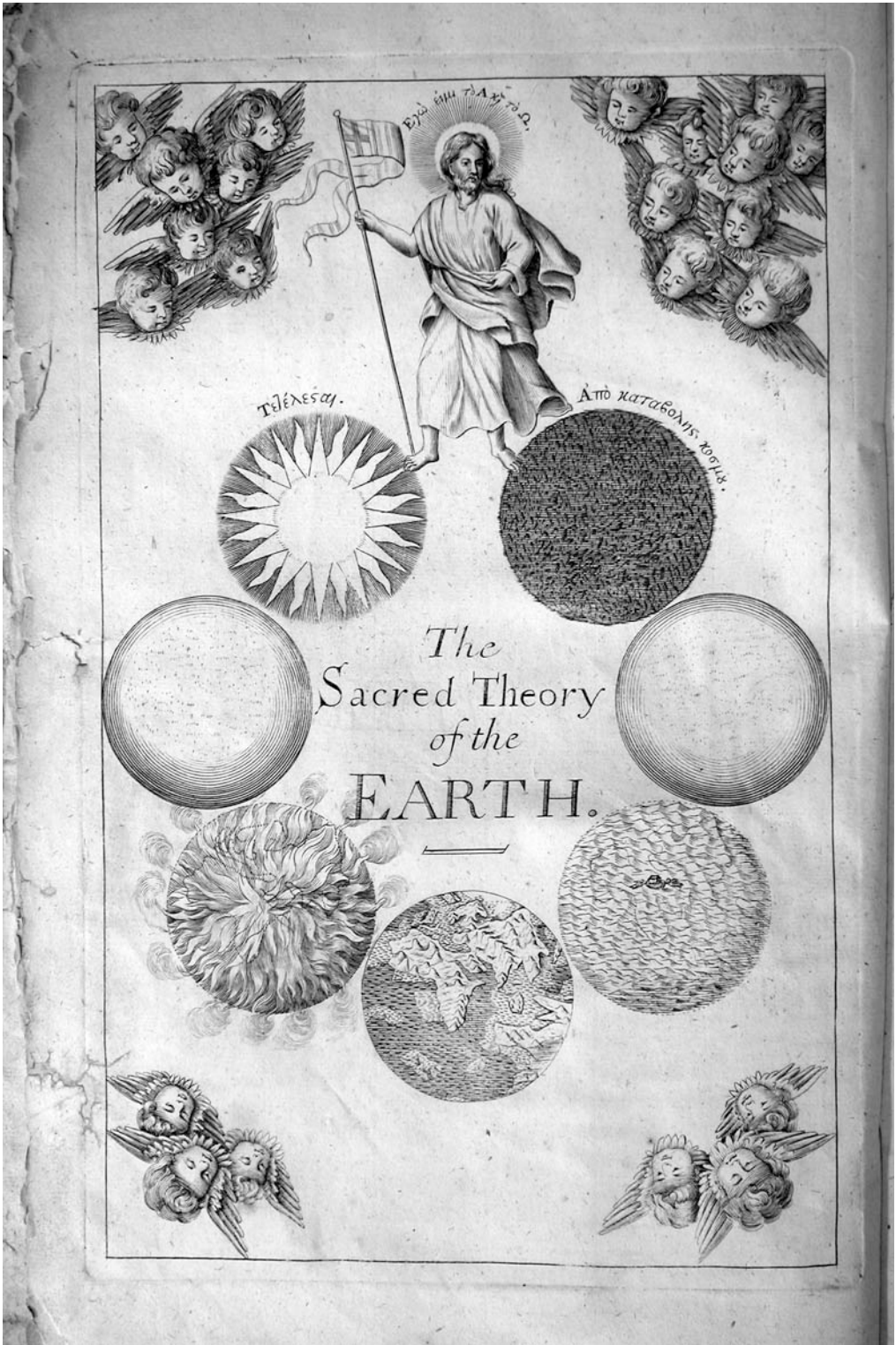
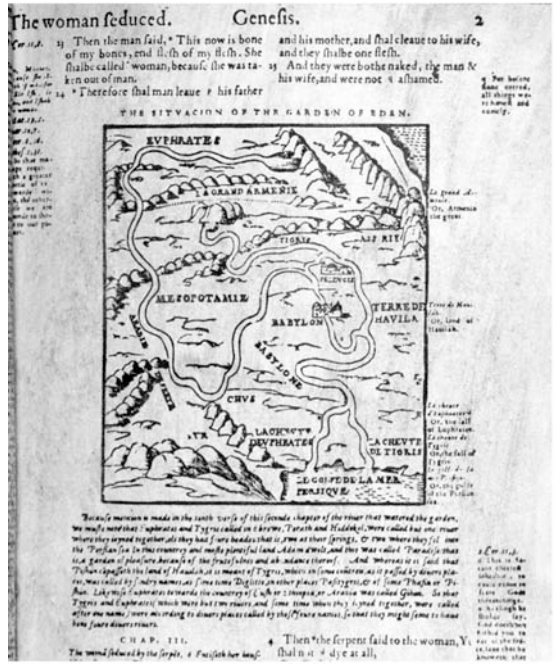


Fig. 7. Frontispiece (Burnet 1684).

(a)



(b)



(c)



Fig. 8. Hexameral idiom: mountains before Adam. (a) Geneva Bible (1560), Genesis 2. (b) Gerard Hoet (1728), Genesis 1. (c) Gerard Hoet (1728), Genesis 2.

associated with hexameral idiom. The global depictions of three writers (Erasmus Warren, Thomas Beverley and William Whiston) illustrate the significance of hexameral idiom in the Burnet controversy.

The Rector of Worlington, Erasmus Warren, rebutted Burnet in *Geologia*, the first of three critiques Warren published in as many years (Warren 1690). Yet *Geologia* was not an early work of geology, but a discourse rooted in the hexameral commentary tradition. Warren reprinted Burnet's section of the original Earth showing an oceanless globe containing a watery abyss closed to the sky (Fig. 9a). Opposing this diagram on the grounds of biblical interpretation, Warren argued that Adam could not have exercised the dominion over the fish and whales that Genesis attributed to him unless there had been open seas from the time of the creation. Warren explained that Burnet's theory 'presents us with a new notion of the Firmament, and makes it to be quite another thing, than what it has always been said to be' (Warren 1690, p. 226). Warren maintained a traditional interpretation that the firmament or expanse is the air in which the birds fly, and the waters above the firmament are the clouds. This interpretation reflected the views of Calvin and the Geneva Bible, for example, as well as that of Descartes some time after publication of the *Principia*.

In the controversy Burnet's images became a common currency for debate. Not only did Warren attack them as surrogates for Burnet's views, but they could also be appropriated in service of rival conceptions. Thomas Beverley showed how easily Burnet's global depictions could be transposed into hexameral idiom, ironically even by one of Burnet's defenders. By printing two global sections resembling Burnet's, Beverley aimed to offer an eirenic defence of Burnet in response to the abusive wit of John Keill. Yet for Beverley the top scene represented not the Flood, but the first day of creation when waters covered the Earth (Fig. 9c). Beverley omitted Noah's ark and the attending angels, as found in Burnet's deluge depiction (Fig. 9b; Beverley 1699). The biblical idiom carried by global depictions was as adaptable as the global depictions themselves.

Descartes and Burnet established a repertoire of diagrams and a variety of visual conventions for mapping transformations in the Earth over time. Once such conventions were established, similar images were used by various writers to support competing conceptions, as may be seen with the example of William Whiston (1667–1752; Whiston 1696). Whiston attacked Burnet on two fronts: his criticism of Burnet's Cartesian natural philosophy was based on Newtonian mathematical physics and he emphasized the creation at least as

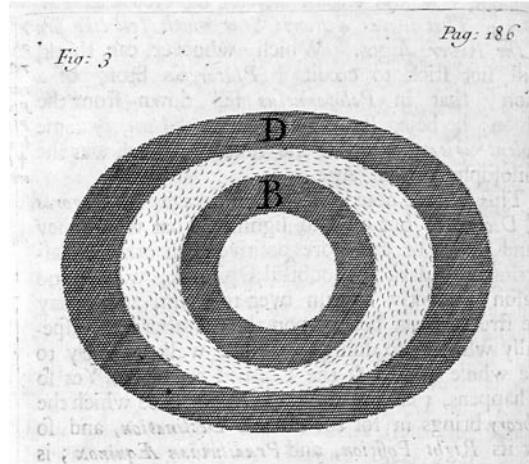
much as the Flood. Whiston's Newtonianism is well known and requires little comment other than to note its expression in his visual representations. Whiston's frontispiece and the seven figures prominently displayed at the front of his *New Theory of the Earth* all feature comets in an unmistakably Newtonian perspective. Newtonian comets were incompatible with Cartesian vortices for various reasons, including their periodic orbits, highly variable inclinations, retrograde orbital directions, and rarefied tails of great length. The reduction of cometary motions to the mathematical rule of an elliptical orbit symbolized the triumph of Newtonian mechanics over Cartesian cosmology. As if to emphasize this triumph, in Whiston's *New Theory of the Earth* the favoured Newtonian agent, a comet, arrived in time for almost every purpose under heaven: to provide the material of the chaos at creation, to give the Earth a shock at the fall, to supply the water of the Flood and to ignite the Earth at the final conflagration. And if all this were not enough, Whiston included a Latin dedication of his *New Theory* to Newton.

However, Whiston's presentation was adamantly hexameral as well as Newtonian. In opposition to Burnet, Whiston set out to find a concordism between the creation account and the stages of the formation of the present state of the Earth, beginning his *New Theory* with a 94 page 'Discourse on the Mosaick History of the Creation'. Whiston copied his global sections (Fig. 10, bottom row) almost directly from Burnet (Fig. 10, top row), but for Whiston it was imperative to specify how the geogonic sections, which had now taken on a life of their own, might be fitted into Moses' account of the creation week.

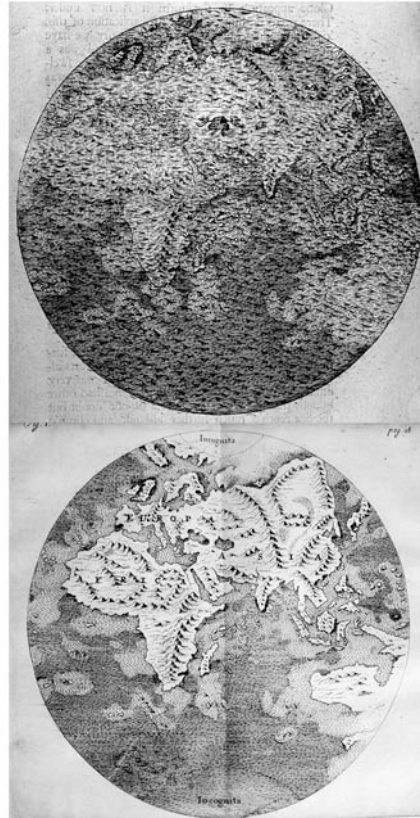
Burnet's first global section represented the chaos. Whiston's first global section was an almost identical redrawing of Burnet's, except for the solid hot core added in the centre region, which identifies the chaos as a cometary body (Fig. 10a). Whiston appropriated Burnet's first four figures in almost identical form to show a gradual division of layers, yet Whiston's global sections served a hexameral chronology.

For Whiston, the first two sections preceded the works of the six days, when darkness covered the face of the deep (the chaotic cometary atmosphere) and the Spirit hovered over the waters. In text accompanying the second section (Fig. 10b), Whiston described a division of the outer atmosphere according to specific gravity (as did Woodward 1695). This separation yielded a dense and heavy abyss that encompassed the central solid body, and an outer, more airy region composed of a mixture of particles. So far, except for the Newtonian comet, Whiston's account and diagram both resembled Burnet's.

(a)



(b)



(c)

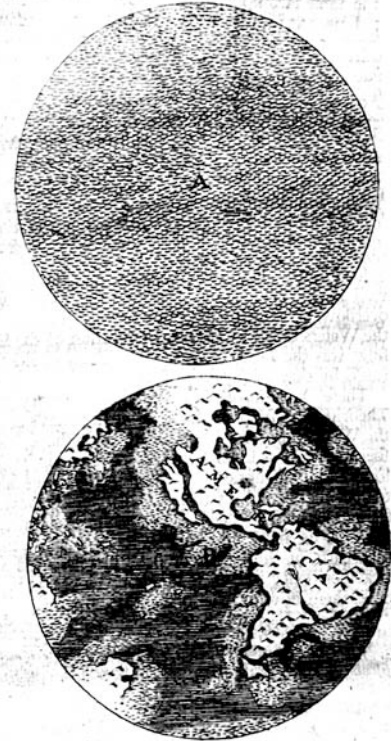


Fig. 9. (a) *Geologia* (Warren 1690, p. 186). Firmament (D) and watery abyss (between B and D). (b) *The Theory of the Earth* (Burnet 1684), Flood and present world. (c) Beverley (1699), creation and present world.

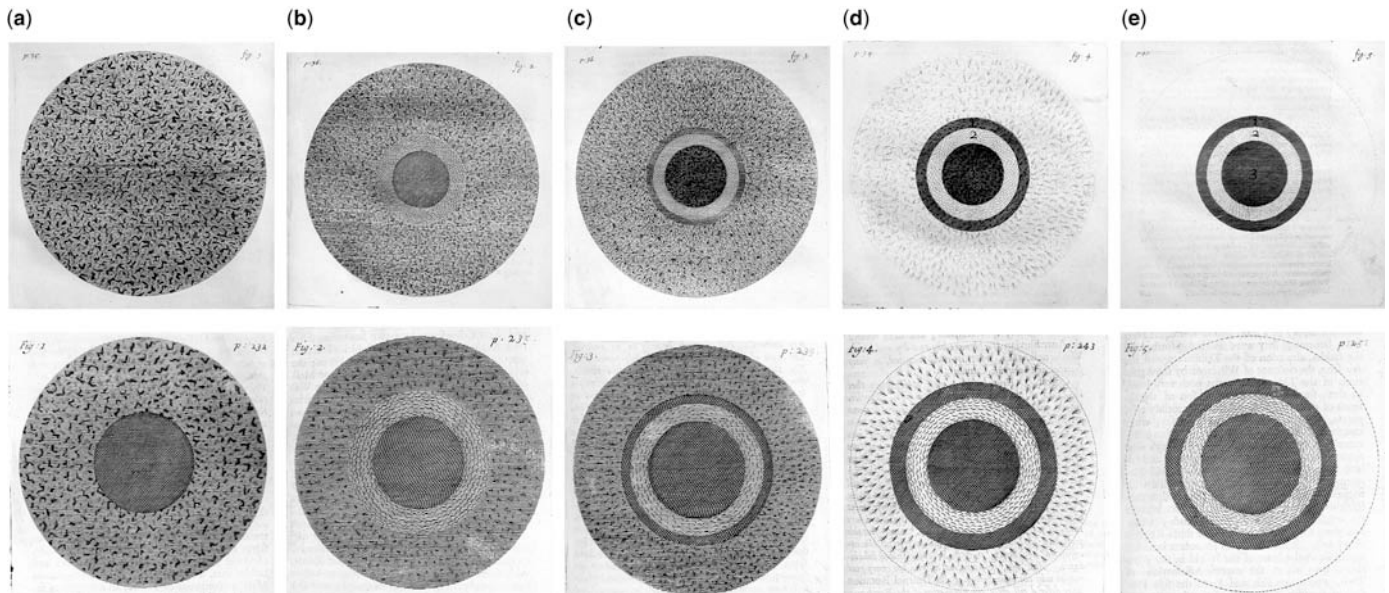


Fig. 10. Geogonic series of Burnet (top row) and Whiston (bottom row). **(a)** Section 1, original chaos. Top: Burnet (1681, p. 35). Bottom: Whiston (1696, p. 232); a comet. **(b)** Section 2, division of layers. Top: Burnet (1681, p. 36). Bottom: Whiston (1696, p. 235); before the first day. **(c)** Section 3, solid orb of the Earth. Top: Burnet (1681, p. 38). Bottom: Whiston (1696, p. 239); Day 1. **(d)** Section 4, air, earth, waters. Top: Burnet (1681, p. 39). Bottom: Whiston (1696, p. 243); Day 2 and Day 3. **(e)** Section 5, atmosphere clearing. Top: Burnet (1681, p. 41). Bottom: Whiston (1696, p. 251); Day 4.

With the third section Whiston described the formation upon the abyss of a 'Solid Orb of Earth', just as did Burnet (Fig. 10c). However, for Whiston this was the first day of creation, on which nonfossiliferous strata were laid down. The thickening outer layer hardened over the enclosed abyss. The outermost atmosphere began to clear, allowing light from the Sun to pass through, which successively illuminated the entire globe. Whiston interpreted 'Let there be light' and similar phrases with respect to what an observer of the visible world would perceive if watching from a standpoint on the surface of the Earth itself; such an approach had been practised by Augustine (e.g. Augustine 1982, Vol. 1, pp. 33, 69–71).

In Whiston's fourth section the outermost airy region surrounded the thick solid layer of the Earth, which in turn contained the subterranean waters, in correlation with Burnet's use of the same diagram (Fig. 10d). However, this durability of visual representation belies the very different contexts, in terms of both cosmology and interpretation, into which Whiston appropriated them. To Whiston, Newton rather than Descartes read the book of God's works correctly, and Moses rather than Peter wrote the relevant passages of God's word, for to Whiston this figure illustrated the work of the second day, the separation of waters above and below the firmament. Like so many others, Whiston identified the firmament as the air and the superior waters as the clouds. These vapours escaped being trapped in the subterranean watery abyss beneath the outer layer of crust.

Whiston used the same figure (Fig. 10d) for his account of the third day, irrevocably parting company with Burnet. For Whiston there must have been a separation of dry land and sea rather than a smooth and uniform paradisiacal globe. Consequently, Whiston argued that the settling of particles out of the chaos did not produce a uniform orb of the Earth, but that it consolidated unevenly and compacted irregularly, 'distinguish'd into Mountains, Plains and Valleys' (Whiston 1696, p. 245). For Whiston the original 'strata,' in contrast to those of Nicolaus Steno (1638–1686) in his *Prodromus* (Steno 1669), were not horizontal or concentric but irregular and inclined. In this conception Whiston followed the views expressed by Isaac Newton (1643–1727) in a 1681 letter to Burnet (Brewster 1855, Vol. 2, p. 450). Whiston justified using the fourth section to illustrate the third day by citing the insensible vertical thickness on such a small scale drawing. Needless to say, Burnet would have found the uneven paradisiacal surface postulated by Whiston as repugnant as Whiston's use of his beautifully smooth diagrams to illustrate it.

Whiston's fifth section again resembled Burnet's depiction of the clearing of the atmosphere, but

Whiston appropriated it into the context of the creation week to represent the work of the fourth day (Fig. 10e). As a consequence of accommodating the hexameral account to an earthbound perspective, the Sun and stars, although created before the creation week, were not described until the fourth day, when the atmosphere cleared enough to make them distinctly visible. Thus Whiston wholly transposed Burnet's geogonic series into a narrative organized by the hexameral framework.

Burnet and Whiston invoked biblical idiom in an explicitly theoretical role as part of a concordist rather than a merely compatibilist interpretation. To interpret the book of God's word and the book of God's works, particularly in areas where either one or both were obscure, one might employ biblical idiom to ensure their compatibility. However, if both books were deemed to be unambiguously clear, one might aim to go further and demonstrate specific areas of concordism. Both Burnet and Whiston rejected the compatibilist strategy with its Augustinian principle of allowing for multiple competing literal interpretations. They both emphasized instead the concordist ideal that the Bible cannot be interpreted rightly, or literally, without the aid of a good physical theory.

At some point either prior to or at the beginning of the first day, Whiston argued, the cometary chaos was given an annual motion in a circular orbit around the Sun, either by the direct finger of God or by some other peculiar providence. Thus throughout the creation week, according to Whiston, the Earth had an annual motion but no daily or diurnal motion. Consequently, each day was equivalent to a year; its 'evening and morning' were six months of darkness followed by six months of daylight. This 'literal interpretation' of the length of the days resolved a number of difficulties for Whiston, including the duration required for various natural processes once set in motion by the divine fiat (Whiston 1696, pp. 89ff.). Thus on the third day, during six months of darkness, vapours condensed and fell upon the Earth, filling its depressions to form the seas. During the subsequent six months of daylight, the newly watered and fertile land sprouted the terrestrial plants, as Genesis related. The year-long 'days' assisted Whiston in his explanation of the sixth day as well. The production of the terrestrial animals occurred during the first half of the sixth year. Created in the morning of the sixth day, that is, at the beginning of the second half of the sixth year, Adam enjoyed perhaps six months in Paradise before his fall, which Whiston situated at the beginning of the seventh day. Besides giving Adam time to name the animals before falling into the deep sleep during which Eve would be formed from his rib, a long day allowed for their mutual acquaintance and

joint appointment as stewards of the Earth (Whiston 1696, pp. 81–89, 257).

Whiston provided no diagram to illustrate the work of the fifth day (i.e. the production of aquatic and aerial life). We will not consider here additional parallels, such as Burnet's sixth figure that illustrated the ovoid structure of the antediluvian globe, which Whiston adopted as well (Magruder 2008).

The use of hexameral idiom was not exclusive; Whiston, for example, also employed the idiom of

the fall, Flood and apocalypse, as well as classical idiom, although hexameral idiom was most prominently embedded in his global depictions. However, on balance, the Burnet controversy saw a rejection of Burnet's Theory of the Earth in favour of traditional hexameral idiom, whether that idiom was couched in terms of Newtonian physics and astronomy by Whiston, or in terms of other technical traditions and natural philosophies by Warren and other critics.



Fig. 11. *Geestelyke Natuurkunde* (Scheuchzer 1728). (a–c) Global sections for Days 1 and 2. (d–f) Two global hemisections and two landscape depictions of the beginning and end of Day 3.

Conclusion: hexameral idiom and global depictions in a contested print tradition

Hexameral idiom embedded within global depictions in Theories of the Earth reinforced temporal conceptions of Earth history, and proved durable and versatile. First, hexameral idiom carried a temporal significance for Robert Fludd, Descartes, Warren, Whiston and many others. Concordist schemes were precarious, yet the directionalist tendency of the idiom persisted through various interpretations. A convenient endpoint for this survey is the *Kupfer-Bibel* of Johann Jakob Scheuchzer (1672–1733), published also in Latin and Dutch as *Physica Sacra* and *Geestelyke Natuurkunde*, which served as the starting point of Rudwick’s *Scenes from Deep Time* (Scheuchzer

1728; Rudwick 1992). Scheuchzer began this multi-volume folio collection of biblical illustrations with a series of global depictions representing the works of the first three days. On the first day, when darkness covered the face of the deep, God said ‘let there be light’ (Fig. 11a and b). On the second day the firmament divided the waters (Fig. 11c). On the third day, the waters below gathered together to form the sea, separate from dry land (Fig. 11d–f). The lower hemisphere of Figure 11e represents the Earth at the start of the third day; the top hemisphere depicts the Earth at the end of the third day. Scheuchzer accompanied this global section with landscape depictions, again corresponding to the beginning and end of the third day (Fig. 11d and f, respectively). The entire argument to this point about whole-Earth depictions of

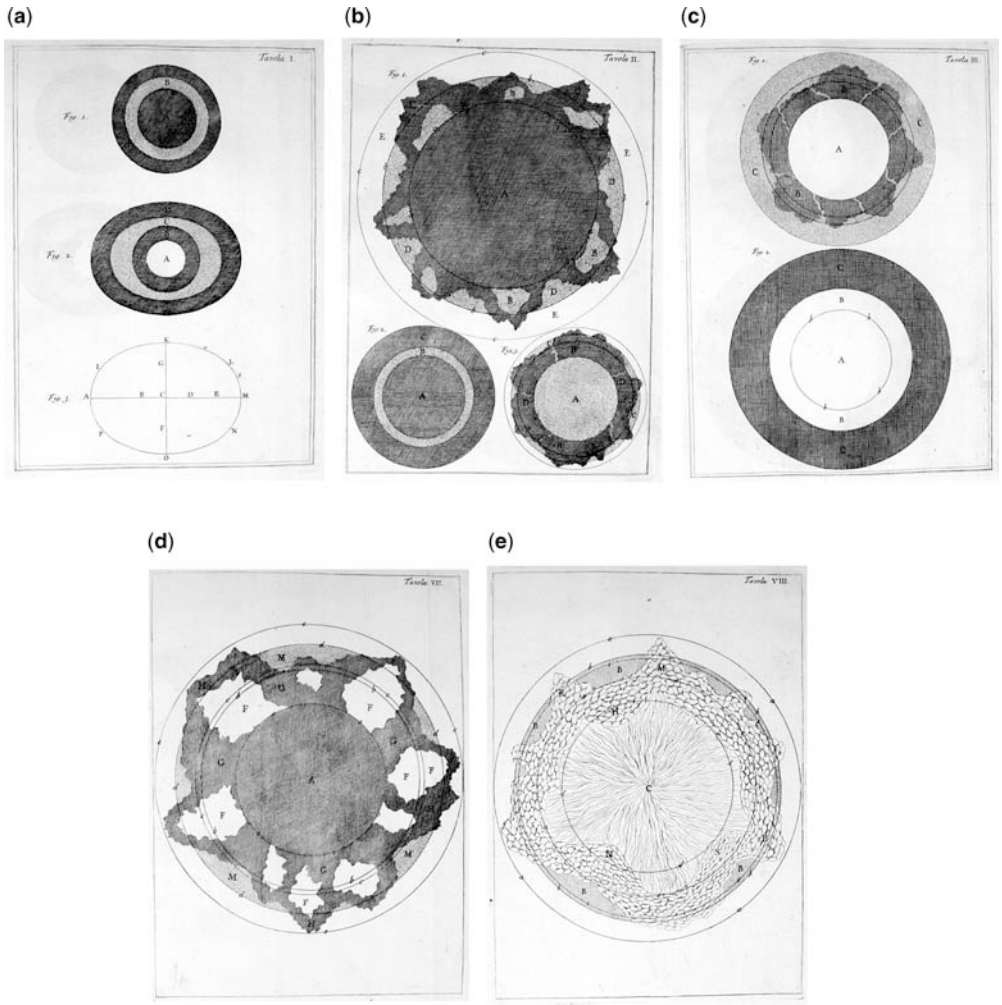


Fig. 12. Global sections Moro (1740). (a) Tavola I. (b) Tavola II. (c) Tavola III. (d) Tavola VII. (e) Tavola VIII.

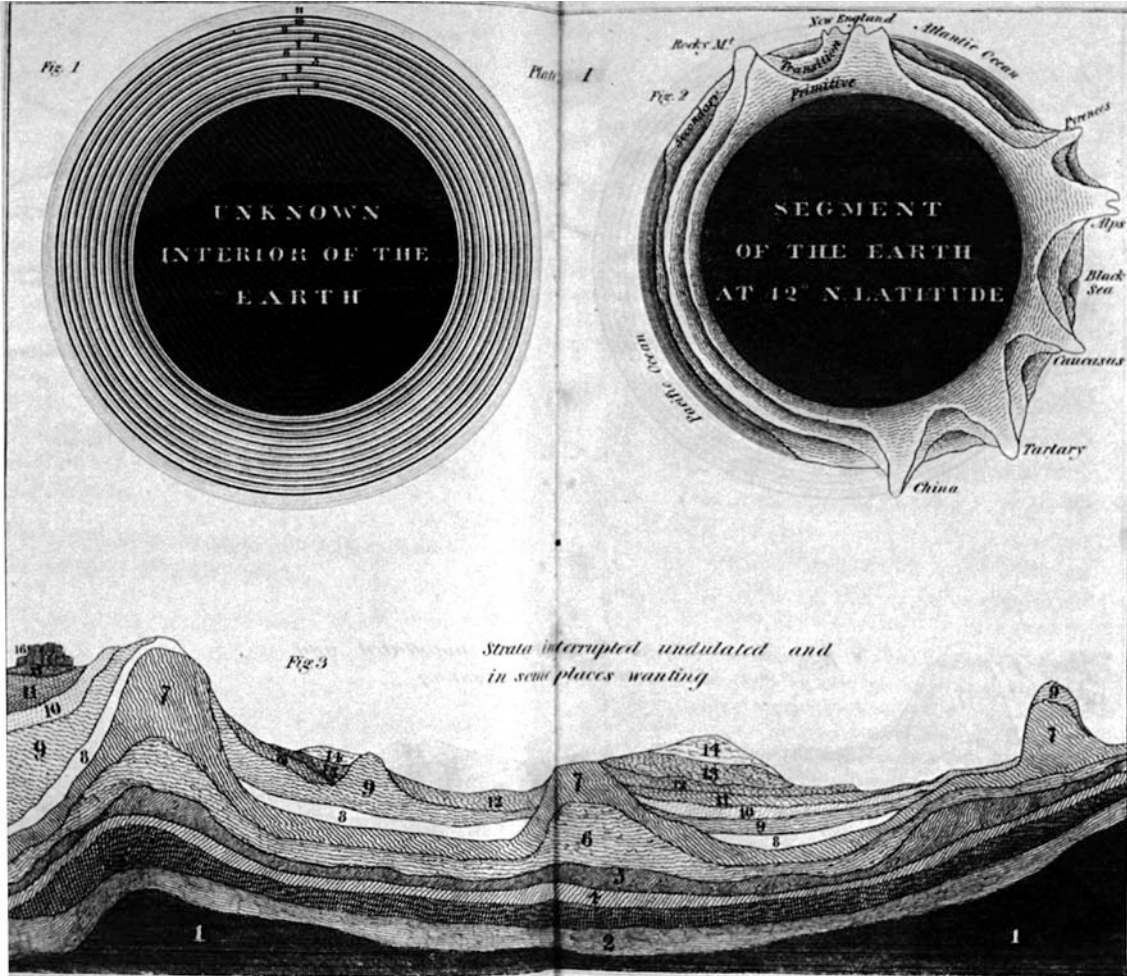


Fig. 13. Eaton (1820), plate 1: Fig. 1, Day 2; Fig. 2, Day 3; Fig. 3.

hexameral idiom in the century prior to Scheuchzer confirms Rudwick's assessment based on the landscape depictions: 'Perhaps the most significant feature of biblical illustrations such as Scheuchzer's was that they depicted a sequence of scenes in a temporal drama that had direction and meaning built into its structure' (Rudwick 1992, p. 26).

In 1740 Antonio Lazzaro Moro (1687–1764) published an account of the globe including a series of striking global sections that began with Burnet-style diagrams (Fig. 12; Moro 1740). Like Whiston, Moro explicitly assigned them to the third day rather than to the Flood. Also unlike Burnet, Moro proposed that dry land on the surface of the Earth was elevated by the action of subterranean fire. Oldroyd has argued that Moro's Theory of the Earth was historical in character: 'As early as 1740 there was in Moro's work something approaching an historical attitude towards a study of the Earth, despite the fact that it was linked with a particular theory, and also attempted a union with the traditional Judaeo-Christian history of Genesis' (Oldroyd 1979, pp. 196–197). Scheuchzer and Moro wrote squarely in the tradition of Theories of the Earth and reflected the temporal, directionalist sensibilities developed in association with hexameral idiom.

Second, hexameral idiom embedded within global depictions proved durable from the 17th century to the emergence of geology as an organized technical discipline. Many writers succumbed to the lure of concordism and produced successive, mutually contradictory schemes. Others, such as Nicolaus Steno, restricted themselves to compatibilist perspectives, employing hexameral idiom with full recognition of the complexity of the act of interpreting the book of God's word and the book of God's works. Although each concordist scheme was precarious at best, the underlying idiom proved resilient and endured. The idiom of Genesis 1 was not exclusive, but it was pervasive over the century from Fludd to Scheuchzer while a tacit consensus was being developed that the Earth possessed an interesting developmental history. Even later, when a geologist wished to persuade readers who might not share the tacit assumptions of directionalist development and an ancient age of the Earth, a continuing association of hexameral idiom with global sections might still facilitate the reception of emerging geological ideas, as in Amos Eaton's global sections representing the second and third days of the creation week (Fig. 13; Eaton 1820).

Finally, hexameral idiom proved versatile and accommodating. As a linguistic common ground, it facilitated critical interaction between a variety of technical and disciplinary contexts. Even when there was no common technical context,

disciplinary expertise or natural philosophy, hexameral idiom provided a common point of contact for structuring debate. The use of embedded hexameral idiom cut like a corridor across a variety of disparate technical and philosophical contexts (Table 1, rightmost column), and thus offered a public means of access to a forum that was contested across various disciplinary divides. Whenever a historical figure employed hexameral idiom, historians should ask how that idiom allowed the work to engage a broad readership representing multiple areas of expertise. When geology became sufficiently organized, practitioners no longer needed to use this idiom unless they wished to appeal to a broader audience that did not share their tacit assumptions. In this public and contested character of hexameral idiom lies the most important clue to the character of global depictions and of Theories of the Earth themselves. In my earlier paper (Magruder 2006), I argued that global depictions played a similar role of facilitating interaction across disciplinary divides. This versatility of both hexameral idiom and global depictions in bringing various technical traditions into a common critical debate explains why they were so frequently associated with each other in the emergence of the capacious and contested print tradition of Theories of the Earth.

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