

Title Page

Stones with Souls: How Have Meteorites Been Viewed in the Past and How Are They Viewed in the Present?

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## Master's Degrees by Examination and Dissertation

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## Abstract

This study investigates how meteorites have been viewed across cultures and historical periods, discovering their position as sacred, political, and symbolic objects. Meteoritic iron was associated with the heavens in some of the earliest civilisations, and Sumerian and Egyptian linguistic traditions linked iron directly to the sky or to divine beings. Studies which included the black stone of Emesa, the Aegospotami and Abydos stones, the Cybele stone, and the sacred stones of Orchomenus, Cassandra, Tyre, Ephesus, Paphos, Delphi, and Mecca, all illustrate how these objects shaped religious belief, were used politically, and created enduring myths and legends. Medieval and early modern examples, such as the falls at Nogata, Ensisheim, and Willamette, show how meteoritic finds influenced ritual practices, legal structures, and developing scientific investigation. In regions which included Africa, America, and Asia, meteorites acquired cultural significance through oral tradition, craftsmanship, and mythology. Objects such as Libyan Desert Glass, Inuit tools, and Javanese kris blades demonstrate how celestial materials were incorporated into both practical and ceremonial artefacts. Using the structures of theorists such as Lévi-Strauss, Durkheim, Eliade, and Patrick Curry, the study interprets meteorites as objects whose meaning arises through cultural structures, collective rituals, sacred manifestations, and the experience of enchantment. Although science has advanced, meteorites continue to inspire wonder, appearing in museums, jewellery, and popular culture. These stones have acted as intermediaries between earth and sky, reflecting the desire to locate cosmic meaning inside the physical world, as if they were stones with souls.

## Introduction

### Stones with souls

Richard M. Pearl<sup>1</sup> states that almost certainly the first iron used by man, and perhaps the only iron in some instances, was meteoritic. In a number of languages, the word for iron is linked to the words for star and sky. The relationship between iron, meteors, lightning and power is generally observed across cultures, and the Egyptian phrase *bjz n pt*, which means 'iron of the sky', is similar to the Sumerian term *ku<sub>3</sub>-an*.<sup>2</sup> Three words were used to designate iron in Sumerian: *an-na*, *an-bar* and *ku<sub>3</sub>-an*. The common feature of AN could be used as an abbreviated form to describe iron. In Sumerian lists of metals, which go back to texts dated to the Uruk III period (c. 3200–2900 BCE), the sign AN had a well-established meaning of the sky-God An, 'sky' or 'heaven'.<sup>3</sup> Meteorites have played a part in art, religion, science and literature. However, scientists rejected the idea that the stones were from outer space until early in the 19th century.<sup>4</sup>

George F. Moore<sup>5</sup> wrote that stones with souls, or holy stones, came in various forms, often being endowed with magical properties such as the power of movement or speech, some being considered lucky while others unlucky. Moore<sup>6</sup> identified these stones as *baetylia* or meteorites and distinguished them from larger natural rock formations that people had shaped into cones, pillars, and oblong alters and used in ritual worship. These *baetylia* were small stones, and Moore<sup>7</sup> believed that they were probably prehistoric stone implements, although some could have 'fallen from heaven' as was the common belief. Pearl<sup>8</sup> considered that the most interesting meteorite falls were the ones known to have injured people, killed animals, and damaged buildings. These were from more recent times and could be validated, whereas some of the ancient reports, although perhaps more dramatic, could not be authenticated.

There is literature that defines meteorites, listing them by name, and analysing their composition; some also mention myths associated with certain meteorites. At the same time, other literature describes meteorite hunting, crystal healing and more modern events

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<sup>1</sup> Richard M. Pearl, *Fallen from Heaven: Meteorites and Man* (Colorado: Earth Science Publishing Company, 1975), p. 9.

<sup>2</sup> Victoria Almansa-Villatoro, 'The Cultural Indexicality of the N41 Sign for *bjz*: The Metal of the Sky and the Sky of Metal', *The Journal of Egyptian Archaeology*, 105.1 (2019), pp. 73–81 (p. 81).

<sup>3</sup> Almansa-Villatoro, 'The Cultural Indexicality of the N41', p. 79.

<sup>4</sup> Pearl, *Fallen from Heaven*, p. 7.

<sup>5</sup> George F. Moore, 'Baetylia', *American Journal of Archaeology*, 7.2 (1903), pp. 198–208 (p. 199).

<sup>6</sup> Moore, 'Baetylia', p. 204.

<sup>7</sup> Moore, 'Baetylia', p. 205.

<sup>8</sup> Pearl, *Fallen from Heaven*, p. 13.

associated with meteorites and tektites. Tektites were often collected as talismans and regarded as objects of mystery in the past.<sup>9</sup> While there are reports on individual meteorites and their recovery, such as those by R. E. Peary,<sup>10</sup> and books that provide a short list of meteorites with types and potential myths, such as those by Pearl,<sup>11</sup> there is little that connects these ideas. Meteorites were often considered messages and messengers from heaven; if meteoric events were seen with awe and wonder in the past, is it possible that they still fulfil this role in the present? Therefore, do contemporary humans still seek a connection to the sky through meteorites as did the people of the past? To address this question, a museum and library-based research was undertaken to investigate the historical and contemporary relationship between meteorites and people. This study included tektites as well as meteorites. The investigation used a number of relevant literature resources, including books, journal papers and conference proceedings; photographs and illustrations were included of relevant items and areas as required. Thus, as the understanding of meteorites has evolved over time, a thorough examination of the available literature will investigate the question: *Stones with Souls*: how have meteorites been viewed in the past and how are they viewed in the present?

#### Is it a Meteorite or a Tektite?

A rock becomes a meteorite only after it has landed on the Earth; while a space rock is travelling through the atmosphere, it is called a meteoroid, and while it is in space, it is a meteor.<sup>12</sup> A meteoroid can range in size from dust particles to small asteroids, but those that have survived the trip through the atmosphere to become a meteorite are usually the size of a pebble or small rock. Despite their resemblance to Earth rocks, meteorites typically have a glossy, burnt appearance called a fusion crust. This crust was created by the outer surface of the meteoroid melting as it travelled through the atmosphere; this melting also produced displays called fireballs or shooting stars. Meteorites are divided into three major categories: these are 'stony', 'iron' and 'stony-iron'. The majority of meteorites that have landed on Earth are stony; however, stony meteorites are much harder to differentiate from Earth rocks than

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<sup>9</sup> G. J. H. McCall, *Tektites in the Geological Record: Showers of Glass from the Sky* (London: The Geological Society, 2001), p. 1.

<sup>10</sup> R. E. Peary, 'Four Years' Arctic Exploration, 1898-1902', *The Geographical Journal*, 22.6 (1903), pp. 646–668.

<sup>11</sup> Pearl, *Fallen from Heaven*.

<sup>12</sup> National Aeronautics and Space Administration, *Meteors & Meteorites Facts* (2025) <<https://science.nasa.gov/solar-system/meteors-meteorites/facts/>> [accessed 21 March 2025].

iron meteorites, which are heavier.<sup>13</sup> This led to the iron meteorite being the more common find as it both looked and felt different to a common Earth rock.

A small meteorite would typically make a shallow indentation in the ground known as an impact pit; a larger meteorite may form a crater, while the most colossal could create the impact feature known as an astrobleme (Greek for star wound).<sup>14</sup> The geological area surrounding the impact site would be drastically deformed if a meteorite strike were large enough to create an astrobleme. The terrestrial rocks that have been physically changed by the heat, pressure, and shock waves associated with a massive meteorite impact are known as impactites. Libyan Desert Glass and Darwin Glass are impactite sands.

Tektites are, in the simplest terms, small pebble-like pieces of natural glass, varying in colour from black to green.<sup>15</sup> Outwardly, some tektites resemble obsidian, the most prevalent of the several natural glass types found on Earth.<sup>16</sup> However, unlike Earthly obsidian, tektites are composed of a glass, which melts at a far higher temperature and has a much higher viscosity. Over the past century, there have been a number of schools of thought regarding the origin of tektites; however, today it is generally accepted that they were created by an extremely rare meteor or comet impact. The impact caused the ejection of molten terrestrial material from the crater into the atmosphere, where it solidified and rained down as tektites. However, G. J. H. McCall<sup>17</sup> believes that 'many questions concerning tektites remain unsolved – the mystery is still there'.

Although tektites are sometimes discovered as angular shards or irregular blobs, they are typically a splash shape of some kind.<sup>18</sup> Spheres, discs, rods, teardrops, dumbbells, and lenses are some examples of these splash forms. Tektites are located in strewn-fields that do not cover the entire Earth. Within the strewn-field they are found more or less randomly. This is different to a meteorite strewn-field where the heavier fragments will be found at the extreme travel end of the distribution ellipse. There are four recognised tektite strewn-fields and some smaller sites where tektites or a very similar glass are located. These strewn-fields are the Central European (moldavite tektites), the North American (georgiites and bediasite tektites), the Ivory Coast, and the Australasian (australites, indochinites, thailandites, malaysianites, philippinites, billitonites, and javanites).<sup>19</sup>

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<sup>13</sup> National Aeronautics and Space Administration, 2025.

<sup>14</sup> Geoffrey Notkin, *Impactites: Ghostly Footprints of Ancient Meteorites* (2025) <<https://geology.com/meteorites/impactites.shtml>> [accessed 23 March 2025].

<sup>15</sup> McCall, *Tektites*, p.1.

<sup>16</sup> McCall, *Tektites*, p. 5.

<sup>17</sup> McCall, *Tektites*, p. 3.

<sup>18</sup> McCall, *Tektites*, p. 5.

<sup>19</sup> McCall, *Tektites*, pp. 10-23.

## Geomythology

Nicholas Campion<sup>20</sup> points out that star myths may preserve the memory of ancient meteor strikes, and they are present in most cultures. Dorothy B. Vitaliano<sup>21</sup> created the term 'geomythology', which she considers to be 'the geologic application of euhemerism'. In order to try to connect mythology with known history, the geomythologist looks for the actual geologic event that has generated a myth or a story in the past. Thus, it is an interdisciplinary field that encompasses mythology, folklore, history, archaeology, and earth science. In addition, geomythology includes what folklorists refer to as aetiological or explanatory myths, which are created to explain different aspects of the human environment. Many of these myths, as well as some pseudo-folklore, or fakelore, as Richard M. Dorson<sup>22</sup> named it, are based on what has been described by Jan Harold Brunvand<sup>23</sup> as the 'folklore-attracting features of dramatic geography' and lay claim to explain the origin of remarkable landforms around the world. Occasionally, a small-scale feature, such as a distinctive mineral, may even serve as a source of legend. At the same time, aetiological myths that seek to explain earthquakes and volcanic eruptions have flourished in regions of the world that experience these recurring, ominous, and breath-taking natural events.<sup>24</sup>

## Meteorite Naming

For anyone with an interest in meteorites, reliable and unmistakable meteorite names are indispensable. Official names are required to publish meteorite studies, in meeting proceedings, for identification in museums and to buy and sell meteorites. The identification of specific meteorite falls should be a simple matter, as a meteorite is named after its place of fall.<sup>25</sup> However, in the late 1800s, meteorites were often named after the person who found them; this was found to be unsatisfactory for several reasons.<sup>26</sup> The name gave no idea of the find site; meteorites collected by different individuals in the same area were unconnected and

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<sup>20</sup> Nicholas Campion, *Astrology and Cosmology in the World's Religions* (New York: New York University Press, 2012), p. 30.

<sup>21</sup> Dorothy B. Vitaliano, 'Geomythology: The Impact of Geologic Events on History and Legend with Special Reference to Atlantis' *Journal of the Folklore Institute*, 5.1 (1968), pp. 5-30 (p. 5).

<sup>22</sup> Richard M. Dorson, *Folklore and Fakelore: Essays Toward a Discipline of Folk Studies* (Cambridge, MA: Harvard University Press, 1976), p. 5.

<sup>23</sup> Jan Harold Brunvand, *The Study of American Folklore: An Introduction* (New York: W. W. Norton, 1968), p. 971.

<sup>24</sup> Dorothy B. Vitaliano, *Legends of the Earth: Their Geologic Origins* (Bloomington: Indiana University Press, 1973), p. 1.

<sup>25</sup> G. I. Huss, 'Mounting Problems in the Naming of Meteorite Discoveries', *Meteoritics*, 6.1, (1971), pp. 21-25 (p. 21).

<sup>26</sup> Huss, 'Mounting Problems', p. 21.

were named after the museum collectors, not the original finders. As G. I. Huss<sup>27</sup> explains, the names of individuals were proving inadequate, and meteorites began to be named after places and topographical features. Consequently, a meteorite may be named after a town, city, mountain peak, prominent hill or bluff, or occasionally for a river or stream. However, this system, while straightforward, ran into problems such as identical place names and adjacent and over-lapping meteorite falls. For example, 'the Ponca Creek meteorite was called the Dakota Iron even though it was found in what is now Nebraska; the Bear Creek Iron was called the Colorado Iron; and the Red River Meteorite was variously called the Gibb's Meteorite, the Louisiana Meteorite, the Texas Meteorite, and the Brazos Meteorite, with the result that today its place of find is still not certainly known'.<sup>28</sup>

At the Field Museum of Natural History in Chicago, in 1933, 'The Society for Research on Meteorites' was founded.<sup>29</sup> Yearly conferences were suspended from 1942 to 1945, and a new name, 'The Meteoritical Society', was adopted at the 1946 meeting. During the 1950s, the Society was essentially moribund. However, following the beginning of the Space Age in the 1960s, the Society gradually attracted members with backgrounds in impact dynamics, petrology, isotope geochemistry, mineralogy, electron microprobe and neutron activation studies, and more. The Meteoritical Society founded the Meteorite Nomenclature Committee (NomCom) in 1973, and this body is now in charge of creating standards for meteorite naming, approving new names, choosing whether to pair or separate previously named meteorites, and publishing this information in the Meteoritical Bulletin and the Meteoritical Bulletin Database.<sup>30</sup> The database contains, at the last update (27 March 2025), 77419 valid meteorite names, which include relict meteorites (these are highly altered objects that possibly have a meteoritic origin), 6393 provisional names, and 16902 full-text writeups.<sup>31</sup>

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<sup>27</sup> Huss, 'Mounting Problems', p. 22.

<sup>28</sup> Huss, 'Mounting Problems', p. 22.

<sup>29</sup> The Meteoritical Society: International Society for Meteoritics and Planetary Science, *Meteorite Names* (2025) <<https://meteoritical.org/>> [accessed 31 March 2025].

<sup>30</sup> The Meteoritical Society, *Meteorite Names*, 2025.

<sup>31</sup> The Meteoritical Society: International Society for Meteoritics and Planetary Science, *Meteoritical Bulletin Database* (2025) <<https://www.lpi.usra.edu/meteor/>> [accessed 31 March 2025].

## Literature Review

### Scepticism and Theories

Undoubtedly, meteorites have been falling on the Earth since time began.<sup>32</sup> Scientists have estimated that 44,000 kilograms of meteoritic debris fall on the Earth every day.<sup>33</sup> However, nearly all this material is incinerated in Earth's atmosphere almost immediately.<sup>34</sup> The larger pieces that survive the ride through Earth's atmosphere appear as shooting stars, fireballs, or meteoroids, while the atmospheric transit can create a sonic boom which may be heard by people some distance away from the scene of the actual fall. A fireball that has exploded is called a bolide, and it may disintegrate into dust or fall as a few or many thousand meteorite fragments.<sup>35</sup> A fall is considered by scientists to have been observed by witnesses, while a find is a meteorite whose fall was unobserved but is later identified as a meteorite due to its composition. However, the majority of natural philosophers in the eighteenth century either disbelieved or questioned that meteorites fell.<sup>36</sup> The rejection of an uncommon yet genuine natural event has been looked upon as an important error by the scientific community of the day, especially as it lasted for approximately a hundred years. It is still regarded as a source of embarrassment by scientists.<sup>37</sup>

As discussed by Friedrich M. Berwerth,<sup>38</sup> the fall that occurred near Luce in France in 1768 caused the professors and academics in Paris great consternation, as they were unable to comprehend the described events and the unidentified material. Berwerth<sup>39</sup> notes that the French chemist Antoine Lavoisier (1743–1794) suggested the meteorite found might be a type of iron pyrite. Berwerth<sup>40</sup> also discussed the attitude taken by Andreas Xavier Stütz (1747–1806), director of the court mineral cabinet in Vienna. This was of total disbelief that the stories of iron from the sky could be believed. While the iron masses of Agram and Eichstadt may have appeared to have fallen from heaven, he considered that these myths existed due to the glaring ignorance of natural history and practical physics in the past. Berwerth<sup>41</sup> also mentions the response by American President Thomas Jefferson (1743-1826) to reports of stones falling from the sky in Connecticut. It was claimed that Jefferson replied

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<sup>32</sup> J.G. Burke, *Cosmic Debris: Meteorites in History* (Berkeley: University of California Press, 1991), p. 1.

<sup>33</sup> National Aeronautics and Space Administration, 2025.

<sup>34</sup> Burke, *Cosmic Debris*, p. 1.

<sup>35</sup> Burke, *Cosmic Debris*, p. 1.

<sup>36</sup> Burke, *Cosmic Debris*, p. 5.

<sup>37</sup> Burke, *Cosmic Debris*, p. 5.

<sup>38</sup> Friedrich M. Berwerth, 'On the Origin of Meteorites', *Annual Report of the Smithsonian Institution*, (1916), pp. 311–320 (p. 312).

<sup>39</sup> Berwerth, 'On the Origin of Meteorites', p. 312.

<sup>40</sup> Berwerth, 'On the Origin of Meteorites', p. 312.

<sup>41</sup> Berwerth, 'On the Origin of Meteorites', p. 312.

when told of the assertions: 'It is easier to believe that two Yankee professors would lie than that stones would fall from heaven'.<sup>42</sup> McCall<sup>43</sup> comments that even the most respected members of a community are disposed to exaggerate an observation, and that a rumour may easily be converted into the truth; therefore, the scepticism of the scientific community of the day could be seen as justified. Fritz Paneth<sup>44</sup> put forward one explanation that appears to have gained popularity in articles about meteorites: that Enlightenment natural philosophers prioritised reason and empirical evidence over accepting claims that contradicted established understanding. At the same time, it is possible that the members of the Paris-based Académie Royale des Sciences were overzealous, inflexible, and too quick to disbelieve eyewitness accounts in their quest to dispel common superstitions.<sup>45</sup> However, Burke<sup>46</sup> contends that all explanations of Enlightenment scepticism regarding meteorite falls to date have one flaw in common: they do not adequately account for the understanding and practice of chemistry during the eighteenth century, nor do they explain eighteenth century concepts regarding meteorology or the genesis of minerals. However credulous the prevailing ideas of the eighteenth-century as to the origins of natural atmospheric events may appear by contemporary standards, scientists of the time had grounds for their scepticism; apart from attributing reports of stones falling from the sky to delusion, exaggeration, or foolishness.

In the eighteenth century, the word meteors did not have the meaning it has today. In 1704, the English writer, scientist and vicar John Harris<sup>47</sup> (c. 1666–1719) defined meteors in the following way:

METEORS, (according to the *Cartesians*) are certain various Impressions made upon the Elements, exhibiting them in different Forms, and are called *Meteors* from their Elevation; because for the most part, they appear high in the Air, and they are either Fiery, Airy, or Watery. *Fiery Meteors*, are such as consist of a Fat, Sulphureous kindled Smoak, whereof there are several kinds: as *Ignis Fatuus*, *Trabs*, *Ignis Pyramidalis*, *Draco Volans*, *Capra Saltans*, *Thunder and Lightning*, etc. *Airy Meteors*, are such as consist of Flatuous and Spirituous Exhalations, as *Winds*, etc. *Watery Meteors*, consist of Vapours, or Watery Particles, by the Action of Heat separated from each other and variously modified as *Rain*, *Dew*, etc.

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<sup>42</sup> Berwerth, 'On the Origin of Meteorites', p. 312.

<sup>43</sup> G J H McCall, *Meteorites and their Origins*, (Newton Abbot: David and Charles, 1973), p. 17.

<sup>44</sup> Fritz Paneth, *The Origin of Meteorites: Being the Halley Lecture Delivered on 16 May 1940*, (Oxford: Clarendon Press, 1940), pp. 12.

<sup>45</sup> Burke, *Cosmic Debris*, p. 5.

<sup>46</sup> Burke, *Cosmic Debris*, p. 5.

<sup>47</sup> John Harris, *Lexicon Technicum: or an Universal English Dictionary of Arts and Sciences: Explaining not only the Terms of Art, but the Arts Themselves Vol 1*, 2<sup>nd</sup> edn. (London: printed for Dan Brown and others, 1708).

The meteorological theory developed by the Greek philosopher Aristotle<sup>48</sup> (384–322 BCE) in approximately 340 BCE, and later discussed by the Roman philosopher Seneca<sup>49</sup> (c. 3–65 BCE), is the basis of this early eighteenth-century description and explanation of meteors or shooting stars. To the eighteenth-century academics and scientists, meteors were brief atmospheric events resulting from the interaction of terrestrial vapours or exhalations in the air; they consisted of one of the elemental forces, either air, fire, or water.<sup>50</sup> Depending on the specific type of mixing process that had taken place in the atmosphere, they appeared in different ways. Aristotle's opinions about astronomy and physics were largely overturned during the scientific revolution of the sixteenth and seventeenth centuries.<sup>51</sup> It was shown that planets and their moons orbit the sun in elliptical paths, following the law of universal gravitation. However, the concept of quintessence, or aether, remained. It was believed this substance allowed light from the sun and stars to travel through space and acted as a medium for gravitational force. While most of Aristotle's views on the sublunary region between the Earth and the Moon were still respected, one important exception was his theory about comets. Aristotle proposed that comets were meteors in the upper atmosphere, although this view was challenged by Seneca.<sup>52</sup> As discussed by Burke<sup>53</sup> it was not until the late sixteenth century that observations, especially those by the Danish astronomer Tycho Brahe (1546–1601), proved that comets were actually cosmic events.

From the mid-eighteenth century onward, Burke<sup>54</sup> proposed that many scientists began to consider that meteors, fireballs, and auroras were extraordinary exhibitions of atmospheric electricity or magnetism. These concepts started to become strong alternatives to the idea of meteors being enflamed earthly exhalations, due to the experiments of the American polymath Benjamin Franklin<sup>55</sup> (1706–1790) and others. However, electricity also supplied a vital element to the exhalation theory, as it provided the most likely source of vapour ignition.<sup>56</sup> The physical theory, as proposed by the English polymath Isaac Newton<sup>57</sup>

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<sup>48</sup> Aristotle, *Meteorologica I*, trans. by H. D. P. Lee, Loeb Classical Library 397 (Cambridge, MA: Harvard University Press, 1952), IV.341b–342a.1–30, pp. 29–35.

<sup>49</sup> Seneca, *Natural Questions Vol. I*, trans. by Thomas H. Corcoran, Loeb Classical Library 450 (Cambridge, MA: Harvard University Press, 1971), I.5, p. 17.

<sup>50</sup> Burke, *Cosmic Debris*, p. 6.

<sup>51</sup> Burke, *Cosmic Debris*, p. 6.

<sup>52</sup> Seneca, *Natural Questions Vol. II*, trans. by Thomas H. Corcoran, Loeb Classical Library 457 (Cambridge, MA: Harvard University Press, 1972), VII.

<sup>53</sup> Burke, *Cosmic Debris*, p. 6.

<sup>54</sup> Burke, *Cosmic Debris*, p. 10.

<sup>55</sup> Benjamin Franklin, 'The Kite Experiment', *The Pennsylvania Gazette*, October 19 1752.

<<https://founders.archives.gov/documents/Franklin/01-04-02-0135>> [accessed 15 April 2025].

<sup>56</sup> Burke, *Cosmic Debris*, p. 10.

<sup>57</sup> Isaac Newton, *Opticks: or, a Treatise of the Reflections, Refractions, Inflections and Colours of Light*, 4<sup>th</sup> edn. (London: William Innys, 1730), 3.1, p. 368.

(1643–1727), held that material could not fall to Earth from space because only the aether and the great celestial bodies were believed to be found there. Additionally, there began to be a belief that stones could not be formed in the atmosphere. The French chemist Nicolas Lémery<sup>58</sup> (1645–1715) wrote in 1700, 'as for the lightning stones with which the common people want thunder to always be accompanied, their existence seems very doubtful to me' (my translation).<sup>59</sup> However, Lémery<sup>60</sup> considered that it was 'not absolutely impossible that hurricanes, by rising rapidly to the clouds ... sometimes carry off with them stony and mineral materials, which soften and unify by heat, form what is called thunderstone'<sup>61</sup> (my translation) and therefore deposited an earthly stone that appeared to come from the air. The distinct differences between terrestrial and meteoritic irons were not recognised in the eighteenth century because of a lack of understanding of the physics and chemistry of metals.<sup>62</sup>

There was an evolving acceptance amongst mineralogists and chemists during the early part of the eighteenth-century that it was impossible for stones to be produced in the air or in the clouds. The studies of early archaeologists, mineralogists, and palaeontologists were also giving rise to the concept that thunderstones were either fossils, ancient stone tools, or a crystalline aggregate. The French antiquary Nicolas Mahudel<sup>63</sup> (1673–1747) gave a detailed description of thunderstones to the Académie Royale, showing they were in fact lithic artefacts. Nevertheless, other reports of rains of blood or milk, such as those mentioned by the writer Pliny the Elder<sup>64</sup> (c. 23–79 CE), undermined the credibility of accounts concerning stones falling from the sky. Nonetheless, it was the scientific concepts of the age that played a key role in the doubt and uncertainty shown by eighteenth-century natural philosophers. Those who denied the validity of the accounts felt they had comprehensive reasons for disbelieving that stones fell; specifically, their creation in the Earth's atmosphere was considered impossible, and there was nothing in cosmic space apart from planets,

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<sup>58</sup> Nicolas Lémery. 'Explication Physique et Chimique des Feux souterrains, des Tremblements de Terre, des Ouragans, des Éclairs et du Tonnerre', *Mémoires de Mathématique et de Physique de l'Académie Royale des Sciences*, (1700), pp. 101–110 (p. 106).

<sup>59</sup> Quant aux pierres de foudre dont le vulgaire veut que le Tonnerre soit toujours accompagné, leur existence me paroît bien douteuse.

<sup>60</sup> Lémery. 'Explication Physique', pp. 106–107.

<sup>61</sup> il n'est pourtant pas absolument impossible que les Ouragans en montant rapidement jusqu'aux nues ... n'enlèvent quelquefois avec eux des matières pierreuses & minérales, qui s'amollissant & s'unissant par la chaleur, forment ce qu'on appelle pierre de Tonnerre.

<sup>62</sup> Burke, *Cosmic Debris*, p. 30.

<sup>63</sup> Nicolas, Mahudel, 'Sur les prétendues Pierres de Foudre', *Histoire et Mémoires de l'Académie Royale des Inscriptions et Belles Lettres depuis l'année 1734 jusques & compris l'année 1737*, (Paris: Imprimerie Royale, 1740), pp. 163–169.

<sup>64</sup> Pliny, *Natural History Vol. I: Books 1–2*, trans. by H. Rackham, Loeb Classical Library 330 (Cambridge, MA: Harvard University Press, 1938), II.147, p. 283.

comets, and stars. These theories were still credited by those who accepted the fall of stones from the sky, assuming the stones were pyroclastic material or something similar.

### Acceptance and Theories

Between 1794 and 1803, scientists began to accept the falls and finds of meteorites; Burke<sup>65</sup> attributed this relatively rapid change in opinions to the following four factors. The book, published in 1794 by German musician and physicist Ernst F. F. Chladni<sup>66</sup> (1756–1827), who proposed that material from the cosmos penetrated the Earth's atmosphere, created a fireball, and released meteorites. A report published by British chemist Edward C. Howard<sup>67</sup> (1774–1816), found that several meteoric stones from around the world had comparable chemical structures, he also found that these stones and 'native iron' contained nickel. The physicist, mathematician and astronomer Jean-Baptiste Biot<sup>68</sup> (1774–1862), gave a detailed report to the Institut National de France in July 1803 that numerous stones had been dropped by a fireball at L'Aigle in Normandy in April. This was an important report as Biot travelled to L'Aigle to examine the evidence. Matthieu Gounelle<sup>69</sup> believed it was unlikely that Chladni travelled to St. Petersburg to see the famous Pallas iron. However, Ursula B. Marvin<sup>70</sup> suggested that Chladni may have visited the Pallas iron, although this remains unproven. Similarly, the English scientists concerned with the chemical analyses of meteorites and the debate regarding falling stones did not travel to Yorkshire to see the 1795 Wold Cottage meteorite; instead, they viewed the stone at Piccadilly for the sum of one shilling.<sup>71</sup> In Gounelle's<sup>72</sup> opinion, Biot established the overall dependability of peasants' testimonies about meteorite falls, and solved the difficulty of the credibility of witnesses by visiting the meteorite fall site and interviewing the people himself. The last factor, according to Burke,<sup>73</sup> was the quantity of meteorite falls that were coming to the notice of the scientific community. Chladni<sup>74</sup> listed and discussed eyewitness reports of falls in his book, including

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<sup>65</sup> Burke, *Cosmic Debris*, p. 37.

<sup>66</sup> Ernst F. F., Chladni, *Über den Ursprung der von Pallas gefundenen und anderer ihr ähnlicher Eisenmassen, und über einige damit in Verbindung stehende Naturerscheinungen* (Riga: Hartknoch, 1794).

<sup>67</sup> Edward C. Howard, 'Experiments and Observations on Certain Stony and Metalline Substances, which are said to have Fallen on the Earth: Also on Various Kinds of Native Iron', *Philosophical Transactions of the Royal Society*, 92.1 (1802), pp. 168–212.

<sup>68</sup> Jean-Baptiste Boit, 'Relation d'un Voyage Fait dans le Département de l'Orne, pour Constater la Réalité d'un Météore Observé à L'Aigle, le 26 Floréal an 11', *De l'Institut Nationale*, (Thermidor an XI - 1803).

<sup>69</sup> Matthieu Gounelle, 'The Meteorite fall at L'Aigle and the Biot Report: Exploring the Cradle of Meteoritics', *Meteoritics and Planetary Science Supplement*, 38 (2003), pp. 73–89 (p. 78).

<sup>70</sup> Ursula B. Marvin, 'Ernst Florens Friedrich Chladni (1756–1827) and the Origins of Modern Meteorite Research', *Meteoritics & Planetary Science*, 31 (1996), pp. 545–588 (p. 557).

<sup>71</sup> Gounelle, 'The Meteorite fall at L'Aigle', p. 79.

<sup>72</sup> Gounelle, 'The Meteorite fall at L'Aigle', p. 79.

<sup>73</sup> Burke, *Cosmic Debris*, p. 37.

<sup>74</sup> Chladni, *Ueber den Ursprung der von Pallas*.

the Lucania iron mentioned by Pliny<sup>75</sup> and the Hraschina (Agram) iron from Croatia, written about by Stütz,<sup>76</sup> Burke<sup>77</sup> lists the following reported witnessed falls:

- Siena, Italy, in 1794
- Wold Cottage, Yorkshire, in 1795
- Evora Monte, Portugal, in 1796
- Salles, Rhône, France, in 1798
- Krakhut, Benares, Uttar Pradesh, India, in 1798
- Pettiswood, Ireland, in 1779 (reported in 1796)
- Barbotan, France, in 1790.

Consequently, the acceptance of meteorite falls was influenced by the noticeable rise in falls being reported.<sup>78</sup> The viewpoints displayed by scientific journals varied, as noted by Burke<sup>79</sup>, but the Philosophical Magazine, Bibliothèque Britannique, and the Journal de Physique all published reports of falls as well as counter arguments.

The Siena fall in 1794 led Italian scientists to be the first to accept falls.<sup>80</sup> However, by the end of 1797, several prominent German scientists announced their acceptance of meteorites. The British scientists followed in around 1800, and by 1802, French scientists had started to acknowledge meteorite falls. However, the French Revolution (1789–1799) and internal politics may have played a part in the delayed French acknowledgement. In the United States, scepticism continued until much later; the delay in acceptance could perhaps be explained by the time it took European scientific publications to reach America. However, the scientific theory of the probable origin of meteorites did not undergo a transformation simply because falls were accepted. The scientists of the time, while accepting that stones fell, were still confused about where the stones came from; it was acknowledged that there was no origin theory that was acceptable to a majority.

The theories reveal the enduring influence of Aristotle's meteorological philosophy and the limited understanding of the physics of the atmosphere and its composition.<sup>81</sup> Before the development of thermodynamics and electromagnetic theory, there was considerable confusion regarding the nature of heat, light, electricity, and magnetism. While many theories suggested that meteorites had an extra-terrestrial origin, very few scientists believed in a cosmic origin. The prevailing belief was that the Earth-Moon system was a closed unit,

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<sup>75</sup> Pliny, *Natural History Vol. I*, II.147, p. 285.

<sup>76</sup> Andreas Stütz, 'Über einige vorgeblich vom Himmel gefallene Steine' *Bergbaukunde, Leipzig*, 2 (1790), pp. 398–409.

<sup>77</sup> Burke, *Cosmic Debris*, p. 37.

<sup>78</sup> Burke, *Cosmic Debris*, p. 37.

<sup>79</sup> Burke, *Cosmic Debris*, p. 38.

<sup>80</sup> Burke, *Cosmic Debris*, p. 38.

<sup>81</sup> Burke, *Cosmic Debris*, p. 58.

which led to greater support for theories proposing that meteorites originated within this system.<sup>82</sup> A few of these proposals were that meteorites were produced in the sky, were ejected from lunar volcanoes, or dropped from passing comets. A clear distinction was made between these concepts and those suggesting that meteorites were fragments of a planetary destruction or the remains from the creation of the Solar System. A minority speculated that meteorites could result from active volcanic eruptions on Earth or from large primitive volcanoes in its early history.<sup>83</sup>

In the early twentieth century, several scientific advancements occurred that affected meteorite research; these refined ideas concerning meteorite chemistry, mineralogy, and structure.<sup>84</sup> They also demonstrated that the knowledge, methods and instrumentation of the age were inadequate for the task of unravelling the secrets of meteorites. However, scientific research and developments necessitated by World War II equipped scientists with new technologies and ideas. Atomic physics, X-ray crystallography, and chemical thermodynamics were areas of substantial development.<sup>85</sup> With the discovery of radioactivity, meteorites were examined to see if they contained radioactive elements and to establish their ages by the calculation of radioactive half-lives. The discovery of isotopes prompted investigations to determine whether the isotopic arrangement of elements in meteorites and terrestrial rocks was comparable. X-ray crystallography allowed the sizes of atoms and ions to be measured, which gave a more precise understanding of the occurrence of isomorphism. While the development of quantitative X-ray spectroscopy resulted in the detection of trace elements present in meteorites. However, scientists still had unresolved questions concerning meteorites. These included questions on the formation of the Widmanstätten structure (the interlocking crystals of kamacite and taenite form a distinctive pattern) in iron meteorites; suitable methods for defining meteorite ages; the cause of some terrestrial and lunar craters; and how tektites were created. However, by the 1950s, scientists had concluded that research on meteorites would not only solve the mysteries of their origin but also provide insight into when and how the solar system was created.<sup>86</sup>

Aerial surveys, structural, magnetic, and seismic data, coupled with signs of shock metamorphism in nearby rocks, help geologists to confirm that a crater was formed by a meteorite impact. Around seventy craters have been identified since the 1950s as probably

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<sup>82</sup> Burke, *Cosmic Debris*, p. 58.

<sup>83</sup> Burke, *Cosmic Debris*, p. 58.

<sup>84</sup> Burke, *Cosmic Debris*, p. 237.

<sup>85</sup> Burke, *Cosmic Debris*, p. 237.

<sup>86</sup> Burke, *Cosmic Debris*, p. 280.

being meteoric.<sup>87</sup> Lunar explorations provided scientists with evidence on impact craters, especially regarding their ages; this had been estimated previously from crater density distributions. Radioisotope dating of the rocks brought back from the Apollo Moon landings revealed that the number of strikes by meteorites on the Moon, which produced craters, in the first half-billion years of Solar System history was about one hundred times the current rate.<sup>88</sup> Geologists conjecture that Earth experienced a similar bombardment during this period; however, there is no evidence of these early terrestrial craters. One of the oldest known craters is the Sudbury Basin in Ontario, Canada, which has been estimated at 1.8 billion years old. The studies of impact craters and lunar rocks also provided new insights into the origin of tektites.<sup>89</sup> In the early 1960s, researchers believed that the lack of any cosmogenic isotopes in tektites excluded any extra-terrestrial source other than the Moon. However, further examination detected coesite and baddeleyite in some tektites. Iron-nickel spherules were also detected in philippinites, which suggested that tektites might be impact glass expelled from meteorite craters. The Nördlinger Ries crater in western Bavaria was identified as the parent crater of the moldavite-strewn field located three hundred km away, and the parent crater of the Ivory Coast tektite field was identified as the four hundred km distant Lake Bosumtwi in Ghana. Radiometric dating of both craters and the nearby tektites indicated that they were formed at the same time. Additionally, the Apollo missions did not bring back any silica-rich rocks from the Moon, which raised significant doubts regarding a lunar origin for tektites. As a result, many geochemists have come to regard tektites as terrestrial impact glass.

In the late 1800s, diamonds were found in iron meteorites, and it was therefore assumed that meteorites originated in a sizeable planet with a high-pressure core.<sup>90</sup> However, as discussed by Marvin<sup>91</sup> the American physical chemist Harold C. Urey (1893-1981) argued that diamond formation would require a body the size of the Moon with high gravitational pressure. However, further cooling-rate calculations showed that Widmanstätten patterns would only be formed in small, relatively low-pressure bodies. These conflicting requirements were resolved in December 1954 when General Electric's 'Project Superpressure' succeeded in creating non-natural diamonds.<sup>92</sup> The angstrom-sized black diamonds formed in clumps and were comparable to the meteoritic diamonds in the Canyon

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<sup>87</sup> Burke, *Cosmic Debris*, p. 318.

<sup>88</sup> Burke, *Cosmic Debris*, p. 318.

<sup>89</sup> Burke, *Cosmic Debris*, p. 318.

<sup>90</sup> Marvin, 'Ernst Florens Friedrich Chladni', p. 581.

<sup>91</sup> Marvin, 'Ernst Florens Friedrich Chladni', p. 581.

<sup>92</sup> Lydia Pyne, *Genuine Fakes: How Phony Things Teach Us About Real Stuff* (London: Bloomsbury Publishing, 2019), pp. 77–110.

Diablo iron from Arizona; on this evidence, it was concluded that meteoritic diamonds formed under shock pressures experienced during impacts in space or with the Earth<sup>93</sup>. Once the prerequisite for a large parent planet was eliminated, various studies have suggested that meteorites are the result of collisions between asteroids.<sup>94</sup> However, meteorites have been identified from two other sources since the 1980s. The first meteorite identified as coming from the Moon was Allan Hills 81005, found in Antarctica in 1982.<sup>95</sup> Also found in Antarctica, Elephant Moraine 79001 was confirmed as a meteorite from Mars in 1983, using Martian soil and atmosphere analysed by the Viking landers on Mars in 1976.<sup>96</sup> Meteorites are now widely recognised as debris from asteroid collisions with the Moon, Mars, and each other.

### Wonders from the Sky

Since the 17<sup>th</sup> century, meteorites from over one thousand observed falls have been retrieved globally, and many have been well documented and scientifically analysed.<sup>97</sup> Most are now in public or private collections. However, before the 17<sup>th</sup> century, only two falls with surviving material are known: the Nogata fall in Japan (861 CE) and the Ensisheim fall in Alsace, France (1492 CE).<sup>98</sup> Other early falls mainly rely on written sources, as the meteorites themselves are either lost or destroyed.<sup>99</sup> Further back in time, accounts blend with myth and legend, making it harder to identify genuine falls.

### Sol Invictus Elagabal

The city of Emesa (Homs, Syria), situated on the Orontes River, approximately equidistant between Damascus and Antioch, contained a magnificent temple dedicated to the sun god.<sup>100</sup> The Roman historian Herodian<sup>101</sup> (c. 170–240 CE) reported that the God was

<sup>93</sup> M. E Lipschutz and E. Anders, 'The Record in the Meteorites-IV Origin of Diamonds in Iron Meteorites', *Geochimica et Cosmochimica Acta*, 25.4 (1961), p. 314.

<sup>94</sup> Marvin, 'Ernst Florens Friedrich Chladni', p. 581.

<sup>95</sup> J. N. Grossman, 'The Meteoritical Bulletin, no. 76: The U.S. Antarctic Meteorite Collection', *Meteoritics*, 29.1 (1994), pp. 100–143 (p.100).

<sup>96</sup> Harry. Y McSween Jr., 'What we have Learned about Mars from SNC Meteorites', *Meteoritics*, 29 (1994), pp. 757–779 (p. 758).

<sup>97</sup> Massimo D'Orazio, 'Meteorite Records in the Ancient Greek and Latin Literature: Between History and Myth' in *Myth and Geology: Geological Society Special Publication no. 273*, ed. by L. Piccardi and W. B. Masse (London: Geological Society, 2007), pp. 215–225 (p. 215).

<sup>98</sup> Monica Grady, *Catalogue of Meteorites (MetCat)* (from *Catalogue of Meteorites*), [Data set resource] Natural History Museum (2022) <<https://data.nhm.ac.uk/dataset/metcat/resource/96dc3c09-49fd-4af6-b2fb-5a48a76d09ee>> [accessed 11 July 2025].

<sup>99</sup> D'Orazio, 'Meteorite Records in the Ancient Greek and Latin Literature', p. 215.

<sup>100</sup> Hubert A. Newton, 'The Worship of Meteorites' *Nature*, 56.1450 (1897), pp. 355–359 (p. 358).

<sup>101</sup> Herodian, *History of the Empire Vol II*, trans. by C. R. Whittaker, Loeb Classical Library 455 (Cambridge, MA: Harvard University Press, 1970), V.3.4, p. 19.

worshipped under his Phoenician name, Elagabalus. Herodian<sup>102</sup> described the deity as follows: 'There was no actual man-made statue of the god, the sort Greeks and Romans put up; but there was an enormous stone, rounded at the base and coming to a point on the top, conical in shape and black'. The stone was venerated as though it had fallen from heaven, and worshippers interpreted its bulges and patterns as symbolic of the sun. Pierre M. Bellemare<sup>103</sup> has suggested that this sun god may have been represented by a meteorite. As explained by Martijn Icks,<sup>104</sup> this local Syrian deity briefly became the major deity in Rome as Sol Invictus Elagabal, usurping the throne of Jupiter Optimus Maximus. Elagabal (El'Gabal) was served in Emesa by a fourteen-year-old high priest, Varius Avitus Bassianus (c. 204–222 CE), who performed rituals and danced for the God.<sup>105</sup> Bassianus captured the attention of Roman soldiers stationed nearby, and he was declared emperor under the claim that he was an illegitimate son of Caracalla (188–217 CE).<sup>106</sup> In reality, he was the first cousin once removed of Caracalla; however, his grandmother spread the false claim to secure army support.<sup>107</sup> With this backing, Bassianus seized the throne, becoming the third ruler of the Severan dynasty and taking the name Marcus Aurelius Antoninus to reinforce his connection to Caracalla. He is frequently referred to as Emperor Elagabalus or Heliogabalus, a name that seems to have been used only after his murder.<sup>108</sup>

Elagabalus travelled with his God from Syria to Rome, overwintering in Nicomedia.<sup>109</sup> Upon arrival, his position appeared relatively secure, with formal support from the army and Senate, and any rivals removed.<sup>110</sup> Subsequently, Elagabalus married Julia Cornelia Paula, described by Herodian<sup>111</sup> as a member of a very aristocratic Roman family. In Antioch, coins were minted that depicted the black stone of Emesa carried on a

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<sup>102</sup> Herodian, *History of the Empire Vol. II*, V.3.5, pp. 19–21.

<sup>103</sup> Pierre M Bellemare, 'Meteorite Sparks a Cult', *The Royal Astronomical Society of Canada*, 90.5/6 (1996), pp. 287–291 (p. 287).

<sup>104</sup> Martijn Icks, 'Empire of the Sun? Civic Responses to the Rise and Fall of Sol Elagabal in the Roman Empire', in *Ritual Dynamics and Religious Change in the Roman Empire: Proceedings of the Eighth Workshop of the International Network Impact of Empire (Heidelberg, July 5-7, 2007)*, ed. by Olivier Hekster, Sebastian Schmidt-Hofner and Christian Witschel (Leiden: Brill, 2009), pp. 111–120 (p. 111).

<sup>105</sup> Jussi Rantala, 'Ruling in Purple ... and Wearing Make-up: Gendered Adventures of Emperor Elagabalus as seen by Cassius Dio and Herodian', in *Exploring Gender Diversity in the Ancient World*, ed. by Allison Surtees and Jennifer Dyer (Edinburgh: Edinburgh University Press, 2020), pp. 118–128 (p. 118).

<sup>106</sup> Icks, 'Empire of the Sun?', p. 111.

<sup>107</sup> Bellemare, 'Meteorite Sparks a Cult', p. 288.

<sup>108</sup> Rantala, 'Ruling in Purple', p. 118.

<sup>109</sup> Herodian, *History of the Empire Vol. II*, V.5.3, p. 39.

<sup>110</sup> Martijn Icks, 'Priesthood and Imperial Power the Religious Reforms of Heliogabalus, 220-222 AD', in *The Impact of Imperial Rome on Religions, Ritual and Religious Life in the Roman Empire: Proceedings from the Fifth Workshop of the International Network Impact of Empire (Roman Empire, 200 B.C. - A.D. 476) Münster, June 30 - July 4, 2004*, ed. by Lukas De Blois, Peter Funke and Johannes Hahn (Leiden: Brill, 2006), pp. 169-178 (p. 172).

<sup>111</sup> Herodian, *History of the Empire Vol. II*, V.6.1, p. 47.

chariot (Figure 1), whereas in Rome, coins mainly featured Fortuna, Pax, Mars, and Providentia, with Jupiter as the supreme god.<sup>112</sup> Icks<sup>113</sup> suggests this may have been an attempt to help the emperor, 'fit in' upon reaching Rome.



Figure 1. Gold Aureus. Bust of Elagabalus (obverse). Triumphal car, drawn by four horses, pacing right, carrying conical stone representing the god Baal, emblazoned with eagle: about it, four parasols. (reverse). Museum Number 1922,0909.4. Image: © The Trustees of the British Museum. CC BY-NC-SA 4.0.

Nevertheless, by 221–222 CE, a unique title began to appear on coins; Elagabalus was proclaimed the 'most elevated priest of the invincible Sun god Elagabal'. Coins from Rome and Antioch showed Elagabalus dressed as a high priest, sacrificing at an altar, and wearing, on the obverse, something that is usually described as a 'horn'. However, Icks<sup>114</sup> has suggested it may represent a bull's penis (Figure 2). The senator and historian Dio Cassius<sup>115</sup> (c. 150–235 CE), considered that Elagabalus's conduct contained many irregularities, however his main 'offence consisted, not in his introducing a foreign god into Rome or in his exalting him in very strange ways, but in his placing him even before Jupiter himself and causing himself to be voted his priest, also in his circumcising himself and abstaining from swine's flesh'. Jupiter was absent from coins after 220 CE; henceforth, coins depicted either the black stone of Elagabal or Sol in anthropomorphic form.

<sup>112</sup> Icks, 'Priesthood and Imperial Power', pp. 172–173.

<sup>113</sup> Icks, 'Priesthood and Imperial Power', p. 172.

<sup>114</sup> Icks, 'Priesthood and Imperial Power', p. 173.

<sup>115</sup> Dio Cassius, *Roman History Vol. IX*, trans. by Earnest Cary and Herbert B. Foster, Loeb Classical Library 177 (Cambridge, MA: Harvard University Press, 1927), LXXX.11, p. 457.



Figure 2. Silver Denarius. Bust of Elagabalus with horn (obverse). Elagabalus standing left, sacrificing from patera held in right hand over lighted altar and holding club in left hand; behind altar, prostrate bull; in left and right field, star. (reverse). Museum Number R.15595. Image: © The Trustees of the British Museum. CC BY-NC-SA 4.0.

Elagabalus divorced and married multiple women, including a Vestal Virgin, prompting Dio Cassius<sup>116</sup> to remark that he 'ought to have been scourged in the Forum, thrown into prison and then put to death'. Icks<sup>117</sup> noted that the god Elagabal also underwent symbolic marriages, first to Athena, who proved to be too warlike, and later to Urania (Dea Caelestis). On the Palatine, there was a temple dedicated to Elagabal with a second located in the outskirts. Herodian<sup>118</sup> recorded that at midsummer the god travelled to the suburban temple amid feasting and entertainment for the populace. According to Herodian,<sup>119</sup> the god was placed in a lavishly decorated chariot drawn by six pure white horses, each caparisoned with gold. The reins were attached so that the god appeared to drive, as no one actually sat in the chariot. Elagabalus ran backwards in front, so that he looked at the god while holding the horses' bridles. To prevent him from accidentally tripping, golden sand was laid on the ground, and bodyguards supported him on either side. Given the short duration of Elagabalus's reign, this rite could have occurred only once or twice.

<sup>116</sup> Dio Cassius, *Roman History Vol. IX*, LXXX.9, p. 459.

<sup>117</sup> Icks, 'Priesthood and Imperial Power', p. 175.

<sup>118</sup> Herodian, *History of the Empire Vol. II*, V.6.6, p. 53.

<sup>119</sup> Herodian, *History of the Empire Vol. II*, V.6.7-8, pp. 53–55.



Figure 3. Gold Aureus. Bust of Uranus Antoninus (obverse). Conical stone draped and ornamented (reverse). Museum Number 1864,1128.119. Image: © The Trustees of the British Museum. CC BY-NC-SA 4.0.

Uranus Antoninus, a shadowy figure about whom little is known, is depicted on the obverse of a gold aureus (Figure 3). At the same time, the reverse illustrates the stone of Emesa as a substantial block placed on a pedestal. The stone appears draped, open at the front, and secured at the bottom by a large, unusually shaped clasp. The protrusions noted by Herodian<sup>120</sup> are visible. It has been suggested that some of the protrusions could be flower decorations.<sup>121</sup> The top of the aerolith is surmounted by three tapering structures, suggested by Bellemare<sup>122</sup> to be precious stones, but their purpose is unclear. Lastly, on either side of the god stand two items, while Figure 1 shows four similar structures, often described as 'parasols'. However, as some are shown 'unfurled' within the temple (Figure 4), Bellemare<sup>123</sup> proposed they may have ritual significance rather than being actual parasols. Comparable items appear in Egyptian Pharaonic art and were found in the tomb of Tutankhamun, that is ostrich feather fans or sunshades. Lanny Bell<sup>124</sup> observed that 'the carrying of fans in processions would seem to have been a public declaration that the person or sacred object on display had an indwelling divine presence'. The fan in Figure 5 is without its feathers, but it contains the detail of an ankh carrying a fan behind the pharaoh. John McDonald<sup>125</sup> observed that:

<sup>120</sup> Herodian, *History of the Empire Vol. II*, V.3.5, p. 21.

<sup>121</sup> Bellemare, 'Meteorite Sparks a Cult', p. 290.

<sup>122</sup> Bellemare, 'Meteorite Sparks a Cult', p. 290.

<sup>123</sup> Bellemare, 'Meteorite Sparks a Cult', p. 290.

<sup>124</sup> Lanny Bell, 'Aspects of the Cult of the Deified Tutankhamun' in *Mélanges Gamal Eddin Mokhtar, Vol. 1*, ed. Paule Posener-Kriéger (Cairo: Institut Français D'Archéologie Orientale, 1985), pp. 31–59 (p. 34).

<sup>125</sup> John McDonald, 'Egyptian Sunshades', *Notes in the History of Art*, 18.2 (1999), pp. 8–14 (p. 11).

A shade, especially if in intimate association with the king, should probably be construed in sacral terms. Holding a shade above the figure of the king effectively divides the world into two domains, a sacred space and a profane. Additionally, the sunshade is a device capable of stirring the air. Since air is breath and breath means life, the sunshade can symbolise life itself.

Therefore, it is reasonable to suggest that the parasols of Roman Emesa and the fans of Pharaonic Egypt served the same purpose, publicly demonstrating divinity.



*Figure 4. Pierced copper alloy coin. Bust of Uranius Antoninus (obverse). Hexastyle temple of Elagabal at Emesa; in temple, conical stone of Elagabal shaded by two parasols. (reverse). Museum Number 1864,0910.140. Image: © The Trustees of the British Museum. CC BY-NC-SA 4.0.*



Figure 5. Fan of Tutankhamun found in his Tomb. Cairo Museum. JE62001. S. Hayter, 2023.

Gaston H. Halsberghe<sup>126</sup> proposed that Elagabalus's reforms were an early attempt to create a universal faith by religious syncretism. By placing important cult objects such as 'the stone of the Magna Mater-Cybele, the *Palladium*, the fire of Vesta and others' into the *Elagabalium*, Halsberghe<sup>127</sup> argued, Elagabalus sought to unify the empire under a new state religion, with himself as high priest and the other cults as subordinate, a possible precursor to Christianity. Robert Turcan, cited by Icks<sup>128</sup>, similarly suggested that Elagabalus intended to promote religious unification across the empire. However, Icks<sup>129</sup> notes that there is little indication of the assurance of an afterlife or of any well-developed theology. Elagabal was clearly not a monotheistic god, as he had married other goddesses, and there is no indication that the cult sought to convert non-believers or that there was much to believe in. In the opinion of Icks,<sup>130</sup> any comparisons to fourth and fifth-century Christianity are therefore inappropriate, as Elagabalus did not view the worship of his deity as a way to unite the empire.

The only remnants of the black stone of Emesa are ancient texts and symbolic representations, predominantly on coins. The fate of the stone after the murder of Elagabalus and the disposal of his body in the Tiber remains unclear. Dio Cassius<sup>131</sup> reported that 'as for Elagabalus himself [the god], he was banished from Rome altogether.' According to Herodian,<sup>132</sup> 'the statues of the gods, which the previous emperor had moved from their places, were returned to their original ancient temples and shrines', presumably including the black stone's return to Syria. Bellemare<sup>133</sup> proposed that the stone was reinstalled in Emesa, but when the temple became a Christian church, during the 4<sup>th</sup> century, the stone was probably broken up. Newton<sup>134</sup> suggested that with the cessation of Elagabal worship after the assassination of Elagabalus, the stone was probably discarded. Icks<sup>135</sup> maintained that Jupiter was reinstated as the head of the Roman pantheon and the black stone was returned to Emesa. Burke<sup>136</sup> noted that the fate of the stone was unknown, while D'Orazio<sup>137</sup> said simply

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<sup>126</sup> Gaston H. Halsberghe, *The Cult of Sol Invictus* (Leiden: E.J Brill, 1972), p. 104.

<sup>127</sup> Halsberghe, *The Cult of Sol Invictus*, p. 104.

<sup>128</sup> Robert Turcan, *Héliogabale et le Sacre du Soleil* (Paris: Albin Michel, 1985), p. 55, cited in Martijn Icks, 'Empire of the Sun? Civic Responses to the Rise and Fall of Sol Elagabal in the Roman Empire', in *Ritual Dynamics and Religious Change in the Roman Empire: Proceedings of the Eighth Workshop of the International Network Impact of Empire (Heidelberg, July 5-7, 2007)*, ed. by Olivier Hekster, Sebastian Schmidt-Hofner and Christian Witschel (Leiden: Brill, 2009), pp. 111–120 (p. 112).

<sup>129</sup> Icks, 'Empire of the Sun?' p. 113.

<sup>130</sup> Icks, 'Empire of the Sun?' p. 120.

<sup>131</sup> Dio Cassius, *Roman History Vol. IX*, LXXX.21, p. 479.

<sup>132</sup> Herodian, *History of the Empire Vol. II*, VI.1.3, p. 81.

<sup>133</sup> Bellemare, 'Meteorite Sparks a Cult', p. 288.

<sup>134</sup> Newton, 'The Worship of Meteorites', p. 358.

<sup>135</sup> Icks, 'Empire of the Sun?', p. 112.

<sup>136</sup> Burke, *Cosmic Debris*, p. 221.

<sup>137</sup> D'Orazio, 'Meteorite Records in the Ancient Greek and Latin Literature', p. 221.

it 'was never seen again'. During an excavation of the palace of the Caesars in Rome, the natural philosopher Monsignor Francesco Bianchini<sup>138</sup> (1662–1729) discovered a conical stone, three feet tall by three feet wide, with a flint like colour but softer. Unfortunately, the stone was badly damaged and not preserved, although Bianchini<sup>139</sup> suggested it might have been the black stone of Elagabalus.

The temple of the sun god Elagabal has not been found. It is usually considered to be in Emesa, now Homs, Syria; it could have stood on the Citadel or on the site now occupied by the al-Nuri Mosque in the old town. Excavations conducted from 1995 to 1999 uncovered some Roman era archaeology, but nothing that indicated a substantial structure, such as a temple.<sup>140</sup> Warwick Ball<sup>141</sup> has suggested that the sun temple of Emesa may not have been at Homs at all, proposing instead that it corresponds with the temple complex at Baalbek in Lebanon. However, Gary K. Young<sup>142</sup> argues that the epigraphic and written evidence cannot support placing the missing temple at Baalbek, and it must be in or near Homs.

#### Aegospotami Meteorite

Aegospotami (Goat River) was located on the eastern shore of the Gallipoli peninsula, across the Dardanelles (Hellespont) from Lampsacus and Abydos (Avydus).<sup>143</sup> Figure 6 shows its approximate location in relation to other towns. A key battle occurred at Aegospotami in 405 BCE, when the Spartan leader Lysander destroyed the Athenian fleet, effectively ending the Peloponnesian War, as Athens surrendered soon after.<sup>144</sup> The river lay in Thrace, in the Chersonese, and although the exact location is uncertain, 4th and 5th century coins attest to the existence of a settlement there.<sup>145</sup> The philosopher and historian Plutarch<sup>146</sup> (c. 40–120 BCE) wrote that 'according to the common belief, a stone of vast size had fallen from heaven at Aegospotami'. Plutarch<sup>147</sup> notes that the stone was seen as a portent of the Athenian defeat and was 'shown to this day by the dwellers in the Chersonese, who hold it in reverence'. The

<sup>138</sup> Francesco Bianchini, *Del Palazzo de Cesari: Opera Postuma di Monsignor Francesco Bianchini Veronese* (Verona: Per Pierantonio Berno, Stampatore, e Librajò nella via de' Leoni, 1738), p. 255.

<sup>139</sup> Bianchini, *Del Palazzo de Cesari*, p. 275.

<sup>140</sup> G.R.D King, 'Archaeological Fieldwork at the Citadel of Homs, Syria: 1995–1999', *Levant*, 34:1 (2002), pp. 39–58 (p. 45).

<sup>141</sup> Warwick Ball, *Rome in the East: The Transformation of an Empire* (London: Routledge, 2000), pp. 37–47.

<sup>142</sup> Gary K Young, 'Emesa and Baalbek: Where is the Temple of Elahagabal?' *Levant*, 35.1 (2003), pp. 159–162 (p. 162).

<sup>143</sup> E.T. Theodossiou, and others, 'The fall of a meteorite at Aegospotami in 467/6 BC' *Journal of Astronomical History and Heritage*, 5.2 (2002), pp. 135 – 140 (p. 135).

<sup>144</sup> Theodossiou, 'The fall of a meteorite at Aegospotami in 467/6 BC', p. 135.

<sup>145</sup> Barry Strauss, 'A Note on the Topography and Tactics of the Battle of Aegospotami' *The American Journal of Philology* 108.4 (1987), pp. 741–745 (p. 741).

<sup>146</sup> Plutarch, *Lives Vol. IV: Alcibiades and Coriolanus. Lysander and Sulla*, trans. by Bernadotte Perrin, Loeb Classical Library 80 (Cambridge, MA: Harvard University Press, 1916), XII, pp. 261–263.

<sup>147</sup> Plutarch, *Lives Vol. IV*, XII, p. 263.

Aegospotami fall is also referenced on a broken stela known as the Parian Marble, a chronicle of significant events spanning c. 3800–264 BCE.<sup>148</sup> The two surviving parts of the stela are housed at the Ashmolean Museum, Oxford and the Archaeological Museum of Paros, Greece. Strabo<sup>149</sup> also mentions the fall of a stone during the Persian Wars at Aegospotami, a town that was completely destroyed.

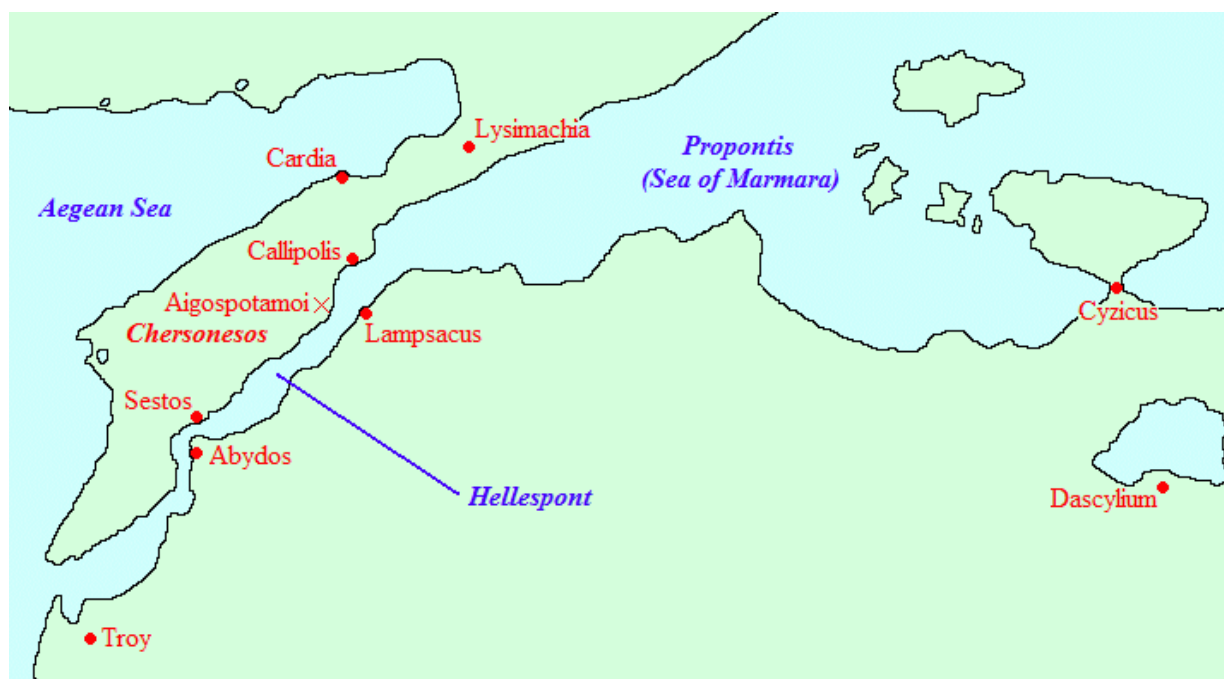


Figure 6. Map showing the approximate location of Aegospotami. All content copyright © 1995–2025 Livius.org. All rights reserved.

According to Pliny,<sup>150</sup> during the second year of the 78th Olympiad (467/6 BCE), the philosopher Anaxagoras of Clazomenae (c. 500–467 BCE) is said to have predicted that a rock would fall from the sun. The narrative recounted that a brown stone, about the size of a wagon load, fell during the day in the Goat's River district of Thrace, where it still was during the time of Pliny.<sup>151</sup> At the time of the fall, a comet was observed in the night sky. Aristotle<sup>152</sup> considered the stone that fell at Aegospotami to be a terrestrial rock lifted by the wind, noting that a comet had been sighted in the west. Another meteorite, smaller in size,

<sup>148</sup> Joseph Robertson, *The Parian Chronicle: Or the Chronicle of the Arundelian Marbles; with a Dissertation Concerning its Authenticity* (London: printed for J. Walters, 1788), p. 38.

<sup>149</sup> Strabo, *Geography, Vol. III: Books 67*, trans. by Horace Leonard Jones, Loeb Classical Library 182 (Cambridge, MA: Harvard University Press, 1924), Fragments of Book VII, p. 377.

<sup>150</sup> Pliny, *Natural History Vol. I*, II.149, p. 285.

<sup>151</sup> Pliny, *Natural History Vol. I*, II.149, p. 285.

<sup>152</sup> Aristotle, *Meteorologica I*, IV.344b.30, p. 55.

was reportedly worshipped at the exercising ground at Abydos; this fall had also been predicted by Anaxagoras.<sup>153</sup>

The fall of this large stone, most likely an iron meteorite, was recorded by Greek doxographers and authors at Aegospotami and was conceivably predicted by Anaxagoras. The fall was accurately dated on the Parian Marble and linked to the defeat of the Athenians. Both the Aegospotami and Abydos stones were worshipped by the local people as celestial in origin. The precise location of Aegospotami is disputed, and as a river location, it could have drastically changed over time. Therefore, the Aegospotami meteorite may have been covered in sediment or possibly weathered away; its location has not been found.<sup>154</sup> In Abydos, substantial construction works undertaken by Sultan Selim III in 1807, which included the destruction of the gymnasium, mean that the fate of the second stone is likewise unknown.<sup>155</sup>

### The Cybele Stone or Magna Mater

The goddess Cybele, mother of the gods Jupiter, Neptune, and Pluto, was worshipped in Pessinus in Phrygia. According to Newton,<sup>156</sup> a meteoric stone fell near Pessinus in antiquity and was taken to her shrine, where it was installed and venerated as her image. This image and its associated cult gained widespread recognition. However, A. McBeath and A. D. Gheorghe<sup>157</sup> argue that there is no evidence that the Cybele Stone was considered a sky fallen object until the Romans adopted her cult. The Roman historian Livy<sup>158</sup> (c. 59–17 BCE) explained the motivation behind the search for the Magna Mater and its transportation to Rome. However, he does not describe the stone itself, referring to it only as 'a sacred stone that the local people said was the mother of the gods'.<sup>159</sup> There had been an increase in the frequency of stone showers in Italy, whether these were meteoric or volcanic is unknown, and the Senate had asked for the Sibylline books to be consulted for guidance.<sup>160</sup> The Sibylline books were Greek oracles which allegedly dated from the rule of the last king of Rome, Lucius Tarquinius Superbus (reigned 534–510 BCE).<sup>161</sup> These omens coincided with the Second Punic War (218–201 BCE) against Hannibal, poor harvests, and an outbreak of

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<sup>153</sup> Pliny, *Natural History Vol. I*, II.150, p. 287.

<sup>154</sup> Theodossiou, 'The fall of a meteorite at Aegospotami in 467/6 BC' p. 138.

<sup>155</sup> Theodossiou, 'The fall of a meteorite at Aegospotami in 467/6 BC' p. 138.

<sup>156</sup> Newton, 'The Worship of Meteorites', p. 357

<sup>157</sup> A. McBeath and A. D. Gheorghe, 'Meteor Beliefs Project: Meteorite Worship in the Ancient Greek and Roman Worlds', *WGN, Journal of the International Meteor Organization*, 33.5 (2005), pp. 135–144 (p. 138) <<https://adsabs.harvard.edu/full/2005JIMO...33..135M>> [accessed 20 July 2025].

<sup>158</sup> Livy, *History of Rome, Vol. VIII*, ed. and trans. by J. C. Yardley, Loeb Classical Library 381 (Cambridge, MA: Harvard University Press, 2021), XXIX.10–14, pp. 229–247.

<sup>159</sup> Livy, *History of Rome, Vol. VIII*, XXIX.11, p. 233.

<sup>160</sup> Livy, *History of Rome, Vol. VIII*, XXIX.10, pp. 229–231.

<sup>161</sup> McBeath and Gheorghe, 'Meteorite Worship in the Ancient Greek and Roman Worlds', (p. 138).

illness among the Roman soldiers. The Sibylline books foretold that a foreign invader could be defeated if the Idaean Mother (Magna Mater) was brought to Rome from Pessinus.<sup>162</sup> Further confirmation came from the oracle of the Pythian Apollo at Delphi, and a delegation was sent to recover the stone from King Attalus of Phrygia. The oracle at Delphi advised that the goddess must be greeted by 'the best man in Rome'<sup>163</sup> when the emissaries returned with her. Publius Cornelius Scipio Nasica was chosen for this honour and received the goddess at Ostia. The stone was then passed hand to hand by Roman matrons before being placed in the Temple of Victory on the Palatine Hill.<sup>164</sup>

In the story recounted by Herodian,<sup>165</sup> Zeus caused the statue of the goddess to fall from the sky. The statue was made from an unrecognised material and may not have been made by human hands. Claudia Quinta is central to Herodian's<sup>166</sup> story of the goddess's arrival in Rome. As the ship carrying the Magna Mater approached the mouth of the Tiber River, it ran aground on a sandbar. Rumours had circulated questioning Claudia's chastity, but when the ship became stuck, Claudia prayed to the goddess for assistance. Miraculously, she single-handedly released and towed the ship to its mooring, which demonstrated both Claudia's virtue and the goddess's willingness to protect Rome.<sup>167</sup> Shortly afterwards, Rome succeeded in defeating the Carthaginian leader Hannibal. The Roman poet Ovid<sup>168</sup> (c. 43 BCE–17 CE) also recounted Claudia Quinta's role in the goddess's arrival in Rome. However, he emphasises that 'the goddess herself, seated in a wagon, drove in through the Capeno Gate', highlighting the divine agency in the event.

In addition to the Spring festival of Cybele and Attis, the Romans celebrated the introduction of Cybele to Rome with an annual festival of games and feasting named the Megalesia.<sup>169</sup> On what was known as 'the day of washing,' the cult statue of the goddess was taken in a procession to a side stream of the Tiber called the Almo.<sup>170</sup> There, the statue and other cult objects were ritually washed before being returned to the city and adorned with flowers.<sup>171</sup> The Magna Mater was also called the Needle of Cybele, reflecting its thin,

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<sup>162</sup> Livy, *History of Rome*, Vol. VIII, XXIX.10, p. 231.

<sup>163</sup> Livy, *History of Rome*, Vol. VIII, XXIX.10, p. 231.

<sup>164</sup> McBeath and Gheorghe, 'Meteorite Worship in the Ancient Greek and Roman Worlds', (p. 139).

<sup>165</sup> Herodian, *History of the Empire Vol. I*, trans. by C. R. Whittaker, Loeb Classical Library 454 (Cambridge, MA: Harvard University Press, 1969), I.10.7, pp. 67–69.

<sup>166</sup> Herodian, *History of the Empire Vol. I*, I.11.4, pp. 71–73.

<sup>167</sup> Herodian, *History of the Empire Vol. I*, I.11.4, pp. 71–73.

<sup>168</sup> Ovid, *Fasti*, trans. by James G. Frazer, revised by G. P. Goold, Loeb Classical Library 253 (Cambridge, MA: Harvard University Press, 1931), IV.291–329, pp. 211–213.

<sup>169</sup> Ovid, *Fasti*, IV.355, p. 215.

<sup>170</sup> Mary Beard, 'The Cult of the "Great Mother" in Imperial Rome: The Roman and the Foreign' in *Greek and Roman Festivals: Content, Meaning, and Practice*, ed. by J. Rasmus Brandt, and Jon W. Iddeng (Oxford: Oxford Academic, 2012), pp. 323–362 (p. 334).

<sup>171</sup> Ovid, *Fasti*, IV.335–345, p. 213.

pointed form, and it was listed among the seven sacred items, known as the *pignora imperii*, considered crucial for maintaining Roman rule over its empire.<sup>172</sup>

As Mary Beard<sup>173</sup> observed, the stone is frequently identified as a black meteorite in writing from the 18<sup>th</sup> century onwards; however, many early writers, such as Herodian, refer to it as a statue. Livy,<sup>174</sup> in contrast, asserts that it was the goddess herself, as a sacred stone, rather than a statue, that was sent to Rome. In Asia Minor and Hellenistic Greece, the Magna Mater was typically depicted in an anthropomorphic form; perhaps this was a predominantly primitive version of the goddess that the Romans received.<sup>175</sup> The Christian apologist Arnobius<sup>176</sup> (c. 255–330 CE) described what was sent by King Attalus to Rome as nothing less:

than a stone, not large, which could be carried in a man's hand without any pressure—of a dusky and black colour—not smooth, but having little corners standing out, and which today we all see put in that image instead of a face, rough and unhewn, giving to the figure a countenance by no means lifelike.

If Arnobius reported accurately, he saw the Magna Mater in Rome during the reign of Diocletian (c. 242–312 CE). Therefore, the sacred stone would appear to have been placed into an anthropomorphic mount, perhaps hollowing out the face of the goddess, and became part of a statue.<sup>177</sup> The Roman Christian poet Prudentius<sup>178</sup> (348–413 CE) described the goddess as 'a paltry black stone encased in silver with a woman's features', noting that it was placed in a chariot to travel to the place where it would be washed.

From the meagre descriptions of the Magna Mater, it would appear to have been a smallish black stone, easily moved by hand, that was later set in an anthropomorphic statue as the face. However, archaeologist Rodolfo Lanciani<sup>179</sup> (1845–1929) believed that Elagabalus took the stone of Cybele and moved it to his temple in Rome under the name of Sol Elagabal. This would imply a considerably larger stone if the coin in Figure 1 accurately reflected its

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<sup>172</sup> Servius, *Servii Grammatici Qui Feruntur in Vergilii Carmina Commentarii: Vol. II Aeneidos Librorum VI–XII*, trans. by Georgius Thilo and Hermannus Hagen (Leipzig: B. G. Teubner, 1881), 188.25, p. 141.

<sup>173</sup> Beard, 'The Cult of the "Great Mother" in Imperial Rome', p. 328.

<sup>174</sup> Livy, *History of Rome, Vol. VIII*, XXIX.11, p. 233.

<sup>175</sup> Beard, 'The Cult of the "Great Mother" in Imperial Rome', p. 328.

<sup>176</sup> Arnobius, *Ante-Nicene Christian Library: Translations of the Writings of the Fathers down to AD 325: The Seven Books of Arnobius Adversus Gentes Vol. 19*, trans. by Hamilton Bryce and Hugh Campbell, ed. by Alexander Roberts and James Donaldson (Edinburgh: T&T Clark, 1871), p. 362.

<sup>177</sup> Kirk Summers, "'Lucretius" Roman Cybele' in *Cybele, Attis, and Related Cults: Essays in Memory of M.J. Vermaseren: Religions in the Graeco-Roman World, vol. 131*, ed. by Eugene N Lane (Leiden: E. J. Brill, 1996), pp. 337–366 (pp. 363–364).

<sup>178</sup> Prudentius, *Against Symmachus 2: Crowns of Martyrdom: Scenes from History: Epilogue*, trans. by H. J. Thomson, Loeb Classical Library 398 (Cambridge, MA: Harvard University Press, 1953), X.154–160, pp. 239–241.

<sup>179</sup> Rodolfo Lanciani, *Ancient Rome in the Light of Recent Discoveries* (Boston: Houghton, Mifflin and Company, 1898), p. 127.

relative size. Lanciani<sup>180</sup> believed that Herodian's description of the stone was 'absolutely identical with the description of the needle of Cybele.' During his excavations of the palace of the Caesars, Lanciani<sup>181</sup> hoped to find the stone, but was disappointed, believing it had been found and subsequently lost by Bianchini. Confusion arose over which stone had actually been discovered: Bianchini<sup>182</sup> appeared to believe his find was the Emesa stone of Elagabalus, while Lanciani<sup>183</sup> believed it was the Cybele stone Elagabalus had repurposed for Sol Elagabal.

### The Three Stones of the Graces

The town of Orchomenus (Boeotia, Greece) was described by the traveller and geographer Pausanias<sup>184</sup> (c. 110–180 CE) as the most ancient seat of the cult of the Graces as well as a sanctuary of Dionysus. In the sanctuary dedicated to the Graces, three stones were worshipped, which were believed to have fallen from the sky during the time of the legendary king of Thebes, Eteocles, the son of Oedipus. As discussed by Albert Schachter,<sup>185</sup> nothing is known about the worship of the Graces apart from a reference in Ephoros to gifts and the Charitesia of Orchomenos, known from some inscriptions.

### The Cassandria Stone

A significant meteorite fall was reported in the city of Cassandria on the Pallene peninsula in Greece. In 356 BCE, Philip II of Macedon (382–336 BCE) captured Potidaea, destroyed the city and transferred its territory to the Olynthians. The Macedonian king Cassander (c. 355–297 BCE) founded a new city on the same site in 316 BCE, which he named Cassandria.<sup>186</sup> Pliny<sup>187</sup> recorded the veneration of a sky-fallen stone in Cassandria, the ancient city of Potidaea, highlighting that the town was a colony settled because of the meteorite fall. Egyptologist G. A. Wainwright<sup>188</sup> (1879–1964) explored the identification of Ammon with Zeus and meteorites. In a subsequent paper, he referenced the Cassandria meteorite fall,<sup>189</sup>

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<sup>180</sup> Lanciani, *Ancient Rome in the Light of Recent Discoveries*, p. 127.

<sup>181</sup> Lanciani, *Ancient Rome in the Light of Recent Discoveries*, p. 127.

<sup>182</sup> Bianchini, *Del Palazzo de Cesari*, p. 255.

<sup>183</sup> Lanciani, *Ancient Rome in the Light of Recent Discoveries*, p. 127.

<sup>184</sup> Pausanias, *Description of Greece, Vol. IV: Books 8.22–10*, trans. by W. H. S. Jones, Loeb Classical Library 297 (Cambridge, MA: Harvard University Press, 1935), IX.38.1, p. 341.

<sup>185</sup> Schachter, Albert, 'Cults of Boiotia: 1 Acheloos to Hera', *Bulletin Supplement: University of London, Institute of Classical Studies*, 38.1 (1981), pp. ii–254 (pp. 140–144).

<sup>186</sup> D'Orazio, 'Meteorite Records in the Ancient Greek and Latin Literature', p. 220.

<sup>187</sup> Pliny, *Natural History Vol. I*, II.150, p. 287.

<sup>188</sup> G. A. Wainwright, 'The Aniconic Form of Amon in the New Kingdom', *Annales du Service des Antiquités de l'Égypte XXVIII*, (1928), pp. 175–189.

<sup>189</sup> G. A. Wainwright, 'The Relationship of Amūn to Zeus and His Connexion with Meteorites', *The Journal of Egyptian Archaeology*, 16.1/2 (1930), pp. 35–38 (p. 36).

observing that the city of Potidaea was dedicated to the worship of Poseidon, after whom it was named, as evidenced by a temple and coins depicting Poseidon from at least 500 BCE.<sup>190</sup> Under Emperor Augustus (63 BCE–14 CE), Cassandria was established as a Roman colony and resumed minting coins. Notably, the new coinage featured the horned, bearded head of Zeus-Ammon, which replaced the symbols of Poseidon. Wainwright<sup>191</sup> interpreted this significant change as an indication that the Romans recognised the meteorite fall as a supernatural event, and wished to honour the sky-God Zeus-Ammon, to whom they attributed the portent.

### The Stone of Astarte at Tyre

Sacred stones, or *baetyls*, were worshipped in Phoenician sanctuaries at Byblos, Aphaca, Sidon, and Tyre. One of these stones was revered as the simulacrum of the goddess Astarte, who was honoured as both a heavenly figure and an earth mother.<sup>192</sup> Philon of Byblos (64–141 CE) recounted the myth associated with this stone when he translated a Phoenician history, originally authored by Sanchuniathon of Berytus, from Phoenician into Greek.<sup>193</sup> Although most of Philon's work has been lost, a narrative concerning the stone of Astarte survived as a quotation preserved by Eusebius of Caesarea<sup>194</sup> (c. 260/265–339 CE):

And Astarte set the head of a bull upon her own head as a mark of royalty; and in travelling round the world she found a star that had fallen from the sky, which she took up and consecrated in the holy island Tyre. And the Phoenicians say that Astarte is Aphrodite.

The numismatist George Francis Hill<sup>195</sup> (1867–1948) connected this statement with an aerolite in a portable shrine represented on an imperial coin of Tyre (Figure 7). While the classical scholar Arthur Bernard Cook<sup>196</sup> (1868–1952) suggested that the stone depicted on the coin was the 'emerald block of Herakles'. Cook<sup>197</sup> proposed that, as the Tyrians considered the celestial Herakles as the partner of the celestial Astarte, the two explanations were not necessarily irreconcilable.

<sup>190</sup> Wainwright, 'The Relationship of Amūn to Zeus and His Connexion with Meteorites', p. 36.

<sup>191</sup> Wainwright, 'The Relationship of Amūn to Zeus and His Connexion with Meteorites', p. 36.

<sup>192</sup> D'Orazio, 'Meteorite Records in the Ancient Greek and Latin Literature', p. 221.

<sup>193</sup> D'Orazio, 'Meteorite Records in the Ancient Greek and Latin Literature', p. 221.

<sup>194</sup> Eusebius, *Preparation for the Gospel: Part I*, trans. by Edwin Hamilton Gifford (London: Henry Frowde, 1908), I.X.38c, p. 43.

<sup>195</sup> George Francis Hill, 'Some Graeco-Phoenician Shrines', *The Journal of Hellenic Studies*, 31 (1911), pp. 56–64.

<sup>196</sup> Arthur Bernard Cook, *Zeus a Study in Ancient Religion: Volume I Zeus God of the Bright Sky* (Cambridge: Cambridge University Press, 1914), p. 356.

<sup>197</sup> Arthur Bernard Cook, *Zeus a Study in Ancient Religion: Volume III Zeus God of the Dark Sky (Earthquakes, Clouds, Wind, Dew, Rain, Meteorites)* (Cambridge: Cambridge University Press, 1940), p. 892.



Figure 7. Copper alloy coin. Ruler Valerian, minted in Tyre. Museum Number 1895,0509.17. Image: © The Trustees of the British Museum. CC BY-NC-SA 4.0.

### The Artemis Stone at Ephesus

The Greek temple of Ephesus (Selçuk, Turkey), famously one of the Seven Wonders of the Ancient World, housed the stone of Artemis, which has often been cited among the sacred meteorites of antiquity.<sup>198</sup> The tradition of its heavenly origin is documented in Acts of the Apostles 19:35.<sup>199</sup> Despite its reputation in the ancient world, D'Orazio<sup>200</sup> found no references in Latin or Greek texts describing the stone as unworked or of celestial origin.

Cook<sup>201</sup> described an artefact (*baitylos*) obtained by Sir William Ridgeway, via the consular service at Smyrna, together with other items from Ephesus. The object was a greenish stone, dated to approximately 2000 BCE, and resembled other stones believed to possess life or to facilitate access to a deity, most frequently Zeus. Cook<sup>202</sup> noted it had a quasi-human form (Figure 8). A tin band surrounded the stone, from which four pairs of tin pendants were evenly suspended. At the base, opposite each pendant, was a hole, probably intended for the insertion of a stud, possibly of amber or glass. Cook<sup>203</sup> proposed that the 'humanised pounder' might represent the Zeus-fallen image of the Ephesian Artemis, noting that 'by an impressive coincidence, the pounder actually came from Ephesos'. Kenneth P.

<sup>198</sup> D'Orazio, 'Meteorite Records in the Ancient Greek and Latin Literature', p. 221.

<sup>199</sup> The Holy Bible: The Revised Version, (Oxford: Henry Frowde, 1910), Acts 19:35.

<sup>200</sup> D'Orazio, 'Meteorite Records in the Ancient Greek and Latin Literature', p. 221.

<sup>201</sup> Cook, *Zeus God of the Dark Sky*, p. 898.

<sup>202</sup> Cook, *Zeus God of the Dark Sky*, p. 899.

<sup>203</sup> Cook, *Zeus God of the Dark Sky*, p. 900.

Oakley<sup>204</sup> (1911–1981), anthropologist, palaeontologist and geologist, discovered that the City of Liverpool Museums had purchased the stone. He obtained authorisation for the Natural History department of the British Museum to examine it, confirming that it was a terrestrial rock, not a meteorite.<sup>205</sup> As discussed by Oakley,<sup>206</sup> Elaine Tankard, former Keeper of Archaeology at Liverpool Museums, proposed that the Diopet would have fitted in the crown of the statue of Artemis (Figure 9), as evidenced by features observed in extant replicas.

Multiple interpretations have been proposed regarding the globular objects on the chest of the Ephesian Artemis, although most are considered unlikely (Figure 10). Suggested identifications include breasts, as discussed by Lynn R. LiDionnici,<sup>207</sup> a view that emerged during the Christian era in works by Minucius Felix and Jerome. Guy MacLean Rogers<sup>208</sup> proposed bull's testicles or the Hittite leather bags called *kursa* as possibilities, while Charles Seltman<sup>209</sup> suggested dates, as he considered the idea of bee ova as 'too fanciful'. Most scholars concur that, regardless of their precise identification, these objects symbolise Artemis's established role as a fertility goddess. Key objections to interpreting them as breasts include the lack of anatomical form or nipples, incorrect positioning on the torso, and the fact that they are not rendered in the same colour as the face, hands, and feet in statues where these areas are depicted as dark.<sup>210</sup> However, it should be noted that in Figure 11, the head, hands and feet are a modern restoration. Anton Bammer<sup>211</sup> argued that the seed-shaped or teardrop-shaped amber ornaments found at Ephesus demonstrate that this type of breast jewellery for the cult statue was already established in the Geometric period. The symmetrically placed pairs of tin pendants on the Diopet may also provide a clue, as they could have inspired the shapes on the torso of the goddess.

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<sup>204</sup> Kenneth P. Oakley, 'The Diopet of Ephesus', *Folklore*, 82.3 (1971), pp. 207–211 (p. 207).

<sup>205</sup> Oakley, 'The Diopet of Ephesus', p. 207.

<sup>206</sup> Oakley, 'The Diopet of Ephesus', p. 210.

<sup>207</sup> Lynn R. LiDionnici, 'The Images of Artemis Ephesia and Greco-Roman Worship: A Reconsideration', *The Harvard Theological Review*, 85.4 (1992), pp. 389–415 (p. 392).

<sup>208</sup> Guy MacLean Rogers, *The Mysteries of Artemis of Ephesos: Cult, Polis, and Change in the Graeco-Roman World* (New Haven: Yale University Press, 2012), pp. 180–181.

<sup>209</sup> Charles Seltman, 'The Wardrobe of Artemis', *Numismatic Chronicle*, 6.12 (1952) pp. 33–44 (pp.42–49).

<sup>210</sup> Seltman, 'The Wardrobe of Artemis', p. 41.

<sup>211</sup> Anton Bammer, 'A "Peripteros" of the Geometric Period in the Artemision of Ephesus', *Anatolian Studies*, 40 (1990), pp. 137–160 (p. 153).



A *baitylos*(?) from Ephesos,  
now at Queens' College, Cambridge.

*See page 898 ff. with fig. 731.*

Figure 8. Diopet of Ephesus. Now at Liverpool Museums. Plate LXVII. Arthur Bernard Cook, *Zeus a Study in Ancient Religion: Volume III Zeus God of the Dark Sky (Earthquakes, Clouds, Wind, Dew, Rain, Meteorites)*.

Newton<sup>212</sup> believed it was unlikely that the first century Ephesian Artemis images were themselves meteorites, despite the designation *Diipetes*, meaning 'fallen from the sky'. However, he considered that evidence suggested a meteoric stone may have served as the original model for these images. Newton<sup>213</sup> proposed that the original stone may have disappeared during one of the temple's destructions, and that, over time, there may have been a desire to represent the goddess in a more artistic form than the original stone allowed. Newton<sup>214</sup> argued that the various representations of the Ephesian Artemis exhibited a shared characteristic, which he presented as evidence that the original image originated from a celestial source. Newton<sup>215</sup> suggested the sculptors had adapted the meteorite's moulded shape, regmaglypts and fusion crust to create the distinctive features of the Ephesian Artemis. At the principal sanctuary in Ephesus, the Biblical record indicated that the image of Artemis was believed to have descended from Jupiter. Wainwright<sup>216</sup> noted that this association implied the object may have been a meteorite, considering the role of Jupiter as a sky deity. Additional sanctuaries dedicated to Artemis were established at Perga, Poglā, and Andeda in Pamphylia. Since it was unlikely these sites could obtain the original meteorite, Wainwright<sup>217</sup> suggested that each location adopted a substitute in the form of an *omphalos*.

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<sup>212</sup> Newton, 'The Worship of Meteorites', p. 359.

<sup>213</sup> Newton, 'The Worship of Meteorites', p. 359.

<sup>214</sup> Newton, 'The Worship of Meteorites', p. 359.

<sup>215</sup> Newton, 'The Worship of Meteorites', p. 359.

<sup>216</sup> Wainwright, 'The Aniconic Form of Amon in the New Kingdom', p. 186.

<sup>217</sup> Wainwright, 'The Aniconic Form of Amon in the New Kingdom', p. 186.



Figure 9. The Great Artemis. Ephesus Museum in Selçuk. Height 292 cm. Inv. No. 712. Turkish Archaeological News. CC BY-NC-ND 3.0..



Figure 10 The Beautiful Artemis. Ephesus Museum in Selçuk. Height 174.5 cm. Inv. No. 718. Turkish Archaeological News. CC BY-NC-ND 3.0.



Figure 11. Farnese Artemis. The head, hands and feet are a modern restoration by Giuseppe Valadier. Accession number Inv. 6278. Museo Archeologico Nazionale di Napoli. Photographer Marie-Lan Nguyen (2011). CCA 2.5 Generic license.

### The Aphrodite stone of Paphos

Burke<sup>218</sup> claimed that three temples of Aphrodite in Anatolia were connected to a meteorite: the first at Aphaca, the second at Byblos, and the third at Paphos on Cyprus. Aphaca was considered sacred because Aphrodite Urania, Urania meaning 'heavenly', was believed to have fallen there as 'fire from a star'.<sup>219</sup> The temple at Paphos and its stone were celebrated on many Roman coins.<sup>220</sup> In most depictions, the stone is shown inside a double-columned temple with a peristyle and a semi-circular pool or fence in front. The Roman historian Tacitus<sup>221</sup> (c. 56–120 CE) recorded the visit of Emperor Titus (39–81 CE) to the Aphrodite temple at Paphos in 69 CE, and described the Aphrodite image as not human in shape, but 'a rounded mass broader at its base and smaller at the top'. During excavations of the Aphrodite temple in 1888, a large dark conical stone was discovered, although it was not initially recognised as the sacred stone.<sup>222</sup> The stone, now housed in the Archaeological Museum of Kouklia (Figure 12), has subsequently been identified as a terrestrial rock.<sup>223</sup>



Figure 12. Kouklia, Baetyl, Old Paphos, Archaeological Museum. Photographer Jona Lendering (2017). CC0 1.0 Universal.

<sup>218</sup> Burke, *Cosmic Debris*, p. 221.

<sup>219</sup> Burke, *Cosmic Debris*, p. 221.

<sup>220</sup> D'Orazio, 'Meteorite Records in the Ancient Greek and Latin Literature', p. 220.

<sup>221</sup> Tacitus, *Histories: Books 1-3*, trans. by Clifford H. Moore, Loeb Classical Library 111 (Cambridge, MA: Harvard University Press, 1925), II.3, p. 165.

<sup>222</sup> Philip Mozel, and Meg Morden, 'The Cult Statue of Aphrodite at Palaepaphos: A Meteorite?', *Journal of the Royal Astronomical Society of Canada*, 100.4 (2006), pp. 149-155 (p. 150).

<sup>223</sup> Mozel, and Morden, 'The Cult Statue of Aphrodite at Palaepaphos: A Meteorite?', p. 153.

## Stones at Delphi

Pausanias<sup>224</sup> stated that a small stone, above the grave of Neoptolemus, son of Achilles, was venerated at Delphi. At the time of his writing, the stone was still preserved, anointed daily with olive oil, and covered with raw wool during feast days. According to legend, Rhea gave this stone to Kronos, king of the gods, in place of the newborn Zeus. Kronos swallowed the stone, which he later expelled onto the Earth. D'Orazio<sup>225</sup> noted that this Kronos stone was distinct from the omphalos stone of Delphi, which marked the Earth's centre as identified by Zeus and which was housed in the temple of Apollo. The Greeks believed Delphi was the Earth's navel because two eagles sent forth by Zeus, one flying east, the other west, met there simultaneously.<sup>226</sup> However, Burke<sup>227</sup> interpreted the stone described by Pausanias as the same one that marked the Earth's centre.

## Kaaba Stone

The Kaaba Stone, or Hajar al-Aswad, is commonly considered to be the most revered rock in the world.<sup>228</sup> It is known by several names that imply a heavenly origin, including the Black Stone, the Object from Heaven and the Star of Paradise. The stone symbolises unity among Muslims and is recognised as one of the most significant emblems of Islam.<sup>229</sup> Its importance stems from associations with the Prophet Abraham and the Prophet Muhammad; however, it is not considered divine. After Mohammed conquered Mecca, he dedicated the veneration of the Black Stone to Allah.<sup>230</sup> During the sevenfold circumambulation of the Kaaba, he saluted the stone with his staff and kissed it. He then ordered the destruction of the other 360 idols in the temple. Various traditions recount the origin of the stone: some claim it fell from Paradise with Adam; others say Gabriel gave it to Abraham, or to Ishmael, during the reconstruction of the Kaaba after the Flood.<sup>231</sup> As recorded by Mohd A.R. Khan,<sup>232</sup> the

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<sup>224</sup> Pausanias, *Description of Greece*, Vol. IV, X.24.6, p. 511.

<sup>225</sup> D'Orazio, 'Meteorite Records in the Ancient Greek and Latin Literature', p. 220.

<sup>226</sup> E. M. Berens, *Myths and Legends of Ancient Greece and Rome*, 9<sup>th</sup> edn. (London: Blackie and Son Limited, 1892), pp. 82–83.

<sup>227</sup> Burke, *Cosmic Debris*, pp. 219–220.

<sup>228</sup> R. S. Dietz, and J. McHone, 'Kaaba Stone: Not a Meteorite, Probably an Agate', *Meteoritics*, 9.2 (1974), pp. 173–179 (p. 173).

<sup>229</sup> Kerim Kocak, 'Features of the Hajar Al-Aswad, Black Stone of Makkah, Saudi Arabia', *Konya Journal of Engineering Sciences*, (2023), pp. 601–609 (p. 601) <<https://doi.org/10.36306/konjes.1244222>> [accessed 21 Sept 2025].

<sup>230</sup> Newton, 'The Worship of Meteorites', p. 356.

<sup>231</sup> Newton, 'The Worship of Meteorites', p. 356.

<sup>232</sup> Mohd A.R Khan, 'On the Meteoritic Origin of the Black Stone of the Ka'bah'. *Popular Astronomy*, 46 (1938), pp. 403–407, cited in Dietz, R. S. and McHone, J., 'Kaaba Stone: Not a Meteorite, Probably an Agate', *Meteoritics*, 9.2 (1974), pp. 173–179 (p.173).

stone has been stolen, subjected to fire, and broken into pieces. The pieces are currently mounted in a silver frame (Figure 13) in the northeast corner of the Kaaba in Mecca.<sup>233</sup>



Figure 13. Eastern corner of the Kaaba with the Black Stone, al-Hajar al-Aswad (photos: Saudi Arabia General Presidency of the Grand Mosque and the Prophet's Mosque). Dr Elizabeth Macaulay, "The Kaaba," in *Smarthistory*, August 8, 2015.

The Kaaba stone is reputed to have turned black after being kissed by a sinner, although it was originally a transparent hyacinth.<sup>234</sup> Other traditions claim it was originally white, while more recent observers have described it as black outside with a silver-grey interior, containing small embedded green cubes.<sup>235</sup> The original colour remains uncertain, and exposure to fire may have contributed to its current colour. Several theories have been proposed regarding its provenance.<sup>236</sup> Elspeth Thomsen<sup>237</sup> has suggested that the stone is Wabar glass (a tektite). This identification was partly based on the belief that the stone floated on water, a belief that had been used to identify it in 952 CE, when it was returned after its theft in 930 CE.<sup>238</sup> Paul Partsch<sup>239</sup> (1789–1856), curator of the Austro-Hungarian imperial mineral collection, published a comprehensive analysis and proposed a possible meteoritic origin. However, it is important to recognise that this evaluation was based on second-hand descriptions, as the stone itself was not accessible for direct study. Dietz and

<sup>233</sup> Dietz, and McHone, 'Kaaba Stone: Not a Meteorite, Probably an Agate', p. 173.

<sup>234</sup> Newton, 'The Worship of Meteorites', p. 356.

<sup>235</sup> Francesco G. Fedele, 'An Obsidian Cache from Temple B', in *Barāqish/Yathill (Yemen) 1986-2007: Excavations of Temple B and Related Research and Restoration / Extramural Excavations in Area C and Overview Studies*, ed. by Sabina Antonini and Francesco G. Fedele (Oxford: Archaeopress, 2021), pp. 187–194 (p.194).

<sup>236</sup> Kocak, 'Features of the Hajar Al-Aswad', pp. 605–606.

<sup>237</sup> Elspeth Thomsen, 'New Light on the Origin of the Holy Black Stone of the Ka'ba', *Meteoritics*, 15.1 (1980), pp. 87–91 (pp. 89–90).

<sup>238</sup> Heinrich Freiherrn von Maltzan, *Meine Wallfahrt nach Mekka: Reise in der Küstengegend und im Innern von Hedschas: Zweiter Band* (Leipzig: Dyk'sche Buchhandlung, 1865), p. 36.

<sup>239</sup> Paul Partsch, 'Über den schwarzen Stein der Kaaba zu Mekka', *Denkschriften der Akademie der Wissenschaften*, 13 (1857), pp. 1–5.

McHone<sup>240</sup> have suggested that the stone could be agate, while other proposals are obsidian, lava, pumice and basalt. The Natural History Museum in London currently classifies it as a pseudometeorite.<sup>241</sup>

A detailed image of the stone was first released by the Saudi government in 2021.<sup>242</sup> The image was obtained using the focus stacking method over more than 50 hours, and a composite image was produced of up to 49,000 megapixels.<sup>243</sup> Kameram 1.6.1.3 image processing software was then used to measure the size of the gravels and their constituents. The Kaaba stone was found to display various gravels varying from 9.7 to 27 mm in size and short prismatic black crystals of 0.33 to 0.85 mm in length, which were in a brownish to reddish cement. The stone exhibited an equigranular texture, which suggested a non-volcanic origin.<sup>244</sup> However, due to restrictions on any invasive scientific investigations using modern techniques, no studies can be carried out using mineral, isotopic, or rock chemistry.<sup>245</sup> Consequently, the origin of the Black Stone must remain the subject of conjecture.

#### Nogata Fall, Japan

According to tradition, a detonation and a brilliant flash were observed one night, followed by the fall of a strange stone within the Suga Jinja shrine precinct.<sup>246</sup> Villagers recovered the stone the next morning from a hole in the earth. The stone has been kept at the shrine, and its fall date, April 7 in the third year of Jogan (May 19, 861, Julian calendar), is recorded on the wooden box that contains it, making it the oldest observed meteorite fall on record. A Shinto priest permitted Masako Shima<sup>247</sup> to take a sample of the stone for analysis, which confirmed that it is indeed a meteorite. Carbon 14 dating was conducted on the wooden box, and while the results were not completely conclusive, the age of the material roughly corresponded with the date of the fall.<sup>248</sup> However, Sadao Murayama<sup>249</sup> noted that both the script and the box type belong to a later period. The meteorite is kept at the Suga

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<sup>240</sup> Dietz, and McHone, 'Kaaba Stone: Not a Meteorite, Probably an Agate', p. 175.

<sup>241</sup> Grady, *Catalogue of Meteorites (MetCat)*.

<sup>242</sup> Kocak, 'Features of the Hajar Al-Aswad', p. 605.

<sup>243</sup> Kocak, 'Features of the Hajar Al-Aswad', p. 605.

<sup>244</sup> Kocak, 'Features of the Hajar Al-Aswad', p. 605.

<sup>245</sup> Kocak, 'Features of the Hajar Al-Aswad', p. 606.

<sup>246</sup> Masako Shima and others, 'Description, Chemical Composition and Noble Gases of the Chondrite Nogata' *Meteoritics*, 18.2 (1983), pp. 87–102 (p. 88).

<sup>247</sup> Shima, 'Description, Chemical Composition and Noble Gases of the Chondrite Nogata', p. 88.

<sup>248</sup> Shima, 'Description, Chemical Composition and Noble Gases of the Chondrite Nogata', p. 89.

<sup>249</sup> Meteoritical Society, 'Nogata (Japan)', *Meteoritical Bulletin*, 58 (1980), in *Meteoritical Bulletin Database, Lunar and Planetary Institute* <<https://www.lpi.usra.edu/meteor/metbull.php?code=16988>> [accessed 4 October 2025] (source cited: S. Murayama, letter of 13 June 1980).

Jinja shrine as a 'shrine treasure'.<sup>250</sup> It is publicly displayed during the grand shrine festival every five years, when it travels in a cart at the head of a parade of other decorated carts (Figure 14).



Figure 14. Nogata meteorite at the quinquennial festival held in October 2011. Yamaoka, Hitoshi, 'The Quinquennial Grand Shrine Festival with the Nogata Meteorite'.

#### Ensisheim Fall, Alsace, France

The oldest recorded witnessed meteorite fall in Europe, of which remains are preserved, occurred at Ensisheim.<sup>251</sup> The stone fell on November 7, 1492, outside the city wall of Ensisheim in Alsace, in what was the Holy Roman Empire and is now part of north-eastern France.<sup>252</sup> The fall was seen by a boy, who led people to the deep hole the stone had made, and the crowd hoisted the rock out of the ground.<sup>253</sup> The city's chief magistrate stopped people from chipping off pieces of the meteorite, and the stone was moved to outside the church door. King Maximilian I (1459–1519), who later became Holy Roman Emperor, visited Ensisheim on November 26. On his orders, the meteorite was chained in the local

<sup>250</sup> Hitoshi Yamaoka, 'The Quinquennial Grand Shrine Festival with the Nogata Meteorite' *Proceedings of the International Astronomical Union*, 10.H16 (2012), p. 167.

<sup>251</sup> Ingrid D. Rowland, 'A Contemporary Account of the Ensisheim Meteorite, 1492', *Meteoritics*, (1990) 25.1, pp. 19–22, (p. 19).

<sup>252</sup> Ursula B. Marvin, 'The Meteorite of Ensisheim: 1492 to 1992', *Meteoritics*, 27.1 (1992), pp. 28–72 (p. 29).

<sup>253</sup> Marvin, 'The Meteorite of Ensisheim', p. 29.

church. Maximilian and his advisors interpreted the fall as a divine omen, signalling God's favour in his future military campaign.<sup>254</sup> The stone was placed in the parish church at Ensisheim with an explanatory notice which begins:

On Wednesday, Nov. 7. The night before St. Martin's Day, in the year of our Lord 1492, a singular miracle happened: for between the hours of eleven and twelve a loud clap of thunder took place, with a long-continued noise, which was heard at a great distance; and a stone fell from the heavens in the Ban of Ensisheim.<sup>255</sup>

This was the first witnessed meteorite fall recorded after the invention of printing in the 1450s. Within weeks, illustrated broadsheets featuring dramatic woodcuts were produced and circulated in three cities.<sup>256</sup> The German humanist and satirist Sebastian Brant (c. 1457–1521) composed verses about the meteorite, linking it to themes of heavenly warnings and celestial signs.<sup>257</sup> Brant proposed that the stone was a bad omen for the enemies of Maximilian, thus supporting his military ambitions. In 1793, the revolutionary committee of the French Republic placed the stone on display in the Bibliothèque Nationale in Colmar.<sup>258</sup> Large pieces were taken for analysis, and it was eventually confirmed as a match to other stones that had 'fallen from the clouds'.<sup>259</sup> In 1803, the stone was returned to its place in the church.<sup>260</sup> After the collapse of the church tower in 1854, the meteorite was moved to the Palais de la Régence, where it remains today as part of a small museum collection.<sup>261</sup>

#### Tomanowos or the Willamette Meteorite

The Willamette Meteorite (Figure 15) was found by Ellis Hughes and Mr Dale in 1902 and was named by Henry A. Ward<sup>262</sup> after he visited the find site in Clackamas County, Oregon. Hughes and his son worked unobserved for three months to move the approximately 14,150 kilogram meteorite from its original location, three-quarters of a mile, to their farm.<sup>263</sup> Hughes charged 25 cents admission to see the meteorite.<sup>264</sup> However, one visitor was an attorney for the Oregon Iron and Steel Company, who realised that the meteorite had been

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<sup>254</sup> Marvin, 'The Meteorite of Ensisheim', p. 29.

<sup>255</sup> M. De Drée, 'LIV. On the Stones said to have Fallen at Ensisheim, in the neighbourhood of Agen, and at Other Places', *The Philosophical Magazine*, 16.64 (1803), pp. 289–298 (p. 289).

<sup>256</sup> Marvin, 'The Meteorite of Ensisheim', p. 29.

<sup>257</sup> Marvin, 'The Meteorite of Ensisheim', p. 29.

<sup>258</sup> Marvin, 'The Meteorite of Ensisheim', p. 54.

<sup>259</sup> Marvin, 'The Meteorite of Ensisheim', p. 56.

<sup>260</sup> Marvin, 'The Meteorite of Ensisheim', p. 56.

<sup>261</sup> Marvin, 'The Meteorite of Ensisheim', p. 65.

<sup>262</sup> Henry A. Ward, 'The Willamette Meteorite', *Proceedings of the Rochester Academy of Science*, 4.8 (1904), pp. 137–148 (p.137).

<sup>263</sup> Ward, 'The Willamette Meteorite', p. 138.

<sup>264</sup> Vagn F. Buchwald, *Handbook of Iron Meteorites. Vol. 3* (Berkeley: University of California Press, 1975), p. 1313.

found on property owned by his employers. The company sued Hughes, claiming the meteorite had been stolen, while Hughes contended it was an abandoned Native American relic, not real estate, and therefore personal property. To support his argument, Hughes called two Native American witnesses who attested to the meteorite's cultural and spiritual significance.<sup>265</sup> Susap, a 70-year-old Klickitat man, testified that, as a child, he had seen the meteorite and that Chief Wochimo of the Clackamas tribe had told him that it was sacred and used in ceremonies.<sup>266</sup> Local people washed their faces in the water collected in the meteorite's natural bowls, while warriors plunged their arrows in the water before fighting with nearby tribes. Sol Clark, a 47-year-old Wasco man, testified that the meteorite had belonged to the medicine men of the Clackamas tribe, who had used it in their religious practices until about 1870.<sup>267</sup> Despite these testimonies, the court ruled in favour of the company, because the meteorite had been on their land when Hughes had moved it. The company took possession in 1905 and later sold it to Mrs Sarah T. Dodge, who donated it to the American Museum of Natural History in New York, where it remains today.<sup>268</sup>



Figure 15. Willamette Meteorite with Children Showing the Size. Now at American Museum of Natural History, New York. Plate XVI. Henry A. Ward, 'The Willamette Meteorite', *Proceedings of the Rochester Academy of Science*, 4.8, (1904).

In 2000, the American Museum of Natural History and the Confederated Tribes of the Grand Ronde Community of Oregon made an important agreement about the Willamette

<sup>265</sup> Buchwald, *Handbook of Iron Meteorites*. Vol. 3, p. 1313.

<sup>266</sup> Buchwald, *Handbook of Iron Meteorites*. Vol. 3, p. 1313.

<sup>267</sup> Buchwald, *Handbook of Iron Meteorites*. Vol. 3, p. 1313.

<sup>268</sup> Buchwald, *Handbook of Iron Meteorites*. Vol. 3, p. 1314.

Meteorite, known to the tribe as Tomanowos, or 'Heavenly Visitor'.<sup>269</sup> The agreement recognised that the meteorite is both a famous scientific object and a sacred part of Grand Ronde culture. The museum keeps Tomanowos on display for the public, but the Grand Ronde are allowed to visit it every year for their religious and ceremonial traditions.<sup>270</sup> These yearly visits help the Grand Ronde maintain their spiritual connection to Tomanowos and show a balance between scientific care and cultural respect.

### Other Stones from the Heavens

Prospectors, farmers, archaeologists, and explorers have found meteorites or their fragments in contexts suggesting that they were worshipped, revered, or highly valued. However, most are not associated with any known legend. The Mbosi meteorite had been treated as taboo by local people for generations when it was reported by W. H. Nott, a private surveyor, in 1930.<sup>271</sup> It was partially unearthed, and several pieces were removed. Later, it was fully excavated and mounted on a concrete plinth (Figure 16). The Tanzanian government declared it a protected monument in 1967. A 2023 study examined local attitudes toward the meteorite and found that many residents viewed it positively.<sup>272</sup> Economically, it was seen as contributing to Songwe's revenue through tourism; socially, its presence had encouraged infrastructure development and strengthened community bonds; and culturally, it had helped to highlight and preserve local heritage. Another meteorite that has become a tourist attraction is the Hoba Iron, situated near Grootfontein in Namibia. Found on the Hoba West farm in the 1920s, it is the largest known complete meteorite on Earth.<sup>273</sup> Its name, Hoba, comes from the Khoekhoegowab word meaning 'gift' according to the Namibia Tourism Board.<sup>274</sup> Declared a national monument in 1955, the meteorite weighs an estimated 60,000 kilograms and has remained in its original location, despite early proposals to move it.<sup>275</sup>

<sup>269</sup> American Museum of Natural History, *Willamette Meteorite Agreement* (2000) <[https://www.amnh.org/exhibitions/permanent/the-universe/planets/planetary-impacts/willamette-meteorite-t%C9%99man%C9%99was/agreement?utm\\_source=chatgpt.com](https://www.amnh.org/exhibitions/permanent/the-universe/planets/planetary-impacts/willamette-meteorite-t%C9%99man%C9%99was/agreement?utm_source=chatgpt.com)> [accessed 12 October 2025].

<sup>270</sup> American Museum of Natural History, *Willamette Meteorite Agreement* (2000).

<sup>271</sup> Vagn F. Buchwald, *Handbook of Iron Meteorites. Vol. 2* (Berkeley: University of California Press, 1975), p. 814.

<sup>272</sup> Mtae, H. G., 'Mbosi Meteorite as a Niche for Community Development in Songwe Region, Tanzania', *East African Journal of Education and Social Sciences*, 4.3 (2023), pp. 29–39 (p. 37) <<https://doi.org/10.46606/eajess2023v04i04.0300>> [accessed 21 June 2025].

<sup>273</sup> P. E. Spargo, 'The History of the Hoba Meteorite: Part I: Nature and Discovery', *Monthly Notes of the Astronomical Society of Southern Africa*, 67. 5 & 6 (2008), pp. 85–94 (pp. 85–86).

<sup>274</sup> Visit Namibia, *Hoba Meteorite National Heritage Site* (2025) <<https://visitnamibia.com.na/directory/hoba-meteorite-national-heritage-site/>> [accessed 3 November 2025]

<sup>275</sup> Spargo, 'The History of the Hoba Meteorite: Part I', pp. 90–91.



Figure 16. Mbozi Meteorite in the Ngorongoro Lengail UNESCO Global Geopark Tanzania. NCAA 2025 All rights Reserved.

According to Burke,<sup>276</sup> some people believed that the fall of the Jhung chondrite in West Punjab, Pakistan, in 1873 was a divine warning caused by the sinfulness of humanity. Burke<sup>277</sup> noted a similar view was held by the locals when the Durala stone fell in the Punjab, India, in 1815, producing fear and consternation. The event caused the Rajah to grant an Englishman permission to remove the stone, although some Brahmins desired to erect a temple for its worship.

<sup>276</sup> Burke, *Cosmic Debris*, p. 219.

<sup>277</sup> Burke, *Cosmic Debris*, p. 219.



Figure 17. The Morito Meteorite, Palacio de Minería, Mexico City. Photographer Thelmadatter (2009). Licence CCA-Share Alike 3.0 Unported.

Meteorita de El Morito originally fell in the Hidalgo del Parral Municipality, Chihuahua, Mexico.<sup>278</sup> As discussed by L. Fletcher,<sup>279</sup> the meteorite was mentioned in the journal of Father Gerónimo de Zárate Salmerón, a missionary in the area in the early 1620s. Salmerón<sup>280</sup> retold an ancient Indian tradition about an iron object lying near the wagon route to New Mexico. The story recalled the arrival of the Mexicans to populate Old Mexico. When they stopped there, the idol had spoken to them and told them to keep it there as a memory. The Indians also claimed that a demon, taking the form of a very wrinkled old woman, had carried the rock. A large part of the meteorite is now on display in the Palacio de Minería, Mexico City (Figure 17).

In 1853, a meteorite fell on the East African coast, north of Zanzibar and was seen by some shepherd boys.<sup>281</sup> The local people, identified by Newton<sup>282</sup> as the Wanikas, regarded the stone as a god as it had fallen from the sky. They built a shrine, clothed and anointed the rock, and adorned it with pearls. When some German missionaries attempted to buy the stone, the villagers initially refused. However, following a Masai raid some years later, they lost confidence in the power of the stone and agreed to sell it. Newton,<sup>283</sup> who wrote a

<sup>278</sup> Buchwald, *Handbook of Iron Meteorites*. Vol. 3, p. 838.

<sup>279</sup> L. Fletcher, 'On the Mexican Meteorites, with Especial Regard to the Supposed Occurrence of Wide-spread Meteoritic Showers', *The Mineralogical Magazine and Journal of the Mineralogical Society*, 9.42 (1890), pp. 91–178 (pp. 129–130).

<sup>280</sup> *Documentos para la Historia de México, Tercera Serie, Tomo Primero* (México: Imprenta de Vicente García Torres, 1856), pp. 47–48.

<sup>281</sup> Newton, 'The Worship of Meteorites', p. 355.

<sup>282</sup> Newton, 'The Worship of Meteorites', p. 355.

<sup>283</sup> Newton, 'The Worship of Meteorites', p. 355.

systematic account of meteorite veneration, reported that the stone was sent to Munich. Farrington<sup>284</sup> identified the meteorite in the collection of the Academy of Sciences of Munich as the Duruma stone. Burke<sup>285</sup> repeated the story of the fall of the meteorite, and that it had been decorated with pearls. Otto Buchner<sup>286</sup> referred to the stone as Turuma or Duruma. As discussed by Buchner,<sup>287</sup> the stone was donated by Dr Barth of Calw to Munich, and he provided the information about its collection. This was most likely Christian Gottlob Barth (1799–1862), a German Protestant minister, who developed his collections through an extensive missionary network.<sup>288</sup> Buchner<sup>289</sup> observed that the date of the fall coincided exactly with that given for the Segowlee fall in India, which created some confusion. He also noted that, despite extensive searches, no further information about the stone had been found in the treatise of the Munich Academy.<sup>290</sup> Buchner<sup>291</sup> stated that the stone had been decorated with glass beads (*glasperlen*), not pearls. It is possible that the stone was destroyed during the bombing raids of the Second World War, although this is not mentioned in its entry in the Meteoritical Bulletin Database.<sup>292</sup>

Descriptions of cosmic events and meteorite falls appear throughout Australian Aboriginal oral traditions. At times, these accounts described the impact events in detail, suggesting these were observed events with identified locations. Duane W. Hamacher and Ray P. Norris<sup>293</sup> discovered that, although detailed Aboriginal accounts of meteorite strikes were widespread in the literature, no material evidence had been found linking any of these stories to meteorite falls documented by modern science.

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<sup>284</sup> Oliver C. Farrington, 'The Worship and Folk-Lore of Meteorites', *The Journal of American Folklore*, 13.50 (1900), pp. 199–208 (pp. 203–204).

<sup>285</sup> Burke, *Cosmic Debris*, p. 226.

<sup>286</sup> Otto Buchner, *Die Meteoriten in Sammlungen, Ihre Geschichte, Mineralogische und Chemische Beschaffenheit* (Leipzig: Wilhelm Engelmann, 1863), pp. 85–87.

<sup>287</sup> Buchner, *Die Meteoriten in Sammlungen*, p. 86.

<sup>288</sup> Jan Hüsken, 'Missionary Societies and Religious Orders in German Colonies and Their Contribution to Ethnographic Collections', *Working Paper Deutsches Zentrum Kulturgutverluste*, 9/2025 (2025) <<https://doi.org/10.25360/01-2025-00046>> [accessed 31 October 2025], p. 38.

<sup>289</sup> Buchner, *Die Meteoriten in Sammlungen*, pp. 86–87.

<sup>290</sup> Buchner, *Die Meteoriten in Sammlungen*, p. 87.

<sup>291</sup> Buchner, *Die Meteoriten in Sammlungen*, p. 86.

<sup>292</sup> Meteoritical Society, *Meteoritical Bulletin Database: Duruma* (2025) <<https://www.lpi.usra.edu/meteor/metbull.cfm?code=7752>> [accessed 19 October 2025].

<sup>293</sup> Duane W. Hamacher and Ray. P. Norris, 'Australian Aboriginal Geomythology: Eyewitness Accounts of Cosmic Impacts?', *Archaeoastronomy: The Journal of Astronomy in Culture*, 22 (2009), pp. 60–93.

## Forged from the Sky

Meteoritic iron was used to make early tools, jewellery, and weapons. These items demonstrated technical skill, but they also probably held symbolic importance as the material was known to have fallen from the sky. In ancient Egypt, for instance, beads from the prehistoric Gerzeh cemetery were made from meteoritic iron dating to c. 3300 BCE.<sup>294</sup> These would have been valued as *bjꜣ n pt* or 'iron of the sky',<sup>295</sup> suggesting a divine or celestial origin. On the body of Tutankhamun, a dagger was discovered with a meteoritic iron blade, accompanied by a wadjet eye amulet and a miniature headrest also of meteoric iron.<sup>296</sup> The iron dagger was placed alongside another dagger made of gold, suggesting that the meteoritic iron held a status comparable to that of gold rather than serving a merely practical function. This elevated valuation accorded with Egyptian religious conceptions in which iron was viewed as a celestial substance; for example, the Pyramid Texts likened the iron bones of the pharaoh to the Imperishable Stars.<sup>297</sup>

Across cultures, weapons forged from celestial metal or identified as iron from the sky served not merely as instruments of warfare but as symbols of sacred legitimacy. The bearer of a sky-forged weapon was thought to wield not only physical might but the authority of the heavens, fusing cosmology and sovereignty in a single gesture. Seven Kris daggers from central Java, now in the Weltmuseum Wien, were analysed using handheld XRF spectroscopy.<sup>298</sup> Initial findings suggested that the blades may have been forged using metal derived from the Prambanan iron meteorite. Meteoritic iron was also found in two weapons in the Smithsonian collection: the broad axe (34.10) and the dagger-axe (34.11), dating to the Zhou period (c. 1046 BCE–256 BCE) in China.<sup>299</sup> If the fall of the meteorite had been witnessed, the metal would probably have been regarded as fortunate or sacred, appropriate for the weapons of royalty.<sup>300</sup> In these examples, meteoritic iron appears to take the place of the jade that would normally have been inlaid in such bronze weapons.

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<sup>294</sup> Diane Johnson and others, 'Analysis of a Prehistoric Egyptian Iron Bead with Implications for the use and Perception of Meteorite Iron in Ancient Egypt', *Meteoritics and Planetary Science*, 48.6 (2013), pp. 997–1006 (p.1004).

<sup>295</sup> Victoria Almansa-Villatoro, 'What Ancient Egyptians Knew about Meteorites: Long before Modern Astronomers', *Sapiens*, 3 October 2023. <<https://www.sapiens.org/archaeology/ancient-egyptians-meteorites-astronomy/>> [accessed 29 April 2025].

<sup>296</sup> Katja Broschat and others, *Iron from Tutankhamun's Tomb* trans. by Manon Schutz (Cairo: The American University in Cairo Press, 2022), pp. 27–30.

<sup>297</sup> Almansa-Villatoro, 'The Cultural Indexicality of the N41', p. 76.

<sup>298</sup> F. Brandstätter and others, 'Meteoritic Iron in Javanese Kris Daggers: A Comparative XRF Study Performed on Original Daggers and Newly Forged Test Objects', *79th Annual Meeting of the Meteoritical Society*, 79 (2016), id 6168 <<https://www.hou.usra.edu/meetings/metsoc2016/pdf/6168.pdf>> [accessed 07 November 2025].

<sup>299</sup> Rutherford J. Gettens, Roy S. Clarke Jr., and W. T. Chase, *Two Early Chinese Bronze Weapons with Meteoritic Iron Blades: Occasional Papers, Vol. 4. No. 1*, (Washington DC: Freer Gallery of Art, 1971), p 1.

<sup>300</sup> Gettens, *Two Early Chinese Bronze Weapons with Meteoritic Iron Blades*, p. 70.

A meteorite was seen to fall in Jalandhar, prompting Emperor Jahangir (1569–1627)<sup>301</sup> to order a master blacksmith to forge weapons from the iron. Using a mixture of three parts meteorite iron to one-part ordinary iron, the blacksmith crafted two swords, a knife, and a dagger.<sup>302</sup> Of these, only the knife has survived (Figure 18). An inscription along its spine recorded the date, the use of meteorite iron, and the command of Jahangir for the weapons to be made.



Figure 18. Knife made for Jahangir. Smithsonian: Freer Gallery of Art. Accession No. F1955.27a-b. Usage Conditions Apply.

As noted by Donald J. Blakeslee<sup>303</sup> in the American Plains, some meteorites became shrines, while others were positioned in revered locations. Many were transported long distances from original fall sites and placed in graves, along travel routes, or near notable landscape features. The Hopewell culture, a prehistoric Native American society that thrived in eastern North America c. 400 BCE–400 CE, was recognised for its construction of elaborate burial mounds and earthworks.<sup>304</sup> Much of Hopewell's artistic production, technical innovation, and long-distance trade would appear to have been directed towards

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<sup>301</sup> Jahangir, *The Tūzuk-I-Jahāngīrī, or, Memoirs of Jahāngīr Vol. 2*, trans. by Alexander Rogers, ed. by Henry Beveridge (London: Royal Asiatic Society, 1914), pp. 204–205.

<sup>302</sup> Jahangir, *The Tūzuk-I-Jahāngīrī*, p. 204.

<sup>303</sup> Donald J Blakeslee, 'Shrines to the Buffalo Spirit: Meteorites and Meteorite Shrines on the Plains', *Midcontinental Journal of Archaeology*, 48.1 (2023), pp. 47–70.

<sup>304</sup> Olaf. H. Prufer, 'Prehistoric Hopewell Meteorite Collecting: Context and Implications', *The Ohio Journal of Science*, 61.6 (1961), pp. 341–352 (p. 341).

acquiring items for interment. Notably, meteoric iron was among these materials, in the form of unmodified meteorite fragments and as cold worked objects, including tools and thin iron foils applied as decorative overlays.<sup>305</sup>

The so-called 'Buddha from Space', a statue carved from a rare meteorite, has created extensive debate regarding its origin. While the provenance of the sculpture itself has remained uncertain, the meteoritic material of the statue is likely to have come from the Tanna-Tuva border region of eastern Siberia and Mongolia.<sup>306</sup> Although the figure has been associated with Vaiśravaṇa, its stylistic features also led to suggestions of an eleventh-century Bon cultural context. Both the iconographic interpretation and the dating remain speculative.<sup>307</sup> The deliberate carving and partial gilding of an iron meteorite, a challenging sculptural medium, indicated that the artist had been aware of the material's exceptional, and likely sacred, nature.<sup>308</sup> Isrun Engelhardt<sup>309</sup> suggested 'that the meteorite statue portrays Nicholas Roerich (1874–1947) as Rigden Jyepo or Reta Rigden'. Roerich, an artist, public figure and Theosophist, travelled through Asia with his wife during the mid-1920s, and Engelhardt<sup>310</sup> proposed that he may have identified himself with Rigden Jyepo, the final ruler of the legendary kingdom of Shambhala. Since the statue has passed into private ownership and is no longer available for examination, a secure conclusion cannot be drawn regarding its date of creation or provenance.<sup>311</sup>

Captain John Ross (1777–1856) headed a British Navy expedition in 1818 to search for the Northwest Passage.<sup>312</sup> Ross and his party reached Melville Bay and encountered a party of Inughuit who had come to the area to procure iron for their knife and harpoon blades. Due to weather and time constraints, Ross was unable to trace the source of the iron, although he correctly identified the iron as meteoric. It was not until 1894 that Peary was shown the location of the pieces of meteorite that became known as 'the Woman', 'the Dog' and 'Ahnighito'.<sup>313</sup> All three pieces are now on display in the Hall of Meteorites at the American

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<sup>305</sup> Prufer, 'Prehistoric Hopewell Meteorite Collecting', p. 341.

<sup>306</sup> Elmar Buchner and others, 'Buddha from Space: An Ancient Object of Art Made of a Chinga Iron Meteorite Fragment', *Meteoritics & Planetary Science*, 47.9 (2012), pp. 1491–1501 (p. 1499).

<sup>307</sup> Buchner and others, 'Buddha from Space', p. 1499.

<sup>308</sup> Buchner and others, 'Buddha from Space', p. 1499.

<sup>309</sup> Isrun Engelhardt, 'The Strange Case of the "Buddha from Space"', *Revue d'Études Tibétaines*, 42 (2017), pp. 39–67 (p.63).

<sup>310</sup> Engelhardt, 'The Strange Case of the "Buddha from Space"', p.54.

<sup>311</sup> Engelhardt, 'The Strange Case of the "Buddha from Space"', p.64.

<sup>312</sup> Martin Appelt and others, *The Cultural History of the Innaanganeq / Cape York Meteorite: Technical Report* (Nuuk: Greenland National Museum & Archives, 2015), pp. 10–11.

<sup>313</sup> Appelt and others, *The Cultural History of the Innaanganeq*, p.12.

Museum of Natural History, New York.<sup>314</sup> The Cape York meteorite field in northwest Greenland had long provided a valuable source of workable meteoritic iron for local Inuit communities.<sup>315</sup> The iron was cold-hammered into knife blades, harpoon tips, and small tools, and traded into Arctic Canada, although apparently not into Greenland.<sup>316</sup>

If meteoritic iron can be seen as the material expression of cosmic matter, tektites represent a different aspect of this process: terrestrial matter transformed through the impact and heat of a meteor strike. A yellow scarab sits at the centre of one of Tutankhamun's pectorals, discovered within the mummy bands.<sup>317</sup> The pectoral (Figure 19) weaves together several themes linked to the cyclical movements of the sun and moon, celestial bodies closely tied to pharaonic power. Although the scarab was first thought to be chalcedony, it was later identified as a tektite, specifically Libyan Desert Glass.<sup>318</sup> George A. Baker<sup>319</sup> noted that australites, a type of tektite, held special importance for some Aboriginal Australian communities. They were used for healing, rainmaking, sending messages, ceremonial punishment, surgical rites, as amulets and sources of spiritual power. It was suggested by archaeological evidence that they were especially valued as ceremonial and magical objects, preserved and regarded as stones of magic and mystery.

Just as early societies had fashioned meteoritic iron into tools, weapons, and other objects imbued with celestial meaning, modern makers continue to incorporate these materials into contemporary jewellery, coins, cars and knives. Examples include jewellery created by Reinhold Ziegler,<sup>320</sup> collectable coins such as the 2021 Niue Island two dollars,<sup>321</sup> the special edition Rolls-Royce Phantom Tranquillity,<sup>322</sup> and 'The Sword of Heavenly Iron'<sup>323</sup>

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<sup>314</sup> American Museum of Natural History, Fragments of Cape York: Hall of Meteorites (2025) <<https://www.amnh.org/exhibitions/permanent/meteorites/meteorites/fragments-of-cape-york>> [accessed 04 November 2025].

<sup>315</sup> Vagn. F. Buchwald, 'On the use of Iron by Eskimos in Greenland', *Materials Characterisation*, 29.2 (1992), pp. 139-176.

<sup>316</sup> Appelt and others, *The Cultural History of the Innaanganeq*, p.4.

<sup>317</sup> Francesco Tiradritti, Araldo De Luca, , and Maṭḥaf al-Miṣrī, *The Cairo Museum: Masterpieces of Egyptian Art* (London: Thames & Hudson, 1999), pp. 236–237.

<sup>318</sup> M. P. Riccardi and others, 'Gemmology in the Service of Archaeometry' in *EMU Notes on Mineralogy, Vol 20: The Contribution of Mineralogy to Cultural Heritage*, ed. by Gilberto Artioli and Roberta Oberti (London: Mineralogical Society of Great Britain & Ireland, 2019), pp. 345–362 (pp. 356–360).

<sup>319</sup> George A. Baker, *Memoirs of the National Museum of Victoria 22.8: The Role of Australites in Aboriginal Customs* (Melbourne: National Museum of Victoria, 1957), p. 1.

<sup>320</sup> Reinhold Ziegler, *Cosmic Debris: Meteorites and Jewellery Objects* (Stuttgart: Arnoldsche Art Publishers, 2014).

<sup>321</sup> German Mint, *2021 Niue Island: Impact Moments: Meteorite 2 oz Silver HR*, (2025) <<https://germaniamint.com/2021-niue-island-impact-moments-meteorite-2-oz-silver-hr/>> [accessed 16 November 2025].

<sup>322</sup> Rolls-Royce Motor Cars PressClub, Rolls-Royce Phantom Tranquillity, (2025) <<https://www.press.rolls-roycemotorcars.com/rolls-royce-motor-cars-pressclub/photo/detail/P90338728/ROLLS-ROYCE-PHANTOM-TRANQUILLITY>> [accessed 16 November 2025].

<sup>323</sup> Tokyo Skytree Town ® Campus, *The Sword of Heavenly Iron (Tentetsutou)*, (2025) <<https://cit-skytree.jp/en/exhibitions/sword/>> [accessed 16 November 2025]

on display at the Chiba Institute of Technology, Tokyo, reflecting a persistent fascination with matter believed to originate from the sky. However, despite their popularity in modern pieces, claims that moldavite<sup>324</sup> and other tektites were used in Palaeolithic or otherwise ancient jewellery, often circulated in commercial or New Age contexts, remain largely unsupported. Firm archaeological evidence exists only for a few well-documented cases, such as the pectoral of Tutankhamun,<sup>325</sup> and no broader pattern of ancient tektite adornment has been reliably demonstrated.



Figure 19. Tutankhamun Pectoral. Cairo Museum JE61884. Jon Bodsworth, 2007, Wikimedia Commons, Copyrighted free use.

<sup>324</sup> Michael Gienger, *Crystal Power, Crystal Healing*, trans. by Astrid Mick, Revised Edition (London: Cassell Illustrated, 2015), p.340.

<sup>325</sup> Tiradritti, *The Cairo Museum: Masterpieces of Egyptian Art*, pp. 236–237.

The use of meteoritic iron illustrates how material culture operated as a bridge between the human world and a larger cosmological order. As the earliest sources of workable iron literally fell from the sky, it was experienced not as an everyday resource but as an unexpected arrival from a heavenly source. This observation fitted with the observation by Mircea Eliade<sup>326</sup> that ancient societies separated the sacred from the everyday, endowing unusual materials with a sacred quality, a sign of the divine. Working meteoric iron into tools and weapons took more than skill; it showed how, as Durkheim<sup>327</sup> noted, societies invest certain materials with meanings that bind people together and affirm a shared order. Blades and artifacts made from iron that fell from the sky were not merely implements of war, they were symbols of power thought to carry the authority of the heavens themselves. Even today, meteoritic iron continues to attract attention in auctions, museums and tourist displays, where each piece is named, recorded, and studied, showing that its unusual origin still inspires curiosity and fascination.

Tektites reveal a parallel but more uncertain form of the sacred. While the archaeological record suggested only limited and regionally specific evidence, such as the Tutankhamun pectoral and certain Australian examples, their unusual appearance would suggest that they were sometimes treated as objects of special significance. Their glossy surfaces, their origins in explosive natural events, and their transition from stone into glass echoed the view of Eliade<sup>328</sup> that mythic objects could carry transformative qualities. Even if their ritual or amuletic use was not widespread, their selection and use indicated that some communities perceived them as a unique material. Today, tektites continue to be popular as amulets or charms, showing that their unusual origins still inspire fascination and a sense of special significance.

At the same time, the varied meanings attached to meteorites illustrated the basic patterns that Lévi-Strauss<sup>329</sup> recognised in mythic thought. Whether seen as iron from the sky, pieces of lightning, or simply as unusual stones, meteorites and tektites were drawn into symbolic systems that dealt with basic opposites, such as sky and earth, chaos and order, danger and safety. Their continued fascination, even in later scientific or collector contexts, reflected what Patrick Curry<sup>330</sup> described as the experience of enchantment: a mode of

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<sup>326</sup> Mircea Eliade, *The Sacred and the Profane: The Nature of Religion*, trans. by Willard R Trask (New York: Harcourt, Brace and Company, 1959), pp. 11–12.

<sup>327</sup> Emile Durkheim, *The Elementary Forms of the Religious Life*, trans. by Joseph Ward Swain (New York: Dover Publications, Inc., 2008), pp. 212–213.

<sup>328</sup> Eliade, *The Sacred and the Profane*, p. 12.

<sup>329</sup> Claude Lévi-Strauss, *Structural Anthropology*, trans. by Claire Jacobson and Brooke Grundfest Schoepf (New York: Basic Books Inc., 1963), pp. 206–231.

<sup>330</sup> Patrick Curry, 'The Experience of Enchantment and the Sense of Wonder', *Green Letters*, 25.2 (2021) pp. 115-129 <<https://doi.org/10.1080/14688417.2021.1928530>>

perception in which the world appeared relational, meaningful, and charged with more-than-human significance. The use of meteoritic iron and tektites, therefore, shows not only the material transformations they underwent but also a constant human effort to find the sacred in the physical things. Their worship, trade, and general use show a continuing connection between the sky and the earth, in which people frequently give cosmic meaning to meteorites, linking the past and present through a desire to connect with energies beyond the ordinary world.

## Conclusion

The evidence has shown that stones believed to have fallen from the sky played an important role in many cultures long before the scientific study of meteorites began. Although only two early identified falls have physically survived, written accounts have shown that such stones were often treated with awe and linked to divine power. This can be identified in Emesa, where the black conical stone of Elagabal had been honoured as a heavenly object. When Bassianus became emperor, he took this sacred stone to Rome, and its cult briefly flourished across the empire. However, the attempt to elevate the Syrian sun god above Jupiter created tension within Roman society. The rituals and behaviour of the emperor were seen as objectionable by many; this has caused both ancient and modern authors to judge his reign harshly. However, his actions revealed how a single object, seen as a gift from the gods, could shape political identity, religious practice, and the nature of imperial power. The images found on coins of Elagabalus and Uranius Antoninus indicated how the stone was transported, displayed and interpreted, including the use of drapery, decorative elements, and ritual objects. The parasols or fan-like structures, when compared with Egyptian examples, further showed that objects creating shade or movement of air could be said to mark sacred space and to express the idea of divine presence. This connection could support the interpretation of the rites of Elagabal belonging to a wider system of royal and religious symbolism. Later interpretations of reforms carried out by Elagabalus suggested ambitious religious aims, yet the surviving evidence showed that the cult lacked key features of a universal or evangelistic faith. After the death of Elagabalus, the fate of the black stone remained uncertain, and while scholars offered various theories, none were supported by firm archaeological proof. The unknown fate of the stone and the unidentified location of its Syrian temple illustrate how little has survived of this once-prominent cult.

Despite this, the coins and written record furnish an impression of a black stone that shaped Roman religion and politics.

The accounts of the Aegospotami stone show how a single extraordinary event became fixed in local memory and also had a wider historical significance. Ancient writers consistently described the fall of a massive stone near the Hellespont, treating it as an event of both celestial and political significance. Plutarch, Strabo, and the compiler of the Parian Marble all linked the fall of the stone with the Athenian defeat at Aegospotami in 405 BCE. The story surrounding Anaxagoras also revealed how early thinkers attempted to understand such occurrences and how later generations turned these stories into signs and prophecies. The worship of both the Aegospotami stone and the smaller stone at Abydos showed that communities regarded these objects as divine or celestial. Although the stones apparently remained visible for centuries, their ultimate fate is unknown. Their legacy survives mainly through textual accounts that recorded how people once interpreted stones that fell from the sky.

The traditions surrounding the Magna Mater provide yet another example of how the identities of sacred stones evolved as they moved across cultures. Although later writers often described the Cybele stone as a sky stone, the earlier evidence is ambiguous. Early accounts did not clearly claim a sky-fallen origin; that idea developed only after the Romans adopted the cult. The story of the journey of the stone from Pessinus to Rome showed how omens, oracles, and political pressure combined to justify its transfer during the Second Punic War. The narratives of Herodian and Ovid further emphasised divine intervention, especially through the figure of Claudia Quinta, whose actions were interpreted as proof of both personal virtue and Cybele's support for Rome. The descriptions offered by Arnobius and Prudentius suggested that the object was a small, dark, irregular stone later set within an anthropomorphic statue, allowing it to function both as a relic and an image. Later scholars have speculated whether this stone could be connected to the black stone of Elagabalus, although the evidence remains inconclusive. Overall, the story of the Magna Mater illustrates how a seemingly modest object could become central to religious identity, political symbolism, and changing interpretations across centuries.

At Orchomenus, Pausanias recorded that three stones associated with the Graces were believed to have descended from the heavens during the mythical age of Eteocles. Although the rituals associated with the Graces are now unknown, the existence of these stones in their sanctuary demonstrates how stones could function as centres of devotion. The story of the Cassandria meteorite illustrates how a single event could affect both the founding of a settlement and religious worship. The memory of a meteorite fall that founded a city was

mentioned by Pliny, and the later coinage that displayed the image of Zeus-Ammon perhaps indicated that the Romans accepted a divine element to the fall. The change from Poseidon to Zeus-Ammon as the principal God of the city implied that the meteorite fall affected the religious outlook of the citizens. The stone of Astarte at Tyre offers another case in which a story about a heavenly object grew into a lasting cult. Philon tells how the goddess discovered a fallen star and consecrated it, and the coins from Tyre indicate that this sacred stone continued to hold an important place in local worship. Taken together, these examples show how people saw stones that fell from the sky as bearers of divine force.

The traditions surrounding the Ephesian Artemis showed how a sacred image could accumulate layers of meaning over time. Although Acts of the Apostles referred to the object as 'fallen from the sky,' ancient Greek and Latin authors did not clearly describe the Artemis stone as unworked or meteoritic, leaving its true nature uncertain. Cook's discussion of the greenish *baitylos* from Ephesus demonstrated how easily such stones could be linked to divine origins, yet scientific examination later confirmed that the object was terrestrial. Even so, scholars such as Oakley and Tankard proposed that a stone of this kind might once have been set in the crown of the cult statue, suggesting a continuing symbolic connection between the goddess and a celestial object. Interpretations of the distinctive objects on the chest of the goddess showed how later writers have attempted to explain traditional iconography whose original meaning has been lost. Whether seen as breasts, bull's testicles, dates, or seed-shaped ornaments, these elements consistently reinforced the association of the goddess with fertility. The argument of Newton that the earliest Artemis image may have been inspired by a meteorite could be seen to reflect an early belief that images of the gods could fall from the sky. The spread of associated cults throughout Asia Minor showed how this symbolic power extended well beyond Ephesus itself.

Similar patterns appear at Paphos, Delphi, and Mecca, where sacred stones played essential roles in religious life. At Paphos, Tacitus described the stone of Aphrodite as conical, simple and non-human in form. Modern excavators found a rock that matched this description; however, the stone was found to be terrestrial, not meteoric. Its long-standing religious importance was demonstrated by its repeated appearance on Roman coins. At Delphi, the stone associated with the Kronos myth illustrates how a physical object was part of a myth. Pausanias's account of ritual care for the stone showed that it remained an active focus of devotion. Interpretations differ over whether this stone and the omphalos were identical. In Mecca, the Black Stone of the Kaaba offers a rare example of a sacred object whose veneration transcended multiple historical transformations. Although there are many

theories regarding its origin, due to restrictions on testing, scientific certainty is impossible, keeping its source founded in religious tradition rather than empirical verification.

By the Middle Ages, documented meteorite falls such as those at Nogata, Ensisheim, and Willamette show how meteorites could affect ceremonial tradition, create legal disputes, and develop scientific inquiry. The Nogata fall of 861 CE became a Shinto shrine treasure and was ritually paraded every five years. It was confirmed as a meteorite by modern scientific analysis. Showing how a historical event can be verified by modern scientific methods. The 1492 Ensisheim fall, which was seen by Maximilian I as a sign from God, was rapidly spread through Europe by printed broadsheets, which displayed the political and cultural impact of the event. The Willamette Meteorite shows how a stone can become a site of conflict between different groups of people. The desire to own the meteorite and make money by displaying it, the eventual acquisition by a museum, and the Indigenous Indian testimony confirming its long-standing spiritual importance demonstrate how an object can become a site of conflict between different groups. Nevertheless, the 2000 agreement between the tribe and the museum represents a modern attempt to reconcile scientific and indigenous traditions.

The meteorites discussed in this section illustrate the wide range of responses that celestial stones inspired in different societies. Many stones were discovered by farmers, travellers, or missionaries; however, their meanings were shaped by long-standing beliefs rather than by scientific study. The Mbosi meteorite was treated as taboo for generations, which showed how a stone could acquire cultural influence through tradition. Its later protection as a national monument, and the positive attitudes recorded in recent research, demonstrated how ancient reverence could evolve into modern heritage value and tourism. The Hoba meteorite, which caused much excitement on its discovery, has also become a tourist attraction. While others, such as the Jhung and Durala stones, reveal how falls were often interpreted as divine warnings or signs. In some cases, communities wished to worship the stones, while in others, fear or uncertainty encouraged their removal.

The myths linked to the El Morito meteorite, and its connection with an ancestral idol and a supernatural story, demonstrate how meteorites could become part of wider historical traditions. The account of a meteorite falling on the coast near Zanzibar, later named the Duruma stone, revealed how European collectors and missionaries became involved in the future of a meteorite. Finally, the widespread Aboriginal narratives about cosmic events indicated that meteorite falls and impact stories held deep significance, even though no physical remains had yet been linked to these traditions. Across many ancient cultures, meteoritic iron and tektites carried both practical and cosmic significance. Egyptian objects

such as the Gerzeh beads and the iron dagger of Tutankhamun were revered as 'iron of the sky.' Across Asia, meteoric metal was incorporated into Chinese weapons, Javanese Kris blades, and Mughal swords, showing exceptional skill and celestial favour. In the Americas, Hopewell artworks and Inuit tools from Cape York meteorites held ceremonial, aesthetic, and practical value. Tektites such as Libyan Desert Glass and Australites further show how unusual celestial materials were transformed into objects linked to spirituality, power, and cosmic meaning.

Although modern makers continue to incorporate meteoritic iron and tektites into jewellery, coins, and artefacts, the archaeological record confirms only a few ancient examples, such as Tutankhamun's pectoral. However, these stones were treated as special, connecting the earthly world with the sky. Societies regarded them as sacred, following outlines observed by Eliade and Durkheim, in which rare or unusual items reinforced social unity and personified divine power. In many cultures, meteorites and tektites were seen through symbolic ideas that juxtaposed sky and earth, danger and safety, and order and chaos. The use, worship, and continued interest in stones from the sky illustrate a continuing desire to connect with the heavens, giving physical matter a cosmic significance and joining past and present through wonder, ritual, and workmanship.

As theorists such as Lévi-Strauss, Durkheim, Eliade, and Patrick Curry suggest in different ways, the meaning of these objects emerged through cultural interpretation. For Lévi-Strauss, meteorites participate in wider symbolic structures; for Durkheim, they gain power through collective ritual; and for Eliade, they function as hierophanies, manifestations of the sacred. Patrick Curry, by contrast, emphasises 'enchantment' and the participatory, relational experiences through which people engage with unusual phenomena, seeing sacred objects as part of a living, meaningful world rather than as symbols or social constructs alone. All four views agree that the significance of meteorites was not in their physical form but in how people interpreted them, whether this was through social structure, community traditions, religion, or personal experience. Even today, meteorites continue to inspire fascination, from museum displays and modern jewellery to scientific investigation, showing people's enduring wish to attribute cosmic significance to stones from the sky. Across cultures and time, these stones illustrate a continuing human effort to connect the earthly and celestial realms, to locate the sacred within material objects, and to express social, political, and spiritual meaning through stones with souls.

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