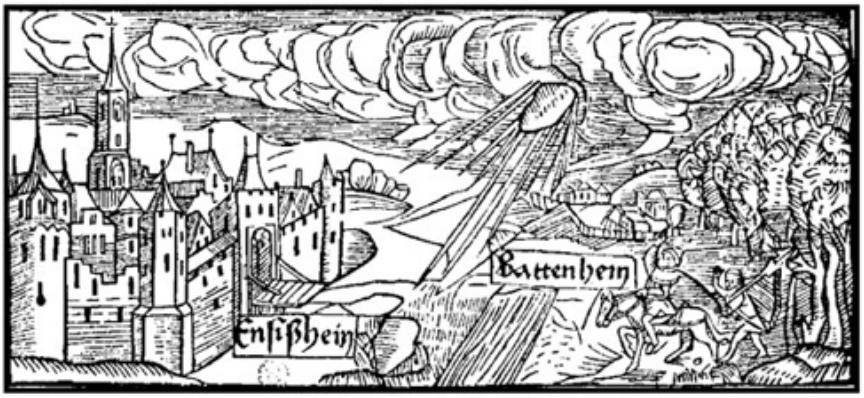
Meteorites in Ancient Times

Meteor Omens

Meteorites have played many key roles throughout history and across many cultures. The observation of a meteor, or shooting star, was considered a celestial omen, switching between being a bad or good sign depending on the time and place. When Shakespeare wrote 'The Life and Death of Richard II' he uses a meteor to foreshadow the "death [or fall] of kings", as the sight of a meteor was a bad omen at this time. A 147kg meteorite that fell in a wheat field outside Ensisheim (France) in 1492 was chained to the wall in a local church after the Emperor, Maximillian the First, claimed it was an 'omen of divine protection against invasion'. Historic records of meteors are often seen in artwork and literature from the time.



Brant, 1492. Zentralbibliothek, Zurich.

Figure 1 Artwork depicting the fall of the Ensisheim meteorite of 1492

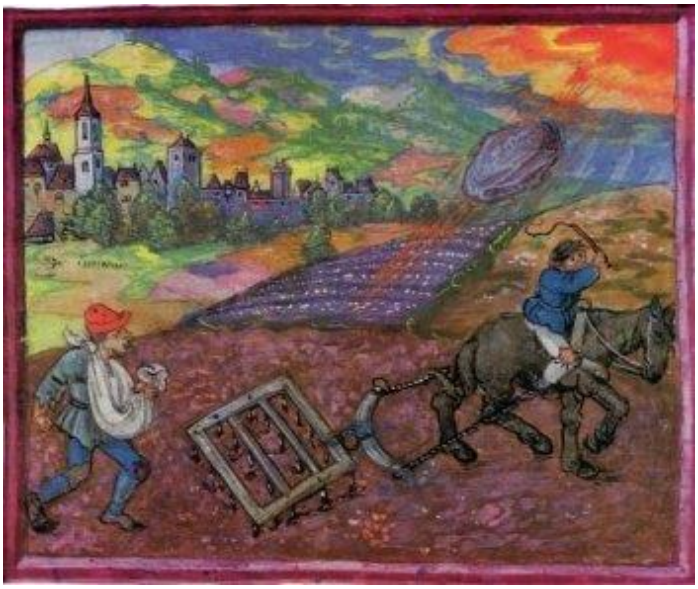


Figure 2 Artwork depicting the fall of the Ensisheim meteorite of 1492 in the form of woodcuts.

Sources:

- https://www.meteorite-times.com/accretion-desk/ensisheim-the-king-of-meteorites/
- https://motherboard.vice.com/en_us/article/jpgk47/this-famous-1492-meteorite-impact-was-interpreted-as-an-omen-from-god

Meteorites and Religion

While meteors were omens, the meteorites themselves were seen as sacred objects or objects of power, to be worshipped and used in religious ceremonies. Having 'fallen from the heavens' they often became the source of cultish worship. One meteorite holds the place of honour at Apollo's Temple at Delphi, where the ancient Greeks believed Cronos (the god Saturn being the Roman variant) threw the rock from above after his dethronement by his son Zeus. The ancient Greeks believed Delphi was chosen due to its location as the centre of the Earth. Many Greek and Roman temples enshrined rocks that had reportedly 'fallen from heaven' called *baitylia* in Greek, meaning 'residence of Gods'. There are also references to meteorites in the Bible, where Jacob lays his head on a *betyl* stone - Hebrew for meteorite.

Some meteorites from ancient times are still revered today, such as the 'Black Stone of Mecca' or 'Kaaba Stone'- which is not an object of worship itself, but a venerated relic. The holy Islamic city sees millions of visitors as part of a pilgrimage (Hajj) that Muslims wish to attend at least once in their life. At the centre is the Kaaba, a cubic structure covered in cloth. The pilgrimage is complete once the Kaaba has been circled seven times and the pilgrim has touched the 'right hand of God'.

The Black Stone is the eastern cornerstone of the Kaaba and is believed to be a meteorite due to its black exterior and greyish interior, along with the fact that within the Islamic faith it is referred to as a *betyl* and is associated with 'ejection from Heaven'. However, scientific analysis of the Kaaba Stone is not possible due to its significance and reputation, meaning it is unlikely for anyone to know for certain its true origins. Some now believe it may simply be basalt stone or dark agate, while another theory suggests it is an impactite (i.e. a meteorite-related impact glass, possibly from the Wabar meteorite, which fell in Saudi Arabia, just over 1000 km away from Mecca).

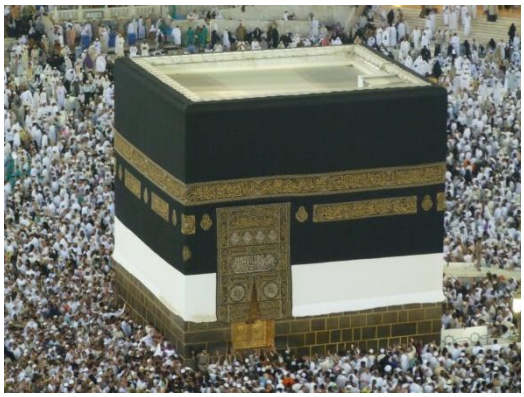


Figure 3 The Kaaba in the Masjid el Haram, Mecca, 2010 (Image Wikimedia commons).

Figure 4 The remains of Apollo's temple at Delphi

Sources:

- https://www.bibliotecapleyades.net/mistic/meteorites_religion.htm
- http://www.ancient-origins.net/artifacts-other-artifacts/kaaba-black-stone-holy-stone-outer-space-003661

Meteorites in Everyday Use

The ability to work metal is so important in history that historians have named many eras for the metal that could be worked and was in common use, from copper to bronze to iron. What historians and archaeologists have also found is the sporadic use of iron, dating from the late Neolithic period up through the Bronze Age, in places such as the eastern Mediterranean, despite the lack of smelted iron. Therefore the source of all of these is strongly linked to meteorites, but the question that still lingers is what methods these ancient civilisations used to work the metal.

It is undeniable that throughout history meteors and meteorites have been important in many cultures and civilisations, often with an association to Gods and Heaven. However, some cultures also saw the more practical uses of meteorites, beyond being a source for worship. Pre-Iron age (and the knowledge of mining and smelting iron), the only source of workable iron (through 'cold working') was that provided by iron meteorites.

Amongst the uses people found for iron meteorites are beads, jewellery and statues – for example the Chinga meteorite is believed to have been used to make the 'Iron Man', a Buddha statue from around the 11th century in Tibet. Meteoritic iron was also used to make weapons such as arrow heads, blades, spear tips and even cutting edges for tools, whilst still also incorporating them in ceremonial ways, sometimes found in burials.

Figure 5 Two beads from the Hopewell burial mound (Photo Tim McCoy)

Figure 6 The Iron Man statue from Tibet (image from National Geographic)

Sources:

- https://www.theguardian.com/world/2012/sep/28/nazi-buddha-statue-carved-from-meteorite

Native Americans are amongst the cultures that not only placed importance on but also shaped meteorites. In the Hopewell burial mounds, Ohio, several items either made from, or coated in, meteorite material were found, including beads and earspools. The Clackamas tribes reportedly dipped arrow and spear heads into the water collected in the Willamette iron meteorite before a hunt, believing it would strengthen their weapons. There is the suggestion that meteorites also conveyed a sign of status and may well have been traded by the Native Americans and other cultures, like the Inuit.

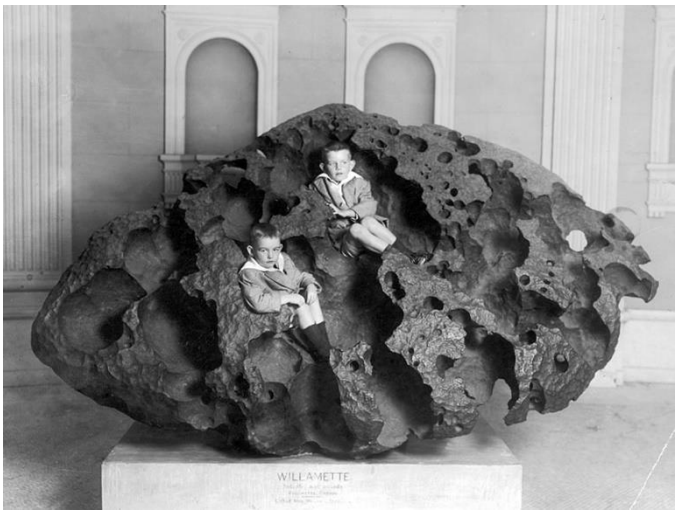


Figure 7 Willamette meteorite in the American Museum of Natural History, New York, 1911

Sources:

- http://insider.si.edu/2017/05/ancient-native-american-beads-traced-otherworldy-source-meteorite/
- https://www.amnh.org/exhibitions/permanent-exhibitions/rose-center-for-earth-and-space/dorothy-and-lewis-b.-cullman-hall-of-the-universe/planets/planetary-impacts/the-willamette-meteorite

The Inuit made harpoons and cutting edges for tools using the fragments of the Cape York meteorite as a metal source. Forging them through the cold-working methods of stamping and hammering using rocks. The early Inuit settlers at Cape York were surround by glaciers and sea, so it was surprising to early explorers that the locals had iron tool components, considering the harsh landscape and difficulty in sourcing materials for smelting. Initially the Inuit did not share knowledge of the meteorite with explorers, only saying the resource came from the 'Iron Mountain'. In 1894 explorer Robert Peary had three of the large meteorites removed to New York, along with various Inuit artefacts. It is thought that while they used the meteorite fragments to make knives and cutting edges they may also have used pieces to trade with other communities, as the main source for iron in the Eastern Artic.

Figure 8 Harpoon tip made from meteoric iron (image Wikimedia commons)

Sources:

- http://www.ironfromthesky.org/?p=310
- http://www.ancient-origins.net/news-history-archaeology/people-arctic-worked-meteorite-iron-1200-years-ago-002573

The earliest known iron to be found in Egypt was excavated from a cemetery in Gerzeh in 1911, about 70km from Cairo. There, two graves were found to contain iron beads. The cemetery was dated to around 3300 BCE, meaning the iron beads were made around 3000 years before the earliest evidence of large scale iron smelting in the region. This led to scientific analysis which showed the beads were composed of a nickel-rich iron, revealing that the beads were in fact made from an iron meteorite. Another clue to their origin was the unique form of a crystallographic pattern known as Widmanstätten, only seen with meteorites.

Egyptian burials often included items of significance or function, such as shiny stones and gold artefacts, perhaps as a sign of social status or because they were believed to have protective properties, so the inclusion of meteoric iron showed it held some importance to Egyptians at this time.

These beads were not the only example of prehistoric iron found in early Egypt, although many of the other artefacts still need further analysis to confirm their origin. A clear indicator that these could be from iron meteorites is that the term for iron in ancient Egyptian translates as “iron of the sky”. This was a term used from the 19th Dynasty onwards (around 1300 BCE), suggesting that they may have witnessed a meteorite event at this time.

Following the discovery of Tutankhamun’s tomb in 1922, nineteen objects of a nickel-rich iron composition were found. The most interesting of these is a dagger, which matched another dagger made of gold, making a set similar to those used in an ‘opening of the mouth’ ceremony for the deceased. The other objects include miniature blades, a miniature headrest and a bracelet, and records suggest that at least some of these objects may have been gifts from the King of Mittani to Tutankhamun’s grandfather. What is particularly special about the dagger is the level of skill that has been used in producing it.

Figures 9 & 10: Dagger from Tutankhamun's tomb with gold sheath (left) and an iron bead from Gerzeh cemetery (right).

Figure 10

Figure 9

Sources:

- http://www.bbc.co.uk/news/world-middle-east-36432635
- http://news.nationalgeographic.com/news/2013/13/130822-ancient-egypt-beads-meteorites-iron-gerzeh/
- http://www.ironfromthesky.org/?p=366
- http://onlinelibrary.wiley.com/doi/10.1111/maps.12120/pdf

Albert Jambon, a French scientist, has been carrying out geochemical analysis on numerous Bronze Age artefacts in order to understand their origin. He looked for traces of nickel and cobalt, both found in much higher quantities in meteorites, using x-ray fluorescence spectroscopy. Jambon came to the conclusion that the iron used for these artefacts most likely had an extra-terrestrial beginning. Amongst the objects studied are a dagger from Alaca Höyük in Turkey (around 2500 BCE), a pendant from Umm el-Marra in Syria (approximately 2300 BCE), an axe from Ugarit in Syria (1400 BCE) and relics from the Shang dynasty civilization in China (1400 BCE). These findings match with the conclusions made last year about Tutankhamun's dagger, in that pre-Iron-age civilizations used meteoritic iron rather than rudimentary smelting techniques.

With Jambon's findings from this year and those about the Egyptian artefacts from last year we can now make assumptions that iron in use before the Iron Age came from meteorites and not from

smelting. We can also see that meteoritic Iron stopped being a resource in places once we were capable of smelting iron from terrestrial ores. However, that does not mean that people stopped using it completely, in remote areas where the knowledge of smelting was unknown and the resources were not readily available, people still used meteorites. This is shown in the case of the Innuits.

Figure 11 Albert Jambon and a meteorite

Figure 12 Iron dagger found in Alaca Höyük, Turkey, dated to around 2500 BCE

Sources:

- http://www.iflscience.com/chemistry/iron-weapons-and-tools-from-the-bronze-age-have-an-extraterrestrial-origin/
- http://www.sciencedirect.com/science/article/pii/S0305440317301322?via%3Dihub#!

Shaping Meteorites

These cultures were shaping nickel-iron meteorites pre-Iron Age and before the widespread knowledge of smelting iron ore. This meant that iron meteorites were their only source of iron, and they had to be shaped through a variety of cold-working methods, where mechanical stress and not heat are used to create permanent changes to the shape.

Analysis of the beads found in Egypt (dating to approximately 3400 BCE) show that they are iron meteorites that were worked into small, thin, sheet and rolled into tube shapes. They would have been flattened by multiple cycles of hammering and rolling, which suggests an advanced understanding of how to work the material.

Professor Thilo Rehren, archaeologist from University College London, says the "*shape of the beads is obtained by smithing and rolling, most likely with multiple cycles of hammering"* which varies from the other beads from the tomb which were made by *"traditional stone working techniques such as carving or drilling*."

In Cape York, the meteorite named 'Woman' was surrounded by thousands of small stone boulders, likely the tools used to 'work' the meteorite. The exact methods used by the Inuit are uncertain - either they broke off small parts of this meteorite to make knives and harpoons by flattening and grinding sharp edges, or they used the larger meteorite as a type of anvil to work smaller fragments of iron from the material they had collected.

Nickel-iron meteorites have a much higher level of nickel (7 – 15%) when compared with modern stainless steel (0.5 – 2%). Nickel is extremely hard to forge (heat and then work) as it resists forming, and this, along with the varying quality and fractured structure of meteorites (from heating passing through the atmosphere) means that meteorites are not suitable for forging.

Meteorites also contain no carbon, and it is carbon which makes a blade hard and allows it to keep a sharp edge. While the rigid nature of nickel and the high nickel content can somewhat make up for this, a knife made from iron meteorite would be more decorative then effective. While the nature of iron to oxidise in water means that it is not the most suitable material for use in a ring that will be worn every day, it would work well for other jewellery like pendants and earrings.

Sources:

- http://www.instructables.com/id/Meteorite-Ring/
- https://www.tf.uni-kiel.de/matwis/amat/iss/kap_a/advanced/aa_2_4.html

Further Reading

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