

Radio Meteors—On Your PC!

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The ICOM IC-PCR1000 is presented as a very suitable radio for radio meteor observers.

In the last few years, innovative electronics has taken markets to the point where it is difficult to differentiate the toys from the functional items. One such item is presented in this article as a wonderfully versatile, comprehensive, and powerful instrument that merits consideration by anyone casually or seriously interested in meteor astronomy.

The radio I am referring to is the ICOM IC-PCR1000, available on the American market. (For commercial information on this radio, refer to <http://www.icomamerica.com>.) The radio offers all modes (AM/FM/WFM/SSB/CW) on almost all frequencies between 500 kHz and 1300 MHz. This offers the possibility of monitoring *any* frequency and *mode* used to monitor radio meteor activity using your PC as the radio dial and a radio that is not much larger than a zip drive. The receiver does not cover the cellular phone frequency ranges. I have had one of these radios for the past several months, and am continually amazed by its performance and versatility. It is easy to install, and offers a huge spectrum coverage for only 400 USD. I have at times in the past spent almost that much just to get a converter to monitor a single frequency.

The antenna that comes with the radio is useless, except for local FM. For radio meteor monitoring, I use a three element Yagi for TV Channel 4, or for other frequencies, a doublet antenna cut to the appropriate half wavelength. A seven-foot doublet will work very well on all the low TV channels (2–5). The antenna connects to the radio through a BNC connector. The instruction manual emphasizes that a resonant antenna is the best way to maximize performance on specific frequencies. The radio requires a dedicated RS-232 port on a PC. Port options are available in the installation process. The addition of a converter to change from a DB9 to a DB25 RS-232 plug-in may be required. By using an external speaker, it is possible to connect a detector to the speaker coil to input the audio into another computing or counting device. My computer is a 133 MHz Pentium, and only runs one program at a time, but some of the more recent and faster PCs that run partition supervisor, dual screen, and/or background would allow the radio to be operated concurrently with other programs.

The active visual observer could use this radio to monitor for the onset of meteor activity, a scenario that is played out regularly by HAM radio operators who use periods of enhanced meteor activity to try for radio contacts via meteor trails. Several radios that offer similar frequency coverage capabilities are available from about 1500 USD up to several thousands of dollars. At 400 USD, this unit is an affordable and functional addition to your meteor monitoring activities.

Meteors, Comets, and Millennialism

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An overview of meteoric and cometary activity between circa 250 BC and circa 1600 AD is discussed with especial regard to the inclusion of meteoric imagery in Christian religious texts. Evidence is presented to suggest meteoric images played a leading role in the creation of millennial fears among adherents of the early medieval Church in Europe, which fears still persist into modern times, but which may have their origins in Mesopotamia circa 2200 BC. An extended discussion of meteoric imagery in Christian writings is also presented.

1. Introduction

In 1990, Rasmussen published details on a statistical examination of meteor shower, fireball, and meteorite data between 700 BC and 1850 AD [1]. He found evidence for a circa 1050-year periodicity in increased meteoric activity seen from Earth within that interval, and lesser

evidence for a circa 325-year subsidiary (possibly harmonic) periodicity. It could be argued that the longer-term implications of his findings are uncertain, due to the examined interval being just under 2.5 times the circa 1050-year periodicity's length. However, it is intriguing that, within this interval, and especially in the last 1300 years of it, millennialism among the world's Christian community featuring strong celestial imagery, has apparently risen from nowhere to have now become a prominent feature near the end of each century, possessed of a particular underlying dominance in the Western world's media as millennium's end in 2000-2001 approaches.

2. Millennialism

Millennialism is the belief that the end of the world is imminent, thought to be foretold by events on Earth such as wars, famines, diseases, and earthquakes, and astronomical signs in the sky like eclipses and stars falling from the heavens. It is a peculiarly Christian phenomenon which was encouraged by the medieval Church to deter recalcitrance among the populace in many Christian countries, with elements of it also used for political ends. An example of this latter was the meteor storm of April 3, 1095, which was coupled with other events interpreted as signs in November 1095 when Pope Urban II authorized the First Crusade [2, pp. 112–113 and references therein].

The importance of the 1000-year period to Christians seems to be most obviously stated in the biblical *Book of Revelation (Rev.)*. For instance, in *Rev.* 20–21, after signs and events presaging the end-times, there is a passage describing how an angel descends from heaven and overpowers Satan in the form of a huge dragon, casting him into the Abyss, to be chained and sealed-in for 1000 years. Christ and his risen believers reign on Earth for this millennium, and then the rest of the dead are revived and Satan released prior to the Last Judgment, the end of the world, and the appearance of a new one. All this makes clear why Christians should have associated the end of the world with millennium's end and sought signs giving advance warning of it.

The dating of the Christian millennia is attributable to Dionysius Exiguus (“Little Dennis,” circa 500–560 AD [3]), an abbot acclaimed as a brilliant scholar, mathematician, and astronomer. In 525, Pope John I tasked him with foretelling the date for Easter. At the time, this was an esoteric matter which few were thought capable of, but using known lunar cycles—a method he had to conceal by mystical language—Little Dennis ultimately produced and published an Easter date-list for 95 years from 532 to 627. His listing included the new dating notation “Anno Domini” (AD) to replace the then-existing “Anno Diocletiani,” as this celebrated the Roman Emperor noted for persecuting Christians.

For a now unknown reason, Dennis chose the year 531 years before his own time for his “Year 1,” as the year of Christ's birth. Recent scholars have suggested dates from circa 7 BC to circa 7 AD as Christ's birth-year, so that 2001 ± 7 years will see, or has already seen, the start of the third Christian millennium. Those who wish to could thus celebrate the coming millennium in 2001 as a reaffirmation of our humanity, as its date results from human error!

3. Meteor and comet activity

Drawing on various ancient and medieval sources, it is possible to construct at least a qualitative time line of cometary and meteoric activity for the period before and during which millennialism first appeared and developed, as Table 1 demonstrates. From the 15th and 16th centuries onwards, there are problems in interpreting the data, because of the rapidly increasing global population, and a consequent rise in the number of astronomical observations being made, although most of the data used in Table 1, especially for meteoric activity, was roughly corrected for such population shifts in the references used. Information after circa 1500 AD is of lesser interest in considering the origins of millennialism anyway.

Several points are worth further comment. Firstly, except for the earliest period in Table 1, prior to which the available records are often not sufficiently detailed or extensive enough to definitely indicate specific comet or meteor fluxes, an increased comet flux was registered about

1–2 centuries before an over 1–2 century-long increase in meteoric activity. The limited number of such events cannot be seen as conclusive, and could simply be coincidental, but the time delay would easily accommodate typical loop-formation times for meteor streams visible from Earth and associated with average short-period comets, as well as being similar to the largest short-period comet orbital periods.

Table 1 – A qualitative time line showing periods of enhanced meteoric and cometary activity, from circa 250 BC to circa 1600 AD, compiled from data in [1,2,4].

Dates	Events
ca. 250 BC– ca. 50 AD	<i>Bright meteors</i> : Increased flux from ca. 250 BC to early decades AD, with peak ca. 150 BC. <i>Meteors and meteor showers</i> : Enhanced activity from ca. 200 BC to ca. 50 AD.
ca. 100 AD	<i>Meteors and meteor showers</i> : Possible enhanced activity.
200–300	<i>Comets</i> : Increased flux.
400–500	<i>Meteors and meteor showers</i> : Enhanced activity.
ca. 600–ca. 650 ca. 750–ca. 1400	<i>Meteors and meteor showers</i> : Strongly enhanced activity? <i>Comets</i> : Increased flux 8th–11th C. and again 13th–14th C. <i>Bright meteors</i> : Increased activity 9th–13th C., with huge peak in 11th C. <i>Meteors and meteor showers</i> : Enhanced activity ca. 750–ca. 1250, with peaks ca. 850–ca. 950 and in 11th C.
1400–1600	<i>Comets</i> : Increased flux. <i>Meteors and meteor showers</i> : Enhanced activity, becoming greatly enhanced during 17th C.

Secondly, significant peaks in bright meteor activity coupled with extensive enhancements in meteoric activity generally (showers and storms) coincided with both the BC/AD boundary period and around the end of the 1st millennium AD, with lesser, though still more obvious, activity bracketing these times by 100–200 years. These might be just by-chance coincidences again, but the second was clearly most serendipitous for Church purposes if so. Evidence to be examined later supports the idea that the BC/AD boundary enhancement resulted in the inclusion of meteor storm imagery in biblical and early extra-biblical Christian literature for the first time as well.

The shortest enhancements in meteoric events within the 1st millennium, ca. 100 and ca. 600–650, are more suspected than well-attested, but the longer 5th century peak can be traced rather better, and immediately preceded Little Dennis’s calendrical work. There are also surviving fresh Christian texts from around the 5th and 8th–10th centuries which use meteoric imagery, but the dating of these works is often uncertain, and it would be unwise to use them, or the AD dating revision, to draw conclusions from. It is clearer that upswings in meteoric and cometary activities were often used by the Church authorities to reaffirm the principles of millennialism, however.

4. Meteoric imagery in Christian sources

Generally speaking, the Old Testament (OT) biblical sources are believed to have been written during the last millennium BC, while the New Testament (NT) texts belong unsurprisingly to the opening centuries AD. A further class of Christian texts, sometimes called “The Apocrypha” (with a meaning of “secret” or “hidden,” though in especially protestant Christian terms, these works are often treated as false, which has led to the modern English word “apocryphal” having the meaning “dubious, false”), span the late centuries BC into the early medieval AD period. Here, I have preferred the term “extra-biblical” to “apocryphal,” since later attempts to discredit them conceal the fact that such works were hugely influential on medieval Christian beliefs, especially as many were often available in local languages. For example, the detailed Christian

concepts of heaven and particularly hell, which reach their pinnacle of expression in Dante Alighieri's "The Divine Comedy" (completed 1321), can be traced chiefly through extra-biblical sources written during the 1st millennium AD.

The OT books show a singular lack of reference to falling stars. The sole unequivocal mention is in *Isaiah* 14:12, where "Daystar, son of Dawn" (a title of Satan's as Lucifer, "Light-bringer," the morning star, often taken to be the planet Venus) falls to the ground from the heavens. *Isaiah* 14:15 varies this by having Daystar flung into Sheol, the Abyss, instead, though here "Daystar" refers to the King of Babylon, not Satan. *Isaiah* is thought to have been written around the 6th century BC.

Numerous OT references are to effects which could be reinterpreted as meteors or meteorite impacts, but which are actually stated as being fire falling from heaven, lightning strikes, or hailstones instead. Falls of fire from heaven are among the most frequent of these in biblical sources, beginning with the destruction of the cities Sodom and Gomorrah, the plain around them, and all living things on it by a rain of fire and brimstone (modernly regarded as burning sulphur) from heaven in *Genesis* 19:24–26. Such fire is re-used in this blanket way in for instance, *Psalms* 11 and 18, *Wisdom* 16:16–17, as well as in the NT *Luke* 17:29 (repeating the Sodom and Gomorrah story) and *Rev.* 13:11–13. This last is an apocalyptic usage which recurs reworked in extra-biblical sources such as the ca. 2nd century AD *Syriac Apocalypse of Baruch* 27:10 [6, p. 855], or a late 12th century German poem listing the signs before Doomsday [7, p. 120], where the 15th and final sign is God's fire shooting 40 fathoms into the Earth, destroying both it and heaven. In the ca. 2nd–3rd century AD *Sibylline Oracles* 2 [8, pp. 613–614], this is converted into a river of fire and brimstone which pours down from heaven.

Such fire can also be targeted more precisely, however. In *Numbers* 16:35, fire shoots from the god Yahweh and consumes a group of 250 men making incense offerings, while in *1 Kings* 18:38 (written ca. 7th century BC), this same fire consumes only a burnt offering, the wood it was burnt on, and some water in a trench around the altar. Later, this accuracy improves still more. In the *Testament of Abraham* 10:13–14 [9, p. 408], written in the early centuries AD, Abraham has the archangel Michael have fire descend from heaven to destroy just two burglars!

Lightning is a phenomenon often linked popularly or in folklore to meteors. The similarities—swift, bright, unexpected, linear (though in lightning's case only roughly)—make such a colloquial connection unavoidable. Lightning also frequently strikes the Earth and is followed by the loud rumbling of thunder. For a casual witness, the difference between this and the events of a meteorite impact is nonexistent. Medieval woodcuts of meteoritic events commonly show lightning in association, and meteorites can be folklorically named "thunderstones." Lightning can start fires too, and in Jewish and Christian literature is typically perceived as an agent of divine retribution. Some of the descriptions of fire descending from heaven are tied in with lightning imagery, so lightning strikes causing fires may well be intended in these instances. We should recall that popularly, even today, small meteorites are thought to be hot enough to start fires on landing (cf. the media reports discussed by Korlević [10], following a brilliant meteor being linked to a house fire on the opposite side of the Adriatic Sea in January 1993), however generally incorrect such a belief may be.

In the OT, lightning is commonly described as either like, or the same as, divine arrows used against transgressors and enemies, as seen in *2 Samuel* 22:8–15, where the fire-breathing god Yahweh rocks Earth and the heavens in his descent, wrapped in dark clouds, throwing down hail, fire and shooting lightning arrows before him. As *Job* 36:29–33 (probably written in the early 5th century BC) makes clear, the "Tent of Yahweh" is a dark, threatening thundercloud, imagery reinforced in *Psalms* 18 and 77, while 76 and 144 support the lightning-arrows concept. Lightning used as a punishment for sinners recurs in the late 1st century BC biblical *Book of Wisdom* (5:21–22) and the extra-biblical *Apocalypse of Abraham* 8:1–7 ([11, p.375] dated vaguely between ca. 70 AD and the mid-4th century), where Abraham's father is killed and his house destroyed when God hurls a thunderbolt at it, which sets it alight.

An important extra-biblical text dealing with large amounts of Jewish astronomical lore, and which also contains some fascinating vision-imagery, highly influential on that later used in *Revelation*, is the circa late 3rd to early 2nd century BC *Book of Enoch* (now normally called *1 Enoch*; [12, 13]). In his second vision (*1 Enoch* 43–44 [12, p.226]) the patriarch Enoch describes seeing the “other lightnings,” which are different to the ordinary thunder and lightning he had seen in an earlier vision. These “others” are with the stars of heaven, and he sees how the stars’ revolution produces them. He goes on to discuss how some stars arise and become lightnings, but then cannot part with their new forms. This is a feasible lay-description of meteors which also invokes Aristotle’s theory that meteors occurred when vapors rose from the Earth and became ignited by the friction of the rotating celestial spheres, or the change in pressure due to cold higher in the atmosphere, described in *Meteorologica* Book I, Chapter 4 ([14, pp. 28–35]; written circa the mid-4th century BC). It also shows an understanding that “shooting stars” were neither the same as “ordinary” lightning, nor the fixed stars, while implying a loose connection to both phenomena.

Hail is used much as fire and lightning in Jewish and Christian texts, as a punishment, with most references to it being typical for a heavy meteorological hailstorm, as in *Job* 20:23 (coupled with God’s burning wrath and (lightning?) arrows), or *Wisdom* 16:16–17 (with torrential rain and fire). However, *Wisdom* 5:22 with its furious hailstones being hurled from a catapult, suggests a more directly-targeted use which could hint at a more meteoritic source. Further variants creep into the later extra-biblical material, for example “great hailstones of severe fire” which will fall on the Last Day, according to the late 2nd century AD *Epistle of the Apostles* 34 [8, p. 578]. A particularly interesting event occurs in the *Acts of Paul* 7 ([8, p. 379]; from the end of the 2nd century AD), where “a violent and exceedingly heavy hail-storm fell from heaven, although the sky was clear” to save Paul and a baptized lion from being killed by an armed crowd. The description is of a severe natural event, but the clear sky could infer a combined meteoritic and hailstorm explanation.

Many of the fire-lightning-hail events could also be visualized as pyroclastic bombs hurled from a distant volcano, but none of this should be taken to imply that the ancient authors were describing single, specific events they had witnessed. While this may seem self-evident, many scientific authors over the years have made exactly this mistake. A classic example is to see a particular volcanic eruption (e.g., Santorini, ca. 1604 BC) or comet (e.g., Halley, ca. 1404 BC) in the *Exodus* 13:21–22 imagery of the pillar of cloud-by-day and fire-by-night which leads the Israelites out of Egypt. This pillar is the god Yahweh, and as we have seen already, he always appears in OT descriptions as a cloudy and/or fiery presence, a theological fact which is generally overlooked in scientific treatments. Non-theological discussions also usually fail to note the many unknowns about the biblical Israelite exodus, including when it occurred, where it started from, which directions the Israelites traveled in, or where the two critical places *en route* (the Sea of Reeds—often mistranslated as the Red Sea—and Mount Sinai) were, as well as the fact that at least two distinct migration tales have been drawn on in constructing the biblical exodus story!

In all of this imagery found in Jewish and Christian texts from OT times forwards, apart from *Isaiah*’s falling Daystar, the closest we come to true meteors can perhaps be found in the objects like burning coals or torches that dart to and fro between four, winged composite creatures (which themselves vanish and reappear like lightning flashes) in the midst of Yahweh’s brilliant, fiery chariot in the prophet Ezekiel’s vision *Ezekiel* 1:1–28, especially 13–14). *Ezekiel*’s dating is uncertain, but the prophet flourished ca. 593–571 BC. Like the *Book of Enoch*, *Ezekiel*’s visionary images were highly influential on those used in *Revelation*. In a later vision (*Ezekiel* 10:1–17), Ezekiel sees an angel instructed to take some of these darting, fiery coals and scatter them over the city of Jerusalem to destroy it, following the slaughter of sinners there. Such use of specifically burning coals against transgressors is apparent again in *Psalms* 11 and 140, for instance.

Clear references to falling stars only commence with the apocalyptic biblical and extra-biblical material which flourished especially between the circa 2nd century BC and the circa 1st century AD. The ending of this period is less easy to define, but most texts using typical apocalyptic imagery later than the circa 3rd century AD seem to offer simply variants on earlier ideas, and no longer appear as original (on Jewish and Christian apocalyptic written between ca. 300 BC and ca. 300 AD, see [15]).

Such reworking of material helped carry apocalyptic traditions and beliefs through as common knowledge well into the medieval period in forms including the circa 6th/8th century *Saltair Na Rann*, and the medieval *Evernew Tongue*, and they continued to recur in official and unofficial Church teachings until relatively modern times. These texts have survived especially well from early Christian Ireland, a peripherally-placed island on Europe's border initially beyond the doctrinal control of the Church of Rome.

1 Enoch dates to the start of the flowering of apocalyptic literature. There, along with the "other lightnings" already discussed, we find another vision (*1 Enoch* 86:1–3 [12, p. 277]) where Enoch sees one star followed by many more fall to Earth to become oxen. The later punishment of these fallen stars (*1 Enoch* 88 [12, p. 278]) makes it clear this is an earlier variant of the war in heaven described in *Rev.* 12:7–9 where Michael and his angels cast down Satan, in the form of a great dragon, and his angels from heaven onto the Earth. This concept of angels becoming falling stars persists into quite modern folklore in parts of Christian Europe, for example. As agents of the fiery, stormy god Yahweh, this is not surprising, and frequent references to the glowing nature or brilliance of the angels can be seen in both OT and NT sources. In the extra-biblical *2 Esdras* 8:21–22 [16, p. 219], we are explicitly told that, at God's command, the angels are changed to wind and fire. The composite text of *2 Esdras* dates from between the 2nd century BC to the 2nd century AD. One version of the *Syriac Narrative of the Assumption of the Virgin Mary* 1, Book III [17, p. 220] contains a description of fiery angels who descend from heaven to defend Mary's house when a mob rises up to attack it. This was probably written in or after the 5th century AD.

In the early 2nd century AD *Apocalypse of Peter*, Ethiopic text 5 [8, p. 602], the spirits of the dead are turned into lightning and fire at God's command on the Day of Judgment, while, in the *Apocalypse of Abraham* 15:7 [11, pp. 379–380], many fiery men running in all directions in heaven, and constantly changing their appearance, are seen by Abraham in the company of an angel. The 3rd/4th century AD *Testament of Solomon* 20:12–17 [18, p. 747] has a description by the demon Ornias of how the demons ascend to heaven and fly among the stars, but on growing exhausted, they "fall away like leaves from trees, and the men that see it think stars are falling from heaven." Ornias continues that the demons fall because of their weakness: "we fall down like lightnings upon the earth, and burn up cities, and set fields on fire," and concludes that they are not the same as the fixed stars which remain secure in the vault of heaven. Something of this notion still survived into medieval times, as a 12th century Anglo-Norman poem listing the fifteen signs before Doomsday attests [7, pp. 28–29]. The second sign in this has the stars fall from heaven and run about the Earth like lightning, in tears and hiding beneath the mountains, until they turn black and plunge into the Abyss.

If *1 Enoch* is near the beginnings of mainstream, original, apocalyptic literature, *Revelation* (dated to ca. 68–70 AD, possibly as late as ca. 95 AD) is towards its end. Although drawing on earlier texts, it represents a culmination of such works and possesses some of the most striking visual imagery in all of biblical literature. One of the most frequently-used of these images in *Revelation* as virtually unique in the Bible is the falling of stars from heaven. In *Rev.* Chapter 6, the breaking of five of seven seals by the Lamb of God brings forth first four apocalyptic riders and then an altar to the martyred dead, before the sixth seal's breaking causes a variety of astronomical and geological events (*Rev.* 6:12–14). These include the falling of stars to Earth like figs shaken from their trees in a high wind, a depiction which re-echoes in dozens of later extra-biblical texts well into medieval times, and which is also found in the biblical gospels of

Matthew (24:29–31) and Mark (13:24–26). In a passage reminiscent of *Ezekiel* 10:1–17, *Rev.* 8:5 records an angel taking live coals from an incense-altar before God's throne and hurling them to Earth, complete with thunder, lightning and an earthquake.

The sounding of the first trumpet of seven (*Rev.* 8:7) brings a fall of hail, fire and blood to burn the Earth, a throwback to the OT, but trumpet 2 (*Rev.* 8:8–9) heralds a new image, a great blazing mountain cast into the sea. The third trumpet (*Rev.* 8:10–11) sees a huge burning star called Wormwood fall on and poison the rivers and springs, while trumpet 5 (*Rev.* 9:1–6) causes a star later described as an angel to fall to Earth, unlock the shaft to the Abyss, and release smoke which rises to darken the sky. From this smoke drop horrific gigantic armored beasts, part-locust, part-scorpion, to attack those not chosen by God. Here we have another definite link between shooting stars and angels. The final chief mention of falling stars is in *Rev.* 12:1–6, where a huge, red, seven-headed dragon sweeps one-third of the stars from the sky with its tail, a prelude to the casting down of Satan's angels in the heavenly war already referred to. Meteors and dragons are also linked together in the popular mind [19].

Later Christian works associate stars or falling stars with fire. In the Ethiopic *Apocalypse of Peter* 5 [17, p. 513], we find, "*the stars shall fly in pieces by flames of fire,*" though a more recent translation [8, p. 602] gives, "*the stars shall be melted by flames of fire*" instead. The early medieval list of signs preceding Doomsday by Peter Damien [7, pp. 27–28] has on the seventh day, "*the planets and stars will spray out fiery tails such as appear in comets, to the Earth and its inhabitants,*" while a comparably-dated Welsh poem *Arwyddion cyn Dydd Brawd* sign 7 [7, p. 116] dealing with the ninth day before the end has "*Sulphurous flames in sparks, A tumult falling from the stars.*" The early Irish medieval tale *The Magi*, which preserves an earlier text now lost, describes the star seen by the magi at the birth of Christ in meteoric terms [20, pp. 40–41]: "*On the calends of January . . . we suddenly saw the sign which had been recounted to us, a great star, trailing fire, between us and heaven. We were pleased at this, and moreover, nobody else saw it but ourselves.*" This is a very apt word-picture of a typical fireball observation, but the details are then inflated (as also often happens in casual fireball reports, though here to a far greater extreme) to have the star's radiance fill all heaven and Earth, and to continue to lead the magi for twelve days from India to Judea, riding magically-swift horses, but still without anyone else spotting it!

One final extra-biblical text to note is the 10th century Irish *Evernew Tongue* 6–7 [20, p. 110], which appears to contain the description of an early electrophonic fireball, witnessed by a large outdoor religious assembly: "*Suddenly, at the end of the eve of Easter, there was heard in the clouds a noise like thunder, or like the crackle of fire. There was a thunderous blast meanwhile, whereby suddenly a solar mass, like a bright sun, was seen in the midst of the tumult. That radiant solar mass . . . was seven times brighter than the Sun . . . the eyes of the host awaited the crash, for they thought that it was a sign of Doomsday.*" The meteor goes on to speak to the assembly in an angelic voice; it is the *Evernew Tongue* itself, alias the apostle Philip.

5. Discussion

From the above, it is clear that the appearance of apocalyptic Christian literature including the first widespread use of falling-star iconography resembling strong meteor showers or storms coincides with the period of increased meteoric activity in the closing centuries BC and the 1st century AD. As other Christian texts draw on commonly-known images, it seems highly likely that because meteor storms and bright meteor showers happened relatively frequently during this time, they were drafted-in to the repertoire of portents, and perhaps even fueled the desire to create fresh apocalyptic literature in the first place.

We know that signs and portents were looked-for in the last few centuries BC, because a Messiah was expected to arrive imminently, and such increased astronomical searching could well have led the religious authors to discover the heightened meteor activity of their day. The Babylonians—an astronomically-experienced people Jewish and proto-Christian scholars would at least have

known of, and most likely had contacts with—recorded much of the information we have on this increased meteoric flux, along with, e.g., the Chinese. One wonders if an extant, if perhaps rudimentary and apparently unstated, knowledge of the ca. 1050-year periodicity in meteoric activity found by Rasmussen helped lead to the expectation of a coming Messiah at this time.

One curiosity is that comets do not obviously feature in early Christian writings at all, which is odd considering how often they were later used as signs to help bend the will of the church-going masses by the clergy. Comets perceived as ill-omens can be traced back to ancient Mesopotamia in the Western tradition, probably to the 2nd millennium BC, if not before, with Greek and Roman authors helping to perpetuate the concept in their writings through to medieval and even modern times. Occasionally, comets were seen as more positive, such as Giotto's use of a comet as the Star of Bethlehem in his ca. 1309 fresco of Christ's nativity at Padua in Italy, but this was uncommon. Comet-fear certainly played a significant role around the end of the 1st millennium AD and has continued as a key facet of millennialism's signs and portents ever since. I have examined these beliefs in comets in more detail elsewhere [21].

6. Conclusion

We will probably never know when the idea that sky portents reflected earthly events began. The earliest connection between strong meteor shower activity and human disasters I have found concerns the collapse of the important and highly influential Akkadian Dynasty in ancient Mesopotamia, and the utter destruction of its capital city Agade, ca. 2200 BC. This date is essentially three ca. 1050-year periods before the 11th century meteoric activity peak, and two such periods before the ca. 150 BC meteoric maximum, which may be nothing other than coincidental, but is intriguing nonetheless.

A text compiling prodigies supposedly predicting the end of the Akkadian Dynasty includes the line "*stars fell repeatedly from the sky*" [22, p. 283], though the text's dating is not clear. One notable and unique poem *The Curse of Agade* (discussed and translated in [23]), probably written within ca. 150 years of Agade's destruction, makes no mention of falling-star portents, so this may be a later—or merely separate—association. Falling stars were generally viewed as ill-omens in ancient Mesopotamia as Oppenheim's commentary in [22] discusses. Another text he quotes with the Agade prodigy runs, "*end of the dynasty, a great star will fall,*" for instance.

The events at, and for about eighty years after, the end of the Akkadian Dynasty were uniquely catastrophic and chaotic in ancient Mesopotamia certainly. *The Curse of Agade* condemns the city to perpetual future obscurity, highly fitting as archaeological investigations since 1761 have so far failed to locate Agade's ruins, despite the fact that the Akkadian language was the *lingua franca* of the region through until the 8th century BC.

Recent evidence has been found suggesting an abrupt climatic change ca. 2000 BC, coupled with distinctive meteoritic impact trace-products in the appropriate archaeological horizons across the Near East, according to Courty [24]. Later in her report to the December 1998 Royal Astronomical Society's London meeting, Courty discussed evidence for an ice-lens micro-structure found in some sampled horizons, which she indicated showed the impact ejecta had been frozen rapidly at high altitude. On re-entering the lower atmosphere, she noted, these ejecta would accumulate as hailstones, a fascinating thought when coupled with the possibly meteoritic hail in biblical and extra-biblical Christian sources. If this all proves correct, perhaps the "Agade event" was the beginning of meteoric activity being associated with end-times scenarios.

General notes

I have preferentially used Wansbrough [25] as my main source of biblical translations and dating, primarily because of its annotated and recent nature. It also includes most of the accepted so-called OT apocrypha as integral parts of the OT (to identify these, see Kee [16]). Other translations of the Bible may vary compared to what I have discussed here. The dating of the extra-biblical materials was derived from the individual reference sources cited. Dates too uncertain or unknown (for instance the first five books of the Bible, or Pentateuch, are commonly stated as being written sometime between the 10th and 4th centuries BC, but were based on earlier, probably oral, traditions) have been omitted here.

References and notes

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