Hist. Sci., xlv (2007)

YOUNG-EARTH CREATIONISTS IN EARLY NINETEENTH-CENTURY BRITAIN? TOWARDS A REASSESSMENT OF 'SCRIPTURAL GEOLOGY'

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In 1994, in these pages, Roger Cooter and Stephen Pumfrey made an eloquent case for the non-partisan study of science's interactions with popular culture. They called for historians of popular science to imitate "the historian of popular customs or the ethnographer of witchcraft" and "adopt a ring-fenced methodological neutrality towards their object of analysis".[1] Thirteen years on, their call appears to have been answered. Our understanding of many areas sidelined by old-style history of science has been greatly enriched. This is especially apparent in the historiography of 'science and religion', where the new drive for non-partisan analysis (advocated most notably by John Brooke and Geoffrey Cantor) has given rise to illuminating studies of transformations of natural knowledge by religious communities and denominations.[2] The truism that natural knowledge is 'contested terrain' is accompanied by a methodological rule of thumb: if an idea or practice was taken seriously by historical actors, it should be taken seriously by historians.

However, not all areas of the history of science have been dealt such even-handed treatment. Closer study of those which have fallen through this particular net confirms Cooter and Pumfrey's suggestion that practising genuinely value-neutral history of science is easier said than done, since it "proceed[s] against cultural values so deeply embedded as to render 'popular science' an oxymoron".[3] The interventions of biblical literalists in early nineteenth-century geology have been briefly highlighted by Brooke and Cantor as important symptoms of a cultural watershed in need of closer attention.[4] Yet the so-called 'scriptural geologists' continue to occupy an anomalous position in the historiography. Accounts of the development of geology routinely make reference to these figures — Granville Penn and Andrew Ure are relatively familiar names — yet they have rarely been the primary subjects of historical research.[5] Such a situation lends itself to the propagation of half-truths, especially as the investigation of these figures involves methodological challenges relating to our inherited terminology, the history of discipline-formation, concepts of 'general' or 'public' opinion, and the vigour of present-day debates paralleling those in the early nineteenth century. These challenges have only rarely been acknowledged, still less met, by scholars commenting on the subject. In this article I aim to set out some of these challenges, to clear the ground for future research by removing some common misconceptions, and to demonstrate that literalist writing on earth history deserves serious historical attention.

0073-2753/07/4504-0357/$10.00

1. THE CHALLENGE OF IMPARTIAL HISTORY

The commonest role which the so-called 'scriptural geologists' have been called on to play in the received history of modern science is that of pantomime villains, baleful but ineffectual opponents of intellectual emancipation. Clutching their Bibles, they lurk behind the scenes, their faces contorted with anger as the chosen hero (be it William Smith, James Hutton, or Charles Lyell) strides centre stage to transform Western thought for ever. Someone in the audience shouts, "Look behind you!" — the dagger is poised to strike — but just in time our hero wheels around. A single blow of his geological hammer sends the bigots back to church where, with a sinister rustling of pamphlets, they huddle together and prepare to fight Huxley in the next act.

This is the picture that emerges from older works on the history of science by pioneering scholars such as Charles Gillispie and Milton Millhauser.[6] The work of these scholars has in many respects been superseded, not least by recent scholarship on evangelical science.[7] The so-called conflict thesis — the idea that 'science' and 'religion' represent historically discrete categories locked in mutual combat — has yielded to a more nuanced understanding of the contexts within which ideas about God and nature have emerged, and celebratory or denunciatory "master narratives" about science–religion interaction have fallen by the scholarly wayside.[8]

Yet in discussions of literalist geology the old conflict-narrative retains its power at both popular and scholarly levels. Heroic narratives about scientific discoverers are back in fashion at the popular level: conservative clergymen provide gratifyingly reactionary symbols of the difficulties the hero must overcome in his or her quest for the truth.[9] The biographer's tendency to identify with his subject affects scholarly historians as well as journalists. Gideon Mantell's most recent biographer, for instance, introduces a discussion of biblical literalism as follows:

> By now, of course, Gideon Mantell had become thoroughly appalled at the public's ignorance of natural history and how shamelessly that ignorance was being exploited by the clergy and other self-serving groups. In the fall of 1835, therefore, he resolved to educate the masses....[10]

This heroic introduction typecasts literalism in advance in the role of 'opposition to real science'; the playing field is tilted by representing the clergy as "self-serving" (as opposed to the disinterested and non-clerical man of science) and of Mantell's audience as empty vessels in need of intellectual leadership. The "self-serving" dimension of Mantell's own activities is naturally not mentioned. Such polarization is compounded by the fact that books like Gillispie's *Genesis and geology* are still treated as unquestioned authorities by some specialists in other fields who touch on this area — a problem compounded by the current blurring of boundaries between academic and popular publications.[11] For many readers, early nineteenth-century biblical-literalist writers on earth history are still confined to Gillispie's "lunatic fringe", their writings "too absurd to disinter".[12]

Misrepresentation can arise not only from getting the facts wrong, but also from a cumulative tendency to focus only on one side of the debate. Among historians of

science, interest in the makers of 'modern geology' rather than its discredited competitor has brought about a situation in which the only literalists one hears about are those whose voices were most strident against the new science. The relative lack of interest in the literalists themselves means that they tend — quite understandably — to become flattened out as a *purely* oppositional phenomenon, a backdrop of reaction against which the work of 'real' geologists stands out more clearly. This is the viewpoint from which most of the best scholarship on literalist earth-history ends up treating these figures.[13] A similar tendency sometimes mars revisionist studies of evangelicalism: if one wishes to recover and celebrate scientifically progressive elements in a movement popularly perceived as reactionary, it becomes tempting to identify reactionary strands within that movement as marginal phenomena and dismiss them without proper analysis.[14]

Provincial investigators and marginalized practices do now attract considerable scholarly attention, so some nineteenth-century literalists occasionally find themselves brought blinking into the limelight in roles other than that of anti-geologist (albeit rarely for more than a few pages at a time).[15] One promising sign is that the convenient (if phenomenally expensive) Thoemmes Press reprints of popular science-writing include a seven-volume set on *Creationism and scriptural geology, 1817–1857*.[16] However, the only book-length treatment so far is Terry Mortenson's revisionist study *The great turning point*, which questions the old assumption that early nineteenth-century literalist writers on earth history were a homogeneous group of scientifically illiterate anti-geologists, and analyses their marginalization as a consequence of broader social and intellectual shifts.[17] *The great turning point* is a mine of information on seven key literalists and the debates in which they engaged. It is, however, unlikely to receive much positive attention among the community of academic historians of science, because it is intended to serve the purposes of a very different community, the young-earth creationist movement.[18] According to the back cover, Mortenson's aim has been to "open eyes and hearts to the veracity of God's Word". He presents the widespread acceptance of old-earth geology by the Victorian church as a "Catastrophic Mistake"[19] while displaying literalists as spokesmen for the mainstream view and a shining example to young-earth creationists today. This purpose is as Whiggish as the secular triumphalism of much recent popular-science writing, marring an otherwise thoughtful survey by causing Mortenson to overestimate the geological knowledge of several literalists and to underestimate the exegetical skills and religious commitments of some old-earth geologists.

On the other hand, some of the counter-claims made by some of Mortenson's opponents are even more overstated, particularly the claim that most people around 1800 already assumed that the earth was created over vast ages rather than in six literal days — a claim designed to push literalism back to the historical fringes as an aberration from religious "orthodoxy".[20] John Lynch, for example, cites the popularity of the "Chaos-Restitution model" among "theologically orthodox" seventeenth- and eighteenth-century scholars to argue that the literal six-day Creation *ex nihilo* had receded from mainstream Christian belief long before 1800. Unfortunately, Lynch's

list of "theologically orthodox individuals" holding non-literalist views includes William Whiston and John Milton, both of whom were technically heretics because they did not believe in the Trinity; his list also includes Thomas Burnet, whose theory of the earth sparked off a controversy lasting several decades.[21]

Biblical exegesis has always been a thoroughly contested practice, and by the late eighteenth century literal and non-literal interpretations of Genesis 1 were both current. Both had their roots in the branching theological debates of the third, fourth, and fifth centuries A.D. The allegorical approaches taken by some Church Fathers had opened a door for old-earth cosmologies (though not to Aristotelian 'eternalism'), but interpretations grounded in a literal reading went back to Eusebius and Jerome, the founders of sacred chronology. This discipline grounded provided a firm basis for subsequent Christian thinking about earth history, especially after the Protestant Reformation:[22] its practitioners used new humanist methods to compare biblical texts with those of other historical traditions in order to pronounce on the shape and meaning of human history. These works provided an authoritative scholarly foundation for the Bible's pre-eminence in structuring world history.[23]

These foundations began to be eroded in the eighteenth century by new critical approaches to biblical texts emanating from the German universities,[24] some of which viewed the Creation-account as a mythical narrative with spiritual rather than historical or philosophical authority — a move mirrored by the rising authority of philosophers and naturalists in the sphere of antediluvian *history*. This 'higher criticism' was digested by many scholars and philosophers in late eighteenth-century Britain, but assent was far from unanimous. The doctrine of the Bible's inerrancy — not new in itself — had been framed in a newly clear-cut and conservative sense around 1800, partly fuelled by counter-revolutionary anxiety: many people blamed atheistic intellectuals for fomenting the French Revolution, and saw Holy Writ as the chief bulwark against similar movements in Protestant Britain.[25]

Clear definition is therefore essential when one is advancing claims about what 'most people' believed. If we are talking about most naturalists engaged in geological fieldwork, then the claim that an old-earth cosmology was widely credited in 1800 stands firm and needs emphasizing. If, however, we are talking more generally about "the majority of educated Christians" or "educated individuals"[26] — let alone the uneducated — then this claim begins to look shaky. In the 1790s John Hunter was warned by a Royal Society colleague against popularizing an old-earth cosmology for fear of offending the "pardonable superstitions" of the literate public; Bibles since 1701 had printed the date "4004 B.C." in the margin alongside the earth's creation in Genesis 1; and schoolteachers often reinforced this view.[27] The rush of furious pamphlets which greeted the publication of Byron's fossil-rich verse-drama *Cain* in 1821, excoriating the poet's use of Cuvier's unbiblical theories, confirms that the radical and Francophile associations of old-earth cosmology remained strong in the minds of many political conservatives.[28]

Of course, scattered evidence of this kind has serious limitations: the fact that the date 4004 B.C. was taught in schools and Bibles does not necessarily mean that

everyone took it equally seriously. Many popular writers on the history of geology assume that around 1800 virtually everyone believed in a 'young earth', completely ignoring the variety and sophistication of early modern cosmologies;[29] it is this popular distortion, as much as Mortenson's own claims, which seems to have sparked off such strong counter-generalizations by his opponents. Norms of belief can be established only on the basis of a socially comprehensive and theologically nuanced survey of a broad range of literature, from sermons and Bible commentaries to newspapers and diaries, and no such survey has yet been undertaken.[30] Yet the evidence mentioned does point to the currency of young-earth views over a significant cross-section of Georgian society, not just a handful of reactionaries on the fringes. After all, if "the majority of educated Christians" already believed in an immeasurably ancient earth, it would hardly have been necessary for popularizers of the new geology in the early Victorian period to expend so much energy in hammering this view home among the middle and upper classes.

Lying unquestioned at the heart of the debate between Mortenson and his critics lies the assumption that, given enough historical research, it is possible to label one particular cosmology in this period as orthodox and the other (by definition) as marginal. This assumption flies in the face of recent scholarship on Victorian concepts of expertise and cultural authority. As Alison Winter puts it, "sciences we now retrospectively regard as heterodox or marginal cannot be considered unambiguously to have held that status at a time when no clear orthodoxy existed that could confer that status upon them".[31] For a country as politically volatile, regionally diverse, and intellectually heterogeneous as early nineteenth-century Britain, confident claims about "the mind of early Victorian orthodoxy"[32] are out of place. Among educated citizens in this period, the "orthodoxy" of an old-earth cosmology was not there for the taking; it had to be painstakingly constructed, using various performance strategies designed to persuade the literate classes that the new school of geology trumped biblical exegesis in questions about earth history. Since the authority of the new geology was under construction, the recent claim that "All geological work that was taken seriously by experts took for granted the reality of deep time"[33] is not only an overstatement but a tautology, translating as "All geological work that was taken seriously by people favouring an old-earth geology favoured an old-earth geology". In its broadest outlines, the early history of British geology is the story of how a new intellectual community (represented by, among others, the core of the Geological Society of London) laid exclusive claim to the telling of pre-human earth history, and to the term 'geology', against the counter-claims of other communities promoting young-earth cosmologies.[34]

For large sectors of the reading public, the new science would ultimately win. By the 1880s, for these people, the word 'geology' would be synonymous with an earth history in which humans were a relatively recent arrival — echoing the way in which the word 'science' had apparently become synonymous with 'natural science' by mid-century, shutting out theology, once queen of the sciences. For much of the nineteenth century, however, and especially in its first half, 'geology' was still a contested term.

Terminology here proves a stumbling-block for the historian, because in speaking of science we have inherited the language of Lyell and Darwin rather than that of Penn and Fairholme. In the discourse of academic history of science, the word 'geologist' (in a nineteenth-century context) generally implies an old-earth cosmology, as well as considerable experience with fieldwork. Geology is treated as a 'scientific' activity, that is, as separate from textual disciplines such as exegesis, although its practitioners might be interested in biblical interpretation on the side.

This semantic field replicates the view promulgated by spokesmen for the new science — men such as Hugh Miller, whose blanket label for their opponents, "anti-geologists", programmatically equated 'geology' with 'old-earth geology'.[35] But several literalist writers saw themselves as 'geologists' too, and, while they often valued fieldwork, saw biblical exegesis and the critical interpretation of other texts as no less central to science in general, and to the reconstruction of earth history in particular. It is easy for present-day commentators to see the literalism debate in terms of evidence versus faith: Lynch, for example, draws a contrast between the élite geologists, for whom "evidence took precedence over biblical exegesis", and the "scriptural geologists", who "felt that no particular expertise was required when examining scientific matters".[36] For the literalists, however, the letter of Scripture was itself evidence of no mean order, calling for the exercise of a different kind of expertise.[37] In any case, evidence does not speak for itself, but requires interpretation. A heap of strata, or a line of Hebrew poetry, could be interpreted in various ways.

To use the words 'geology' or 'science' in senses which automatically exclude literalist perspectives on this debate, then, is to skew the discussion from the start and become complicit in a partisan view which — however justifiable from the standpoint of present-day opponents of young-earth creationism — is inappropriate for the historian. Literalist writers on earth history saw themselves as contributors to science, but the only ones included in the otherwise comprehensive *Dictionary of nineteenth-century British scientists* are those who also contributed to some other scientific field.[38] Andrew Ure is included for his work on chemistry and political economy, but Granville Penn — perhaps the most important and influential of the early literalists — is left out because his writings on earth history do not count as 'science'. Of course, if such a dictionary were to include Penn, it should perhaps also include theologians and educationalists like John Henry Newman, or anyone who expressed scholarly opinions on natural science; but this pragmatic difficulty only points up all the more strikingly the problems involved with our retrospective demarcation of 'science' for an age when that concept was being fiercely fought over in the public realm.[39]

These difficulties are compounded by the visceral distaste that literalism excites among many academic historians. Rehabilitating the historical significance of marginalized practices calls for some degree of historical empathy. Practices such as phrenology, spiritualism, and mesmerism have proved ideal for this treatment.[40] Besides their historical importance, they have the added appeal of no longer appearing to pose a threat to 'our' beliefs: they are perceived as buried in the past, or at

least safely marginal to present-day public culture. Their validity for contemporary practitioners may be upheld, even celebrated, without appearing to give ground to present-day representatives. Early nineteenth-century literalist geology, however, bears all-too-obvious similarities to the alarmingly widespread views of some present-day fundamentalist groups who are often perceived — and, in several cases, claim — to be utterly opposed to both the secular spirit of modern science and the relativist spirit of modern humanities research.[41]

For this reason, Brooke's and Cantor's recommendation for a "non-judgemental attitude" towards phenomena such as nineteenth-century literalist earth-history has proved difficult to put into practice. Lynch's most recent essay on this phenomenon, for instance, appears in a volume on the history of marginalized sciences whose overall aim is specifically to *oppose* the Whiggish view of such practices as being "at best diversions or dead ends, or at worst parallel currents of lunacy".[42] All but one of the contributors sustain this perspective. The exception is Lynch, whose lively four-page account of the "scriptural geologists" seems more concerned to reinforce than to explain their marginalization. Commenting on their exegetical practices, Lynch states that they were "swimming against the stream" of theology as well as geology:[43]

> This raises an interesting point. Even in their theology — what should surely have been their strongpoint — the scriptural geologists were suspect. If anything, they were fighting a rearguard action against those mainstream theologians who sought, in the mind of the scriptural geologists at least, to compromise the divine word.[44]

Notwithstanding the problematic concept of a theological "mainstream" in the embattled early-Victorian church, the choice of words like "suspect" (suspect to whom?) and "rearguard action" (from whose perspective?) suggest that the author has identified too closely with literalism's nineteenth-century opponents, whose deprecating remarks represent the bulk of his primary-source quotations.[45]

Caustic comments by participants on one side of the controversy such as Miller, Lyell, and Sedgwick hardly count as neutral sources, but Lynch is not alone in uncritically reproducing their perspective. Some of the finest living scholars on science and religion, including those known for their vigorous opposition to Whig history in other contexts, occasionally slip up when it comes to the literalists. James Moore's penetrating study of nineteenth-century "geologists and interpreters of Genesis" momentarily loses its poise with the remark that after 1860 "the fatuity and irrelevance of the scriptural geologists was plain for all to see";[46] his phrasing implies that the remaining "scriptural geologists" and their followers had only to open their eyes to "see" their own folly. This dualism has affected even Cantor himself, whose detailed study of Quakers and Jews in science examines how the cultural resources of Quakerism and Anglo-Jewry were variously deployed by different individuals and communities. When Cantor deals with the literalist writers and educationalists in both communities, this constructivist model is put to one side in favour of a monolithic conception of scientific progress and its recalcitrant opponents. Rather than moulding an alternative

natural knowledge of their own, the literalists are described as having "closed their minds", using "questionable" exegetical manoeuvres and a "farrago" of rabbinical references to disguise their own "limited ... knowledge of science".[47] Exegesis, in both Jewish and Christian traditions, is questionable by definition: it represents an ongoing critical conversation between alternative viewpoints, and its stakes are often high. More seriously, Cantor's portrayal implies that if only the literalists had not been so "poorly informed about recent scientific developments"[48] they would have seen the error of their ways. This is open to question, especially considering the subsequent resilience of young-earth creationism in the face of widespread popularization of old-earth geology and evolutionary theory.[49]

If we are to grope towards a more accurate assessment of early nineteenth-century literalists, we need to set aside such monolithic concepts as a generalized 'orthodoxy' or the 'cutting edge of science', disengage our scholarly activity from the politicized controversy surrounding present-day young-earth creationism, and approach literalist earth-science just as we would approach any other 'ethno-science'. This would mean asking the same kinds of questions about its producers that historians have been asking about artisan naturalists, mesmerists, or Quakers and Jews.[50] How and why did they participate in natural science? What were their attitudes to the range of practices current in their day? What techniques did they use in the production of natural knowledge, and what cultural resources did they bring to these activities? How were their productions received and reflected in public culture? Did their practices vary significantly in different countries or regions, among different denominations, or among different social groups?

There is no space here to give these questions the sustained attention they deserve, but in the rest of this article — focusing on Britain, chiefly in the 1820s and 1830s — I shall offer some preliminary reflections and clear some of the ground necessary for a fuller study to be carried out. I shall first outline some fundamental problems associated with the terminology habitually used by historians. In Sections 3 and 4 I shall make a case for considering these figures as more than just a protest movement, presenting some of my own research on their writings (many of which have never been studied before) in order to indicate something of the rich variety that characterized their purposes and literary strategies. In conclusion I shall set their work in the wider context of cosmologies available to the reading public.

2. TERMINOLOGY

Some awareness of the pitfalls inherent in our received historical categories is necessary before we tread the terminological tightrope between anachronism and incomprehensibility. Nineteenth-century literalist earth-history is usually referred to as "scriptural geology" or "Mosaic geology".[51] These labels were current in the 1820s: the former comes from George Bugg's *Scriptural geology* (1826–27), the latter from Granville Penn's *Comparative estimate of the mineral and Mosaical geologies* (1822), and both labels were applied to literalist writers by their opponents.[52] If used without qualification, however, they open up a number of potential misconceptions.

First, they tend to imply that Bugg or Penn can be seen as typical representatives of a homogeneous group. They can also be taken to imply that close attention to the text of Genesis was restricted to this group, obscuring the fact that most old-earth geologists before 1850 also believed in the inspiration and authority of Scripture. Lyell may have sought to seal the science off from scriptural considerations in his *Principles of geology* (1830–33), but many proponents of old-earth geology continued to take a lively interest in interpreting Genesis. Some of them even sought to reclaim the phrases "scriptural geology" or "Mosaic geology" by applying these labels to themselves, as in William Higgins's *Mosaical and mineral geologies* (1832); as a result, some historians have assumed that such writers must have been literalists.[53]

However, rather than taking the six days of Creation to be the first six literal days of earth history, these interpreters found other means of reading indefinite time into the biblical text. Two interpretations became especially popular. One was to read an unmentioned 'gap' of untold aeons somewhere in or before the first three verses of Genesis 1. Normally this 'gap' was positioned between verses 1 and 2, shoehorning the primordial eras of earth history into the phrase תהו ובהו (*tōhu vabōhu*, 'formlessness and emptiness') by which Genesis 1.2 characterizes the ancient earth.[54] The other interpretation used other biblical citations to interpret the Hebrew word יום (*yōm*) as 'age' rather than 'day', producing a prolonged creative 'week'. Some writers went to considerable exegetical lengths to defend such interpretations.[55] Using labels like "scriptural geology" and "Mosaic geology" today, then, risks clouding the issues at stake, especially when some scholars use these labels to denote literalists while others use them to denote old-earth geologists who favoured one or another of the exegetical accommodations just mentioned.[56] The issue was not "Shall we use Scripture?" but rather "How shall we interpret this particular textual crux?"

'Young-earth creationist' seems on the face of it to be an appropriate label for figures whose beliefs about the age of the earth so closely mirror those held by the present-day movement of that name. But although these similarities are instructive, the label bears too specific an identification with today's movement to be viable. Using the same label for both would also paper over some fundamental divergences of approach, as well as implying a direct historical link between the two movements.[57] The same problems attend the modern usage of 'creationist' to refer to people like Buckland who believed that species had been created separately but held to an old-earth cosmology.[58] While such a move is logically appealing, the word 'creationist' today is unfortunately too much bound up with the young-earth variety in the public eye to do more than add further confusion. Present-day creationists are pitted against a well-defined scientific orthodoxy espousing evolutionary theory, but for the old-earth élite in the Geological Society of London in the 1830s evolutionary theory was as irritating and unphilosophical as was literalist earth-history. Calling men like Buckland and Miller "creationists"[59] thus not only unwittingly reduces the scope and tenor of their work, but facilitates the popular myth that they were somehow struggling against an intellectual tide. It is also worth remembering that the term 'evangelical', whether today or in the nineteenth century, has not necessarily entailed

a literal interpretation of Genesis 1, or indeed a rejection of evolutionary theories: as a number of recent studies have shown, evangelicals have long been ranged on both sides of these debates.[60]

In distinguishing between rival cosmologies, some historians have turned to the more promising distinction between "geologists and interpreters of Genesis". According to Moore's influential model, the period 1830–60 witnessed a clash between the "scriptural geologists (exegetes)" who "believe Genesis interprets Nature" and the "harmonizers (older professional geologists)" who "believe Nature interprets [the natural history portions of] Genesis".[61] Useful as this model is, it is important to realize its limitations. It has no place for all those exegetes who, despite not being "professional" geologists in any sense of the word, accommodated Genesis 1 to an old-earth cosmology (usually along the lines indicated above).[62] It also excludes those literalist commentators who took little interest in exegesis.[63] More importantly, narrating the history of the earth before man demanded more than a simple decision about which of Francis Bacon's 'two books', the Bible or Nature, should be given interpretative priority. Such a transparent hierarchy was rare: most writers on this subject read both 'books' in the light of each other, rather than simply twisting one to suit the other.[64] Both 'books' were obscure enough and laconic enough to suggest many possible interpretations (and to require some narrative creativity). But because of the high stakes involved, many writers avoided dwelling on such interpretative ambiguities and instead pressed their own interpretation as strongly as possible. It was perhaps for this reason that the concept of a clear hierarchy of interpretative priority maintained its undeserved high profile: accusations that an opponent was distorting one body of evidence to fit another became such a routine feature of scientific debate that few thought to question the underlying assumptions.

The word 'literalism' raises further difficulties, which are not alleviated by its widespread confusion with the doctrines of biblical authority, divine inspiration, infallibility, and inerrancy.[65] Strictly, the phrase 'biblical literalism' ought to refer to an approach to Scripture which sees a text's meaning as residing primarily in its literal sense rather than in allegorical or metaphorical meanings. Such an approach need not involve any claims about the text's truth-content: deciding that Genesis 1 should be read literally does not necessarily entail accepting that it constitutes accurate information about the natural world. The latter view would require a combination of literalism (in the strict sense just defined) with the separate doctrine of biblical inerrancy. Many radical critiques of Genesis 1 as an outmoded creation-myth were therefore no less literalistic than conservative defences of the same text as a reliable history, but they differed sharply on the question of truth-content. Nevertheless, the phrase 'biblical literalism' is almost universally used by modern historians, sociologists, and literary critics to imply a corresponding belief in the Bible's inerrancy.[66] I propose to follow this general, if imprecise, usage, but it is important to bear in mind the distinctions it effaces.

A further problem relates to the plurality of literal readings of a given text (let alone translations), especially one as laconic as Genesis 1. To what, for instance, does the

phrase "In the beginning" really refer? The beginning of all time, the beginning of earth history, or the beginning of human history? All three could claim to be 'plain' or 'literal' readings. Determining the correct reading introduces considerations external to the passage concerned, such as other parts of Scripture or physical evidence. *A priori*, then, there is room for considerable variety among literalist cosmologies. As we shall see, history confirms this. It was not even obvious to everyone in the early nineteenth century that a literal reading of Genesis 1 necessitated a young-earth cosmology: in the 1830s Buckland himself presented the idea that "the world had existed for millions of years antecedent to the Hebrew account of the creation" as being entirely compatible with "the most literal translations of the Mosaic legends".[67] Finally, it is worth remembering that different levels of literalism could be applied by the same person to different parts of the Bible:[68] belief in the plagues of Egypt or the Virgin Birth as real historical events did not necessarily entail credence in a literal six-day Creation. Few literalists were so extreme as to deny the presence of figurative language anywhere in the Bible, especially in its poetical books (I have not yet come across any commentator who thought that the mountains referred to in Psalm 114 literally "skipped like rams"); but the question of whether or not a narrative text like Genesis 1 contained figurative language was not so easy to answer.

What brings together the writers we are examining, then, was their particular *application* of literalism with respect to Genesis 1, combining various literal readings of the text itself with a cosmology (explicitly grounded in that text) placing the earth's creation approximately four millennia before Christ, and conceiving of this process as lasting for six solar days. My use of the word 'literalist' should therefore be understood in this qualified sense.

3. A PROTEST MOVEMENT?

The nineteenth-century literalists are routinely characterized as a protest movement, a "wave of criticism" "united in a chorus of disapproval" against the new geology.[69] This characterization both derives from and contributes to their placing on the margins of the history of nineteenth-century science, in which they perform a single narrative function of futile opposition. Such treatment obscures the variety of locations, affiliations, and purposes claimed by members of this disparate group.[70]

First of all, the opposition itself cannot be considered as a static phenomenon: it developed as the century progressed, and not all literalists engaged in it. A good example of a fiercely oppositional literalist from the 1820s is George Bugg: his anonymous two-volume treatise *Scriptural geology* harked back to the counter-revolutionary paranoia of the 1790s and 1810s, when geology had been tarred with the brush of deistic materialism. Bugg deplored most aspects of "modern *Geology*" (or simply "*Geology*", typically printed with table-thumping italics). His first volume concludes that "modern *Geology* cannot possibly exist consistently with a fair and literal construction of the *Word of God*", and that it contradicts both sound science and "the plainest dictates of common sense".[71] The second volume concludes:

> Whether, however, *Geologists* have any deep-laid or concealed design against Revelation, or not, the mischievous tendency of this modern Theory is too evident to pass unnoticed.... I ardently hope, however, that we shall ... value more our Bible and its plain and obvious instruction; ... and "*meddle not with them that are given to change*."[72]

Bugg represents "*Geologists*" almost as a secret society dedicated to the overthrow of the established order, rather like those whom Edmund Burke had claimed were responsible for the French Revolution. Suspicious and shrill, *Scriptural geology* serves as a colourful emblem of the phenomenon to which it lent its title;[73] but it is not typical of 1820s literalist writings about the earth, even of those writings which shared Bugg's suspicions. During the 1820s, an unambiguously oppositional stance towards the new geology was confined to a few literalists only, some (but not all) concerned to oppose specific writings such as Buckland's *Reliquiae Diluvianae* (1823) and Cuvier's *Theory of the earth* (translated 1813).[74]

This changed in the 1830s, when old-earth geology began to be promoted with new confidence as a full-scale alternative Creation-narrative.[75] Many literalists felt that the implied denial of the Bible's scientific authority was unacceptably élitist, preventing the common reader from accessing natural knowledge through Scripture.[76] James Mellor Brown, for example, lamented in 1838 that "The Bible after this must cease to be, what it has ever been considered to be, the poor man's book".[77] A coterie of gentlemen was setting itself up as the only group qualified to interpret the "strange" and "repulsive language" in which they claimed the book of nature was written,[78] just as proponents of Continental 'higher criticism' seemed to be claiming that a deep knowledge of Hebrew, Greek, Syriac, and Ethiopic was necessary to understand the Bible itself. Specialist jargon was being wielded to conceal truths that the English of King James had once made clear to all. Such protests recall those made by Robert Boyle and his colleagues against the élitist jargon of scholasticism: many nineteenth-century literalist writers on geology likewise saw themselves as upholding Baconian values against pseudo-philosophical obscurantism.

From the 1830s, the new geology represented a public challenge to literalism, in sites such as the British Association for the Advancement of Science and in publications aimed at a wider reading public. Many literalists now energetically opposed the broad-church secularism of this new élite. Clerical geologists favouring old-earth exegetical theories were singled out for criticism: Brown branded Buckland's Bridgewater Treatise a "direct and real, though disavowed attack on the Mosaic narrative of the creation, made by a Clergyman of the Church of England".[79] Such polemics sometimes made use of counter-revolutionary rhetoric in the manner of Bugg, as when Brown referred to the "*malaria* of French philosophy".[80]

Literalist opposition to the new geology has been relatively well documented by such scholars as Jack Morrell, Arnold Thackray, and Nicolaas Rupke, and will not receive detailed attention here.[81] However, it was not confined to the aggressive polemics which dominate the secondary literature. Counter-arguments ranged from the apoplectic to the urbane, from the spluttering hostility of Henry Cole to the

courteous ruminations of Penn and George Fairholme.[82] Nevertheless, it suited the proponents of the new geology to represent "the Scriptural geology" as a fanatical protest movement whose primary function was to fulminate. Among themselves, élite geologists and their allies reinforced their own heroic image by jokingly aligning themselves with Giordano Bruno, Galileo, and other supposed victims of clerical fanaticism. Lyell, for instance, told his sister in 1829 that Andrew Ure's *New system of geology* was designed "to prove the Hebrew cosmogony, and that we ought all to be burnt in Smithfield",[83] while Mary Buckland remarked to William Whewell in 1833 that, had her husband been alive a century earlier, "fire and faggot would have been his fate, and I daresay our Bampton Lecturer [the literalist Frederick Nolan] would have thought it his duty to assist at such an 'Auto da Fe'".[84]

This portrayal went beyond private jokes. In their public utterances, the more militant geologists presented the literalists as bigots: as participants in one branch of learning (biblical exegesis) rashly "interfer[ing]" in another, entirely distinct branch of learning (geology) whose "natural phenomena" they "ha[d] never studied" but on which they still ventured to pronounce. Accept these terms, and literalist opposition to "the current opinions of geologists" seems arrogant and presumptuous in the extreme.[85] Yet, leaving aside the unworkable assumption that literalists were uninterested in "natural phenomena", this portrayal glosses over the fact that geology was not yet securely established in the public eye as a discipline isolated from exegesis. The authority of specialized geological expertise was presented by Lyell as unquestionable, but that kind of authority was only just beginning to win solid credibility among the polite classes (partly because of the rhetorical efforts of writers like himself). For many, natural science continued to function along eighteenth-century lines, in which a relatively broad constituency participated in the making of knowledge, and only a limited number of investigators — Newton being one — were accorded near-infallible authority. The pages of periodicals such as the *Gentleman's magazine* maintained this tradition well into the 1820s. By the 1830s many popular-science periodicals had switched to the new concept of scientific expertise, issuing predigested scientific information from on high; but we should not assume that their readerships necessarily switched their own attitudes at precisely the same time.

The rhetoric of enlightened inquiry pitted against clerical dogmatism — and the specific example of Galileo — was used by the literalists themselves long before Lyell and the Bucklands took it up. They used this rhetoric to protest against what they saw as over-zealous attacks on their own attitude towards biblical and scientific authority. Penn, for instance, responded to a blistering review of his *Comparative estimate* in the *British critic*, which he called a "paroxysm of polemical intemperance":

> This ardent critic should have lived at least three centuries ago, when reviews *ad excommunicationem* might have acquired some measure of power. In the fervid zeal with which he appears to copy the proceedings of the Pontifical College of 1622, he thus fulminates his Inquisitorial sentence against this Work....[86]

In case the reader does not understand the allusion, a footnote quotes from the standard account of Galileo's trial before the papal authorities.[87] The idea of Penn

as a latter-day Galileo might strike a modern reader as risible, but in the context of geological debate in the early 1820s his point was both serious and — as far as it went — justified. The image of science struggling against bigotry proved useful on both sides of the cosmological divide, helping both literalists and the new geologists to claim the moral high ground.

Much of the alleged 'arrogance' and 'dogmatism' of early nineteenth-century literalist writers on earth history tells us more about present-day conceptions of scientific authority than it tells us about the literalists themselves, many of whom felt themselves to be legitimate participants in a philosophical debate. This perspective helps resolve some apparent contradictions. Stephen Jay Gould was puzzled by the case of Mary Roberts, whose natural-history writings were "as conventional as conventional could possibly be", but whose treatise *The progress of Creation* (1837) held to a six-day Creation and short earth-history despite the accumulated wisdom of "all serious catastrophists" of the day. Roberts also insisted that mastodons were carnivorous and, according to Gould, "lambaste[d] Cuvier, the Newton of natural history" for believing that they ate plants.[88] The passage in question runs:

> Cuvier describes this animal as herbivorous, but surely without reason. We can judge of its nature, only by its remains; and as the most striking characteristic is found in the enormous grinding teeth, which resemble those of the carnivorous species, there is good reason to believe, that the creature preyed on animal food; the more especially, as the grinders of the elephant indicate that it is herbivorous.[89]

This hardly sounds like lambasting, although Gould saw it as an intriguing display of "pugnaciousness" by a woman writer who seemed otherwise to conform to male expectations of submissive female popularizers. Yet the tone is measured and unselfconscious, not polemical, suggesting that Roberts saw Cuvier not as (to quote Gould) "the Newton of natural history" — a towering figure of authority whom it would be quite something to defy — but as just another naturalist with whom she happened to disagree. The kind of authority Cuvier was accorded among élite men of science lay outside Roberts's conception of geology, which operated within the eighteenth-century model of open debate among the literate public.

Even among those literalists who were worried about the authority-claims of the new geology, such worries did not necessarily dominate their practice or find expression only in "polemic pamphlets",[90] numerous though these were from the late 1830s onwards. The idea that the production of literalist earth-history was fuelled by clerical resentment of the encroachments made on their intellectual territory by a new breed of self-styled experts does indeed capture an important facet of the motivations behind some literalist writings of the 1830s and later; but it does not apply to all such writings, still less to those produced previously. It is tempting to construct literalist earth-history in retrospect as the mirror-image or dark twin of 'scientific' geology, as a group of like-minded individuals with a clear collective identity and a sense of shared mission. This move is eased by identifying literalism with clerical

TABLE 1. Locations, professions, and religious denominations of the best-known literalist earth-historians. The third column attempts to indicate when they were actively involved in geological writing or research. Asterisks indicate the existence of *ODNB* entries. Other sources (besides the literary productions of the writers listed) are Knell, *The culture of English geology* (ref. 15) on Young; Lightman (ed.), *Dictionary of nineteenth-century British scientists* (ref. 38) on Roberts and Ure; and Mortenson, *The great turning point* (ref. 17), and articles by Mortenson in *Technical journal*, xiii/1 (1999), 92–99; xiv/1 (2000), 75–80; xvi/2 (2002), 89–94; xvii/1 (2003), 80–87; xx/1 (2006), 109–15, on all these figures apart from Kirby, Rennie, Roberts, Rodd, and Turner. The disproportionate number of Scots in this list — over two-fifths of the total, in a country with a tiny fraction of the British population — calls for further investigation, as does the fact that three of the most prominent English literalists (Bugg, Cockburn, and Gisborne) all studied at St John's College, Cambridge, towards the end of the eighteenth century.

Name	Birthplace	When active in geology	Where based at this time	Profession	Religious denomination
Best, Samuel 1802–1873	?	1837	Hampshire	clergyman, headmaster	Anglican
Brown, J. Mellor 1796?–1867	a British colony	1837–38	? Co. Durham	clergyman	Anglican
Bugg, George 1769–1851	Leicestershire	1826–27	? Home Counties	clergyman	Anglican
Cockburn, William 1774–1858	Scotland	1838–49	York	clergyman (dean)	Anglican
Cole, Henry 1792?–1858	?	1834	London	clergyman	Anglican / Methodist
Fairholme, George 1789–1846	Midlothian	1829–37	Brussels, Ramsgate	banker, landowner	?Presbyterian
Gisborne, Thomas* 1758–1846	Derby	1818, 1837	Staffordshire	clergyman, poet, landowner	Anglican (Clapham Sect)
Kirby, William* 1759–1850	Suffolk	1830–35	Suffolk	clergyman, naturalist	Anglican (High Church)
Murray, John* 1785/6–1851	Wigtownshire	1831–40	Hull	science lecturer, writer, poet	Presbyterian
Penn, Granville* 1761–1844	Buckinghamshire	1822–25	London	civil servant, poet, textual scholar	?Anglican
Rennie, James* 1787–1867	?Ayrshire	1810–15, 1828	Glasgow, London	science lecturer, writer, naturalist	Presbyterian
Rhind, William 1797–1874	Morayshire	1832–44, 1855–58	Edinburgh, Aberdeen	science lecturer, writer, surgeon	?Presbyterian
Roberts, Mary* 1788–1864	London	1837	London	writer, naturalist	Southcottian (ex-Quaker)
Rodd, Thomas, Sr* 1763–1822	London	1806, 1820	London	bookseller, poet	Anglican
Turner, Sharon* 1768–1847	London	1832	London	lawyer, antiquary	Anglican
Ure, Andrew* 1778–1857	Glasgow	1829	Glasgow	science lecturer, chemist, writer	Presbyterian
Young, George* 1777–1848	near Edinburgh	1817–40	Whitby	clergyman, fossil dealer	Presbyterian

conservatism, and it is rendered historiographically plausible by the familiar (if no longer unchallenged) mid-Victorian split between two clearly-defined camps of 'professional secular science' versus 'amateur Anglican science'.[91] One basic problem with this analogy, however, is that many of the most important literalists — more than half of those listed in Table 1 — were not clergymen. The best-known figure from the 1820s, Granville Penn, was an assistant chief clerk in the War Department who became distinguished as a philologist, working on classical and Byzantine literature as well as early Christian writings; other significant figures, such as Andrew Ure, Thomas Rodd, and James Rennie, were not clergymen either. Non-clerical literalists active in the 1830s and 1840s included William Rhind, John Murray, Mary Roberts, Sharon Turner, and the influential George Fairholme.[92]

A more nuanced version of the analogy with later Victorian professionalization holds that, while not all literalists were clergymen, they were at least "genteel laymen ... versed in polite literature; clergymen, linguists, and antiquaries — those, in general, with vested interests in mediating the meaning of books, rather than rocks, in churches and classrooms".[93] But this, too, oversimplifies a multifarious phenomenon, which cannot be reduced to 'textual scholars versus men of science' any more than it can to 'clergy versus new professions' (see again Table 1). Some clerical literalists, such as George Young, were heavily involved in fossil collecting and the fossil trade: Young had a vested interest in maintaining the Yorkshire Philosophical Society (and its museum) as well as his own congregation.[94] William Kirby, another clergyman, was internationally renowned as an entomologist. Furthermore, many non-clerical literalists earned a significant part of their living as lecturers on physical science. Rennie became the first professor of natural history and zoology at King's College, London; Rhind was a freelance lecturer on botany, zoology, and geology in Edinburgh for many years, ultimately gaining a position in the medical faculty of Marischal College, Aberdeen; Ure was professor of natural philosophy at the Andersonian Institution, Glasgow, where he also gave a celebrated series of evening lectures to working men and women; Murray only failed to gain the chemistry chair at King's College, London, in 1831, because of his refusal to join the Church of England as the university regulations required (he was a staunch Presbyterian).[95] Most of these men supplemented their income by writing educational works on the physical sciences: Rennie's *Insect architecture* (1830), for instance, remained in print for several decades.[96] This line of work was now increasingly open to female authors, providing the unmarried Roberts with a modest income. Far from being an "anti-philosophical" movement, as Buckland termed it,[97] for these people literalist earth-history was part of a wider engagement with the sciences.

However, as the third column of Table 1 suggests, geology was not always the chief component of these wider scientific interests. For most of the people mentioned in the previous paragraph, participation in public debate on earth history (whether in print or in person) represented only one phase in scientific careers typically devoted to zoology, botany, chemistry, or the useful arts.[98] Such participation likewise tended to occupy a transient or peripheral position in the careers of the more textually-oriented

literalists, even those whose names became indelibly associated with 'Scriptural geology'. Penn, for example, produced his influential literalist treatise in 1822 when he was more than sixty years old, revising it to meet criticisms three years later; but between then and his death in 1844 he remained aloof from geological debate, focusing instead on philological scholarship. Bugg and Ure each produced a single treatise in mid-career in the late 1820s, retreating from earth history thereafter. Turner was first and foremost an antiquary and historian of Dark Age Britain, a field in which his work is still respected;[99] geology played only a marginal part in his work. Sustained engagements with geological debates — such as may be seen (in divergent modes) in the cases of Fairholme, Young, and Cockburn — were much less common.

These biographical considerations further undermine the validity of labels such as 'scriptural geologist'. For a career geologist like Buckland, geology represented a vital, constitutive part of his professional and personal self-image throughout most of his adult life; but a man such as Turner, whose reputation was built on his antiquarian writings, would have been puzzled to find himself referred to today as "the scriptural geologist Sharon Turner" (an analogous formulation might be "the poet Charles Lyell").[100] This is not a trivial point: the historiographical shadows cast by the received history of geology all too easily distort our perspective. Literalist earth-science did not offer its participants a strong collective identity or sense of shared mission; for them, unlike present-day young-earth creationists, there was no equivalent of the Geological Society of London. Unlike the productions of the latter, bristling with cross-references, early literalist geological writings did not represent a "connected bibliography";[101] many seemed unaware of each other's existence. Rather, they were individuals advancing their own interpretations of Scripture and the strata.

Consequently, they produced a bewildering range of geologies. The results are not always easy to slot into clear 'literalist' or 'liberal' categories. Consider the case of Turner, one of the better-known names in the literature. His *Sacred history of the world* clearly states that Genesis 1 is to be taken literally, according to "the usual and natural meaning of the words and phrases which there occur": six days means six days, so the secondary strata must have been laid down during the 1656 years between the Creation and the Deluge.[102] The book as a whole represents an extended gloss on the Creation-narrative, with a brief glance forward to the Deluge.[103] As a result, Turner was one of the "scriptural geologists" specifically targeted by Buckland for a collective slating in the *Quarterly*; as Buckland put it in 1833, "the time is now arrived when this school must be put down".[104] Yet, tucked into a description of the fossil record in Chapter 18 of the *Sacred history* is the following concession:

> What interval occurred between the first creation of the material substance of our Globe, and the mandate for light to descend upon it — whether months, years, or ages, is not in the slightest degree noticed [in the Bible]. Geology may shorten or extend its duration, as it may find proper. There is no restriction on this part of the subject. In this portion of Time, or Eternity, we may place ... the production of all things to which light was not essentially necessary.[105]

Admittedly, this is not the same 'gap theory' as the version favoured by old-earth geologists like Buckland, according to whom the sun had shone on the eyes of trilobites and the leaves of tree-ferns for aeons before God had said "Let there be light".[106] Turner's 'gap' of darkness has room only for the world before life began, that is, for the formation of the primary rocks. Nevertheless, it is a large concession when viewed by the yardstick of literalism as traditionally defined. Is this a young-earth or an old-earth geology? Such cases raise questions about the adequacy of our received categories for describing the variety of biblical interpretations and scientific opinions current in the early nineteenth century.

The very nature of Protestant exegesis contributed to this plurality. One of the most enduring contrasts by which "scientific geology" has been retrospectively defined against "scriptural geology" has been the idea that proponents of the former accepted (to differing degrees) the "critical" and "scholarly" approach to Scripture developing on the Continent, whereas "Scriptural geologists" remained in thrall to "the precritical view that Genesis ... had been written under divine inspiration by Moses himself".[107] However, notwithstanding the fact that old-earth geologists like Buckland and Sedgwick themselves held the latter view, a survey of literalist earth-histories reveals a considerable spectrum of exegetical practice. Some literalists remained extremely conservative, but others were willing to entertain a critical attitude towards parts of the received text of Genesis — even if they, like most old-earth geologists, kept their distance from certain Continental (and Scottish) interpretations of Genesis 1 as figurative or mythical.

Several writers, for instance, recoiled from the idea that the sun had been created on day four, and proposed that the initial *fiat* "Let there be light" had brought the sun into being; various suggestions were then advanced to explain how the sun had not become visible on earth until day four.[108] In this case, Moses was held to have described the optical effect rather than the astronomical event — an idea which Miller later developed into an ingenious old-earth harmonization between the epochs of geology and the days of Creation in his treatise *The testimony of the rocks*.[109] Penn, perhaps the most experienced exegete among literalist earth-historians, was sensitive to discrepancies between descriptions of natural phenomena in Genesis and those observable in the present day. If the earth had been submerged by the diluvial waters for almost a year, plant life could not have survived; therefore Penn suggested that God must have supernaturally created new vegetation (and animals) after the Deluge.[110] Ure later developed this suggestion, proposing that a subsidiary creation of this kind would help explain why extinct fossil animals were so different to existing species.[111] The exegetical principles beneath such gap-filling exercises were similar to those enabling the more adventurous accommodations favoured by many old-earth geologists.

Some of Penn's suggestions went further than this, however, identifying certain passages in Scripture as uninspired textual accretions. In his account of the Deluge, Penn found an apparent contradiction in the biblical text concerning the rivers of Paradise; he therefore suggested that the passage about the four rivers in Genesis 2.10–14 was

a scribal gloss added to Moses's original text and subsequently incorporated into the letter of Scripture.[112] For this reason Penn was severely castigated by Miller, who in this instance proved a more conservative exegete than Penn. Miller was happy enough to propose an old-earth cosmology when interpreting the meaning of passages in Scripture or filling gaps therein, but as a devout Calvinist he was not prepared to see any passage removed from the status of inspired and infallible truth.[113]

Over and above these differences in exegetical practice, literalists also disagreed among themselves on fundamental aspects of earth history, such as when the strata had been laid down,[114] whether the primary rocks predated the creation of light, whether the Deluge had been violent or tranquil, when and how fossils had been formed, and whether or not species known from a fossil state were still living. Penn's *Comparative estimate* was influential, but other literalists found plenty to disagree with in its pages. The second edition of George Young's and John Bird's *Geological survey of the Yorkshire coast* (1828) offered a typically guarded endorsement: "We are not prepared to admit all that Mr. Penn has advanced; but his theoretical views appear to us, on the whole, much more judicious than those which he combats."[115] Rennie went to such lengths in his *Conversations on geology* (1828) to recommend Penn's *Comparative estimate* that historians used to attribute this book also to Penn (stylistically one of the most unlikely attributions in bibliographic history).[116] Yet Rennie also encouraged his readers to consult the works of Penn's theoretical opponents, since "the Mosaic geology is so recently published, that ... it cannot be looked upon as established".[117] This provisional, inquiring tone belies the traditional opposition between literalists as purveyors of dogmatic Scriptural certainties and scientific geologists as cautious and humble seekers after truth.

This opposition is further blurred by the positive use that many literalist writers made of the work of non-literalist geologists, recommending the latter to their own readers. Disagreements over theory did not preclude positive engagement at other levels, especially during the 1820s, but also to a lesser extent in later decades. Rennie, for instance, recommended such geologists as Horace-Bénedict de Saussure, Alexander von Humboldt, William Conybeare, Leopold von Buch, and Adolphe Brongniart as "the most instructive, though not always the most interesting authors", who "describe what they have examined in nature, sometimes, though not always, unbiassed by theory". This last *caveat* is the only criticism voiced.[118] Buckland presented a more problematic case for literalists, most of whom took exception to his theory that hyenas had once roamed antediluvian England.[119] Yet, despite his reservations about this theory, Rennie devoted four pages of his book's brief preface to a chain of quotations from Buckland's inaugural lecture *Vindiciae geologicae* illustrating geology's natural-theological value:[120] "On this subject we cannot do better than make a few extracts from the observations of Professor Buckland."[121]

Ure, in his *New system of geology* (1829), openly admitted his own debt to the gentlemen of science: he acknowledged the "inestimable" *Outlines of the geology of England and Wales* (1822) by William Conybeare and William Phillips as the main source for his account of the secondary strata.[122] The *Outlines*'s avoidance of

theoretical issues allowed Ure to yoke its stratigraphy to his literalist cosmology: Gillispie called this coupling "forced",[123] but such individualistic syntheses were common fare at this time. More striking was Ure's enthusiasm for the fossil researches of Georges Cuvier and his British followers:

> The author has likewise diligently availed himself of the ample means accumulated in the *Ossemens Fossiles* of Baron Cuvier, the Philosophical and Geological Transactions, &c. of enlivening the dark catacombs of the earth, by interspersing among his descriptions of its mineral planes, an account of their ancient tenants. By transferring to his pages, systematic exemplars of the analytical science displayed by the great naturalist of France, in restoring antediluvian zoology, he expects to make them peculiarly attractive to the English reader.[124]

Ure quoted freely from these works, opening his discussion of "sea lizards" by paraphrasing the equivalent section of Cuvier's *Ossemens fossiles* and excerpting the most dramatically appealing part of Conybeare's Geological Society paper on plesiosaurs.[125] Reading the section on the "Marvellous Iguanodon of Mantell" on its own, isolated from Ure's theoretical framework, one would think Ure a follower of the new geology in all its particulars: Cuvier himself is praised for his "soundness of inference" and "general enlargement of thought".[126] One would never guess that the "ancient epoch" to which Ure alludes was, in his view, coeval with humans.

4. LITERALIST LITERATURE

Literalist writers on earth history, then, were too disparate and too heavily implicated in geology for us to see them as a simple protest-group of 'anti-geologists'. The variety of backgrounds, careers, and approaches sketched out in the previous section finds an apt reflection in the variety of literary genres that housed their views on earth-history. These were not restricted to polemical pamphlets and exegetical treatises, but also included geological compendia for the general reader (such as Ure's *New system of geology*), chatty didactic 'conversations' (such as Rennie's *Conversations on geology*), philosophical or theological dialogues (such as Fowler de Johnsone's *Vindication of the book of Genesis*),[127] illustrated collectors' guides to local geology (such as Young and Bird's *Geological survey*), natural-history compendia in epistolary form (such as Turner's *Sacred history*), narrative renderings of the Creative week (such as Roberts's *Progress of Creation*), and articles in religious, scientific, and general periodicals. In size and cost they ranged from lavish quartos, like Young and Bird's imposing volume, to diminutive duodecimos like Rennie's and the sixpenny pamphlets of William Cockburn;[128] their target readerships ranged from learned scholars to general readers and children.

This variety of products reflects the range of functions and purposes which literalist earth-history was designed to fulfil. It is possible to tease apart three of these purposes: (i) reinforcing the Bible's traditional authority over the telling of earth history; (ii) using natural knowledge to illuminate the biblical narrative or Christian truths in general; and (iii) promoting geology among a wider public. In practice these

functions often merged into each other, and this far-from-exhaustive list should not be taken as a basis for slotting texts into pigeonholes. Individual texts, especially book-length ones, typically worked on a number of levels. However, teasing apart these functions does help to emphasize that the literalist engagement with physical science was more complex than a simple fixation on the Bible. I have listed the functions in descending order of obviousness, and will accordingly spend more time discussing the third than the first.

It comes as no surprise to learn that shoring up the Bible's traditional authority in the sphere of earth history was an important function in these writings. Procedures could differ widely, however. Bugg and Penn shared this aim, as well as a love of italics; but Bugg appealed only to the divine inspiration of Scripture, whereas Penn ostensibly tested the two "geologies" ("mineral" and "Mosaical") by the external standard of Baconian induction. Whereas Bugg denounced Buckland to the skies, Penn took a more courteous tone. This difference went beyond scholarly etiquette: the two literalists directed their readers' attention in opposite directions. Bugg tried to coerce his readers into averting their eyes from the rocks, whereas Penn aimed to "stimulate" their "curiosity", invoking the imaginative potential of geology but arguing that Moses was still the best guide to interpreting these "wonderful", "*amazing*", and "*Divine monuments*".[129] This emphasis on wonder and curiosity is also found in Thomas Rodd's pseudonymous *Defence of the veracity of Moses* (1820). This short book begins, like Bugg's, with dark references to the French Revolution,[130] but its final chapter on the caverns of Derbyshire contain passages which suggest that his motivation for these investigations went beyond strictly exegetical concerns:

> A more frightful Cavern does not exist: by the help of water-rockets it may be seen to advantage.... I could not avoid penning a few lines on this place, which I have visited several times with fresh delight and astonishment:—
>
> .... No seas I range, no foreign soil I tread,
> But far below the earth pursue my way,
> Through regions inaccessible to day;
> The high-arched cavern tow'rs above my head;
> Whilst in the terrible abyss below
> Rush the wild waters, thundering as they flow.[131]

The sublime, of course, had long been hallowed as a high road to devotion, which leads us neatly to the second purpose claimed by literalist writers on earth history: using natural knowledge to shed new light on the biblical narrative and/or the attributes of God. In its more general application, this function was claimed by many other scientific writers, including proponents of old-earth geology such as Buckland and Lyell. Buckland's Bridgewater Treatise, *Geology and mineralogy considered with reference to natural theology*, was at once a palaeontological reference-work and a treatise on natural theology, although opinions differed as to how successful it was in the latter capacity.[132] Many educational books for the Victorian general reader used the language of natural theology as a tool for inculcating scientific knowledge.

As is well known, natural theology in the nineteenth century served as a broad-church platform on which science and religion could interact without doctrinal squabbles.[133] In the scholarship, biblical literalists are usually presented as opposed to this irenic approach because of its tendency to downplay the importance of the Bible in understanding nature. Certainly, some vociferous literalists objected strongly to the British Association for the Advancement of Science's promotion of natural theology to the exclusion of specifically Christian truths and texts. Nevertheless, other literalists (such as Turner and Roberts) opened the door wide to natural theology as an important adjunct to revealed truths. In the first letter in Turner's *Sacred history*, nature appears as a form of Bible commentary: "The grand and beautiful Creation furnishes an illustrating comment on these revealed truths."[134] But Turner's preface shows that his purpose went beyond erudition. He also aimed to enhance his readers' "personal happiness": "What has given more pleasure ... than Dr. PALEY's intelligent work on Natural Theology? The Author cannot forget the enjoyment which he received from it on his first perusal."[135] Such pleasure was closely tied to the overarching goal of natural-theological works, which was, as Turner put it in the final sentence of his preface, to assist the reader "to form right conceptions and exhilarating hopes of this stupendous Being"[136] — a sentiment Lyell would take up one year later from a very different cosmological perspective in the final sentence of his *Principles of geology*, arguing that the study of geology facilitates "a just estimate of the relations which subsist between the finite powers of man and the attributes of an Infinite and Eternal Being".[137]

Turner's and Roberts's brand of natural theology, like that of Paley and Buckland, emphasized the extent to which nature provided evidence of divine benevolence. Every apparent deformity or monstrosity was to be explained as evidence of adaptive ingenuity affording happiness in this best of all possible worlds. Other literalists emphasized the disorder of the earth's crust to show how nature had suffered under the burden of human sin. In the 1810s and 1820s, the mounting geological evidence for a violent deluge enabled writers such as Thomas Gisborne (in his *Testimony of natural theology to Christianity*) to call the earth's strata "a mass of ruins" whose twisted formations and jagged peaks dramatically revealed the consequences of sin and the need for repentance — an argument used in many earlier 'theories of the earth' but now buttressed by new physical evidence.[138]

Many literalists, however, treated the strata and their associated fossils not primarily as aids to devotion and natural theology, but rather as illustrative material with which the laconic Genesis accounts of Creation and the Deluge could be amplified and made sense of philosophically. This aim, too, goes back to Burnet's *Sacred theory* and its kin, which are the ultimate ancestors of works like *A short narrative of the creation and formation of the heavens and the earth* (by "Philo", 1819). Such writings assume (rather than argue) that the Bible is the primary authority on earth history, using physical science to deepen the reader's imaginative grasp of the events narrated in Genesis. They often begin by appealing to the reader's antiquarian curiosity about sublime events of the distant past:

> All of us must be anxious to know with certainty something, at least, of the creation and formation of the planet upon which we live and move; yet how few of us who possess an authentic history of the process, have given to it that consideration which a subject so grand deserves! Who can contemplate the process without amazement! Who can review and reflect upon it without acknowledging the grandeur and power of the Almighty ...?[139]

This exhortation by "Philo" resembles contemporary rhapsodies about the 'book of nature' purveyed by old-earth geologists. The surveyor Robert Bakewell, for example, opened a new chapter of his revised *Introduction to geology* in 1828 as follows:

> If it had been predicted a century ago, that a volume would be discovered, containing the natural history of the earliest inhabitants of the globe, which flourished and perished before the creation of man, with distinct impressions of the forms of animals no longer existing on the earth, — what curiosity would have been excited to see this wonderful volume; how anxiously would Philosophers have waited for the discovery! But this volume is now discovered; it is the volume of Nature, rich with the spoils of primeval ages....[140]

Taken out of context, the main difference between these two passages is the location of that "authentic history" or "volume". For the former, it is in the book of Genesis; for the latter, in the strata. In the 1830s this boundary was blurred still further when several literalists began referring to the strata as "the volume of nature" and to fossils as "the lithographic prints of ancient botany and zoology".[141]

Writers like "Philo" were feeding and drawing on the same enthusiasm for spectacular reconstructions of the distant past that kept artists like John Martin in business during the 1810s and 1820s. Martin, too, sought to deepen his audience's imaginative grasp of specific episodes in sacred history, reconstructing them meticulously in the light of the latest scholarship.[142] Many of his paintings showed divine wrath operating spectacularly on a corrupt ancient civilization. *The Deluge* (1826) is a typical example of his procedure, illustrating Genesis 7 with the help of astronomical speculations: like earlier theorists of the earth he linked the Deluge with the conjunction of the sun, the moon, and a comet.[143] In the 1830s Martin would find himself taking a step into deep time, restoring England's ancient saurians for Mantell and other geologists;[144] but British apocalyptic spectacle in the 1820s was firmly rooted in a literal interpretation of the Bible, with little or no geotheoretical input from the new school of geology. These pictures not only illustrated the Bible, but also reinforced its narrative authority in the most spectacular way imaginable.[145]

Apocalyptic spectacle proved a useful resource for those literalists who wrote earth history with the third aim in view, that of promoting natural science among a wider public. This kind of popularization — in the broad sense, current around 1820, which meant 'making something more widely known' — enshrined various different manners of engagement with natural science. Young and Bird, for instance, wished to promote informed fossil collecting among local people with the time and money to afford such an activity. Their *Geological survey of the Yorkshire coast* (1822),

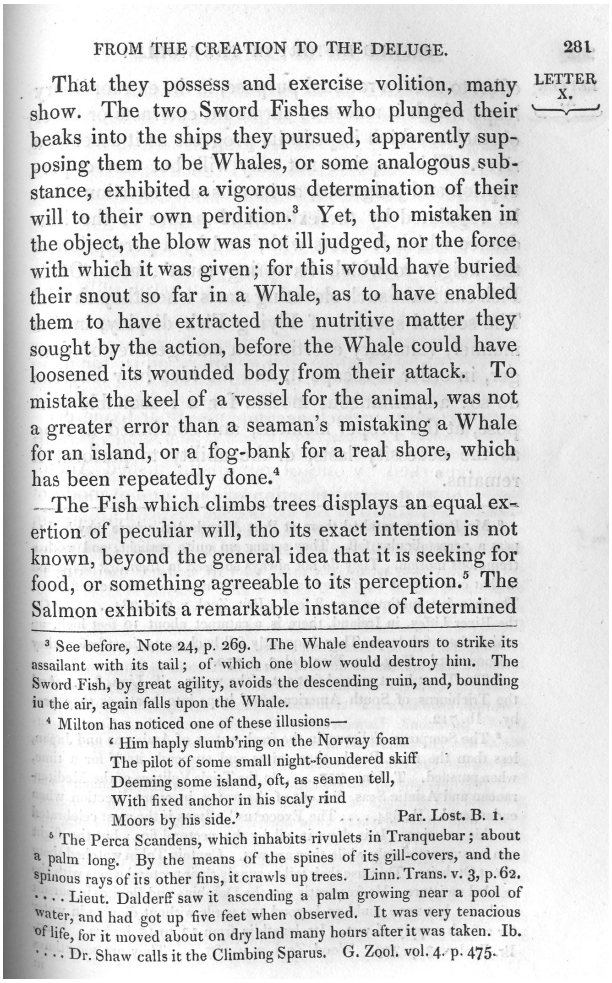
published in Whitby, thus belonged to the same genre as fossil monographs of an old-earth persuasion such as Mantell's *Fossils of the South Downs* (1822).[146] Unlike Mantell's volume, it was successful enough to go into a second edition in 1828.

Other writers had more didactic aims. Rennie's *Conversations on geology* (1828) begins from first principles, taking the form of conversations between an omniscient mother ("Mrs. R.") and her two well-behaved and inquisitive children Edward and Christina. The book was aimed at securing geology a niche as a science suitable for children, and equally appealing to boys and girls. It was modelled on Jane Marcet's bestselling *Conversations on chemistry* (1806):[147] it claimed (not entirely accurately) to be the first treatise on geology written specifically for children, and was popular enough to be reprinted twice, in 1828 and 1840.[148] Ure's *New system of geology* (1829) was targeted at interested adults, and its self-declared aim of imparting useful knowledge about geology for "general persual" suggests a certain continuity with its author's lectures for working men (although the book was not cheap): Ure hoped in this way to contribute to "the general diffusion of knowledge, truth, and piety, over the earth".[149] Turner's and Roberts's aims were equally didactic, but less specialized or systematic: their chief concern seems to have been to impart knowledge within a natural-theological framework about natural history, geology, and physical geography. Both Turner's *Sacred history* and Roberts's *Progress of Creation* in effect use the days of Creation as pegs on which to hang miscellaneous botanical and zoological observations and edifying speculations relating chiefly to "the present condition of the earth", as Roberts's subtitle puts it. Turner even extended this portmanteau structure to the footnotes that hang from his main text, packing them with lively anecdotes and illustrative poetry quotations (Figure 1).

Where popularization came uppermost, the controversy surrounding the age of the earth became less prominent: the wonders of geology were deployed here to attract the uninitiated to a new and exciting science. Consider the following peroration in Young and Bird's treatise of 1822:

> They [fossils] are the medals of the natural history of our globe, recording the changes which it has undergone, and setting before our eyes innumerable specimens of nature's early productions ... at a period far beyond the limits of profane history. They carry back our thoughts to a time when the British Isles had no place, in their present form, on the map of the world; and when land and sea, mountains and valleys, rivers and plains, continents and oceans, must have been arranged in a manner completely different from what we now see. And while their extreme antiquity commands our veneration, their immense number, and inconceivable variety, with the beauty and perfection of many of them, impress us with sentiments of wonder, and may well excite us to admire and praise that infinite Creator, whose works in every age have been great and marvellous.[150]

This passage makes use of most of the rhetorical topoi familiar from the popularization of old-earth geology: fossils as "medals of creation", the sensation of being "carried back" to ages long before historical records (except the Bible), the alien



FROM THE CREATION TO THE DELUGE. 281

LETTER X.

That they possess and exercise volition, many show. The two Sword Fishes who plunged their beaks into the ships they pursued, apparently supposing them to be Whales, or some analogous substance, exhibited a vigorous determination of their will to their own perdition.[3] Yet, tho mistaken in the object, the blow was not ill judged, nor the force with which it was given; for this would have buried their snout so far in a Whale, as to have enabled them to have extracted the nutritive matter they sought by the action, before the Whale could have loosened its wounded body from their attack. To mistake the keel of a vessel for the animal, was not a greater error than a seaman's mistaking a Whale for an island, or a fog-bank for a real shore, which has been repeatedly done.[4]

The Fish which climbs trees displays an equal exertion of peculiar will, tho its exact intention is not known, beyond the general idea that it is seeking for food, or something agreeable to its perception.[5] The Salmon exhibits a remarkable instance of determined

[3] See before, Note 24, p. 269. The Whale endeavours to strike its assailant with its tail; of which one blow would destroy him. The Sword Fish, by great agility, avoids the descending ruin, and, bounding in the air, again falls upon the Whale.

[4] Milton has noticed one of these illusions—

'Him haply slumb'ring on the Norway foam
The pilot of some small night-foundered skiff
Deeming some island, oft, as seamen tell,
With fixed anchor in his scaly rind
Moors by his side.' . . . . . Par. Lost. B. 1.

[5] The Perca Scandens, which inhabits rivulets in Tranquebar; about a palm long. By the means of the spines of its gill-covers, and the spinous rays of its other fins, it crawls up trees. Linn. Trans. v. 3, p. 62. . . . . Lieut. Dalderff saw it ascending a palm growing near a pool of water, and had got up five feet when observed. It was very tenacious of life, for it moved about on dry land many hours after it was taken. Ib. . . . . Dr. Shaw calls it the Climbing Sparus. G. Zool. vol. 4. p. 475.

FIG. 1. Willpower in fish: discursive footnotes from Sharon Turner, *The sacred history of the world* (London, 1832), 281 (author's collection).

appearance of the earth's surface at that period, the aesthetic appeal and "extreme antiquity" of fossils, and the final gesture towards natural theology. The two geologies' difference in assumed timescale seems somewhat immaterial in this context; six thousand years was a long time.

Towards the end of the 1820s, the new repertoire of spectacular British fossil vertebrates enabled literalists to play up still more the thrillingly alien qualities of the antediluvian world outside Eden and the Fertile Crescent, just as old-earth geologists were beginning to do for the world *before* Eden. The preface to Ure's *New system of geology*, for instance, contains an imaginary guided tour led by Cuvier himself:

> In accompanying him through the dark cemeteries of the earth, a mysterious gleam from the primeval world penetrates our soul, and solemnly awakens its deepest faculties. We seem to walk among new orders of beings, endowed with extraordinary forms.... These all speak of a world unlike our own, the fashion of which has long passed away.[151]

This "world" is, if anything, even more alien than Cuvier's, since Ure relaxes his grasp of comparative anatomy and presents a veritable gallery of monsters. The "crocodiles furnished with fins, but no feet" are familiar as ichthyosaurs, but the "sloth ... of the gigantic stature of a rhinoceros" (the ground-dwelling giant Megatherium) was apparently capable of imitating its arboreal cousins, "suspending itself ... from trees of colossal growth" on its "enormous arms and claws".[152] This passage clearly aims to catch readers' curiosity. The main text is more restrained, but sensationalism persists in subtitles and running headers: "Two monstrous sea lizards", "Enormous Megalosaurus of Buckland", "Crocodiles crushed to death".[153]

In geological popularization of any kind, as in many a sermon, devotional reflections and biblical exegesis are often hard to distinguish from theatrical gestures to the gallery. Literalist geology was no exception: entertainment and edification were indissolubly blended. Ure's sensational references to "crushed crocodiles", for instance, testify in his scheme to the convulsions with which God had periodically afflicted the earth as punishment for the sins of antediluvian humans. These catastrophes formed the strata, whose deposition was extraordinarily violent, crushing animals to death where they stood (hence the damaged state of many fossils). The most recent cataclysm was the biblical Deluge, in which all fossil species were destroyed.[154] Like Martin's biblical scenes, this apocalyptic vision carries a clear moral, channelling the thrill of spectacle into religious reflection:

> But that world, the victim of sin, will not have perished in vain, if its mighty ruins serve to rouse its living observers from their slumberous existence, if they lead them to meditate seriously on the origin and end of terrestrial things, and ... the works and ways of Providence.[155]

Turner capitalized on the "terrific" possibilities of diluvial narrative in the concluding sentences of his *Sacred history*:

> We can but faintly conceive the appalling scene. Mankind were surprised ... by the sudden alarm of portentous danger rapidly rushing on them from the blackening and howling sky. The Sun was seen no more — midnight darkness usurped the day — lightnings dreadfully illuminated — thunder rolled with increasing fury — all that was natural, ceased; and in its stead, whirlwind and desolation — Earth rending — cities falling — the roar of tumultuous waters — shrieks and groans of human despair — overwhelming ruin — Universal silence! — and the awful quiet of executed and subsiding retribution![156]

Breathless horror and excitement is racked up by the broken syntax, with dashes separating brief or fragmentary phrases. The overall effect recalls contemporary melodrama playbills: "She Weeps! She Prays! — the door is burst open — The Conflict

— My Sister — My Sister — the hideous form leaves its Victim — 'Tis most awful."[157] In Turner's disaster scenario, as in melodrama itself, moral reflection and voyeuristic sensationalism work together in uneasy but highly marketable proximity.

In Rennie's *Conversations on geology*, the theological associations of fossils are turned to dramatic effect in a somewhat different manner. Towards the end of the book, Mrs. R. whets her children's appetite for geology by revealing that the huge bones once thought to be "those of giants, or of *fallen angels*" belonged to extinct animals. These creatures inhabited the barren land without Eden before perishing in the Deluge "to give place to a new and blessed land". The divine curse under which they lived is reflected in Mrs. R.'s insistence that most of them were ferocious carnivores.[158] A facing illustration (Figure 2) shows one such beast, labelled "Skeleton of a Gigantic Antediluvian Beast of Prey". This is the herbivorous Megatherium, its skeletal form looking especially monstrous since it has been plucked straight out of an eighteenth-century museum display and deposited in a tropical landscape, with a worried-looking living elephant in the background. Where Ure had set this monster improbably swinging in the trees, Rennie makes it play the predator.

These authors sought to generate interest in geology by highlighting its romantic appeal, playing up the savagery of the ancient earth to make it a more attractive object of study. By the late 1820s it was becoming commonplace to compare the wonders of geology with the fictions of romance, but for the most detailed exposition of this theme we must turn to Rennie. Mrs. R. responds as follows to young Christina's suggestion that there are "no romances in philosophy":[159]

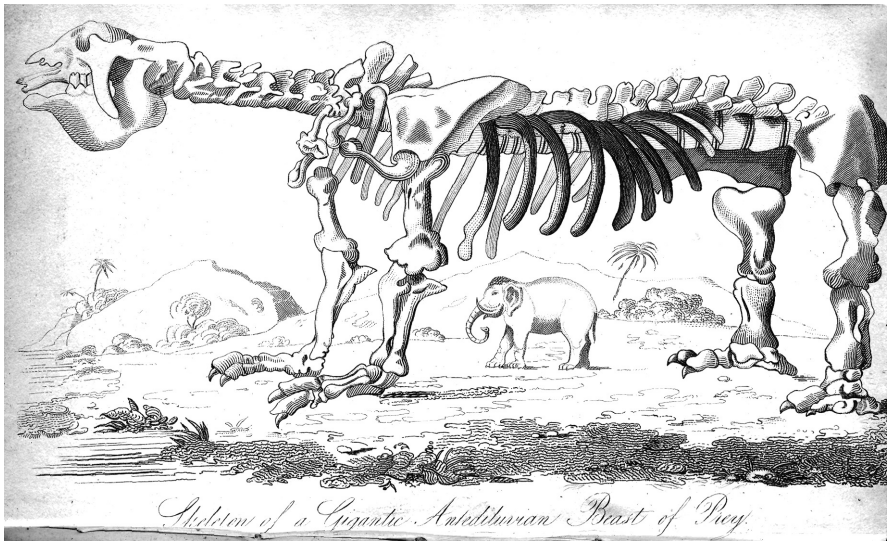


FIG. 2. "Skeleton of a Gigantic Antediluvian Beast of Prey". The herbivorous Megatherium (as seen in the Real Museum, Madrid) interpreted carnivorously in [James Rennie], *Conversations on geology* (London, 1828). This image, identical to that of the first edition, is taken from the third edition (London, 1840), facing p. 302 (author's collection).

> I ... call Geology romantic, because it not only leads us to travel among the wildest scenery of nature, but carries the imagination back to the birth and infancy of our little planet, and follows the history of deluges and hurricanes and earthquakes.... Would you not think it romantic ... to dream about the young world emerging from darkness, and rejoicing in the first dawn of created light? To think of the building of mountains, the hollowing out of valleys, and the gathering together of the great waters of the ocean?[160]

The mother appeals simultaneously to her son's enthusiasm for astronomy and her daughter's love of landscape scenery. The choice of verbs emphasizes the specifically imaginative thrill Rennie wished to awaken: geology "leads us" and "carries the imagination back", enabling us to "dream about" the titanic events of the Creation and Deluge. This, he claims, is the essence of "romance", providing "much more sublime views of the creation than are to be found even in the inspired poem of Milton" — a boast that recalls the response to Burnet and anticipates the hyper-Miltonic ambitions of old-earth geologists such as Miller and Thomas Hawkins.[161]

Upstaging *Paradise lost* was one thing; but what of the Bible? One of the chief complaints directed by literalist writers at old-earth popularizers was that the latter dared to replace the simple, sublime narrative of Genesis 1 with a new and bewildering Creation-myth of their own devising.[162] The ways in which writers like Lyell and Miller appropriated biblical language to this end underlined the impression that they were somehow rewriting Scripture. But it seems clear that when the literalists turned from criticizing their theoretical opponents to promoting geology, they too found it necessary to rewrite Scripture, to render the Creation-narrative more attractive, more morally instructive, and above all more exciting. So Turner recast Genesis 7.11–24 as the *dénouement* of a melodrama, while both he and Roberts turned Genesis 1 into a storied collection of natural-history anecdotes.

More significantly, the drive to romanticize Creation with the help of fossil monsters meant taking the early chapters of sacred history into uncharted waters, or at least well beyond their traditional and anthropocentric focal point of the Fertile Crescent, constructing romantic, bestial narratives about the wildernesses of antediluvian Europe. Ever since the Middle Ages scholars had delighted in populating these ancient wastelands with living creatures; literalists' stories about outlandish beasts of prey answered to the same narrative need as apocryphal legends about fallen angels, dragons, and the offspring of Cain, and they made similarly creative use of biblical lore concerning Leviathan and Behemoth. A particularly skilful example of this appropriation of biblical language to write a geological story occurs in the concluding pages of James Mellor Brown's *Reflections on geology* (1838), in which a trip to a geology museum sparks off visions of an antediluvian wilderness:

> There is something affecting in walking among those ancient relics — something which irresistibly makes a solemn impression on our feelings. It is like wandering through the catacombs of a departed world.[163] I look round the chamber, and see myself surrounded with animal generations now extinct. There lies the Ichthyo-

> saurus on his lias bed! I shudder at the giant reptile, and rejoice that he is now still forever.[164]

Having introduced a specifically devotional atmosphere in his allusion ("catacombs of a departed world") to Edward Young's immensely popular devotional poem *Night thoughts*, Brown now moves into firmly biblical territory with a stylistic *tour de force*:

> There is the Mammoth:— "his bones are as strong pieces of brass; they are like bars of iron. His teeth are like the upper and the nether millstones." The Dinotherium, the Iguanodon, the Plesiosaurus, and the Pterodactylus, are there also; and I think of Behemoth, and the Unicorn, and of Leviathan, that "king of all the children of pride." On earth are not now their like. The shady trees and the reeds were their covert; they could drink up a river and not haste. For a while these lordly monsters trampled on the forests, and made the wilderness a solitary place. In their days the earth was the habitation of dragons. — But they have now passed away. He who made them made his sword to approach unto them, and they perished. But their memorial perished not with them. They have left their bones as a monument of their strength and terror,— a monument more durable than brass. On the shores of those ancient seas where these monsters took their pastime, "the print of a man's foot," it is said, is not to be seen:— the beasts of the field, the fowls of the air, the creeping things of the earth, and the fishes of the sea, were the sole tenants of those wide domains; for as yet man had not wandered from the scenes of his early childhood. But as man advanced, they retired before him, and made way for their lord. The sun arose: they gathered themselves together, and laid them down in their dens; and man went forth to his work and to his labour.[165]

Brown's reconstruction of these monsters is built on quotations from the Old Testament, chiefly those describing Leviathan and Behemoth. A close examination of his procedure shows the remarkable extent to which the Bible itself served as a descriptive and stylistic resource for popular geology.

Brown's first quotation is marked off with inverted commas and purports to come from Job 40.18, but the diction has been subtly altered, suggesting that Brown was working from memory: the original reads, "His bones are as strong pieces of brass; his bones are like bars of iron". "His teeth are like the upper and the nether millstones" does not come from any biblical passage at all, but is adapted from a later passage comparing Leviathan's heart to "a piece of the nether millstone" (Job 41.24). Apart from the second quotation (from Job 41.34), the rest of this passage purports to be in Brown's own voice, but it too is a patchwork of quotation and adaptation ('misquotation' seems the wrong word in this context) from the following passages:

Job 41.33, on Leviathan: "Upon earth there is not his like, who is made without fear."

Job 40.21, on Behemoth: "He lieth under the shady trees, in the covert of the reed, and fens."

Job 40.23, on Behemoth: "Behold, he drinketh up a river, and hasteth not."
Isaiah 35.1, on the destruction of Edom: "The wilderness and the solitary place shall be glad."
Isaiah 34.13, on Edom: "And it shall be an habitation of dragons, and a court for owls."
Job 40.19, on Behemoth: "he that made him can make his sword to approach unto him."
Psalm 104.26, on the sea: "there is that leviathan, whom thou hast made to play therein."
Job 40.20, on Behemoth: "Surely the mountains bring him forth food, where all the beasts of the field play."
Genesis 1.26, on human lordship: "let them have dominion over the fish of the sea, and over the fowl of the air ... and over every creeping thing that creepeth upon the earth."
1 Kings 4.33, on Solomon: "he spake also of beasts, and of fowl, and of creeping things, and of fishes."
Psalm 104.22, on lions: "The sun ariseth, they gather themselves together, and lay them down in their dens."
Psalm 104.23: "Man goeth forth unto his work and to his labour until the evening."

The result, like many sermons, is a textual fantasia on biblical themes. Brown has taken many of the quoted phrases completely outside their original contexts, rearranging and rephrasing them to fit his own narrative of extinction and the progress of civilization. Biblical language, in this altered form, makes up the bulk of Brown's description; besides this he only needs to add the occasional sentence or phrase — one of which comes straight out of *Robinson Crusoe* ("I was exceedingly surpriz'd with the Print of a Man's naked Foot on the Shore")[166] — in order to stitch his patchwork together as a unified narrative. The invented passages show the extent to which Brown had internalized the sonorous King James style, particularly the rhythmic features of the prophetic and poetic books of the Old Testament. The sentence "They have left their bones as a monument of their strength and terror,— a monument more durable than brass" employs the familiar Hebrew technique of taking up a word in one half-verse and repeating it in the next, as well as preserving the distinctive imbalance in length between the two half-verses which the King James translation often emphasizes. Likewise, the sentence "But as man advanced, they retired before him, and made way for their lord" is a fair imitation of Hebrew verse parallelism, in which the same action is indicated in two different phrases linked by a conjunction (e.g. "Wash me thoroughly from mine iniquity, and cleanse me from my sin", Psalm 51.2).

Brown's pastiche is so convincing, and so full of real biblical phrases, that his version of earth history ends up sounding as if it came straight from the Bible. It thus helps to enact the scientific authority which he wished to claim for the Bible, against what he saw as the presumptuous claims of Buckland's *Geology and mineralogy* (the book his pamphlet was designed to counter). One page previously, Brown had called

Buckland's book a most "agreeable and intelligent companion" for the visitor to a geological museum,[167] but this praise is somewhat undercut by the passage we have examined: the true "guide" to the wonders of geology is seen to be not Buckland, but the Bible, and Brown takes on the voice of an Old Testament prophet in order to reinforce its authority in the strongest possible terms.

Yet the entertainment factor must not be forgotten, even in a polemical work like Brown's. As with Ure, Rennie, and Turner (and indeed Martin), Brown's mastery of the 'biblical sublime' was part of a wider concern to make natural science appeal to the middle-class churchgoing public. New natural knowledge could both buttress the authority of scripture and bring scripture to life; conversely, the wonders of sacred history and of God Himself could both validate new sciences like geology and lend them an aura of stupendous otherworldly significance. The mutual imaginative reinforcement of science and religion, so convincingly demonstrated by recent scholarship on evangelical science, was thus alive and well among biblical literalists.

5. CONCLUSION

If we stop considering the literalist corpus purely as a literature of protest and view it as equally a literature of popularization, the ferocity of the élite's response becomes more understandable. The literalists had begun one step ahead of the game: in Britain, most leading old-earth geologists in the politically turbulent 1810s and 1820s wished to maintain an empirical self-image for their science, and their opposition to speculation (especially concerning origins) left them unwilling to exploit the full imaginative resources of geology and tell stories about the deep past, at least in their more public utterances. This left a gap in the market which literalist earth-historians were happy to fill: they already had a secure textual basis on which to ground sublime narratives about the earth's origins, so they could theorize with fewer qualms.

By the late 1820s, this efflorescence of literalist geological popularization was clearly beginning to worry the gentlemen of science. Their authority, so cautiously advanced over recent years, was felt to be under threat. In response, as I have suggested elsewhere, some of them began a more concerted public-relations effort, imitating the literalists by promoting geology among a wider middle-class public as a romantic science affording sublime visions of the distant past, but taking a directly oppositional stance to literalism itself. For example, Lyell's articles for the *Quarterly review* and his later *Principles of geology* (1830–33) used the literalists' technique of recasting Miltonic and biblical language to promote an aggressively anti-literalist approach to geology.[168] The best-known popular geological treatises of the 1830s and 1840s, such as Buckland's *Geology and mineralogy* (1836), Mantell's *Wonders of geology* (1838), and Miller's *Old Red Sandstone* (1841), took the campaign a stage further, forging large-scale old-earth narratives of successive creations aimed at dislodging the imaginative sway held by literal interpretations of Genesis 1.[169]

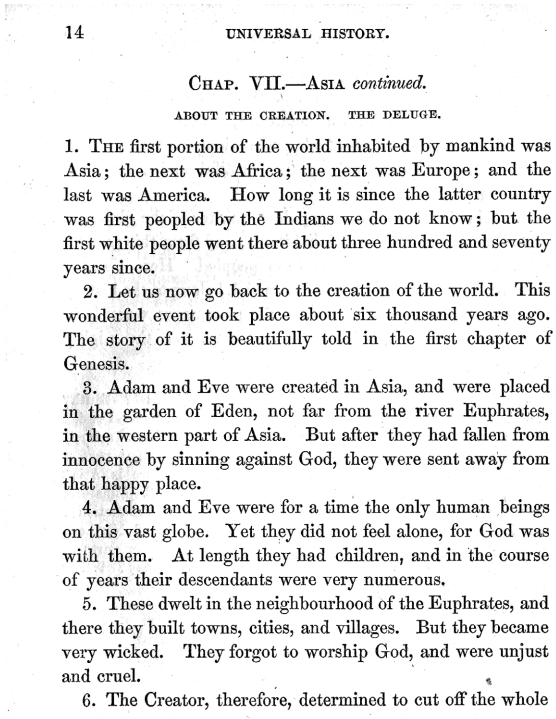
It is possible, with hindsight, to see the period between 1830 and 1860 as the inevitable working-out of the old-earth geologists' triumph over their opponents in a battle for middle-class hearts and minds. At the time, however, the outcome was far

from certain, and the sheer energy with which old-earth popularizers preached their science and castigated the literalists suggests that they, at least, were not taking their manifest destiny for granted. Far from being an approach current only at the "extreme fringes",[170] literalist earth-history enjoyed a high level of public attention. Many of William Cockburn's pamphlets cost only sixpence, in contrast with the lavish works they attacked, and went into several editions within a year of appearing. Turner's *Sacred history* was dearer, but went through eight editions in sixteen years, more than the treatises by Buckland, Mantell, and Miller just mentioned.[171] As for the sermons in which literalist geology was affirmed or assumed, only the most prestigious have been recorded; the total probably far outnumbered the extant printed texts.

For the average educated onlooker in the 1830s, the multiplicity of competing geologies was more likely to confuse than to settle the mind. Even the élite seemed locked in furious debate, disputing the very direction of earth history as well as the precise boundaries of its temporal territories; and they were also fighting on another front against the encroachments of transmutationist theories.[172] As book production became faster and cheaper, the regular reprinting of older works added to the potential for confusion. In 1831, as Lyell struggled to complete the second volume of the *Principles*, Jean André Deluc's 1809 *Letters on physical history* was reprinted;[173] and in 1840, while Miller wrote the articles which would shortly become *The Old Red Sandstone*, the London publisher J. W. Southgate issued Rennie's *Conversations on geology* in a third edition, almost unchanged from 1828. As late as 1860, Nathaniel Hawthorne's *Universal history* was still being published in London, introducing children to the creation of the world as an event which "took place about six thousand years ago" (Figure 3).[174] It sold over a million copies worldwide.

In the increasingly lucrative field of popular-science publishing, up-to-the-minute geotheory was not the prime concern of most publishers. Even where it was, it did not necessarily follow that updating meant erasing literalism. In 1826 a science compendium entitled *The book of nature* was published by a consortium led by Longman. The text was written by the American naturalist John Mason Good, who espoused a cautiously old-earth geology based on Neptunism, exegesis, and a liberal interpretation of the Hebrew word for 'day' (יוֹם *yōm*) as 'age'.[175] In 1834, after Good's death, a new edition was prepared by one of his London friends, incorporating "such improvements and corrections as the progress of knowledge since the first publication of these lectures has rendered necessary", while disclaiming the right to alter any "decidedly avowed sentiment of the author".[176] But Good's views on the Hebrew word for 'day' seemed to require further comment, so the editor added a long footnote at this point in the text. His footnote warns readers against assuming that geological processes in the past worked as slowly as they do today, and recommends Penn's *Comparative estimate* as the best guide on this question.[177] This author saw the "progress of knowledge" since Good's day as best represented by Penn, not Lyell.

To make matters worse, battle-lines between literalist and non-literalist geologies were not always clearly drawn. Many readers' opinions were shaped by periodical reviews, but many periodicals were slow to take sides on this particular issue. Between



14 UNIVERSAL HISTORY.

CHAP. VII.—ASIA *continued.*

ABOUT THE CREATION. THE DELUGE.

1. THE first portion of the world inhabited by mankind was Asia; the next was Africa; the next was Europe; and the last was America. How long it is since the latter country was first peopled by the Indians we do not know; but the first white people went there about three hundred and seventy years since.

2. Let us now go back to the creation of the world. This wonderful event took place about six thousand years ago. The story of it is beautifully told in the first chapter of Genesis.

3. Adam and Eve were created in Asia, and were placed in the garden of Eden, not far from the river Euphrates, in the western part of Asia. But after they had fallen from innocence by sinning against God, they were sent away from that happy place.

4. Adam and Eve were for a time the only human beings on this vast globe. Yet they did not feel alone, for God was with them. At length they had children, and in the course of years their descendants were very numerous.

5. These dwelt in the neighbourhood of the Euphrates, and there they built towns, cities, and villages. But they became very wicked. They forgot to worship God, and were unjust and cruel.

6. The Creator, therefore, determined to cut off the whole

FIG. 3. The creation of the world, in [Nathaniel Hawthorne] "Peter Parley", *Universal history, on the basis of geography,* 7th edn (London, 1860), 14 (author's collection).

1830 and 1833, the *Athenaeum* printed a positive review of each volume of Lyell's *Principles*, but also a sympathetic review of Fairholme's *Geology of scripture*;[178] only in the mid-1830s did this periodical begin to display clear old-earth sympathies. More seriously, individual writers often seemed uninterested in the theoretical gulf separating literalists from geologists of the new school. One writer for the *Eclectic review* in 1831 quoted Sedgwick with approval, but on the same page warmly recommended Ure's literalist *New system of geology* as "an introduction to geology" of "spirit and right feeling".[179] Footnotes achieved the same effect in popular expositions like Maria Hack's largely Lyellian *Geological sketches* (1832) and Turner's literalist *Sacred history*, both of which warmly recommended the works of Ure and his opponents without registering any dissonance. Roberts's prefatory tribute to Penn and Cuvier in the same breath strikes a similar note: the boundary between literalist and non-literalist geologies remained easily blurred.[180]

In the first half of the nineteenth century, the idea that reliable knowledge about earth history could be produced only by an élite of intellectual leaders was far from universally accepted among the literate public, although its proponents were working

hard to cement such a hierarchy.[181] For many, earth history was still in large part public property, thanks partly to its scriptural resonances. The Geological Society grandees might be entitled to a respectful hearing, but informed speculation on this topic was the common right of every thinking person. It was not unpardonable arrogance, but adherence to an established mode of scientific inquiry, that led the Worcester antiquary Jabez Allies in 1835 to conclude from his detailed study of what appeared to be hoofprints in local sandstone that

> the geologists must begin *de novo* in their classifications, and consider that the various strata which have been represented as having been formed thousands and tens of thousands of years before the Mosaic time of the Creation, were many of them formed *within the six days* or periods of the Creation, as stated by Moses, and *the rest subsequently* thereto....[182]

Literalist geologies thus formed part of a spectrum of do-it-yourself approaches to the history of the earth — radical, conservative, or neither — in which exegesis, theology, stratigraphy, inductive philosophy, antiquarianism, politics, and rhetoric were blended to differing degrees. For the speculatively inclined, there were more ways than Buckland's (or Penn's) to fill the gaps in the tantalizingly laconic narrative of Genesis 1. In the 1830s, natural-philosophy students at Aberdeen speculated on a race of pre-Adamite humans living, dying, and being resurrected in the Palaeozoic period; a farmer's son from Glastonbury got rather worked up about the possibility that ichthyosaurs and plesiosaurs represented the "teeming Spawn" of rebel angels during their time on Earth; while a naturalist from Hull used evidence from the book of Job to posit the existence of humans in the period represented by the secondary strata, much to the benefit of the hungry Megalosauri.[183] There was no solid or publicly agreed geohistorical consensus in the 1830s, nor for some time afterwards. This consensus, along with the new model of expert authority and scientific 'orthodoxy', was under construction by the gentlemen of science, under attack by its opponents, and unintentionally subverted by a host of other writers. The reading public had to make what it could of a cacophony of competing cosmologies.

In conclusion, there would appear to be three chief reasons why closer and more nuanced scholarly attention to nineteenth-century literalist earth history is desirable. First and most obviously, the literalists were prominent players in public debates on earth history during a crucial period in the history of modern geology. They helped shape its development to a degree which has not yet been fully appreciated. For this reason alone the historian of geology cannot afford to ignore or dismiss their activities and productions, however outlandish these may seem today.

Second, the abundant textual records left by literalist writers constitute a valuable resource for the historian wishing to reconstruct public attitudes towards the sciences. Unlike the Geological Society, these writers were not trying to form a coherent body of 'knights of the hammer' or erect a strict disciplinary boundary around the study of the earth: instead, they brought a range of practices and preconceptions to bear on the reconstruction of earth history. Although they cannot be taken as simple

representatives of 'the public', their writings reveal divergent attitudes on which the standard sources — the theologically liberal pioneers of old-earth geology — are silent or dismissive. Exegetical and doctrinal conservatism fostered some fascinating (and not always negative) engagements with natural knowledge.

Moreover, by virtue of their marginal position *vis-à-vis* the geological élite, these writers offer a revealing perspective on the exclusivity of the latter group, and on the concomitant fear that science was being taken out of the hands of the people. Here the literalists may be seen joining hands with later Victorian popularizers:

> it really seems to be the object of some men to mystify their readers, and to take a pride in throwing a veil of impenetrable language over their descriptions; thus reversing the real duty of an author, by puzzling people with easy matters, instead of rendering puzzling matters easy.[184]

> Geologists are deservedly proud of the discoveries which they have made, and would fain keep the uninitiated from equal knowledge with themselves. They throw a mist, therefore, around the science, and frighten away the vulgar with unintelligible endecasyllables and cacophonous names.[185]

The first quotation (from 1860) is by the celebrated popularizer J. G. Wood, celebrated both then and now for bringing natural history to a wide public; the second quotation, made twenty years previously, is by Cockburn, notorious both then and now for his vigorous opposition to the British Association for the Advancement of Science.[186] Such juxtapositions remind us that to dismiss even the most pugnacious literalist as nothing more than a bigot closes off some potentially more productive areas of historical inquiry.

Third, although secularization in various forms was on the ascendant among the upper and upper-middle classes, the Bible was still the most important book in early nineteenth-century British cultural life. Although liberalizing churchmen were busily instructing people that the Bible was not intended to teach facts about the natural world, the text of Genesis 1 appeared on the face of it to suggest otherwise, with its bald statements of what had been created when. For all but a growing minority, the Bible remained a vital touchstone for speculation about the natural world; conversely, any thoughtful reading of the first few chapters of Genesis necessarily involved reflections about the natural world. Books like Roberts's and Turner's, using Genesis 1 as a textual framework for reflections on present-day natural history, were the natural fruit of this union, as were the many examples of literalist writings aiming to popularize geology in particular.

These writers did not use the Bible exclusively as a monolithic symbol of priestly authority, to be thumped in order to win an argument. As we have seen, they also used it as a candle to illuminate the mysteries of the distant past, and — with consummate literary and musical sensitivity — as a textual and stylistic resource for bringing history to life. If, as Peter Harrison has argued, the Protestant insistence on literal interpretations of scripture in the sixteenth century stimulated fresh approaches to the investigation of the natural world and helped catalyse the Scientific Revolution[187]

— or if, as Janet Browne has suggested, biblical literalism in the seventeenth and eighteenth centuries was "a way of thinking about the natural world that encouraged careful observations, innovative investigations, and analytic accounts of natural processes based on accepted logical principles"[188] — then we should not be surprised that nineteenth-century literalists pioneered the popularization of geology and participated enthusiastically in natural history.

Some readers of this article will no doubt feel that historiographical fairness risks lending new legitimacy to old beliefs, and that, as objects of study, proponents of a young-earth cosmology should not be taken as seriously as the intellectual progenitors of today's "orthodox" geology, for fear of dissolving all distinction between "good science" and "bad science" in a blur of politically correct relativism. But the question of what constitutes "good science" is for scientists to settle, not historians. The objection is somewhat reminiscent of the hardline evangelical view that Christians ought not to watch films presenting (say) adultery or neo-paganism in a sympathetic light lest they are polluted by the encounter. Why should the historian study only those aspects of the past that resemble his or her own worldview?

It remains to be seen, however, whether the non-partisan study of literalisms past will shed any methodological light on the study of literalisms present and future. Young-earth creationism is likely to remain a stumbling-block for most academic historians and sociologists of science as long as it maintains its popular associations with fundamentalist commitments and their political ramifications. Despite a small number of superb studies of this movement's institutional history and debates among its leading figures,[189] the relative lack (and difficulty) of historical or sociological analyses of the *experience* of literalist natural knowledge among ordinary people lends inertia to the popular notion that current creationist beliefs are the result of 'brainwashing', of passive audiences being deceived by crafty preachers peddling sinister agendas. Recent advances in the history of scientific popularization, audience response, and cultural politics might suggest that a more sophisticated perspective is now overdue, but this field still awaits its harvest. In the meantime, further study of those literalist earth-historians who are safely in their graves has its own part to play in the collaborative enterprise advocated by Cooter and Pumfrey, in a suitably biblical turn of phrase, as the "locat[ing] and restor[ing]" of "the many mansions of science in popular culture ... within their various landscapes".[190]

ACKNOWLEDGEMENTS

Shorter versions of this paper were presented at the annual conference of the British Society for the History of Science at the University of Leeds in August 2005, and at the Cultural History Seminar at the University of Aberdeen in May 2006. I wish to thank the participants for their helpful comments and suggestions. A small portion of the material presented here has also been presented, in a different context, in my book *The earth on show: Fossils and the poetics of popular science, 1802–1856* (Chicago, 2007). I am grateful to the University of Chicago Press for allowing me to reproduce nine paragraphs taken from four different chapters in that book; to Anne

Barton, Boyd Hilton, Nigel Leask, Anne and Clémence O'Connor, Martin Rudwick, Jim Secord, Mike Taylor, and three anonymous referees for their comments on drafts of those chapters; and to Rob Iliffe and two anonymous referees for their comments on this article.

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and Thomas Postlewait (eds), *Victorian science and Victorian values: Literary perspectives* (New York, 1981), 111–36, p. 120; and Lynn L. Merrill, *The romance of Victorian natural history* (Oxford, 1989), 237.

60. This has been emphasized by Yule, "The impact of science" (ref. 13), 328–9; John Hedley Brooke, "The history of science and religion: Some evangelical dimensions", in Livingstone *et al.* (eds), *Evangelicals and science* (ref. 7), 17–40; and Michael Roberts, "Geology and Genesis unearthed" (ref. 15).
61. Moore, "Geologists" (ref. 13), 336. A similar opposition is reflected in Yule, "The impact of science" (ref. 13), 324.
62. For example, John Bird Sumner, *A treatise on the records of the Creation, and on the moral attributes of the Creator* (2 vols, London, 1816), i, 282–5; "Eretzsepher", *Remarks on Dr. Buckland's view of the Mosaic Creation, as the last fitting up of the earth* (London, 1837); John Pye Smith, *On the relation between the holy scriptures and some parts of geological science* (London, 1839); Denis Crofton, *Genesis and geology; or, An investigation into the reconciliation of the modern doctrines of geology, with the declarations of Scripture* (London, 1852); and Richard Chaffer, *The Creation; or The agreement of Scripture and geological science: A sermon preached at the church of St. Alphege, Greenwich* (Greenwich, 1856).
63. For example, George Young and John Bird, *A geological survey of the Yorkshire coast* (Whitby, 1822); and [James Rennie], *Conversations on geology* (London, 1828). Philip Henry Gosse's *Omphalos: An attempt to untie the geological knot* (London, 1857) presents an interesting example: its argument for the plausibility of a young earth makes no use of biblical exegesis apart from the last sentence.
64. For a different perspective on this problematic, see Moore, "The creationist cosmos" (ref. 18), 54–55.
65. For an insightful exploration of some of the methodological difficulties involved in establishing the 'literal sense' of a biblical passage, see Francis Watson, *Text and truth: Redefining biblical theology* (Edinburgh, 1997), 107–24.
66. For a rare exception see Mott T. Greene, "Genesis and geology revisited: The order of nature and the nature of order in nineteenth-century Britain", in Lindberg and Numbers (eds), *When science and Christianity meet* (ref. 7), 139–59, p. 140. Greene prefers the term "biblical realist", which is itself open to further confusion because of its very different and much better-known meaning in late twentieth-century theological debate.
67. Anon., "British Association", *Literary Gazette*, 1836, 634–5, p. 634. For similar old-earth assertions of literalism see "A scriptural geologist", "The bishop of Calcutta" (ref. 53), 27 n.; Henry Christmas, *Echoes of the universe: From the world of matter and the world of spirit* (London, 1850), 105; and Edward Hitchcock, *The religion of geology and its connected sciences* (Glasgow, 1851), 63. Compare, however, Buckland's own very different use of the word 'literal' in his *Geology and mineralogy considered with reference to natural theology* (2 vols, London, 1836), i, 14.
68. For present-day analogues compare Andrew Village, "Factors shaping biblical literalism: A study among Anglican laity", *Journal of beliefs & values*, xxvi (2005), 29–38.
69. For example, Rupke, *Great chain of history* (ref. 13), 42; and Cadbury, *The dinosaur hunters* (ref. 9), 195.
70. This variety has been noted in passing by Rupke (*The great chain of history* (ref. 13), 48) and Michael Roberts ("Geology and Genesis" (ref. 15), 247).
71. [Bugg], *Scriptural geology* (ref. 52), i, 363. Unless otherwise noted, italics in quotations are original.
72. [Bugg], *Scriptural geology* (ref. 52), ii, 355–6.
73. Millhauser, "The scriptural geologists" (ref. 6), 71; Haber, *The age of the world* (ref. 6), 212; and David Elliston Allen, *The naturalist in Britain: A social history* (London, 1976), 70.

74. Rupke has suggested in *The great chain of history* (ref. 13) that literalist earth-history "began to form a coherent body of literature ... specifically in opposition to Buckland's *Reliquiae Diluvianae*" (p. 42), but while Buckland's work clearly provided an important and often negative stimulus for literalist writers, Rupke's suggestion seems to me to flatten out Buckland's significance in geological debate in the 1820s, to gloss over the role played by Cuvier's *Theory of the earth*, and to overstate the literalists' coherence as a movement (see Section 3 of this article). Several literalists made positive rather than negative use of Buckland's cave theories and natural-theological position (e.g. Rennie, Turner, Ure).
75. See O'Connor, *The earth on show* (ref. 34).
76. Moore, "Geologists" (ref. 13), 337; and Rudwick, "The shape and meaning of earth history" (ref. 13), 312.
77. J. Mellor Brown, *Reflections on geology: Suggested by the perusal of Dr Buckland's Bridgewater Treatise* (Edinburgh, 1838), 50.
78. Adam Sedgwick, *A discourse on the studies of the University* (Cambridge, 1833), 9.
79. Brown, *Reflections on geology* (ref. 77), 3.
80. Brown, *Reflections on geology* (ref. 77), 38.
81. See the works cited in ref. 13. It is worth pointing out, however, that this opposition was not motivated purely by theological conservatism. Initial opposition to Buckland's hyena-den theories formed part of a larger tussle between provincial investigators and metropolitan gentlemen over the intellectual (and sometimes physical) ownership of local fossils. On the wider context see Knell, *The culture of English geology* (ref. 15).
82. Henry Cole, *Popular geology subversive of divine revelation! A letter to the Rev. Adam Sedgwick* (London, 1834); Penn, *A comparative estimate* (ref. 52); and George Fairholme, *A general view of the geology of Scripture* (London, 1834).
83. Katherine Lyell, *Life, letters and journals* (ref. 27), i, 238.
84. Jack Morrell and Arnold Thackray (eds), *Gentlemen of science: Early correspondence of the British Association for the Advancement of Science* (London, 1984), 168. This passage is also quoted in Rupke, *The great chain of history* (ref. 13), 49.
85. [Charles Lyell], "Scrope's *Geology of central France*", *Quarterly review*, xxxvi (1827), 437–83, p. 482.
86. Granville Penn, *A comparative estimate of the mineral and Mosaical geologies*, 2nd edn (2 vols, London, 1825), i, pp. xxxvii and xxxvi.
87. Penn, *A comparative estimate* (ref. 86), i, pp. xxxvi–xxxvii, n.
88. Stephen Jay Gould, "The invisible woman", in Barbara T. Gates and Ann B. Shteir (eds), *Natural eloquence: Women reinscribe science* (Madison, 1997), 27–39, p. 38. This essay is also printed in Stephen Jay Gould, *Dinosaur in a haystack* (London, 1997), 187–201.
89. Mary Roberts, *The progress of Creation considered, with reference to the present condition of the earth* (London, 1837), 243.
90. Millhauser, "The scriptural geologists" (ref. 6), 65.
91. The classic account of this split is Frank M. Turner, "The Victorian conflict between science and religion: A professional dimension", *Isis*, lxix (1978), 356–76. Reassessments include David N. Livingstone, "Re-placing Darwin and Christianity", in Lindberg and Numbers (eds), *When science & Christianity meet* (ref. 5), 183–202; and Paul White, "Ministers of culture: Arnold, Huxley and liberal Anglican reform of learning", *History of science*, xliii (2005), 115–38.
92. For further biographical information on Ure, see (besides the works cited in the caption to Table 1) W. S. C. Copeman, "Andrew Ure, M.D., F.R.S. (1778–1857)", *Proceedings of the Royal Society of Medicine*, xliv (1951), 655–62. On Mary Roberts, see also Gillian Lindsay, "Mary Roberts: A neglected naturalist', *Antiquarian book monthly*, xxiii (1996), 20–22; Gould, "The invisible

woman" (ref. 88); and Donald L. Opitz, "Introduction", in Mary Roberts, *The conchologist's companion*, ed. by Bernard Lightman (facsimile reprint of 1st edn, Bristol, 2004), pp. v–x.

93. Moore, "Geologists" (ref. 13), 337.
94. Knell, *The culture of English geology* (ref. 15).
95. For this information see the works cited in the caption to Table 1.
96. James Rennie, *Insect architecture* (London, 1830).
97. Letter from Buckland to Vernon Harcourt, 20 November 1833, printed in Morrell and Thackray (eds), *Gentlemen of science: Early correspondence* (ref. 84), 235.
98. This does not necessarily mean that the people concerned did not continue to practise geology, although several did not; the question is whether or not they published or lectured on this science.
99. See, for instance, Rachel Bromwich, *Matthew Arnold and Celtic literature: A retrospect 1865–1965* (Oxford, 1965), 31–32; and Derek Jarman (ed.), *Aneirin: Y Gododdin: Britain's oldest heroic poem* (Llandysul, 1988), p. lxxxiii.
100. For the epithet applied to Turner see Cantor, *Quakers, Jews, and science* (ref. 47), 128; for some of Lyell's poetic compositions see Katherine Lyell, *Life, letters and journals* (ref. 27), i, 55.
101. Rupke, *The great chain of history* (ref. 13), 42.
102. Sharon Turner, *The sacred history of the world, as displayed in the Creation and subsequent events to the Deluge* (London, 1832), 31, 462. Turner wrote two further volumes in 1834 and 1837.
103. Turner planned, and later wrote, two subsequent volumes on postdiluvian universal history; but his first volume was designed to stand alone (Sharon Turner, *The sacred history* (ref. 102), p. vii).
104. Letter from Buckland to Vernon Harcourt, 20 November 1833, printed in Morrell and Thackray (eds), *Gentlemen of science: Early correspondence* (ref. 84), 235. The projected review was to be written by Sedgwick, but it was never written.
105. Turner, *The sacred history* (ref. 102), 461.
106. Buckland, *Geology and mineralogy* (ref. 67), i, 29–31.
107. Rudwick, "The shape and meaning of earth history" (ref. 13), 312–13.
108. Penn, *A comparative estimate* (ref. 86), i, 182–5; and Mary Roberts, *The progress of Creation* (ref. 89), 3.
109. Miller, *The testimony of the rocks* (ref. 35), 157–91.
110. Penn, *A comparative estimate* (ref. 86), ii, 209–29. Compare Mary Roberts, *The progress of Creation* (ref. 89), 242.
111. Andrew Ure, *A new system of geology, in which the great revolutions of the earth and animated nature, are reconciled at once to modern science and sacred history* (London, 1829), 499–500.
112. Penn, *A comparative estimate* (ref. 86), ii, 231–43. On this strategy see Mortenson, *The great turning point* (ref. 17), 75.
113. Miller, *The testimony of the rocks* (ref. 35), 404–6.
114. Michael Roberts ("Geology and Genesis unearthed" (ref. 15), 247) claims that the literalists all agreed that "the strata were laid down in the Noachian Deluge". This was believed by many, but others (such as Ure and Turner) believed that the secondary formations had been laid down before the Deluge.
115. George Young and John Bird, *A geological survey of the Yorkshire coast*, 2nd edn (Whitby, 1828), 356.
116. Gillispie, *Genesis and geology* (ref. 6), 264; Millhauser, "The scriptural geologists" (ref. 6), 71; David R. Oldroyd, "Historicism and the rise of historical geology", *History of science*, xvii (1979), 191–213 and 227–57, p. 247; and Merrill, *The romance of Victorian natural history* (ref. 59), 84–85. The attribution to Rennie was made in an anonymous literary notice, "Attributed to J.

Rennie, ... Conversations on Geology", *Magazine of natural history*, i (1829), 280.

117. [Rennie], *Conversations on geology* (ref. 63), 45, 290–1.
118. [Rennie], *Conversations on geology* (ref. 63), 290–1.
119. Ure, however, agreed with Buckland's theory, and Turner recommended Buckland's work on the hyenas as "very interesting, and full of enlarged views and information" (Turner, *The sacred history* (ref. 102), 457, n. 51).
120. [Rennie], *Conversations on geology* (ref. 63), 333–6 and pp. vii–xi. On literalist objections to Buckland's hyena-den theory, see Rupke, *The great chain of history* (ref. 13), 42–50.
121. [Rennie], *Conversations on geology* (ref. 63), p. vi.
122. Ure, *A new system of geology* (ref. 111), p. vii. Compare [Rennie], *Conversations on geology* (ref. 63), pp. vii–xi, 290.
123. Gillispie, *Genesis and geology* (ref. 6), 194.
124. Ure, *A new system of geology* (ref. 111), p. viii.
125. Ure, *A new system of geology* (ref. 111), 226–7, 242–3.
126. Ure, *A new system of geology* (ref. 111), 243–7.
127. Fowler de Johnsone, *A vindication of the book of Genesis* (London, 1838). On this work see Terry Mortenson, "British scriptural geologists: Part 10. Fowler de Johnsone", *Technical journal*, xviii (2004), 76–77. I am grateful to Amanda Melendez for providing me with a copy of this article.
128. See, for example, William Cockburn's twelve-page pamphlet *Remarks on the geological lectures of F. J. Francis, Esq.* (London, 1839).
129. Penn, *A comparative estimate* (ref. 86), i, 1–2, 169–71.
130. [Thomas Rodd] "Philobiblos", *A defence of the veracity of Moses, in his records of the Creation and general Deluge* (London, 1820), pp. i–ii.
131. [Rodd], *A defence* (ref. 130), 104–5.
132. On the functions and receptions of Buckland's Bridgewater Treatise see Topham, "Science and popular education" (ref. 53); and Topham, "Beyond the 'common context'" (ref. 28).
133. John Hedley Brooke, "The natural theology of the geologists: Some theological strata", in L. J. Jordanova and Roy S. Porter (eds), *Images of the earth: Essays in the history of the environmental sciences* (Chalfont St Giles, 1979), 39–64; and Brooke and Cantor, *Reconstructing nature* (ref. 2), 176–206.
134. Turner, *The sacred history* (ref. 102), 8.
135. Turner, *The sacred history* (ref. 102), p. vi.
136. Turner, *The sacred history* (ref. 102), p. xii.
137. Charles Lyell, *Principles of geology, being an attempt to explain the former changes of the earth's surface, by reference to causes now in operation* (3 vols, London, 1830–3), iii, 385.
138. Thomas Gisborne, *The testimony of natural theology to Christianity*, 2nd edn (London, 1818), 16–18.
139. "Philo", *A short narrative of the creation and formation of the heavens and the earth, &c. as recorded by Moses in the book of Genesis* (London, 1819), 3. For a similar opening gambit see "Biblicus Delvinus", *Facts, suggestions, and brief inductions in geology* (London, 1838), 1.
140. Robert Bakewell, *An introduction to geology: Comprising the elements of the science in its present advanced state*, 3rd edn (London, 1828), 27.
141. S. Best, *After thoughts on reading Dr. Buckland's Bridgewater Treatise* (London, 1837), 10; and Brown, *Reflections on geology* (ref. 77), 41.
142. On Martin see Thomas Balston, *John Martin 1789–1854: His life and works* (London, 1947); William Feaver, *The art of John Martin* (Oxford, 1975); Morton D. Paley, *The apocalyptic sublime* (New Haven, 1986); and *ODNB*.

143. On this painting see Martin J. S. Rudwick, *Scenes from deep time: Early pictorial representations of the prehistoric world* (Chicago, 1992), 22–24.
144. Rudwick, *Scenes from deep time* (ref. 144), 78–85.
145. On the importance of apocalyptic spectacle for geological popularization, see O'Connor, *The earth on show* (ref. 34), chap. 7.
146. Young and Bird, *A geological survey*, 1st edn (ref. 63); and Gideon Algernon Mantell, *The fossils of the South Downs; or Illustrations of the geology of Sussex* (London, 1822).
147. [Rennie], *Conversations on geology* (ref. 63), 4. Marcet's book had reached an eleventh edition by 1828. For discussion of the latter, see Greg Myers, "Fictionality, demonstration, and a forum for popular science: Jane Marcet's *Conversations on chemistry*", in Gates and Shteir (eds), *Natural eloquence* (ref. 88), 43–60; and Fyfe, "Introduction", in Mary Roberts, *The conchologist's companion* (ref. 92), pp. xxi–xxvii.
148. Earlier examples of didactic geology books aimed in part at children include J. Mawe, *Familiar lessons on mineralogy and geology* (London, 1821) and Delvalle Lowry, *Conversations on mineralogy* (2 vols, London, 1822). Rennie's third edition was published in London by J. W. Southgate in 1840. The second edition of 1828 was identified by John Thackray (handwritten note in Thackray's copy of this edition, property of Maggs Bros, London).
149. Ure, *A new system of geology* (ref. 111), pp. viii, liv.
150. Young and Bird, *A geological survey*, 1st edn (ref. 63), 178–9; and Young and Bird, *A geological survey*, 2nd edn (ref. 115), 186–7.
151. Ure, *A new system of geology* (ref. 111), p. liii.
152. Ure, *A new system of geology* (ref. 111), p. liii.
153. Ure, *A new system of geology* (ref. 111), 226, 221, 259.
154. Ure, *A new system of geology* (ref. 111), pp. 348–9, 498, vi, 501.
155. Ure, *A new system of geology* (ref. 111), pp. liii–liv.
156. Turner, *The sacred history* (ref. 102), 520. Compare Fairholme, *A general view* (ref. 82), 285, on diluvial drifting: "The whole scene now presents itself to the imagination."
157. Undated playbill for a vampire melodrama, reproduced in Louis James (ed.), *English popular literature 1819–1851* (New York, 1976), 226.
158. [Rennie], *Conversations on geology* (ref. 63), 362–4. Rennie cites Cuvier for this view, but (like Roberts) manifestly contradicts him.
159. [Rennie], *Conversations on geology* (ref. 63), 5.
160. [Rennie], *Conversations on geology* (ref. 63), 7–8, noted by Oldroyd, "Historicism" (ref. 116), 247.
161. [Rennie], *Conversations on geology* (ref. 63), 45. On the response to Burnet see Fiona J. Stafford, *The last of the race: The growth of a myth from Milton to Darwin* (Oxford, 1994), 34–36. On later geologists coveting Milton's laurels, see Klaver, *Geology and religious sentiment* (ref. 13), 15–17; Ralph O'Connor, "Thomas Hawkins and geological spectacle", *Proceedings of the Geologists' Association*, cxiv (2003), 227–41; and Ralph O'Connor, "Hugh Miller and geological spectacle", in Lester Borley (ed.), *Celebrating the life and times of Hugh Miller: Scotland in the early 19th century* (Cromarty, 2003), 237–58.
162. See, for example, Fairholme, *A general view* (ref. 82), pp. xii, 323–4.
163. This may be an allusion to Edward Young's famous lines in *Night thoughts* (1745) on the antediluvian world: "Of *One* departed World / I see the mighty Shadow" (Edward Young, *Night thoughts*, ed. by Stephen Cornford (Cambridge, 1989), 260 [Night IX, lines 127–8]).
164. Brown, *Reflections on geology* (ref. 77), 39–40.
165. Brown, *Reflections on geology* (ref. 77), 40.
166. Daniel Defoe, *Robinson Crusoe*, ed. by J. M. Coetzee (Oxford, 1999), 155.

167. Brown, *Reflections on geology* (ref. 77), 39.
168. O'Connor, *The earth on show* (ref. 34), chap. 4.
169. Buckland, *Geology and mineralogy* (ref. 67); Gideon Mantell, *The wonders of geology* (2 vols, London, 1838); and Hugh Miller, *The Old Red Sandstone; or New walks in an old field* (Edinburgh, 1841). For discussion see O'Connor, *The earth on show* (ref. 34), chaps. 6 and 9–10.
170. Fyfe, *Science and salvation* (ref. 7), 24.
171. Buckland's *Geology and mineralogy* had to wait twenty-two years for a third edition, Mantell's *Wonders of geology* went into a seventh edition after nineteen years, and Miller's *Old Red Sandstone* went into a seventh edition after sixteen years.
172. See Yule, "The impact of science" (ref. 13), 328–9. On disputes among élite geologists see Rudwick, *The great Devonian controversy* (ref. 13), and James A. Secord, *Controversy in Victorian geology: The Cambrian–Silurian dispute* (Princeton, 1986). On their battles with transmutationists see Secord, *Victorian sensation* (ref. 28).
173. Jean André Deluc, *Letters on physical history*, transl. by Henry De la Fite (London, 1831).
174. [Nathaniel Hawthorne] "Peter Parley", *Universal history, on the basis of geography*, 7th edn (London, 1860), 14. This book was first published in the United States in 1837; the seventh edition cited is one of many unauthorized British reprints of this book. On Hawthorne and "Peter Parley" see Daniel Roselle, *Samuel Griswold Goodrich, creator of Peter Parley: A study of his life and work* (Albany, 1968), 76–79.
175. John Mason Good, *The book of nature* (3 vols, London, 1826), i, 158–70.
176. John Mason Good, *The book of nature*, 3rd edn (3 vols, London, 1834), i, p. viii.
177. Good, *The book of nature*, 3rd edn (ref. 176), i, 151, n.
178. Anon., "*Principles of geology*", *Athenaeum*, 1830, 595–7; [John Lindley], "*A general view of the geology of Scripture*", *Athenaeum*, 1833, 228–9 (on which see Rupke, *The great chain of history* (ref. 13), 47–48); and [James Apjohn], "*Principles of geology*", *Athenaeum*, 1833, 409–11.
179. Anon., "*Principles of geology*", *Eclectic review*, 3rd ser., vi (1831), 75–81, p. 80.
180. Maria Hack, *Geological sketches, and glimpses of the ancient earth*, 2nd edn (London, 1835), 166–7, 214; Turner, *The sacred history* (ref. 102), 446–58; and Roberts, *The progress of Creation* (ref. 89), p. vi. Compare Thomas Dick's approach as discussed by Astore, *Observing God* (ref. 7), 93–94. For other examples of boundary-blurring, see Yule, "The impact of science" (ref. 13), 97–98, 328–30; and Roberts, "Geology and Genesis unearthed" (ref. 15), 246–7.
181. On this cementing process in early nineteenth-century science generally see Yeo, *Defining science* (ref. 39), 32–39; on its application to geology, see James A. Secord, "Introduction", in Charles Lyell, *Principles of geology*, ed. by James A. Secord (abridged edn, London, 1997), pp. ix–xliii, see pp. xxiii–xxix.
182. Jabez Allies, *Observations on certain curious indentations in the Old Red Sandstone of Worcestershire and Herefordshire, considered as the tracks of antediluvian animals* (London, [1835]), 45. On Allies see *ODNB*.
183. Hugh Miller, "Geology of the Bass", in Thomas McCrie (ed.), *The Bass Rock: Its civil and ecclesiastic history, geology, martyrology, zoology and botany* (Edinburgh, 1848), [51]–[139], pp. [98]–[99]; Thomas Hawkins, *The book of the great sea-dragons, Ichthyosauri and Plesiosauri,* גדלים תנינם *gedolim taninim, of Moses. Extinct monsters of the ancient earth* (London, 1840); Thomas Thompson, "An attempt to ascertain the animals designated in the Scriptures by the names Leviathan and Behemoth", *Magazine of natural history*, viii (1835), 193–7, 307–21 (on which see Rupke, *The great chain of history* (ref. 13), 220).
184. J. G. Wood, *Animal characteristics: or, Sketches and anecdotes of animal life*, 2nd ser. (London, [1860]), 4, quoted and discussed in Bernard Lightman, "The story of nature: Victorian popularizers and scientific narrative", *Victorian review*, xxv/2 (1999–2000), 1–29, p. 14.

185. William Cockburn, *The creation of the world* (London, 1840), 9.
186. Orange, *Philosophers and provincials* (ref. 13), 59–62; Orange, "The idols of the theatre" (ref. 13); Morrell and Thackray, *Gentlemen of science: Early years* (ref. 13), 240–4; and Klaver, *Geology and religious sentiment* (ref. 13), 112–14.
187. Peter Harrison, *The Bible, Protestantism, and the rise of natural science* (Cambridge, 1998).
188. Browne, "Noah's Ark" (ref. 5), 128.
189. Numbers, *The creationists* (ref. 18); and Moore, "The creationist cosmos" (ref. 18). Numbers's book, in particular, contains valuable discussions of audience responses to the twentieth-century institutions, writers, and preachers whose careers form the main focus of his book.
190. Cooter and Pumfrey, "Separate spheres" (ref. 1), 256.