



CHRONOLOGY & CATASTROPHISM

REVIEW 2021:3

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BOOK REVIEWS: *The Nature of the Atom*

On the Origin of Myth in Catastrophic Experience

Plus **Society News and Letters**



The Crab Nebula is the remnant of a massive star in the Milky Way that died 6,500 light-years away. Astronomers and careful observers saw the supernova in the year 1054 AD.

Image credit: NASA, ESA, J. Hester and A. Loll (Arizona State University)



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The Sign of Hezekiah: Retracing the Steps

Marinus Anthony van der Sluijs

The Biblical Passages

Ahaz (c752-c716 BC) was a king of Judah whose reign is presently dated to 732-716 BC. He was succeeded by his son Hezekiah (c739-c687 BC), who ruled 729-687 BC including coregencies and 716-697 BC alone. According to two Biblical passages, Hezekiah fell ill but was granted to live fifteen more years upon intercession to the god Yahweh by the prophet Isaiah. While the healing was brought about by the application of figs, the ‘sign of Hezekiah’ was an unexplained intervention in the natural order by which Yahweh signalled his promise:

Then Isaiah said, ‘... shall the shadow go forward ten steps or go backward ten steps?’ And Hezekiah answered, ‘It is an easy thing for the shadow to go down ten steps; no, but let the shadow go backward ten steps.’ So Isaiah the prophet cried out to Yahweh, and He brought the shadow ten steps backward, by which it had gone down on the steps of Ahaz. [1]

And the word of Yahweh came to Isaiah, saying, ‘Go and tell Hezekiah, ‘... I will bring the shadow on the steps, which has gone down with the sun on the steps of Ahaz, ten steps backward.’ So the sun returned ten steps on the steps by which it had gone down. [2]

According to these verses, the miracle appears to have been a single event transpiring on ‘the steps of Ahaz’ (*ma’ālōt ‘Āhāz*). What is meant by the shadow having “gone down [with the sun] on the steps” is somewhat opaque; the most intuitive interpretation is that this described the time of day when the event took place. Hezekiah’s opinion that “It is an easy thing for the shadow to go down” probably referred to the fact that the shadow always descended – and thereby probably lengthened – on the steps at that time of day. It might go up at another time, but not at this time. The first passage names only the shadow (*šēl*), the second also the sun (*šemeš*). Neither passage reveals whether there was a compensatory extension back to the original condition before the sun or shadow resumed its regular progression; was the change permanent or temporary? Either way, as a ‘sign’ (*‘ōt*) the point was obviously that the clock of the king’s allotted lifespan was set back just like the solar days were.

The story goes on to relate how word of Hezekiah’s recovery reached Marduk-apla-iddina II (d. 700 BC), king of Babylon (722-710 and 703-702 BC), who promptly dispatched envoys to query and congratulate him. [3] The Hebrew rendition of this king’s name is Merodach-Baladan (Mərodak Bal’ādān). On current dating, the mysterious retrogradation must thus be assigned to 702 BC. This is 14 years after Ahaz’s death. At least in terms of Biblical reckoning itself, [4] it was in the same year that Jerusalem was besieged by Sīn-aḥḥē-erība (Sennacherib; c745-681 BC), king of Assyria. The fifteen additional years promised by Isaiah would roughly have doubled Hezekiah’s reign.

Jewish Interpretations

Throughout antiquity, the legend continued to be told unanimously as an anomaly involving the body of the sun itself, implying that the event was simultaneously experienced in Judah, Babylon and elsewhere. A Jewish work dated to c200-175 BC that many denominations classified as apocryphal simply recalled, with respect to Hezekiah:

In his days the sun stepped back,
and he added to life for the king. [5]

In ancient Jewish practice, hours did not have a fixed length, as they have with us, but were relative: all year round, the periods of daylight and night – which vary with the seasons – were divided into twelve equal hours each. Although it cannot simply be assumed that the ‘steps’ in the story corresponded to such relative hours on a one-to-one basis, many of the earlier sources – Jewish, Greek or Roman – implied exactly that. Long shadows are limited to the early morning and the late afternoon, when the sun appears low above the horizon. The shadow’s retreat by ten steps already completed out of a presumed twelve must then have occurred late in the day. This was probably the understanding of the historian Flavius Josephus (AD 37-c100), even if he did not specifically use the word ‘hours’:

When he [Hesaias] questioned him about what sign he wanted to occur, he requested that the sun – since it, as it declined, had already made a shadow of ten paces in his house – might return to the same spot, causing it to cast [the shadow] again. [6]

A narrative offshoot that may have originated with the Babylonian Talmūdist Rab Hūnā (AD c216-c296) told the story from the perspective of the Babylonian king. One account goes as follows:

Merodach-baladan was in the habit of eating at the 6th hour and sleeping until the 9th hour. When, in the days of Hezekiah, the orb of the sun went back ten degrees, Merodach had gone to sleep as usual, but when he rose and found it was morning, he was about to slay all his servants, saying accusingly to them: You have let me sleep all day and all night! They replied, Sire, you ate at your usual time and you slept your usual time: but the orb of the day went backwards [while you slept]. He asked: Which God made it go backwards? They replied: Hezekiah's God made the orb of day go backwards. [7]

The story naïvely makes it seem as if news of Hezekiah's healing could have reached Babylon instantaneously. The 'steps' or 'degrees' in it cannot equal hours as only nine hours of daylight had passed when the king woke up. Yet they must have represented units longer than 18 minutes or else the retrogradation would not have reset the clock to a time in the morning, that is, before the 6th hour. At least four nearly identical versions are on record, in one of which the king's sleeping hours were from the third to the ninth. [8] By giving the adjusted time of his awakening, one of these allows a calculation of the added daylight time – 5 hours – which indicates that each 'step' corresponded to 30 minutes:

... he slept till the ninth hour and rose at the fourth hour. [9]

Yōḥānān bar Nappāḥā (AD c180-279) was an older contemporary of Rab Hūnā, based in Palestine, who read a double event into the Biblical texts: "The day on which Ahaz died consisted of but two hours; and when Hezekiah sickened and recovered, the Holy One, blessed be He, restored those ten hours ..." [10] Clearly, he understood the words "gone down [with the sun] on the steps of Ahaz" as a reference to an earlier historical event instead of an indication of the time on the day of Hezekiah's sign. Equating the 'steps' to hours, what he envisioned was evidently a sudden lengthening of the shadow by ten steps on the day king Ahaz expired, compensated by an instant shortening by the same amount during the reign of his son Hezekiah. Yōḥānān seems to have owed this exegesis to his countryman Yōsē ben Ḥālaptā (2nd century AD), who is cited thus in the chronological treatise *Sēḏer 'Olām Rabbā (The Great Order of the World)*:

It was (2Kings 18: 13) 'in the year 14 of king Hezekiah, Sennacherib attacked ...' ... Before the fall of Sennacherib, Hezekiah was sick for three days. R. Yose says, the downfall of Sennacherib was on the third day of Hezekiah's sickness and the sun was arrested for him as it stood for Ahaz ... [11]

A work of medieval date tied the first of the two events to Ahaz's worship of the heavenly bodies, offensive even to the sun itself. The speakers are first Isaiah and second Hezekiah:

He said to him: Ahaz, your father, was a master in the constellations and he prostrated himself before the sun, the moon, the stars and the constellations, and the sun fled from him and descended in the west ten steps. And if you want, it will descend another ten steps.

He spoke before him: Lord of all worlds, no, just let it turn back these ten steps which it has descended and stand in its place ...

And all the kings of the earth saw [it] and wondered, for there was no [day] like it from the day on which [the world had been created ...] [12]

The French rabbi Solomon ben Isaac *alias* Rashi (1040-1105 AD) provided a different but not unrelated motivation for the shortening of the day of Ahaz's death: "It hastened to go down, and the day was shortened by ten hours on the day Ahaz died, in order that they should not eulogize him, and now they went backwards on the day Hezekiah recovered, and ten hours were added to the day." [13] At any rate, the reading of a pair of events seems to have been not a folk tradition, but the rather strained conjecture of a single rabbi, expanded upon by others. [14] It may be compared to another obscure rabbinical opinion, according to which God shortened and subsequently lengthened the day by two hours as a gesture to Jacob. [15]

As an aside, the quotation given above from *Sēḏer 'Olām Rabbā* shows that the author regarded Hezekiah's illness as concomitant with the miraculous destruction of Sennacherib's army. The proof for this synchronism is far from straightforward, however. On one hand, it seems warranted by 2 Kings 20. 6, yet on the other the transition from chapter 19 to 20 reads like there was a chronological gap between the two events, even if they happened in the same year. [16] In the latter camp, Josephus interpolated a few lines in the Biblical narrative according to which Hezekiah "having been unexpectedly relieved of his fears, offered thanksgiving sacrifices to God along with all the people" in the wake of Sennacherib's defeat but prior to his illness. [17] The matter remains unresolved.

Astronomical Explanations

A vast literature concerns itself with the exact nature of the steps of Ahaz. Skipping over most of this, it will suffice here to reiterate that they need not at all have been degrees on a conventional sundial, but could have been part of a staircase; nor did they necessarily correspond to units of a whole or half hour, instead of far smaller units of time. As for possible explanations of the 'miracle', most can be grouped into astronomical and atmospheric categories. Of the former, a few highlights will be examined before moving on to what is arguably a more realistic approach.

Orbital Change of the Sun

Already implied in the rabbinical sources reviewed above, the oldest and most radical hypothesis is a sudden alteration in the relative positions of the earth and the sun. This would naturally be of worldwide scope and involve a change in the length of the affected day. On a geocentric paradigm, the sun would have returned to an earlier point in its orbit around the earth. Sometimes extended to the moon or other parts of the universe, this type of explanation was routine among the church fathers. [18] According to Hippolytus of Rome (AD c170-c235), Ephraem the Syrian (AD c306-373) and pseudo-Dionysius the Areopagite (late 5th or early 6th century AD), that fateful day had counted 32 daylight hours: 10 normal hours + 10 hours moving back + 10 hours of recovery + the remaining 2 hours. [19] Eustathius of Antioch (d. AD c360) calculated ‘only’ 22 daylight hours, assuming the retrogradation to have been instantaneous: 10 normal hours + 0 hours moving back + 10 hours of recovery + the remaining 2 hours. [20]

Rotational Change of the Earth

The heliocentric alternative is some sudden change in the earth’s axial rotation, be it an inversion in the direction of that rotation or an alteration of the rotational axis in either its tilt or its geographical position. While simplifying the physical explanation of the sun’s apparent return, these options also introduce some almost inevitable catastrophic effects in the way of tsunamis, seismic waves or air blasts into the equation.

That archetypal English catastrophist, William Whiston (1667-1752), named “the real miraculous revolution of the earth, in its diurnal motion, backward, from east to west for a while” as one possible explanation of the miracle, but was quick to subjoin that the length of the day cannot have been lastingly changed as “eclipses elder than that time were observed at the same times of the day as if this miracle had never happened.” [21] It is not clear which eclipses he was thinking of or why he imputed to Josephus the view that “the shadow was accelerated as much at first forward, as it was made to go backward afterward, and so the day was neither longer nor shorter than usual”.

In 1743, the German pastor and headmaster Johann Heyn (1709-1746) – who was much taken by Whiston’s theories of cometary catastrophes – aired the idea that the sign of Hezekiah came about when ‘a comet had passed the earth and disturbed it in its daily rotation.’ [22] He felt that it would still have been a miraculous occasion insofar as Isaiah had been able to foresee it.

Leaving comets out of the picture, the English churchman and ‘chronologist’ Edward Greswell (1797-1869) later speculated that the ten apparent solar hours gained through reversed axial rotation during the reign of Hezekiah corresponded to twelve hours of mean evening time for the given season and location; they would have complemented twelve hours of mean morning time that had been added 810 years earlier at the time of Joshua’s solar miracle, when the earth’s axial rotation had been suspended. [23]

Immanuel Velikovsky (1895-1979) followed the Talmūdic understanding of a pair of counteracting events, which he dated to 701 BC and precisely 23 March 687 BC. He blamed these on the planet Mars making close passages to the earth and thereby disturbing the latter’s rotational axis in its inclination, its geographical positioning and even the velocity of its rotation, though apparently not the direction of its rotation. [24] In doing so, he made much of the blast that would have decimated Sennacherib’s army on the very day that Hezekiah’s health was restored. Upping the ante, he related these events to archaeomagnetic evidence for a geomagnetic ‘reversal’ in the 8th century BC. [25] Peter Warlow (1936-2011) more categorically saw geomagnetic reversals in the palaeo- and archaeomagnetic record as symptomatic of physical inversions of the earth. He uniquely contended that they are illusions created by the magnetic field retaining its original position with respect to space while the earth turns over by 180° in the manner of a tippe-top. [26]

The geomagnetic data set cited for this occasion by Velikovsky has since developed into an impressive body of evidence for a tentative geomagnetic excursion called the Störnö-Etrussia excursion. [27] This is dated to 3000-2200 BP in the broadest sense and 2700-2500 BP in particular, but is still a long way from being universally recognised among geophysicists. Nevertheless, it might be worth considering whether the anomalous behaviour of the shadow associated with Hezekiah’s recovery could have been linked somehow to the irregular geomagnetism of this period. As a variation on Warlow’s scenario, perhaps the worldwide palaeo- and archaeomagnetic imprint of an excursion or even an ‘archaeomagnetic jerk’ at this time is explicable if the earth’s crust experienced a sudden tilt with respect to its fluid outer core – a large wobble, in rotational terms. If this happened in a matter of hours and occurred during the Near Eastern day, the sun would have appeared there to change its position in the sky. The geomagnetic excursion in the geological archives could be explained if the fluids at the earth’s core were also disturbed but capable of returning to their original stable state over the course of a few decades to centuries. The upshot would be that not only the sun, but all celestial bodies changed their altitudes. This could not have been a permanent change, because of the deliberate and accurate polar orientation of the main shaft in the pyramid of Khufu at Gīza (Egypt), which was built long before Hezekiah. [28] If the cited rabbis were right, as seems unlikely, two rapid wobbles may have occurred some 14 years apart, in opposite directions and such that the second one cancelled out the effects of the first one. This would beggar belief even more. The only tenable

scenario in this vein might be a single rapid displacement of the crust with a return to the original position within hours, combined with a prolonged temporary disturbance in the magnetic field at the core.

With or without magnetic accompaniments, a major weakness of any rotational hypothesis is that such a dramatic change in the sun's apparent motion ought to have been observed and recorded in the highly literate and astronomically oriented cultures surrounding Israel and further afield – but no record to such effect is known. The rabbis' assertion that the confusion of the hours of daylight was also felt in Babylon would appear to be no more than fiction grown out of the Biblical narrative of Merodach-Baladan's letter to Hezekiah; indeed, the Chronicler specifically wrote that the envoys were sent 'to inquire about the wonder that had occurred *in the land*' (*lidroš ha-mōpēt 'āšer hāyā bā'āreš*), [29] suggesting that nothing unusual had been experienced in Mesopotamia. [30] This and other objections have frequently been raised.

Velikovsky adduced the Chinese legend of duke Lüyáng, along with some later parallels, and the Greek myth of the sun's reversal at the time of the Argive tyrants Atreus and Thyestes. [31] However, the former belongs in the 5th century BC; [32] although Velikovsky played this date down as one that "is sometimes supposed, on the basis of astronomical computation", there appears to be no dispute that Lüyáng was the grandson of Píng, king of Chǔ, who ruled 528-516 BC. [33] This is far too late for Hezekiah. To quote Velikovsky's critic Bob Forrest, the dates of the Chinese parallels "completely wreck any relevance" these events "might have either to V's scenario or to each other". [34] As for Atreus, [35] the internal chronology of Greek myth places this incident about a generation before the Trojan War, which by all accounts antedated Hezekiah. [36]

As a further valid point, Forrest underscored the distinctly un-catastrophic flavour of the episode with the shadow:

... apart from the two 'miracles' of the dial and the destruction of the army, there is no catastrophism, metaphorical or otherwise, to be seen. ... If there is a cosmic upheaval going on, it certainly doesn't show up in Kings, and it is hard to believe that the dial and the destruction of Sennacherib's army are the only remaining symptoms of such an upheaval in a narrative of the times! ... We are not told that any adverse effects accompanied this event – not even the merest hint of an earthquake – so that its actual catastrophic value is virtually nil. ... if an immense cosmic upheaval were going on in the background, one would expect to hear a bit more about it than that the dial of Ahaz went back on itself and that the army of Sennacherib was mysteriously smitten! ... We have here a 'wonder that was done in the land', not a glimpse of a global catastrophe. [37]

He went on to rightly question the rabbinical opinions endorsed by Velikovsky that the sign of Hezekiah coincided with the destruction of Sennacherib's troops and that it had had a symmetrical counterpart on the day of Ahaz's death: "Such details are surely an indication of a magical and apocryphal literary origin rather than of a factual, impersonal and randomly timed catastrophic origin." [38]

Comet Flyby

Some investigators contemplated an even more direct rôle for comets than initiating a disturbance of the earth's rotation. The British journalist and publisher William Comyns Beaumont (1873-1956) explained the anomaly by "a comet, approaching the earth very closely and throwing its light when the sun sank": "Many records describe comets as like great suns, and it may be believed such was the case in the period of Hezekiah." [39] In support, Beaumont cited a Roman report for c150-146 BC, according to which "a comet shone brightly, no smaller than the sun" (*cometes effulsit non minor sole*), and suspended the night:

At first it was a fiery, reddish circle, emitting bright light sufficient to overcome the darkness; then gradually its size contracted, and its brightness faded, and finally it disappeared totally. [40]

As the author, Seneca, did not specify for how long this was seen, one cannot help wondering whether this was not a slowly fading bolide – and it would be stretching credulity to suppose that a daytime bolide accounts for the sign of Hezekiah. There are good grounds for maintaining a cometary identity of the object mentioned by Seneca, however. [41] Be that as it may, Beaumont's rationale was presumably that Hezekiah's comet was bright enough to overrule the shadow produced by the sun and create its own shadow, resulting in the illusion of a sudden reduction in the shadow caused by the sun. Against this, even a comet capable of dispelling the night could hardly be of such staggering magnitude as to rival the sun by day or twilight as long as its light was reflected sunlight, as is the case with the moon and planets. Moreover, it would likely have been spotted in the sky in the days or weeks leading up to the 'miracle' and been mentioned in the records of other cultures. The desolation caused by its subsequent impact onto the earth should have been plainly recorded in the historical sections of the Bible, rather than being concealed in the rhetoric of prophets, as Beaumont had it. His daft relocation of the scene to the British Isles does not help his cause either.

Eclipse

Less radical proposals, free from catastrophist import, aimed to explain the receding shadow by a solar eclipse. The basic idea that the shadow on Ahaz's steps underwent a rapid change in response to the moon's obscuration of a part of the sun was put forward as long ago as 1849. Writing in that year, German theologian and philosopher Otto Thenius (1801-1876)

suggested the partial eclipse of 26 September 713 BC as the right candidate. [42] This eclipse is no longer recognised today. [43] The English banker and Bible scholar James Whatman Bosanquet (1804-1877), followed by his compatriot George Frederick Chambers (1841-1915), a barrister and amateur astronomer, favoured the annular eclipse of 11 January 689 BC, which would have been partial as seen from Jerusalem and occurred around noon (fig. 1). [44] The eclipsing of the upper segment of the sun's disc "would have had the effect of causing a shadow from the south, cast on a staircase, sloping downwards towards the north, and lying nearly parallel with the steps of the staircase, to recede to the extent described in the history, even 'ten steps', and that with a deliberate motion not to be mistaken, extending over twenty minutes. So great an effect could not have been produced on the steps at any other period of the year". [45] More recently, Margaret Barker seized on the total solar eclipse of 6 August 700 BC, [46] which would have been visible at Jerusalem as "a 75 per cent eclipse of the sun ... in the late afternoon ..., lasting from about half past five until sunset". [47]

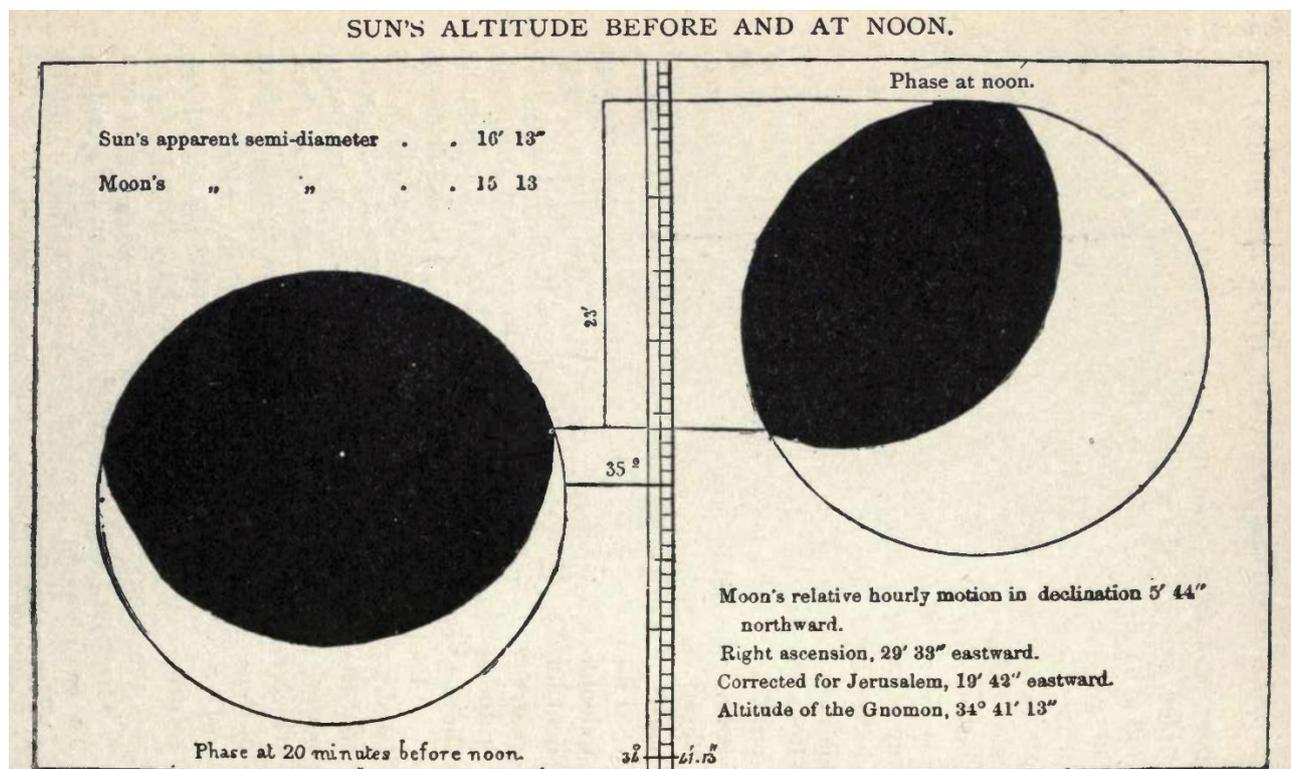


Figure 1: The altitudes of the sun and moon during the solar eclipse of 11 January 689 BC as seen at Jerusalem, 20 minutes before noon (left) and at noon (right). Chambers 1908: 86 figure 12.

The suggestion that the sign of Hezekiah was the effect of an eclipse does hold some attraction, subject to two qualifications. Firstly, the ten steps could only have represented a fairly small amount of time as the changes in the shadow potentially resulting from the eclipse are minute. [48] Second, the eclipse must indeed have been partial at least in Palestine, as the darkening that is characteristic of a total eclipse would certainly have been included in the story – as the main event no less – if it had struck. That the eclipse should have gone unnoticed by the locals is not as strange as it may seem; it takes well over 90% coverage of the sun's surface to produce any noticeable dimming. On these points, all proponents seem to agree. The devil might be in the details, however. The eclipse explanation can only be made to work under very specific conditions regarding the season, time of day and type of installation represented by the 'steps'.

Thenius' scheme was such that 'at the onset of a solar eclipse a retreat of the shadow on the earth occurs, at the end an advance.' [49] Specifically, 'when the western part of the sun is covered by the moon, that is during the first part of a solar eclipse, the centre of the shadow of a body on the earth definitely moves somewhat further west than would be the case without this covering, more exactly: the eastern limit of the penumbra and the western one of the umbra move westward ... During the final part of the solar eclipse, when the eastern part of the sun is covered, the situation is of course reversed, with the shadow now *advancing* a little, i.e., the centre of the shadow deviating slightly towards the east.' [50] On Bosanquet's reconstruction, by contrast, the first half of his preferred eclipse would have seen the shadow descend to the lowest step on a flight of stairs; during the second half, it would have reascended (fig. 2). [51] Bosanquet, therefore, took the Biblical statement that the shadow had gone down by ten steps as a reference to what happened during the first half of the eclipse. The problem is that this is quite an unnatural reading of the text. As noted, the story rather indicates that the shadow's descent was normal for the moment, not part of the unusual event; the miracle lay in the ascent alone. With some special pleading one might suppose that the rapid descent or lengthening was overlooked by all present, except

perhaps Isaiah. Maybe it caught the prophet's eye, made him intuitively realise that it would be followed by a compensatory movement in the opposite direction and thus inspired the question which he put to the king, all without the slightest consciousness of eclipses. If a candidate eclipse occurred at sunrise, too, it might be argued that only the recovery phase was observed, but no such eclipse is available for the period in question.

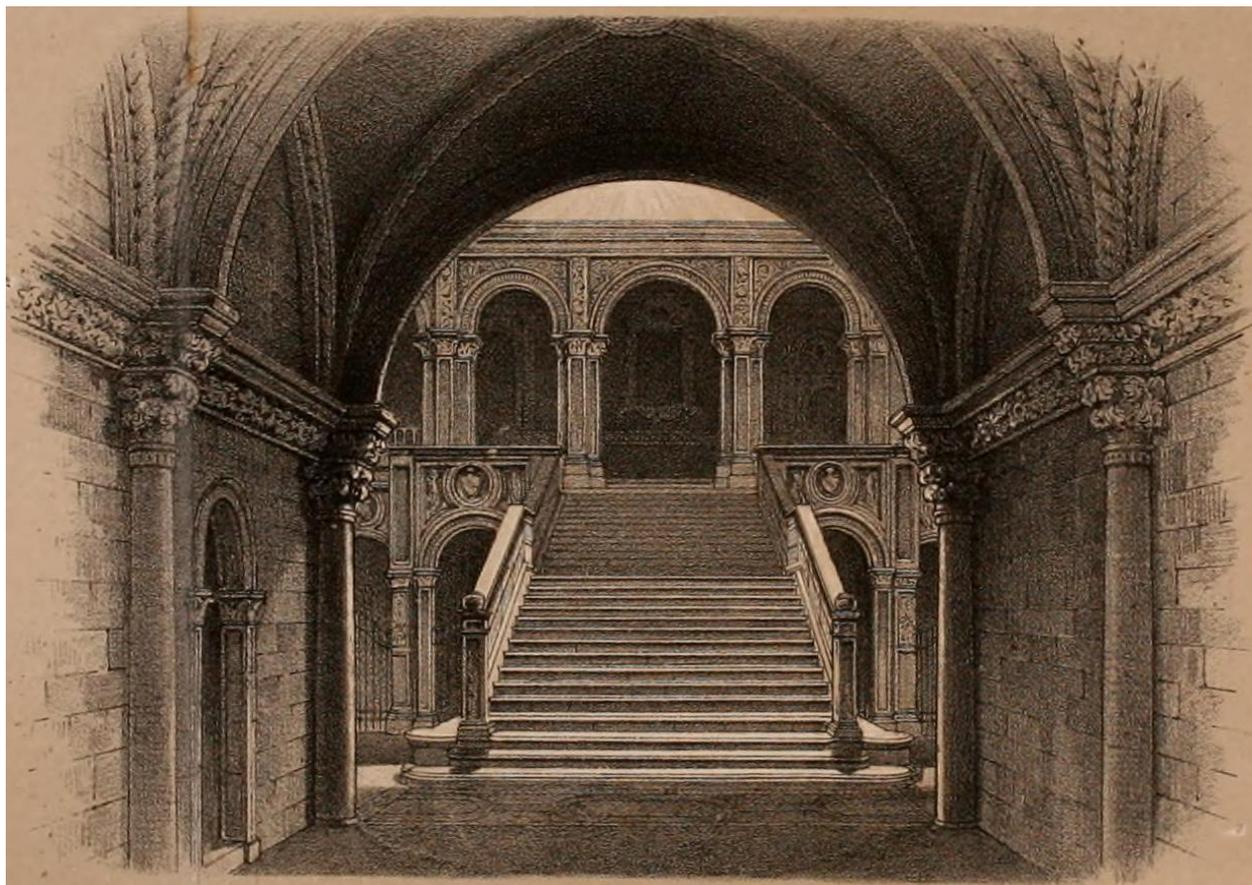


Figure 2: Gnomon of the dial or steps of Ahaz leading to the upper chamber, showing the shadow at noon during the partial eclipse of 11 January 689 BC, as envisioned by Bosanquet. Lithograph by Vincent Brooks, Day & Son. Bosanquet 1874: 36/37 figure.

As for Barker's scenario, her argument that the text "may mean that the shadow did not complete its usual movement" [52] or that "the effect of the eclipse would have been to make the sunset come ten degrees early" [53] is specious; on the timescale of a day, an afternoon shadow reaching less far than usual due to premature darkness is simply not a retracting shadow.

One way or another, the eclipse approach is thus quite contrived, although it is not falsified.

Atmospheric Explanations

Comparatively simpler solutions appear to be available. Could Hezekiah's sign have been a localised event with a purely atmospheric cause instead of a celestial one? As the French Bible scholar, pastor and antiquary Samuel Bochart (Bochartus; 1599-1667) put it in 1646, 'the miracle was in the sundial: not in the sun's body itself'. [54] Although this insight was likely a step in the right direction, Bochart refrained from providing a physical mechanism.

An Atmospheric False Sun

It was the 'prince of philosophers', Baruch Espinosa (Benedictus de Spinoza; 1632-1677), who advanced the bold idea that some optical-atmospheric effect could be behind the tradition of the sun's retrogradation:

So, too, the sign of the shadow moving backwards was revealed to Isaiah according to his understanding, namely by a backward movement of the sun: for he, too, thought that the sun moves, & the earth is at rest. And of parhelia he perhaps never even dreamed. We may assert this without any scruple; for the sign could really have occurred, & been predicted to the king by Isaiah, albeit the Prophet did not know its true cause. [55]

Espinosa did not elaborate, but probably imagined that a sun dog appeared through the window of the palace after the sun had already passed by. This would have given the illusion that the sun had somehow returned to its earlier position.

Parhelia typically form at sunrise or sunset, when shadows are long. The bright light of this one could have partially expelled the shadow caused by the sun on the steps, thus making it seem to retreat. More plausibly perhaps, it may have produced its own rival shadow while the sun itself was blocked from view by a cloud. It is an ingenious thought, structurally similar to Beaumont's cometary suggestion, but is it beyond cavil that a parhelion can be bright enough to cancel the shadow caused by the sun or to produce its own shadow? The Prussian theologian Theodor Christoph Lilienthal (1717-1781) went to some lengths to confute the idea:

For the parhelia do not have a light so bright that they would be able to outshine the true sun. The shadow from the true sun would have remained and at most a duplicate shadow could have been seen. Who would then have thought that the actual shadow had receded? But if the true sun is obscured by clouds; no parhelia tend to show either. Not to mention that several parhelia are generally seen at the same time, which would then have multiplied the shadow even more. [56]

These arguments are surely too strongly worded. There is no physical reason why a parhelion could not be seen while the sun itself and a second parhelion are hidden by a cloud. Yet even if a parhelion might explain the anomaly with the shadow, it could hardly be mistaken for the actual sun; though sun-like, it often shows a marked 'tail' pointing away from the sun, especially when bright. Also, appearing at the same altitude as the sun it would not necessarily give the impression that the clock had been set back to an earlier time of day; most people are not very conscious about the exact place on the horizon where the sun is supposed to rise or set for the time of year.

In the meantime, Whiston had questioned the standard belief in a change of the planet's axial rotation by promoting an atmospheric alternative in the nature of an 'aerial phosphorus':

As to this regress of the shadow, either upon a sun-dial, or the steps of the royal palace built by *Ahaz*, whether it were physically done, by the real miraculous revolution of the earth, in its diurnal motion, backward, from east to west for a while; and its return again to its own natural revolution from west to east; or whether it were not apparent only, and performed by an aerial *phosphorus*: (of which sort, though under other shapes, we have had a great many of late years, (which imitated the sun's motion backward, while a cloud hid the real sun,) cannot now be determined, philosophers and astronomers will naturally incline to the latter hypothesis. [57]

Phōsphoros is Greek for 'light-bearer'. From contemporary usage, [58] it can be surmised that Whiston applied this term to certain auroral phenomena, specifically the auroral arc at a time that the kinship between this and the auroral corona was not yet understood. [59] As an explanation for the sign of Hezekiah, Whiston's rationalisation not only suffers from some of the shortcomings spelled out by Lilienthal, but also falls short in that such arcs are nighttime phenomena.

In light of Bochart's progressive stance, Espinosa's resort to a halo-like effect and Whiston's hunch of a self-luminous light look like a setback in the sense that they again postulated something perceived as an anomaly in the sky, be it now one confined to the atmosphere. Commentators have often pointed out that the passage in 2 *Kings* might be more authentic or less poetic than that in *Isaiah* in restricting the event to the shadow. Going by it, even the perception of an unusual sun need not be conjured up.

The Parallel of Metz

Significantly, a phenomenon of the very same nature as Hezekiah's sign occurred on 7 June 1703 in Metz (France), as reported two years later by the French mathematician Antoine Parent (Parentius; 1666-1716). The principal witnesses were Romuald Le Muet (1660-1739), mathematician and prior of the local convent Hôpital de la Charité St. George, and two monks, who attested to the following in a letter to Parent dated 26 July:

In the Hôpital de la Charité of Metz in Lorraine there is a vertical sundial declining from the south to the east, written down against one of the sides of the House with great accuracy; its axis is fixedly sealed in the wall, & moreover established on a straight and solid stile. In front of this same face of the building, there is a terrace along the Moselle where Father Romuald, prior of the Convent was walking with one of the brothers named Lucien de la Coûture on 7 June 1703 while waiting for the hour of noon, now the one and then the other casting a glance on this Sundial from time to time. When they saw noon having passed, Brother Lucien left Father Romuald to go sound the Angelus; then noon was sounded at the Cathedral, at the Hôpital & at the clock of St. Vincent.

But in the time that Father Romuald still had his view turned towards the Sundial he clearly & distinctly saw the shadow of the axis retracing the path from noon to quarter past 11; which causing him to watch the object more attentively still, he then watched the shadow pass imperceptibly from 11.15 to 11.30; then he called Brother Lucien back to witness this marvel with him.

A South wind was blowing at that time, which caused several small clouds of different thickness & separated from each other to pass in front of the Sun, but without any rain ... Father Romuald further noticed that all these different clouds did not change anything in the movement of the sun's shadow.

Brother Lucien now having returned to join Father Romuald, he asked him if he remembered well where the shadow was when he left him, & he having answered him that he remembered very well that it passed noon, he then showed

him that a cloud thicker than the others & which had prevented seeing the shadow for some time had passed, that it had then indicated only 11.30; at the same time, another brother named Alexis de Laîne, having come down from his cell, came to join them & was very surprised to only observe 11.30 on the Sundial; because he believed it was a quarter past noon.

Father Romuald adds that he stayed for nearly an hour and a half to observe the movement of the shadow, which always seemed to him as regular as usual, except that he initially believed that the shadow moved a little faster from 11.15 to 11.30 than through the other quarters following. [60]

A fourth witness then stepped forward: the prior of Metz's Celestine Order stated shortly afterwards that 'this same day we sounded the *Angelus* of noon at this Convent twice in a row about three quarters of an hour from each other'; when he wished to reprimand the one who had sounded for the second time, the latter 'justified himself in the moment by showing him that it was still only noon at their Sundial.' [61]

In a follow-up publication, Parent added an impressive list of locals, including more clergy, the mayor and a gentleman from Nancy, who had noticed that 'the evening of this retrogradation was extended by almost an hour more than the previous ones & more than the following, although the Sky was covered by clouds' and reported 'the delay of the next day by at least an hour, since it was barely daylight at four o'clock in the morning', while the clock on the cathedral had maintained perfect regularity. [62] Presumably, the astronomical dusk and dawn actually came at the normal times but something played havoc with the sunrays. Whatever caused the disturbance apparently lasted from the noon of the 7th to the next morning.

With the help of a diagram (fig. 3), Parent demonstrated that the sunlight's interference with a 'Vaporous Body' that was transparent on its eastern side and opaque on its western side and passed through the atmosphere with a speed and in a direction close to the apparent direction of the sun at an altitude of 6 or 10 *lieuës* – that is to say, 26 to 45 km – would give the impression 'as if the Sun had suddenly retrograded from 12 to 11'. [63] If subsequently the sun sets, with the foreign body in front of it, the rays 'will raise the Image of the Sun above the horizon ... & thereby delay the night ...' [64] At the end of the night, the body will have drifted away enough from the sun to occupy 'a certain elevation above the Sun', with the effect that the rays only reach the earth with a delay.

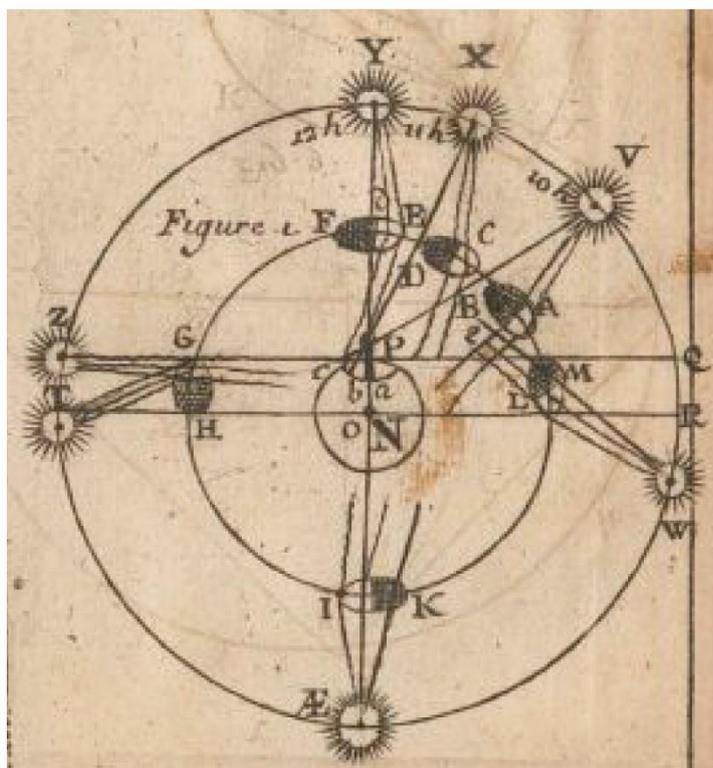


Figure 3: Diagram illustrating how the passage of a half opaque and half vaporous body through the earth's lower atmosphere in the same direction as the sun but at a slightly different rate can produce the optical effects of a retrogression of the shadow on a sundial and a delayed sunset and sunrise (1713). N is the earth, O its centre, a the area of Metz, aP a stylus placed on a south-facing wall, VYTÆR the ecliptic plane, with V, X (both before noon), Y (noon), Z (above the western horizon), T (below the western horizon), Æ (midnight) and W (below the eastern horizon) as different positions of the sun on this parallel. VPc, XPb and YPa are the rays of the sun striking the sundial at 10.00, 11.00 and 12.00, respectively. At T, an image of the sun is projected above the horizon as Z. At W, the rays of the rising sun (WLe) are deflected away from the sundial. Drawn by Antoine Parent (1666-1716). Parent 1713: Pl. 20 figure 1.

Scholarly Reflections

The 'marvel of Metz' caught the attention of German *savants*. Knowing only of Parent's first publication on the subject, the philosopher Ludwig Philipp Thümmig (Thümmigius; 1697-1728) offered a short discussion of it in 1722. In this, he reduced the effect to an enhanced refraction of solar rays due to imperceptibly condensed air, 'whose interstices were filled with heterogeneous and thicker particles'. [65] Another philosopher, Christian Wolff (Wolffius; 1679-1754), did the same the year after. [66] Having not seen Parent's own physical interpretation either, this paragon of the German Enlightenment speculated: 'The rays are refracted when matter is present that condenses the air considerably. ... The clouds that passed by the sun did not cause a change in the shadow of the sundial: therefore, the matter in which the light

was refracted must have been denser than the vapours that the clouds carry. We find that water has a strong refraction, which can cause the same appearance.’ [67] Accordingly, he suggested a simple experiment:

If the sun is not shining, place a light before a sundial, such that the shadow of the pointer falls on the twelfth hour line. Let the light stand still and hold a sphere or simply another glass with water in-between; then the shadow will recede at once. [68]

Wolff reasoned that the peculiar observation at Metz must have been caused by the very rare freezing of ‘dense round drops’ into ‘perfect and transparent ice’ that the wind then conveyed through the air ‘in a thin layer’. [69] It was probably Wolff’s treatment on which Heinrich Friedrich Reischauer (1717-1785), a pastor and philosopher, based his own note on Parent’s report, including a description of the same experiment. [70]

Remarkably, there is no indication that the ecclesiastical observers of the event or the above-mentioned German writers drew a parallel with the sign of Hezekiah. That imaginative leap appears to have been first made by the famous Swiss scholar Johann Jakob Scheuchzer (1672-1733), albeit very tentatively; he cautioned that, as ‘a purely natural phenomenon’, what happened at Metz could at best have a limited bearing on the Biblical wonder (fig. 4). [71] Johann Jacob Schmidt (1691-1762), a Pomeranian pastor, was hardly less reticent on this count. Citing Scheuchzer obliquely for the French precedent and arguably familiar with Wolff’s offering on the subject, he observed that such retrogradations can occur due to ‘a strong refraction or bending of the sunrays in an intervening thick Atmosphaera or atmosphere, namely when it is predominantly filled with frozen raindrops or hail that do not darken the air but strongly refract or bend the sunrays, diverting them to another side.’ [72] The effect could be replicated experimentally: ‘if you put a glass of water between a light and a needle in the evening, the needle’s shadow, if you watch it closely beforehand, will immediately turn somewhere else due to the refraction of the light.’ [73] However, Schmidt hastened to add that the shadow could only be moved in this manner by a small amount – not by the equivalent of ten hours or half-hours – and still came down in defence of a true Biblical miracle.



Figure 4: The sign of Hezekiah as interpreted by Scheuchzer. Copper engraving by Johann Andreas Pfeffel (1674-1748). Scheuchzerus 1733: 620/621 plate 494 = Scheuchzer 1734: 150/151 plate 494.

Other members of the Wolffian school pursued this avenue of thought. Theologian Johann Gustav Reinbeck (1683-1741) compared the spectacle seen in Jerusalem to the Metz event as reported by Wolff, but again commented that the former would still have been a miracle because a regression by as much as ten hours would never be possible by ordinary refraction and because Isaiah could not have anticipated the king’s choice of miracle. [74] Not all displayed this timid

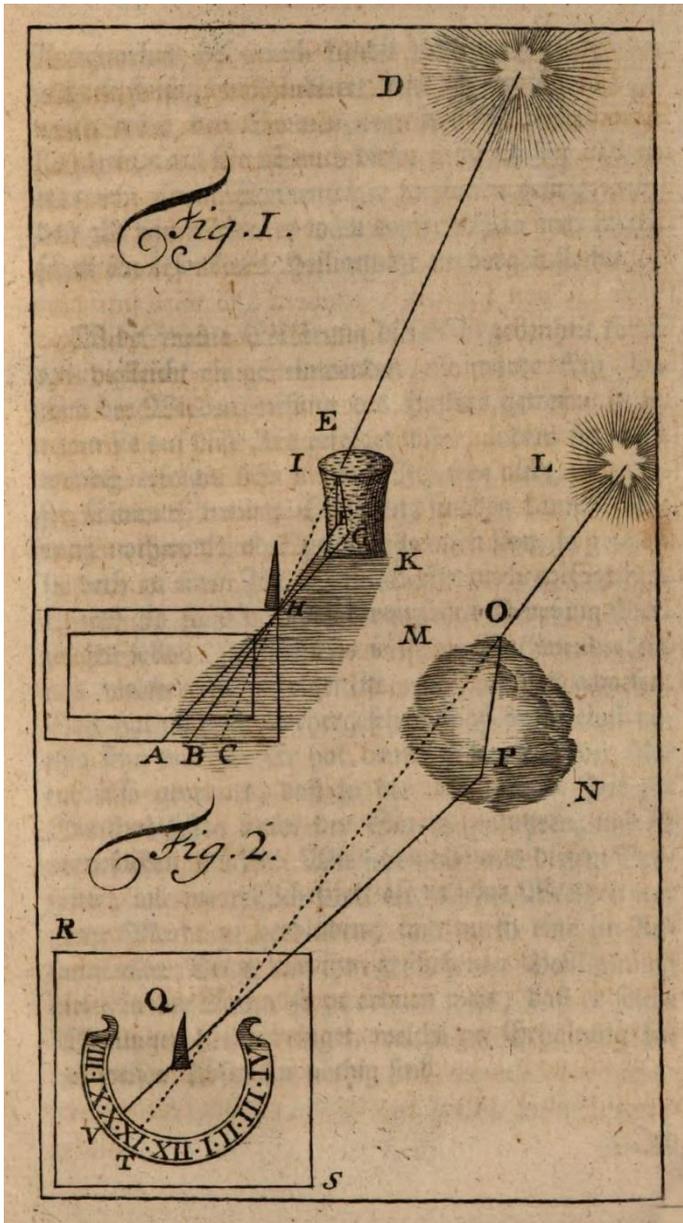


Figure 5: Refraction of the sun's rays through a cup of water (top) and through a vaporous cloud onto a sundial (bottom). Mylius, 'Fortsetzung der Betrachtungen über die Majestät Gottes', 1743, p. 478 figs. 1-2.

inclination. An anonymous writer most likely to be the obscure Carl August Gebhardi (b. c1722) was adamant that Wolff's explanation gave a sufficient account of the Biblical tale. [75]

In a letter to Heyn already cited above, a citizen of Leipzig signing only as 'B. G.' also used the testimony in Parent's first article to explain the sign of Hezekiah. [76] Noting that the refractory explanation obviates the need to invoke a disturbing comet, [77] he, too, claimed that the effect can easily be reproduced experimentally:

For example, one pounds a nail into a wall upon which the sun shines and holds a glass filled with water between it and the sun. Immediately, the shadow recedes. I have pretty often performed this experiment and found it to be correct. [78]

In his response, Heyn accepted the analogy and, paraphrasing Reinbeck's position, noted that the 'steps' of Ahaz need not have equalled hours at all and could have connoted much smaller units of time, though Isaiah's foresight remained puzzling. [79]

Meanwhile, Christlob Mylius (1722-1754), a Saxon physician and naturalist, was as confident as Gebhardi and 'B. G.' had been that 'formerly at the time of Hezekiah a subtle vapour, or a thin cloudlet, could have caused the recession of the shadow on Ahaz's sundial ...' [80] Some practical experimentation, with the shadow cast by an upright pencil as the sunlight again passes through a glass of water (fig. 5), drove Mylius to clarify:

So if one assumes the vapour cloudlet that passes under the sun to be more subtle and transparent still than the glass of water was; just as such vapour cloudlets which are even invisible among us, can easily cause refraction of the sunrays: so one can understand without difficulty how a vapour cloudlet can be between us and the sun without noticeably diminishing its light and causing commingling of the shadow of opaque bodies with its own, which is all too subtle. [81]

Mylius backed this contention up with the case of Metz

[82] and, inferring that the effect ought to be quite common in the real world, without the medium of a glass of water, added an experience that he had had of his own:

I myself have had the good luck to witness such an event recently. For as I was occupying myself with the experiment described, the sky instantly cleared up, having been full of rain clouds before. While I was looking directly at the pinned pencil so as not to miss the full sunshine; its shadow retreated a fair bit, as the sun's rays were only half shining so to speak, without my holding the glass in-between, but immediately returned to its place. This happened because, as I could clearly see, thin cloudlets were still passing below the sun. I was not a little pleased that I had seen exactly what Hezekiah and Isaiah had seen in Jerusalem and Romuald and Lucian in Metz. They had seen the shadow retreat; me too. [83]

Mylius was understandably thrilled, but his own observation of a very fleeting deviation is still some way removed from the error at Metz, which continued for the best part of a 24-hour period. In his defence, however, he could not have known that the Metz disturbance had lasted that long if he had only seen Parent's first article. That aside, it is by no means clear that the shadow on Ahaz's steps immediately returned to its place.

Lilienthal, who was also introduced earlier, must not have read Mylius attentively when he countered that retrogradations of the shadow should be much more common if the mechanism was as simple as that suggested by Mylius. Also, he

wrote, in order to produce a deviation of two and a half hours – let alone ten hours – on Ahaz’s dial, the interfering cloud would have had to be so dense as to be opaque, preventing the shadow from forming altogether. Nor would the curved shape of a glass filled with water be comparable to a cloud, which allows the light to pass through in parallel rays. Refracted sunlight could only naturally explain the Biblical anomaly if the interposed object was at once dense, transparent and light enough to be airborne. Deeming this impossible, Lilienthal instead envisaged a staircase with twenty steps that were covered by the shadow of the palace in the morning and lit up one by one from the top downwards as the sun rose. An earthquake in the mid-afternoon would have raised the palace but not the stairs, so that it would have been like the sun was low above the building again and the king looking out of the window would have seen the shadow cover the steps again (fig. 6). [84]

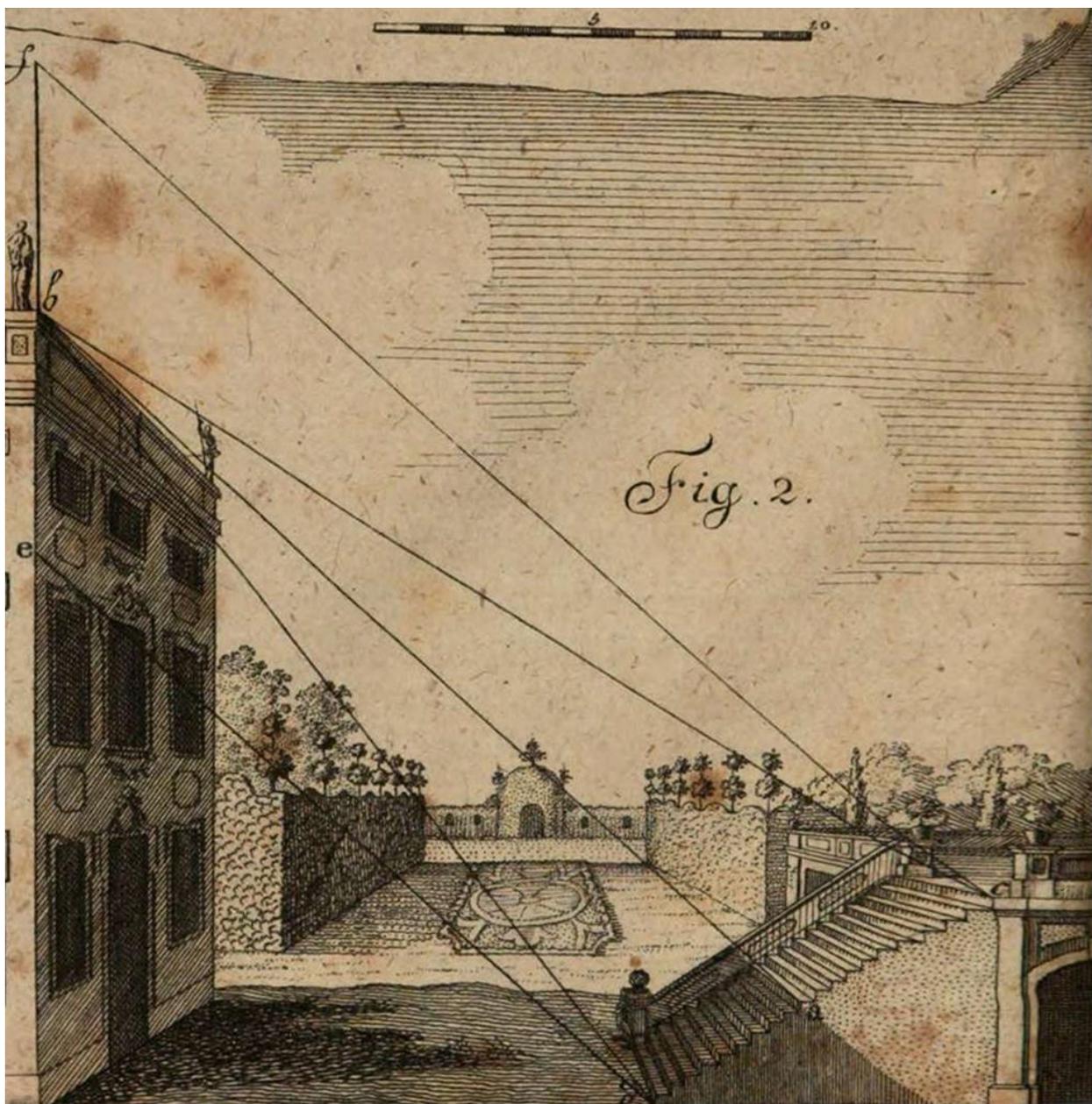


Figure 6: Sudden raising of the palace, such that the top moves from (b) to (f), would extend the shadow on the steps upward from (da) to (dc). Copper engraving. Lilienthal 1760: frontispiece Fig. 2

The most salient downside of this geological stab at an explanation is that the quake would have been so localised that the stairs remained intact even as the building was lifted and that the people in the palace curiously would not have noticed anything other than the change in lighting. On top of that, the ‘going down of the shadow’ would in this case have applied to the upper margin of the shadow only, as the lower margin remained fixed at the bottom of the stairs. That is to say, the ‘going down’ would have entailed a shortening and the ‘going up’ a lengthening. The Biblical text admittedly allows for this reading, but the more instinctive understanding is still that the shadow’s ‘going down’ coincided with its lengthening, the shadow being cast not by the palace but by some gnomon on the opposite side of the stairs from the place.

Another theologian, Johann Kaspar Velthusen (1740-1814), probably had not seen Lilienthal's discourse when he cited Mylius' discussion approvingly in an essay devoted to the subject, noting that he had already performed a similar experiment himself. Submitting that the event in Jerusalem would have been brief, he considered – on the authority of Johann Friedrich Ackerman (1726-1804) – that it might also be explained by sunlight reflected in a mirror producing a secondary shadow while the primary shadow is blocked (for this effect, compare fig. 7). [85] This proposition is on a par with Espinosa's parhelion.

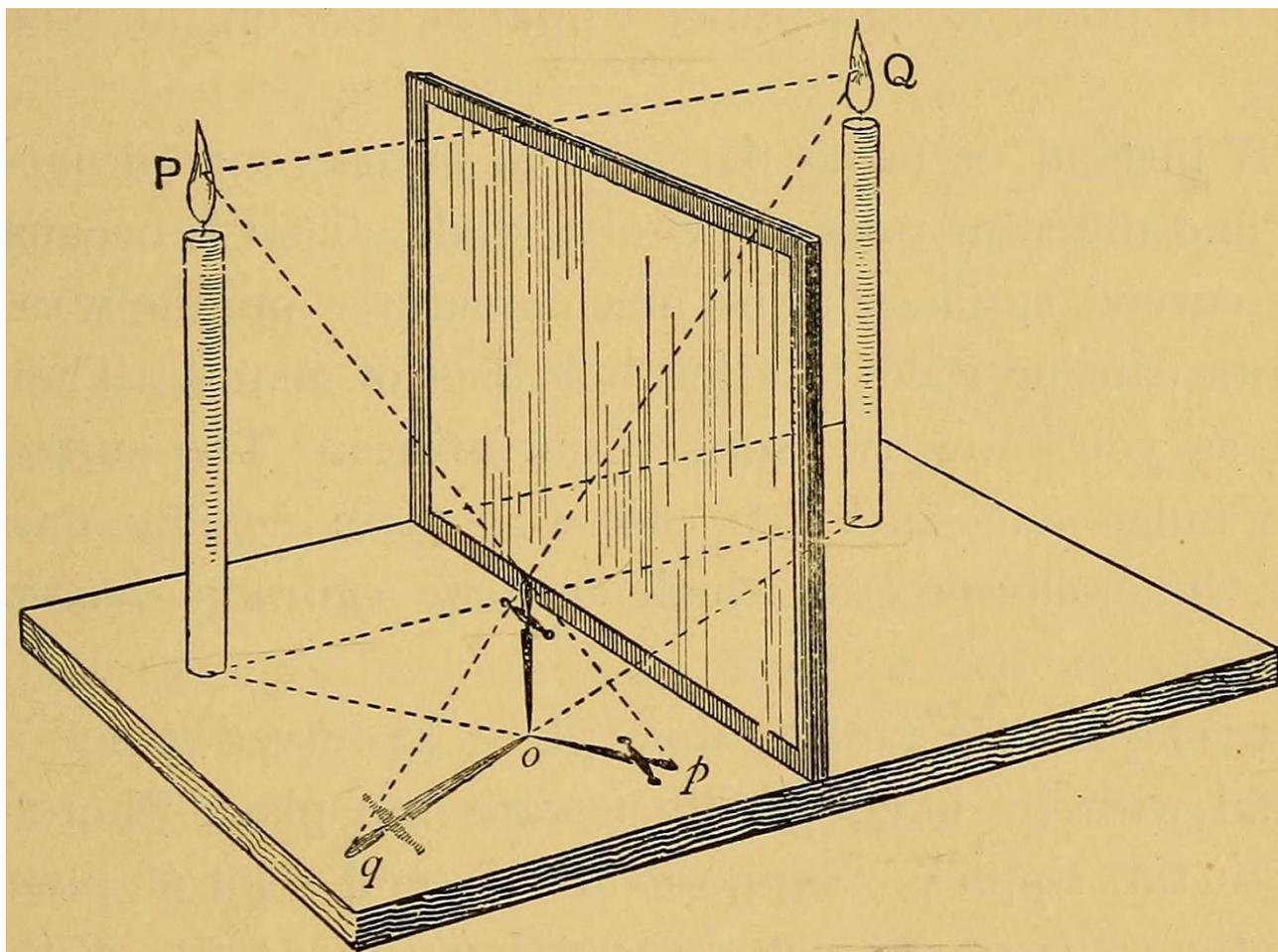


Figure 7: The light from a candle (P) produces a direct shadow (p) of a dagger (o), but also a second shadow (q) if reflected in a mirror, as if a second candle (Q) stood behind the mirror. S. P. Thompson, *Light Visible and Invisible; A Series of Lectures Delivered at the Royal Institution of Great Britain, at Christmas, 1896*, MacMillan and Co., London, 1897, p. 23 fig. 12.

Around the same time, the refraction hypothesis inspired by the mystery of Metz began to make its way into verse-by-verse Bible commentaries. The Swiss pastor Charles-Pierre Chais (1701-1785) repeated Scheuchzer almost *verbatim*, [86] concluding that ‘God only condensed the part of the Atmosphere that covered the Palace’, possibly ‘by using to this end an imperceptible wind that carried vapours there’. [87] Ernst Friedrich Karl Rosenmüller (1768-1835), a noted Orientalist and theologian, relied on Mylius – via Velthusen – as he tackled the problem from the exegetical angle of refracted sunlight. [88]

The idea reached the Anglophone world in two unrelated publications in 1803. The Irish bishop Joseph Stock (1740-1813) took it from Rosenmüller and reproduced a drawing of a combined observatory and dial a few miles from Delhi as a possible analogy to Ahaz's steps. [89] Of a type called Jantar Mantar and dated to the early 18th century, this building still exists. For his part, the English engraver and Biblical scholar Charles Taylor (1756-1823) drew on Scheuchzer, continuing:

Whoever is used to astronomical observations, knows, that what *Hooke* calls *veins of air*, i.e. layers of air of differing densities, and of dissimilar compositions, often interpose between the observer and his object. As the air at different elevations is of different degrees of heat, and pursues different courses, it is very credible, that a quantity of air loaded with transparent vapours, brought from a distance, either by its own properties, or by affecting the air below it, should vary the refractive powers of the atmosphere: the sun's rays passing through this varied portion, would take a new direction, and move the dial shadow accordingly. This refraction occurs every morning and evening in the instance of the twilight, and may occur at noonday, in some degree: but not to anything like the quantity observed

on the dial of Ahaz. In fact, this observation of *Romuald*, to the amount of an hour and half, is a very extraordinary incident. [90]

Up until about 1914, Bible commentaries, encyclopedias and other Old Testament studies continued to cite Le Muet's case in connection with the sign of Hezekiah, diverging widely in their assessments. [91] It sank into oblivion afterwards, but does not appear to have been properly refuted. Lilienthal's argument that the refractive effect through moisture would be too frequent to account for the miracle is tempered by the observation that the incident at Metz is as close an analogy as one could wish for and confirms that whatever caused it is in fact quite rare, especially if its long duration is taken into account. The intention of the present article is to revive the refractory hypothesis on the ground that the Biblical event may have been very similar to what Le Muet and his companions witnessed in 1703, and to a lesser extent what Mylius saw in 1743. Whilst the exact physical mechanism can be debated, the explanation is almost certainly to be sought along these lines. The earth's rotational properties would not have been affected; the time gained on the 'steps', perhaps in a matter of seconds, would have been illusory and compensated by an accelerated progression of the shadow back to the actual, unchanged time, perhaps after some hours. As at Metz, the error on the steps may have been smaller than an hour, reducing each step to the equivalent of 6 minutes at the very most. Dialled down to such proportions, it might be feasible to reproduce the event in a modern experiment and narrow down the requisite types of set-up and weather.

As for the vexing question of how Isaiah could have known in advance that such a prodigy would occur, which compelled so many interpreters to cling to divine intervention, the answer need not be nebulous: thinking a few steps ahead, the prophet may have seen the shadow already commencing to retreat before nimbly putting the choice of direction to the king and, anticipating his response, directing his attention to what was happening on the steps. This may have taken less than a minute, but would have been a marvellous display of quick wit putting the baffled clergy at Metz in the shade, even as he lacked a handle on the physical cause.

Notes and References

1. 2 Kings, 20. 9-11, eds. K. Elliger, W. Rudolph & A. Schenker, תורה נביאים וכתובים *Biblia Hebraica Stuttgartensia*, Deutsche Bibelgesellschaft, Stuttgart, 5th edition, 1997, pp. 661-662, tr. adapted from A. L. Farstad, *The Holy Bible Containing the Old and New Testaments; NKJV; New King James Version; Reference Edition*, Thomas Nelson, Nashville, TN, 1982, p. 346, retaining the name 'Yahweh' instead of translating "the LORD" and rendering all instances of *ma'ālōt* as 'steps' instead of alternately "degrees" and "sundial", to reflect that these words are identical in Hebrew. The events are also alluded to in 2 Chronicles, 32. 24-26, 31. Compare M. A. van der Sluijs, *Traditional Cosmology; The Global Mythology of Cosmic Creation and Destruction*, vol. 5: *Solar and Lunar Anomalies*, All-Round Publications, Vancouver, 2018, pp. 82-84.
2. Isaiah, 38. 4-5, 8, eds. Elliger *et al.*, *op. cit.* [1], p. 732, tr. Adapted from Farstad, *op. cit.* [1], p. 630 as above.
3. 2 Kings, 20. 12-19; 2 Chronicles, 32. 24, 31; Isaiah, 39. 1-8.
4. 2 Kings 18. 2, 13.
5. "en tais hēmérais autou anepódisen ho hēlios / kai proséthēken zōēn basilei." *Ecclesiasticus = Wisdom of Ben Sirach*, 48. 23, ed. A. Rahlfs, *Septuaginta id est Vetus Testamentum Graece iuxta LXX Interpretes*, vol. 1: *Leges et Historiae*, Privilegierte Württembergische Bibelanstalt, Stuttgart, 4th edition, 1950, pp. 464-465, tr. B. G. Wright, in A. Pietersma & B. G. Wright, *A New English Translation of the Septuagint and the Other Greek Translations Traditionally Included under that Title*, Oxford University Press, New York, 2007, p. 759.
6. Josephus, *Jewish Antiquities*, 10. 2. 1 (29), trs. Ch. T. Begg & P. Spilsbury, *Flavius Josephus: Translation and Commentary*, vol. 5: *Judean Antiquities Books 8-10; Translation and Commentary*, Brill, Leiden, 2005, pp. 214-215. The word "declined" translates *apoklínas*, ed. R. Marcus, *Josephus*, vol. 6: *Jewish Antiquities, Books IX-XI*, William Heinemann, London, 1958, p. 172.
7. *Pēsīqta dē-Rab Kahana (Discourses of Rab Kahana; 5th century AD)*, 2. 5, ed. S. Buber, *Pesikta, die älteste Hagada, redigirt in Palästina von Rab Kahana. Herausgegeben nach einer in Zefath vorgefundenen und in Aegypten copirten Handschrift durch den Verein Mekize Nirdamim. Mit kritischen Bemerkungen, Verbesserungen und Vergleichen der Lesearten anderer drei Handschriften in Oxford, Parma und Fez, nebst einer ausführlichen Einleitung*, L. Silbermann, Elk, Poland, 1868, fols. 13v-14r, trs. W. G. Braude & I. J. Kapstein, *Pēsīqta dē-Rab Kahāna; R. Kahana's Compilation of Discourses for Sabbaths and Festal Days; Translated from Hebrew and Aramaic*, Jewish Publication Society of America, Philadelphia, PA, 2nd edition, 2002, p. 38, with their "midday" changed to '6th hour' (*bšš š'wt*) and their "three in the afternoon" to '9th hour' (*tš' š'wt*).
8. These versions are: (1) *Šir ha-Širīm Rabbā (Song of Songs Rabbā; 6th century AD)*, 3. 4. 2, tr. M. Simon, *Esther; Song of Songs*, The Soncino Press, London, 1939, pp. 149-150: "It is related that Merodach was a worshipper of the sun, and he was accustomed to dine every day at the sixth hour and then to sleep till the ninth hour. When the sun went back in the days of Hezekiah, he went to sleep as usual and when he woke, he found it was morning. [He was so angry] that he wanted to kill all his guards. 'What', he said, 'you have let me sleep the whole day and the whole night?' They said to him: 'It is the day that has gone back.'" (2) Rab Hūnā, in *Midraš Tanhūmā Yelammādēnū* (late 8th or early 9th century AD): *Exodus*, 9. 5, tr. S. A. Berman, *Midrash Tanhuma-Yelammedenu; An English Translation of Genesis and Exodus from the Printed Version of Tanhuma-Yelammedenu with an Introduction, Notes, and Indexes*, Ktav Publishing House, Hoboken, NJ, 1996. And at https://www.sefaria.org/Midrash_Tanchuma_Foreword?lang=bi (last accessed 22 November 2017), pp. 575-576:

- “... Berodach [*sic*], who would eat every day at the third hour of the day and would sleep until the ninth hour. Once, during the time of Hezekiah, he was allowed to sleep through the sun’s return on its track. When he awakened and discovered that it was morning, he wanted to slay all his servants. He asked them: ‘Why did you permit me to sleep through a whole day and night?’ They replied: ‘The God of Hezekiah is the greatest of all the gods in the world.’” (3) *Sēpār ha-Ma’asiyyōt (Exempla*; 12th or 13th century AD), 78, tr. M. Gaster, *The Exempla of the Rabbis Being a Collection of Exempla, Apologues and Tales Culled from Hebrew Manuscripts and Rare Hebrew Books*, The Asia Publishing Co., Leipzig, 1924, p. 71: “When the sun had moved backwards at the request of the Prophet Isaiah on the occasion of the illness of Hezekiah, King Merodach believed that he had overslept himself, and had omitted to pay reverence to the sun in the morning.” (4) A Syriac variant contained in a scholion by Jacob of Edessa (AD c640-708) on Ephraem the Syrian’s *Commentary on 2 Kings* (4th century AD), ed. Petrus Benedictus [Buṭros Mubārak], *Sancti Patris Nostri Ephraem Syri Opera Omnia quae Exstant Graece, Syriace, Latine, in Sex Tomos Distributa ad MSS. Codices Vaticanos, Aliosque Castigata, Multis Aucta, Interpretatione, Praefationibus, Notis, Variantibus Lectionibus Illustrata Nunc Primum sub Auspiciis Clementis XII. Pontificis Maximi e Bibliotheca Vaticana Prodeunt*, vol. 1: *Syriace et Latine*, Typographia Vaticana, Rome, 1737, p. 563.
9. *Esther Rabbā* (12th century AD?), 3. 1, tr. Simon, *op. cit.* [8], pp. 43-44.
 10. Yōhānān bar Nappahā, in *Babylonian Talmūd: Sanhedrīn*, 11 (96a), tr. H. Freedman, *Sanhedrin; Translated into English with Notes, Glossary and Indices; Chapters VII-XI*, vol. 2, The Soncino Press, London, 1935, p. 649. Freedman (p. 649 note 6) remarked: “The return of the ten degrees is assumed to mean a prolongation of the day by ten hours, light having healing powers.”
 11. *Sēdēr ‘Ōlām Rabbā*, 23, tr. H. W. Guggenheimer, *Seder Olam; The Rabbinic View of Biblical Chronology; Translated and with Commentary*, Rowman & Littlefield Publishers, Lanham, MD, 2005, pp. 200-201. Note that ‘the sun ... stood’ (*‘āmādā ... ḥammā*) rather than turned back in this passage. Yōsē and Yōhānān have both been viewed as the main editor of this chronicle.
 12. “Er sagte zu ihm: Ahas, dein Vater, war jemand, der die Sternbilder zurückhielt, und er warf sich vor der Sonne, dem Mond und den Sternen nieder, und die Sonne floh vor ihm und stieg zehn Stufen in den Westen hinab. Und wenn du willst, wird sie weitere zehn Stufen hinabsteigen. / Er sprach vor ihm: Herr aller Welten, nur diese zehn Stufen, die sie hinabgestiegen ist, lass sie zurückkehren und an ihrem Platz stehen ... / Und alle Könige der Erde sahen [es] und wunderten sich, denn es gab keinen [Tag] wie ihn vom Tage an, an dem [die Welt erschaffen worden war ...]” *Pirqē dā Rabbī ‘Ēli ‘eẓer (Chapters of Rabbi Eliezer*; 8th or 9th century AD), 52, tr. adapted from D. Börner-Klein, *Pirke de-Rabbi Elieser; Nach der Edition Venedig 1544 unter Berücksichtigung der Edition Warschau 1852 aufbereitet und übersetzt*, Walter de Gruyter, Berlin, 2004, pp. 732-733 (366). Börner-Klein rendered *kōbēš* as ‘held back’, G. Friedlander (*Pirkē de Rabbi Eliezer (The Chapters of Rabbi Eliezer the Great) According to the Text of the Manuscript Belonging to Abraham Epstein of Vienna; Translated and Annotated with Introduction and Indices*, Kegan Paul, Trench, Trubner & Co., London, 1916, p. 425) as “compelled”. The translation ‘master(ed)’, adopted here, better conveys the basic meaning ‘to conquer’. An alternative might be ‘trailblazer’, following the meaning “to pave, grade a road” in M. Jastrow (ed.), *A Dictionary of the Targumim, the Talmud Babli and Yerushalmi, and the Midrashic Literature*, vol. 1: כ-א, Luzac & Co., London, 1903, p. 610 s.v. ‘קָבֵשׁ’.
 13. Rashi, *Commentary on Isaiah*, 38. 8, tr. J. Foer et al. (ed.), *Sefaria* (2012-), at https://www.sefaria.org/Rashi_on_Isaiah.38.8.3?lang=bi (accessed 24 September 2021). Compare Guggenheimer, *op. cit.* [11], p. 205 note 9: “so that Aḥaz should be denied proper funeral speeches.” Hence the interpretive translation of the passage in *Sanhedrīn* by Tz. H. Weinreb (ed.), תלמוד בבלי *Koren Talmud Bavli; The Noé Edition; Commentary by Rabbi Adin Even-Israel Steinsaltz*, vol. 30: סנהדרין ב *Sanhedrin · Part Two*, Koren Publishers, Jerusalem, 2017, p. 310: “On **that day that** Hezekiah’s father, **Ahaz, died**, daylight lasted **two hours**, ten hours shorter than the standard day, so that the wicked Ahaz would be buried hurriedly, without the pomp typically accorded kings.”
 14. The *Targūm Yōnātān* (2nd century AD) is an Aramaic translation of parts of the Hebrew Bible, so called because of its attribution to Yōnātān ben ‘Uzzī’ēl (1st century AD). As translated into English by Guggenheimer (*op. cit.* [11], p. 205 note 9), its rendition of *Isaiah* 38. 8 (ed. A. Sperber, *The Bible in Aramaic Based on Old Manuscripts and Printed Texts*, vol. 3: *The Latter Prophets According to Targum Jonathan*, E. J. Brill, Leiden, 1962, p. 77) would also attest to the double event: “Behold, I shall make return the shadow of the sundial, that advanced at the death of Aḥaz, backwards for 10 hours; and the sun returned 10 markers, of the markers that it had passed.” However, B. D. Chilton (*The Isaiah Targum; Introduction, Translation, Apparatus and Notes*, Michael Glazier, Wilmington, DE, 1987, p. 75) translated more closely to the Hebrew: “Behold, I will make the shadow cast by the declining sun on the stone hours, on the steps of Ahaz, turn back ten hours.” ‘Death’ and ‘steps’ both translate *masqānā*, of which the dictionary meaning is “ascent, final result, conclusion” – M. Sokoloff (ed.), *A Dictionary of Jewish Babylonian Aramaic of the Talmudic and Geonic Periods*, Graphit Press, Jerusalem, 2002, p. 692 s.v. ‘מִסְקָנָא’. The more conservative reading ‘ascent’ in the sense of ‘stairs’ seems recommended.
 15. *Bārēšīt Rabbā (Genesis Rabbā*; AD 400-600?), 68. 10, tr. H. Freedman, *Genesis*, vol. 1, The Soncino Press, London, 1939, pp. 622-623; cf. van der Sluijs, *op. cit.* [1], pp. 42, 46.
 16. Compare the discussion in Guggenheimer, *op. cit.* [11], p. 205 note 8.
 17. Josephus, *Jewish Antiquities*, 10. 2. 1 (24), trs. Begg & Spilsbury, *op. cit.* [6], p. 213.
 18. e.g., Theodoret of Cyrrhus (AD c393-c460), *Quaestiones in Libros Regum (Questions on the Books of the Kings)*, 52 (547A), ed. J. L. Schulze, *Theodoretī, Cyrensis Episcopi, Opera Omnia: Post Recensionem Jacobi Sirmondī, Edidit, Graeca e Codicibus Locupletavit, Antiquiores Editiones Adhibuit, Versionem Latinam Recognovit, Lectionum*

- Varietatem, Amplissimos Indices Adjecit*, vol. 1, Petit-Montrouge, Paris, 1864, pp. 791-792; compare *Commentary on Psalms*, 21. 3 (729), pp. 1003-1004, tr. R. C. Hill, *Theodoret of Cyrus: Commentary on the Psalms*, 1-72, The Catholic University of America Press, Washington, DC, 2000, p. 142; *Commentary on Isaiah*, 11. 429-435, tr. J.-N. Guinot, *Théodoret de Cyr: Commentaire sur Isaïe; Texte critique, traduction et notes*, vol. 2: (Sections 4-13), Les Éditions du Cerf, Paris, 1982, pp. 378-379.
19. Hippolytus, MS. *Parisinus Coislinianus* 193 (11th century AD), fol. 36, ed. A. Gallandius, *Bibliotheca Veterum Patrum Antiquorumque Scriptorum Ecclesiasticorum, Postrema Lugdunensi Multo Locupletior atque Accuratio*, vol. 2, Typographia Joannis Baptistæ Albrittii Hieron. Fil., Venice, 1766, p. 489, tr. S. D. F. Salmond, 'Fragments from his Commentaries on Various Books of Scripture', in A. Roberts & J. Donaldson (eds.), *Hippolytus, Bishop of Rome*, vol. 1, T. & T. Clark, Edinburgh, 1868, p. 441, and in Glycas, *Annals* (AD c1120), 2 (194b), ed. I. Bekkerus, *Michaelis Glycae Annales*, Ed. Weberus, Bonn, 1836, p. 362; Ephraem the Syrian, *Commentary on 2 Kings*, ed. Benedictus, *op. cit.* [8], p. 562; pseudo-Dionysius the Areopagite, *Epistola ad Polycarpum* (*Letter to Polycarp*; 7), 2 (1080d), ed. A. M. Ritter, 'Pseudo-Dionysius Areopagita; De Mystica Theologia; Epistulae', in G. Heil & A. M. Ritter (eds.), *Pseudo-Dionysius Areopagita. De Coelesti Hierarchia, De Ecclesiastica Hierarchia, De Mystica Theologia, Epistulae*, Walter de Gruyter, Berlin, 2nd edition, 2012, p. 168, trs. C. Luibheid & P. Rorem, *Pseudo-Dionysius: The Complete Works*, Paulist Press, New York, 1987, p. 268.
 20. Eustathius of Antioch, *De Engastrimytho contra Origenem* (*The Ventriloquist against Origen*), Fr. 6, in Glycas, *Annals*, 2 (194b), ed. F. Cavallera, *S. Evstathii Episcopi Antiocheni in Lazarvm, Mariam et Martham Homilia Christologica. Nunc Primum e Codice Gronouiano Edita cum Commentario de Fragmentis Eustathianis Accesserunt Fragmenta Flauiani I Antiocheni*, A. Picard et Filivs, Paris, 1905, p. 66 = Bekkerus, *op. cit.* [19], p. 362.
 21. W. Whiston [anonymous], *The Genuine Works of Flavius Josephus: Faithfully Translated from the Original Greek. Containing I. The Life of Josephus, Written by Himself. II. The Antiquities of the Jews, in Twenty Books. III. The Wars of the Jews with the Romans. IV. Defence of the Antiquities of the Jews against Appion [sic]. And V. The Martyrdom of the Maccabees. With Notes Critical and Explanatory. The Whole Illustrated with a Beautiful Set of Copper-Plates*, Christopher Earl, Birmingham, 1770 (1737), p. 354 note *.
 22. "ein Comet vor der Erde vorbeigegangen, und dieselbe in ihrem täglichen Umschwung gestöret habe." Johann Heyn to Carl Wilhelm Christian (1714-1772), baron von Crausen (7 January 1743), ed. J. Heyn, *Gesamlete Briefe von den Cometen, der Sündflut, und dem Vorspiel des jüngsten Gerichts, etc. Worinnen er sich theils den Unternehmungen des Herrn Professor Wiedeburgs, Hn. Prof. Knutzen's, Hn. Rect. Guttmanns, Hn. Mag. Schuberts, Hn. Mag. Obbarius, und seiner übrigen gelehrten Gegner bescheiden widersetzet; theils einige Materien anbringt, welche zur Erläuterung seines Versuchs dienen sollen*, Ambrosius Haude, Berlin, 1745, p.74; cf. 'B. G.' of Leipzig to Johann Heyn (10 April 1743), p. 781.
 23. E. Greswell, *Fasti Temporis Catholici and Origines Kalendariae*, vol. 1, Oxford University Press, 1852, pp. 237-383; vol.4, 1852, pp. 554-622; *Origines Kalendariae Italicae; Nundinal Calendars of Ancient Italy, Nundinal Calendar of Romulus, Calendar of Numa Pompilius, Calendar of the Decemvirs, Irregular Roman Calendar, and Julian Correction. Tables of the Roman Calendar, from U. C. 4 of Varro B. C. 750 to U. C. 1108 A. D. 355*, vol. 2, Oxford University Press, 1854, pp. 518-530; *The Three Witnesses, and the Threefold Cord; Being the Testimony of the Natural Measures of Time, of the Primitive Civil Calendar, and of Antediluvian and Postdiluvian Tradition, on the Principal Questions of Fact in Sacred or Profane Antiquity*, Rivingtons, London, 1862, pp. 98-109. On Joshua's 'long day', see M. A. van der Sluijs, 'Joshua's Celestial Miracle Was not an Eclipse: The Long and the Short', *Culture and Cosmos; A Journal of the History of Astrology and Cultural Astronomy*, 23. 1, 2019, pp. 21-69.
 24. I. Velikovskiy, *Worlds in Collision*, The MacMillan Company, New York, 1950, pp. 216, 218-220, 232-234, 236-238, 312, 319, 324, 381, 385-387, cf. 105-106, 116.
 25. I. Velikovskiy, *Earth in Upheaval*, Victor Gollancz, London, 1955, pp. 132-134. Cf. Th. McCreery, 'Krupp and Velikovskiy', *Kronos; A Journal of Interdisciplinary Synthesis*, 6. 3, 1981, p. 47. T. W. Field ('Evidence of an Inversion Event?', *Aeon; A Symposium on Myth and Science*, 2. 1, 1989, p. 21) ruled out a rotational inversion event around 2800 BP.
 26. P. Warlow, 'Geomagnetic Reversals?', *Journal of Physics A: Mathematical and Theoretical*, 11. 10, 1978, p. 2112; cf. *The Reversing Earth*, J. M. Dent & Sons, London, 1982, pp. 52, 56-59, 191.
 27. The literature on this subject is huge, but has not yet been brought together in one place. A convenient starting point is V. A. Dergachev, O. M. Raspopov, B. van Geel & G. I. Zaitseva, 'The 'Sterno-Etrussia' Geomagnetic Excursion around 2700 BP and Changes of Solar Activity, Cosmic Ray Intensity, and Climate', *Radiocarbon; An International Journal of Cosmogenic Isotope Research*, 46. 2, 2004, pp. 661-681.
 28. See, conveniently, M. Lehner, *The Complete Pyramids; Solving the Ancient Mysteries*, Thames & Hudson, London, 1997, pp. 18, 28.
 29. 2 *Chronicles*, 32. 31, emphasis added.
 30. The alternative translation 'on the earth' is grammatically fine, but would make no sense as the Babylonian king would not need Hezekiah to find out.
 31. Velikovskiy, *op. cit.* [24], pp. 109-111, 216-217, 236. A comparative context for such traditions is provided in van der Sluijs, *op. cit.* [23], pp. 49-52.
 32. Líu Ān (ed.), *Huáinánzǐ* (*Master of Huainan*; 139 BC), 6. 49-50, tr. H. D. Roth, in J. S. Major, S. A. Queen, A. S. Meyer & H. D. Roth, *The Huainanzi; A Guide to the Theory and Practice of Government in Early Han China; Liu An, King of Huainan*, Columbia University Press, New York, 2010, p. 215, with note 9; Wáng Chōng, *Lùnhéng*

- (*Critical Essays*; AD 80), 5. 2 (tr. A. Forke, *Lun-Hêng*, vol. 2: *Miscellaneous Essays of Wang Ch'ung*; *Translated from the Chinese and Annotated*, Georg Reimer, Berlin, 1911, pp. 173-174); 29. 2 (tr. vol. 1: *Philosophical Essays of Wang Ch'ung*; *Translated from the Chinese and Annotated*, Otto Harrassowitz, Leipzig, 1907, p. 89); cf. *The World-Conception of the Chinese; Their Astronomical, Cosmological and Physico-Philosophical Speculations*, Arthur Probsthain, London, 1925, pp. 86-87. The correspondence with the Biblical miracles of Joshua and Hezekiah was noted by the Jesuit missionaries Joachim Bouvet (1656-1730) and François Xavier d'Entrecolles (1664-1741), followed by Antoine Gaubil (1689-1759; *Histoire de l'astronomie Chinoise, avec des dissertations*, Rollin, Paris, 1732, p. 87). In his later years, Gaubil (*Traité de la chronologie Chinoise, divisé en trois parties*, Treuttel et Würtz Libraires, Paris, 1814 [1749], p. 132 note 3; 'Histoire de l'astronomie Chinoise, depuis le commencement de la monarchie Chinoise; jusqu'à l'an 206 avant Jesus-Christ', *Lettres édifiantes et curieuses, écrites des missions étrangères: Mémoires des Indes et de la Chine*, 26 [1783, written after 1749], pp. 243-245) championed the view that Jews had imported these two stories into China between 479 and 248 BC and the *Huáinánzǐ* had collapsed them into one. Rather like Velikovsky, Greswell (*op. cit.* [23], vol. 1, p. 374 note *) dismissed the link with Joshua and insisted that the Chinese with this tale had independently preserved their own observation of the Hezekiah event.
33. e.g., Zhang Zhengming, *A History of Chu*, vol. 2, trs. B. Cao, Ch. Chan & H. Sze Ching, Silkroad Press, Honolulu, HI, 2021, p. 123.
 34. B. Forrest, *Velikovsky's Sources: Worlds in Collision; A Study of an Interdisciplinary Fantasy*, Donald Keith Mills, Aspley Guise, 2nd edition, 2021 (1981), p. 159, cf. 160; *A Guide to Velikovsky's Sources*, Donald Keith Mills, Aspley Guise, 2nd edition, 2017 (1987), pp. 55-56.
 35. e.g., Oenopides of Chios, in Achilles Tatius, *Isagoge ad Arati Phaenomena (Introduction to Aratus' Phenomena)*, 24; Euripides, *Orestes*, 999-1005; *Electra*, 727-730; Plato, *Politicus (Statesman)*, 12 (268e, 269a); pseudo-Apollodorus, *Bibliotheca (Library): Epitome*, 2. 12; Seneca, *Thyestes*, 776-878; Lucan, *Pharsalia = De Bello Civico (On the Civil War)*, 1. 543-544; Hyginus, *Fables*, 88, 258.
 36. See further the discussion in Forrest, *op. cit.* [34], 2021, pp. 92, 99, 560-566, 712; 2017, pp. 57-59.
 37. Forrest, *op. cit.* [34], 2021, pp. 28-29, 383, cf. 631-632.
 38. Forrest, *op. cit.* [34], 2021, p. 63, cf. 99, 381-383; 2017, pp. 54, 56.
 39. C. Beaumont, *Britain – The Key to World History*, Rider and Company, London, 1947, pp. 196-197, cf. 164, 199-204.
 40. Seneca the Younger, *Natural Questions*, 7. 15. 1, ed. Th. H. Corcoran, *Seneca in Ten Volumes*, vol. 10: *Naturales Quaestiones*, part 2, Harvard University Press, Cambridge, MA, 1972, pp. 258-259, tr. H. M. Hine, *Lucius Annaeus Seneca: Natural Questions*, The University of Chicago Press, 2010, p. 124.
 41. *Obsequens (Prodigies)*, 20, tr. A. C. Schlesinger, *Livy*, vol. 14: *Summaries, Fragments, and Obsequens*, Harvard University Press, Cambridge, MA, 1987, pp. 252-253) listed for 147 BC: "A comet blazed for thirty-two days." A. G. Pingré (*Cométographie ou traité historique et théorique des comètes*, vol. 1, L'Imprimerie Royale, Paris, 1783, p. 269) settled for a comet, G. W. Kronk (*Cometography; A Catalog of Comets*, vol. 1: *Ancient-1799*, Cambridge University Press, 1999, pp. 513-514) remained undecided. J. T. Ramsey (*A Descriptive Catalogue of Greco-Roman Comets from 500 B. C. to A. D. 400*, The University of Iowa, Iowa City, IA, 2006, pp. 79-81, cf. 34-35 table) fingered Hipparchus as Seneca's source and identified the comet with one mentioned in Bān Gù, *Qián Hàn Shū (History of Former Hàn; AD 82)*, 26/26b; Xú Tiānlín (ed.), *Xī Hàn Huìyào (Collection of Important Institutions of Western Hàn; AD 1211)*, 28/2a, tr. Ho Peng Yoke, 'Ancient and Mediaeval Observations of Comets and Novae in Chinese Sources', *Vistas in Astronomy*, 5. 1, 1962, p. 144 #32; Sīmǎ Qiān, *Shìjì (Scribe's Records) = Tàishǐgōng Shū (Records of the Grand Historian; c109-91 BC)*, 11 (*Xiàojǐng Běnjì [Imperial Annals of Xiàojǐng]*), tr. B. Watson, *Records of the Grand Historian of China Translated from the Shih Chi of Ssu-ma Ch'ien*, vol. 1: *Early Years of the Han Dynasty 209 to 141 B. C.*, Columbia University Press, New York, 1961, p. 371; cf. J. Williams, *Observations of Comets, from B. C. 611 to A. D. 1640. Extracted from the Chinese Annals. Translated, with Introductory Remarks, and an Appendix, Comprising the Tables Necessary for Reducing Chinese Time to European Reckoning; And a Chinese Celestial Atlas*, Strangeways and Walden, London, 1871, pp. 4-5 #23.
 42. O. Thenius, *Kurzgefasstes exegetisches Handbuch zum Alten Testament*, vol. 9: *Die Bücher der Könige*, Weidmann'sche Buchhandlung, Leipzig, 1849, pp. 403-405, seconded by O. Delitsch (ed.), *Illustrierte Pracht-Bibel oder die ganze heilige Schrift des Alten und Neuen Testaments, nach der deutschen Uebersetzung D. Martin Luther's. Mit zahlreichen Illustrationen und mit erklärenden Anmerkungen*, Verlag der Englischen Kunst-Anstatt von A. H. Payne, Leipzig, 1862, p. 522 note.
 43. F. Espenak & J. Meeus (eds.), *Five Millennium Canon of Solar Eclipses: -1999 to +3000 (2000 BCE to 3000 CE)*, NASA Center for AeroSpace Information, Hanover, MD, 2006, p. A-155.
 44. J. W. Bosanquet, 'Chronology of the Reigns of Tiglath Pileser, Sargon, Shalmanezer, and Sennacherib, in Connexion with the Phenomenon Seen on the Dial of Ahaz', *The Journal of the Royal Asiatic Society of Great Britain and Ireland*, 15, 1855, pp. 277-296; 'Cyrus the Second. Concerning Cyrus, Son of Cambyses King of Persia and of Mandane Daughter of Astyages, who Overthrew Babylon and Released the Jews: As Distinguished from Cyrus Father of Cambyses, who Conquered Astyages, and Founded the Empire of the Medes and Persians', *Transactions of the Society of Biblical Archaeology*, 1. 2, 1872, p. 252; 'On the Synchronous History of Assyria and Judea' = 'Synchronous History of the Reigns of Tiglath-Pileser and Azariah. Shalmanezer and Jotham. Sargon and Ahaz. Sennacherib and Hezekiah', *Transactions of the Society of Biblical Archaeology*, 3. 1, 1874, pp. 31-40, 44, 78 note 1; G. F. Chambers, *The Story of Eclipses*, D. Appleton and Company, New York, 1908, pp. 77-88.
 45. Bosanquet, *op. cit.* [44], 1874, p. 36.

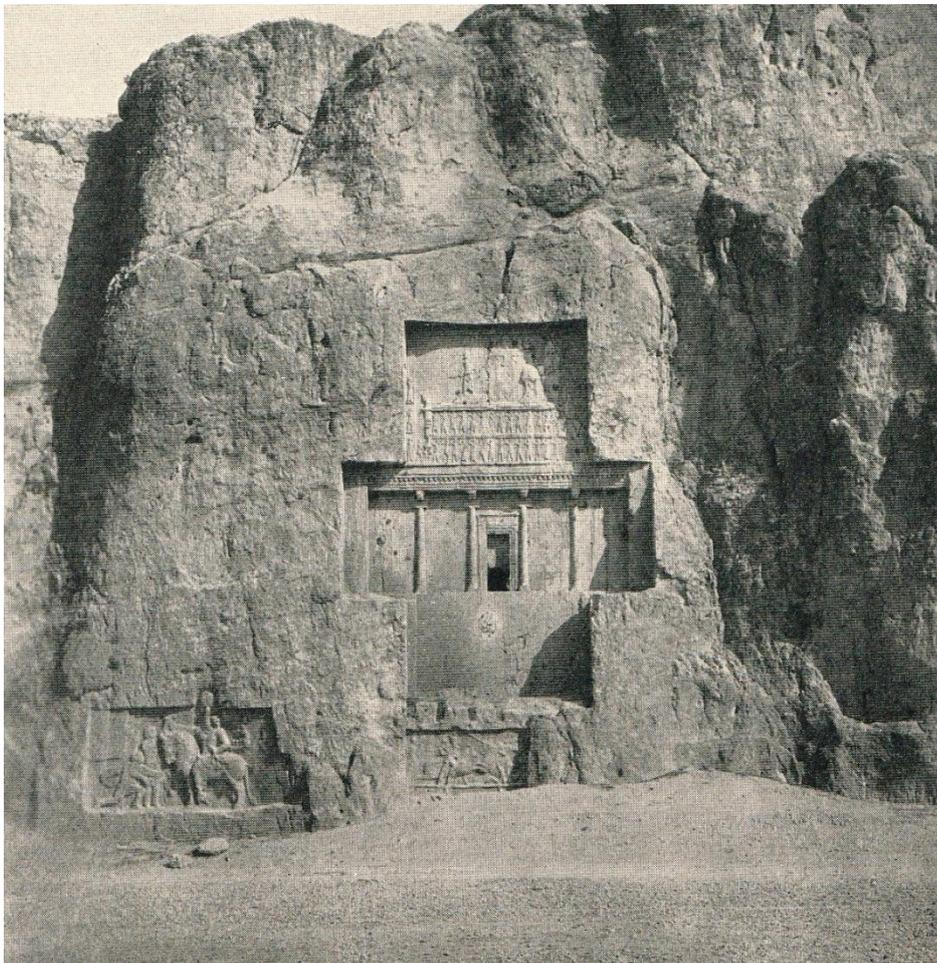
46. M. Kudlek & E. H. Mickler, *Solar and Lunar Eclipses of the Ancient Near East from 3000 B. C. to 0 with Maps*, Verlag Butzon & Bercker Kevelaer, Neukirchen-Vluyn, 1971, p. 64; see Espenak & Meeus, *op. cit.* [43], p. A-155.
47. M. Barker, 'Hezekiah's Boil', *Journal for the Study of the Old Testament*, 95, 2001, p. 40.
48. Thenius, *op. cit.* [42], p. 404.
49. "beim Eintritt einer Sonnenfinsterniss ein Zurückweichen, beim Austritt derselben ein Vorwärtsgehen der Schatten auf der Erde stattfindet." Seyffarth, in Thenius, *op. cit.* [42], p. 403.
50. "wenn der westliche Theil der Sonne vom Monde bedeckt wird, also während des *ersten* Theiles einer Sonnenfinsterniss, rückt die Mitte des Schattens eines Körpers auf der Erde allerdings etwas weiter westlich, als diess ohne diese Bedeckung der Fall sein würde, genauer: die östliche Gränze des Halbschattens und die westliche des Kernschattens rücken westlich ... Während des letzten Theiles der Sonnenfinsterniss, wo der östliche Theil der Sonne bedeckt ist, ist das Verhalten natürlich umgekehrt, indem der Schatten jetzt etwas *vorgeht*, d. h. die Mitte des Schattens etwas nach Osten abweicht." Seebeck, in Thenius, *op. cit.* [42], p. 404.
51. Bosanquet, *op. cit.* [44], 1855, p. 292.
52. Barker, *op. cit.* [47], p. 40.
53. M. Barker, *The Mother of the Lord*, vol. 1: *The Lady of the Temple*, Bloomsbury, London, 2012, p. 83.
54. "miraculum fuit in heliotropio: non in ipso corpore Solis", Samvel Bochartus, *Geographia Sacra*, vol. 2: *Chanaan sev de Coloniis et Sermone Phoenicum. Cvm Tabvlis Chorographicis, & Duplici Indice, 1. Locorum Scripturæ. 2. Rerum & Verborum. Sequuntur Tres Alij Indices in Totum Opus. 1. Fabularum quæ Explicantur aut Refelluntur. 2. Vocum Phoeniciarum, Græcarum, Romanarum, Gallicarum &c. quæ ex Ebræâ Linguâ & Vicinis Deducuntur. 3. Vocum Ebræarum, Syrarum, & Arabicarum, quæ Explicantur aut cum Aliis Conferuntur*, Petrus Cardonellus, Caen, 1646, p. 446.
55. "Sic etiam Esaiæ signum umbræ retrogradæ ad ipsius captum revelatum fuit, nempe per retrogradationem solis: nam etiam putabat solem moveri, & terram quiescere. Et de parheliis forte nunquam nec per somnium cogitavit. Quod nobis sine ullo scrupulo statuere licet; nam signum revera contingere poterat, & regi ab Esaiâ prædici, quamvis Propheta veram ejus causam ignoraret." Benedictus de Spinoza [anonymous], *Tractatus Theologico-Politicus Continens Dissertationes aliquot, quibus Ostenditur Libertatem Philosophandi non tantum Salva Pietate, & Reipublicæ Pace Posse Concedi: Sed eandem nisi cum Pace Reipublicæ, ipsaque Pietate Tolli non Posse*, Henricus Künraht, Hamburg, 1670, p. 22. Compare the translation of M. Silverthorne & J. Israel, *Benedict de Spinoza: Theological-Political Treatise*, Cambridge University Press, 2007, p. 34.
56. "Denn die Nebensonnen haben kein so helles Licht, daß sie die wahre Sonne zu überstralen im Stande wären. Der Schatten von der wahren Sonne würde geblieben und höchstens ein doppelter Schatten seyn gesehen 35arden. Wer hätte dabey wol dencken können, daß der eigentliche Schatten zurücke gegangen sey? Wenn aber die wahre Sonne mit Wolcken verdunkelt ist; so pflegen sich auch keine Nebensonnen zu zeigen. Zu geschweigen, daß gemeiniglich mehrere Nebensonnen zu gleicher Zeit gesehen werden, die also den Schatten noch mehr würden vervielfältiget haben." Th. Ch. Lilienthal, *Die gute Sache der in der heiligen Schrift alten und neuen Testaments enthaltenen göttlichen Offenbarung, wider die Feinde derselben erwiesen und gerettet*, vol. 9, J. H. Hartungs Erben, Kaliningrad, 1760, pp. 428-429. W. Gesenius (*Der Prophet Jesaia. Uebersetzt und mit einem vollständigen philologisch-kritischen und historischen Commentar begleitet*, vol. 2. 2: *Commentar über Kapitel 13-39, nebst einer Chartre*, Friedr. Christ. Wilh Vogel, Leipzig, 1821, p. 987) judged more favourably: 'Spinoza ... is thinking of a parhelion, which could certainly produce a false shadow on the sundial for a while if the actual sun were obscured.' ("Spinoza ... denkt an eine Nebensonne, die allerdings für eine Zeitlang einen falschen Schatten auf den Sonnenzeiger werfen könnte, wenn die eigentliche Sonne verdunkelt wäre.").
57. Whiston, *op. cit.* [21], p. 354 note *.
58. "There has indeed been often seen in the Atmosphere some very Luminous parts even near the Zenith about Midnight ... It seems more probable that these extraordinary Lights proceed from some self-shining Substance or Aerial Phosphorus. A surprizing appearance of this kind was seen at Cambridge about 10 of the Clock at Night and at other very distant Places on the 20th of March in the Year 1706. It was a Semicircle of Light of about two thirds of the ordinary breadth of the milky way but much brighter. The top of it pass'd very near our Zenith inclining about 4 or 5 Degrees to the North, it cross'd the Horizon at a very small distance from the West towards the South, and again about as far from the East towards the North. It was most vivid and best defin'd about the Western Horizon and most faint about the Zenith, where it first began to disappear: there was at the same time an *aurora Borealis*. A Friend of mine saw the same appearance in *Lincolnshire* at the distance of about 70 Miles north of Cambridge: the Semicircle seem'd to Him to lye in the Plane of the Æquator." [R.] Cotes, *An Extract of Some Physico-Mathematical Discourses Contained in Mr. Cotes's Hydrostatical and Pneumatical Lectures: Printed for the Use of Those that Go the Course of Experiments*, publisher and place not stated, 1740, pp. 13-14. This must have been written before 1716, when Cotes died.
59. See further M. A. van der Sluijs, *On the Origin of Myths in Catastrophic Experience*, vol. 2: *The Earth's Aurora*, All-Round Publications, Vancouver, 2021, pp. 16-17.
60. "Il y a dans l'Hôpital de la Charité de Mets en Lorraine un Cadran vertical déclinant du Midy à l'Orient, décrit contre une des faces de la Maison avec beaucoup d'exactitude; son axe est scellé fixement dans le mur, & de plus affermy sur un stile droit & solide. Au devant de cette même face de bâtiment, il y a une terrasse le long de la Moselle où le R. P. Romuald, Prieur du Couvent se promenoit avec un des freres, nommé Lucien de la Coûtüre, le 7. Juin 1703. En attendant l'heure du midy, jettans l'un & l'autre de temps en temps la vûë sur ce Cadran. Lorsqu'ils virent midy passé, le F. Lucien quitta le R. P. Romuald pour aller sonner l'Angelus; alors midy sonna à la Cathedrale, à l'Hôpital

& à l'horloge de S. Vincent. Mais dans le temps que le P. Romuald avoit encore la vûe tournée sur le Cadran, il vit clairement & distinctement l'ombre de l'axe rebrousser chemin de midy jusques à 11 heures & un quart; ce qui le portant à observer la chose encore plus attentivement, il observa ensuite l'ombre passer insensiblement d'11 h. $\frac{1}{4}$ à 11 h. $\frac{1}{2}$; alors il rappella le F. Lucien pour être témoin de cette merveille avec luy. Il souffloit pour lors un vent de Midy qui faisoit passer plusieurs petits nuages differemment épais & séparés les uns des autres au devant du Soleil, mais sans aucune pluye ... le R. P. Romuald remarque de plus que tous ces differens nuages ne changerent rien dans le mouvement de l'ombre du Soleil. Le F. Lucien étant donc revenu joindre le P. Romuald, il luy demanda s'il se souvenoit bien où étoit l'ombre quand il l'avoit quitté, & celui-cy luy ayant répondu qu'il se souvenoit fort bien qu'elle passoit midy, il luy fit voir après qu'un nuage plus épais que les autres, & qui avoit empêché de voir l'ombre pendant quelque temps fut écoulé, qu'il ne marquait alors qu'11 heures $\frac{1}{2}$; dans ce même temps, un autre frere nommé Alexis de Laîne étant descendu de sa cellule vint les joindre, & fut fort surpris de ne remarquer au Cadran qu'11 heures $\frac{1}{2}$; parce qu'il croyoit qu'il étoit midy $\frac{1}{4}$. Le R. P. Romuald ajoute qu'il demeura pendant près d'une heure $\frac{1}{2}$ à observer le mouvement de l'ombre qui luy parut toujours aussi réglé que de coûtume, sinon qu'il crut d'abord que l'ombre passa un peu plus vite d'11 heures $\frac{1}{4}$ à 11 heures $\frac{1}{2}$, que par les autres quarts suivans." [A.] Parent, *Recherches de mathématique et de physique*, vol. 2: *Suite de la III. Partie. Qui est toute composée de pieces nouvelles de l'auteur sur ces deux sciences, dont plus de trente ont été luës dans l'Académie Royale des Sciences en 1699, 1700, 1701 & 1702: D'Analyses de differens ouvrages d'auteurs modernes, & de plusieurs mémoires sur l'histoire naturelle. A quoy on a ajoûté un abrégé du choq des corps, pour servir d'introduction & d'éclaircissement aux elemens de mécanique & de physique de l'auteur*, Jean Jombert & Florentin de l'Aulne, Paris, 1705, pp. 256-259.

61. "ce même jour on sonna l'Angelus de midy à ce Couvent deux fois de suite à $\frac{3}{4}$ d'heure environ l'une de l'autre", "il se justifia dans le moment en luy faisant voir qu'il n'étoit encore que midy à leur Cadran." Parent, *op. cit.* [60], p. 259.
62. "le soir de cette retrogradation fut prolongé de près d'une heure plus que les précédents & plus que les suivans, quoi que le Ciel fût couvert de nuages", "le retardement du jour du lendemain d'une heure au moins, puisqu'à quatre heures du matin à peine faisoit-il jour", [A.] Parent, *Essais et recherches de mathématique et de physique*, vol. 3: *Qui Contient 32 memoires de mathématique & de physique, don't un tiers environ ont été lûs dans l'Academie Royale des Sciences. Des remarques & suplémens sur quelques auteurs illustres, des relations d'histoire naturelle, des experiences & des tables sur differens sujets; avec des éclaircissemens & suplémens pour ce troisième volume, qui contiennent plusieurs choses nouvelles & considerable*, Jean de Nully, Paris, 2nd edition, 1713, pp. 35-37.
63. "Corps Halitueux", "comme si le Soleil avoit retrogradé tout à coup de 12. À 11." Parent, *op. cit.* [62], p. 40.
64. "releveront l'Image du Soleil au dessus de l'horison ... & par là retarderont la nuit ...", "une certaine élévation au dessus du Soleil", Parent, *op. cit.* [62], p. 41.
65. "interstitiolis ejus moleculis heterogeneis iisque crassioribus refertis", L. Ph. Thümmigius, *Disputatio Physico-Mathematica, qua Phænomenon Singulare Solis Coelo Sereno Pallescentis ad Rationes Revocatum*, Joh. Christ. Hilligerus, Halle an der Saale, 1722, p. 19 (12.00 > **10.15**). Citations of Parent's first article frequently misreported the date of the event, the time on the sundial to which the pointer reverted (11.15) and the time when Lucien rejoined Romuald (11.30). In some instances, such mis-readings even resulted in a duplication of the regression. The following text keeps track of these errors at their first appearance in the literature or when compounded, but not when they are repeated in derivative publications.
66. Ch. Wolff, *Vernünfftige Gedancken von den Würckungen der Natur, den Liebhabern der Wahrheit mitgetheilet*, Rengerischen Buchhandlung, Halle, 1723, pp. 427-429 (12.00 > 11.15 > **10.30**).
67. "Die Strahlen werden gebrochen, wenn eine Materie vorhanden, welche die Lufft sehr verdicket. ... Die Wolcken, so bey der Sonne vorbey zogen, haben keine Aenderung im Schatten der Sonnen-Uhr verursacht: daher muß die Materie, darinnen das Licht gebrochen worden, dichter gewesen seyn als die Dünste, welche die Wolcken führen. Wir finden, daß das Wasser eine starcke Refraction hat, die dergleichen Erscheinung verursachen kan." Wolff, *op. cit.* [66], p. 429.
68. "Man stelle, wenn die Sonne nicht scheint, ein Licht für eine Sonnen-Uhr, daß der Schatten des Zeigers auf die zwölfte Stunden-Linie fället. Das Licht lasse man unverrücket stehen und halte eine Kugel oder nur ein anderes Glaß mit Wasser darzwischen; so wird der Schatten auf einmahl zurücke gehen." Wolff, *op. cit.* [66], p. 429.
69. "dichte rundte Tropffen", "vollkommenes und dursichtiges Eis", "in einer dünnen Lage", Wolff, *op. cit.* [66], pp. 429-430.
70. "Man stelle nur, wenn die Sonne nicht scheint, ein Licht für eine Sonnen-Uhr, daß der Schatten des Zeigers auf die 12te Stunden-Linie falle. Das Licht lasse man unverrücket stehen, und halte ein Glaß mit Wasser dazwischen, so wird der Schatten auf einmal zurück gehen." H. F. Reischauer, *Vernünfftige Gedanken ueber die Werke der Natur; Wie uns diese zur Erkänntnis und Verehrung des Schöpfers leiten sollen; Entworfen und mit nöhtigen Figuren und Register versehen*, Johann Heinrich Meyer, Lemgo, 1747, p. 170 (12.00 > 11.15 > **10.30**).
71. "Phænomenon merè naturelle" = "Phénomene ... purement naturel", J. J. Schevchzerus, *Physica Sacra; Iconibvs Æneis Illustrata Procurante & Sumtus Suppeditante Johanne Andrea Pfeffel, Augustano, Sacrae Cæsareæ Majestatis Chalcographo Aulico*, vol. 3: *A Tab. CCCCXVI. ad DXCIV*, publisher not stated, Augsburg & Ulm, 1733, p. 624 = J.-J. Scheuchzer, *Physique sacrée, ou histoire-naturelle de la Bible. Enrichie de figures en taille-douce, gravées par les soins de Jean-André Pfeffel, graveur de S. M. Impériale*, vol. 5, Pierre Schenk & Pierre Mortier, Amsterdam, 1734, p. 156 (12.00 > **10.30**).

72. “einer starcken Refraction oder Brechung der Sonnen-Strahlen in einer darzwischen getretenen dicken Atmosphæra oder Luft-Kreiß, wenn nemlich dieselbe mit gefrorenen Regen-Tropfen oder Hagel häufig angefüllet ist, welche die Luft zwar nicht verdunckeln, aber doch die Sonnen-Strahlen starck refringiren oder brechen, und auf eine andere Seite hinlencken.” J. J. Schmidt, *Biblischer Mathematicus; Erläuterung der Heil. Schrift aus den mathematischen Wissenschaften der Arithmetik, Geometrie, Static, Architectur, Astronomie, Horographie und Optic, mit nöthigen Kupfern und vollständigen Registern herausgegeben. Als ein Anhang ist beygefüget Herrn George Sarganecks Versuch einer Anwendung der Mathematic in dem Articul von der Grösse der Sünden-Schulden*, Gottlob Benjamin Frommann, Sulechów, 1736, p. 537 (27 June).
73. “wenn man zu Abends ein Glas Wasser zwischen ein Licht und Nadel setzt, so wird sich der Schatten von der Nadel, wenn man denselben zuvor genau bemercket, durch die Refraction des Lichts sogleich anders wohin wenden.” Schmidt, *op. cit.* [72], p. 538.
74. J. G. Reinbeck, *Betrachtungen über die in der Augspurgischen Confeßion enthaltene und damit verknüpfte göttliche Wahrheiten, welche theils aus vernünftigen Gründen allesamt aber aus heiliger göttlicher Schrift hergeleitet und zur Uebung in der wahren Gottseeligkeit angewendet werden, fortgesetzt von Israel Gottlieb Canz öffentlichen Lehrer der Weltweißheit auf der Universität zu Tübingen*, vol. 4, Ambrosius Haude, Berlin, 1741, pp. 167-168.
75. C. Au. Gebhardi [anonymous], *Vernunftmäßige Betrachtung derer übernatürlichen Begebenheiten, ausgefertigt von einem Freunde der Wahrheit*, Verlag des Verfassers, Amsterdam, 1743, pp. 18-20.
76. ‘B. G.’ to Johann Heyn (10 April 1743), ed. Heyn, *op. cit.* [22], pp. 779-780 (12.00 > **11.45** > **10.30**).
77. as above, p. 781.
78. “Man schlägt, zum Exempel, in eine Wand, wo die Sonne anscheinet, einen Nagel, und hält zwischen ihm und der Sonne ein Glas voll Wasser. Alsbald gehet der Schatten zurück. Ich habe diesen Versuch gar oft gemacht und richtig befunden.” As above, p. 780.
79. Johann Heyn to ‘B. G.’ (date not stated), ed. Heyn, *op. cit.* [22], pp. 793-794.
80. “hat auch ehemals zu den Zeiten des Hiskias ein subtiler Dunst, oder ein dünnes Wölkchen, die Zurückgehung des Schattens am Sonnenzeiger Ahas verursachen können ...” Ch. Mylius, ‘Fortsetzung der Betrachtungen über die Majestät Gottes’, *Belustigungen des Verstandes und des Witzes* (December 1743), pp. 474-475.
81. “Wenn man also das Dunstwölkchen, welches unter der Sonne hinfährt, noch subtiler und durchsichtiger annimmt, als das Glas mit dem Wasser war; wie denn dergleichen Dunstwölkchen, welche so gar bey uns unsichtbar sind, die Brechung der Sonnenstralen leicht verursachen können: so kann man ohne Schwierigkeit begreifen, wie ein Dunstwölkchen zwischen uns und der Sonne seyn kann, ohne den Schein derselben merklich zu verhindern und zu verursachen, daß man die Schatten undurchsichtiger Körper mit dem seinigen, welcher allzu subtil ist, vermengt.” Mylius, *op. cit.* [80], p. 475.
82. Mylius, *op. cit.* [80], p. 476 (12.00 > **11.45** > **10.30**). As these errors are identical to B. G.’s, one wonders whether ‘B. G.’ as really Mylius.
83. “Ich selbst habe das Glück gehabt, dergleichen Begebenheit letzthin wahrzunehmen. 37enna Is ich mich mit dem beschriebenen Versuche beschäftigte, so klärte sich gleich der Himmel auf, welcher zuvor voller Regenwolken gewesen war. Indem ich nun genau auf den eingeschlagenen Stift sah, um den völligen Sonnenschein nicht zu versäumen; so gieng der Schatten desselben, als die Sonnenstralen so zu reden nur halb leuchteten, ohne daß ich das Glas dazwischen hielt, einen guten Theil zurück, kehrte aber sogleich wieder an seinen Ort. Dieses kam daher, weil, wie ich gar wohl sah, noch dünne Wölkchen unter der Sonne vorbey zogen. Ich freute mich nicht wenig darüber, daß ich eben das gesehen, was Hiskias und Esaïas zu Jerusalem, und Romuald und Lucian zu Metz gesehen haben. Sie sahen den Schatten zurückgehen; ich auch.” Mylius, *op. cit.* [80], p. 477.
84. Lilienthal, *op. cit.* [56], pp. 429-446.
85. J. K. Velthusen, ‘Beytrag zur Aufklärung des Dankliedes Hiskiä, Jes. 38. v. 9-20. Nebst einigen zur Erläuterung desselben dienlichen Anmerkungen über den Character dieses Königes, und über das Wunder am zurückgegangenen Schatten’, in J. A. Cramer (ed.), *Beyträge zur Beförderung theologischer und anderer wichtigen Kenntnisse von kielischen und auswärtigen Gelehrten*, vol. 1, Carl Ernst Bohn, Kiel and Hamburg, 1777, pp. 15-21, especially 16-18 note 12.
86. Ch. Chais (ed.), *La Sainte Bible, ou le Vieux et le Nouveau Testament; Avec un commentaire littéral, composé de notes choisies, & tirées de divers auteurs Anglois*, vol. 6. 2, Marc Michel Rey, Amsterdam, 1777, p. XXIII note 77.
87. “Dieu ne fit que condenser la partie de l’Atmosphère qui couvroit le Palais”, “en se servant pour cela d’un vent imperceptible qui y transporta des vapeurs”, Chais, *op. cit.* [86], pp. XXII-XXIII.
88. E. F. C. Rosenmüller(us) (tr.), *Scholia in Vetvs Testamentvm*, vol. 3: *Iesaiae Vaticanina Complectens*, part 2 = *Iesaiae Vaticanina Latine Vertit et Explicavit*, vol. 2, Ioh. Ambros. Barth, Leipzig, 1793, pp. 785-786, getting the amount of extended time wrong as one and a half hours (*sesquihoram*) (12.00 > **10.30**). Other than Bible commentaries, see further G. L. Bauer, *Hebräische Mythologie des alten und neuen Testaments, mit Parallelen aus der Mythologie anderer Völker, vornemlich der Griechen und Römer*, vol. 2, Weygandschen Buchhandlung, Leipzig, 1802, p. 207; ‘P.’, *Ausführliche Erklärung der sämtlichen, in den historischen heiligen Schriften der Hebräer enthaltenen Wundergeschichten aus natürlichen Ursachen; durchaus begleitet mit philologischen, kritischen und historischen Anmerkungen*, publisher not stated, Berlin, 1806, p. 236.
89. J. Stock (tr.), *The Book of the Prophet Isaiah: In Hebrew and English. The Hebrew Text Metrically Arranged: The Translation Altered from that of Bishop Lowth. With Notes Critical and Explanatory*, R. Cruttwell, Bath, 1803, p. 109 note.

90. Ch. Taylor, *Scripture Illustrated, by Means of Natural Science: In Botany, Geology, Geography, Natural History, Natural Philosophy, Utensils, Domestic and Military, Habiliments, Manners, and Customs, &c. &c.*, W. Blackader, London, 1803, pp. 117-118; cf. *Calmet's Dictionary of the Holy Bible, with the Biblical Fragments*, vol. 3: *Fragments to Calmet's Dictionary of the Holy Bible; Illustrating the Manners, Incidents, and Phraseology, of the Holy Scriptures*, Holdsworth and Ball, London, 5th edition, 1830 (1796), pp. 5-8.
91. e.g., Gesenius, *op. cit.* [56], p. 987 (**27 March**); G. B. Winer (ed.), *Biblisches Realwörterbuch zum Handgebrauch für Studierende, Kandidaten, Gymnasiallehrer und Prediger*, vol. 1: A-K, Carl Heinrich Reclam, Leipzig, 2nd edition, 1833, p. 589; 3rd edition, 1847, p. 499 s.v. 'Hiskias'; S. Cahen (tr.), *La Bible, traduction nouvelle, avec l'Hébreu en regard, accompagné des points-voyelles et des accents toniques (בגיונות) avec des notes philologiques, géographiques et littéraires, et les principales variantes de la version des Septante et du texte Samaritain; dédiée à S. M. Louis-Philippe Ier, roi des Français*, vol. 8: *Les Prophètes*, part 3: 'ספר מלכים א' וב' - *Melachime (Rois) I et II*, S. Cahen, Paris, 1836, p. 182, cf. 3-4; K. F. Keil, *Commentar über die Bücher der Könige*, Otto Model, Tartu and Leipzig, 1845, p. 551; C. F. Keil, *Die Bücher der Könige*, Dörffling and Franke, Leipzig, 1865, p. 345; J. Kitto (ed.), *Standard Edition. The Pictorial Bible; Being the Old and New Testaments According to the Authorized Version: Illustrated with Steel Engravings, after Celebrated Pictures, and Many Hundred Wood-Cuts, Representing the Landscape Scenes, from Original Drawings, or from Authentic Engravings; And the Subjects of Natural History, Costume, and Antiquities, from the Best Sources. To which Are Added Original Notes, Chiefly Explanatory, in Connexion with the of the Sacred Scriptures as Require Observation*, vol. 2, Charles Knight, London, 1849, p. 379; Delitsch, *op. cit.* [42], p. 522 note; A. Smythe Palmer [anonymous], 'A Critical Examination of the Miracle at Beth-Horon', *The Church Quarterly Review*, 17. 34, 1884, p. 338; *A Misunderstood Miracle: An Essay in Favour of a New Interpretation of 'The Sun Standing Still' in Joshua X. 12-14*, Swan Sonnenschein, Lowrey & Co., London, 1887, p. 66; F. W. J. Dilloo, *Das Wunder an den Stufen des Ahas. Eine exegetische Studie*, Höveker & Zoon, Amsterdam, 1885, pp. 30-31; A. Edersheim, *The History of Israel and Judah from the Decline of the Two Kingdoms to the Assyrian and Babylonian Captivity*, The Religious Tract Society, London, 1887, p. 165.



The tomb of the Persian King Darius I at Persepolis, cut into the rock face of the mountainside near the palace. In the top relief, the Great King is shown worshipping Ahura-Mazda, and below are two rows of figures, thirteen in each row, representing the nations of the Persian Empire. The inscription on the tomb is trilingual, having text in Old Persian, Elamite and Akkadian. It provided a start to the decipherment of Elamite.

The carvings of the rock below are much later, of the Sassanian period. The one on the left shows Shapur I receiving the surrender of the Roman Emperor Valerian, c260 AD, after the battle of Edessa.