The Dark Ages : Were They Darker Than We Imagined?

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As we approach the end of the Second Millennium, a review of ancient history is not what you would normally expect to read in the pages of *Universe*. Indeed, except for reflecting on the AD 837 apparition of Halley's Comet (when it should have been as bright as Venus and would have moved through 60 degrees of sky in one day as it passed just 0.03 AU from Earth - three times closer than Hyakutake in 1996), you may well wonder what we could learn from any astronomical events that occurred more than a thousand years ago.

Any history text will say that the Dark Ages refers to the period after the fall of the Roman Empire in the middle of the 1st Millennium (it was not sponsored by the International Dark Sky Association). It was a time when European civilization stagnated - even that term is a generous description of the living standards and social setting of the next few centuries. In a broader sense, however, "Dark Ages" can be applied to a few eras of social upheaval over the last several thousand years, which fits in nicely with what you're about to read - stay with me, as the *possible* astronomical implications will soon become apparent.

Physical Aspects Of The Dark Ages

Let's first look at the onset of "the" Dark Ages in the sixth century AD. The Roman Empire was finished, nothing was happening in the sciences, and worse was happening in nature. The Italian historian Flavius Cassiodorus wrote about conditions that he experienced during the year AD 536 :

> "*The Sun...seems to have lost its wonted light, and appears of a bluish colour. We marvel to see no shadows of our bodies at noon, to feel the mighty vigour of the Sun's heat wasted into feebleness, and the phenomena which accompany an eclipse prolonged through almost a whole year. We have had a summer without heat. The crops have been chilled by north winds, [and] the rain is denied.*"

Other writers of the time described similar conditions :

> Procopius : "*...during this year a most dread portent took place. For the Sun gave forth its light without brightness...and it seemed exceedingly like the Sun in eclipse, for the beams it shed were not clear.*"
>
> Lydus : "*The Sun became dim...for nearly the whole year...so that the fruits were killed at an unseasonable time.*"
>
> Michael the Syrian : "*The Sun became dark and its darkness lasted for eighteen months. Each day it shone for about four hours, and still this light was only a feeble shadow...the fruits did not ripen and the wine tasted like sour grapes.*"

Was this a local phenomenon? According to the book "Volcanoes of the World", Dr. Timothy Bratton has noted that there was a small eruption of the volcano Mt. Vesuvius in AD 536. Could this be the cause? It may well have contributed to the scene (although the eruption was much smaller than the big one of AD 79), but it can not really account for the similar conditions that were experienced around the world.

In China, "*the stars were lost from view for three months*". Records indicate that the light from the Sun dimmed, the expected rains did not eventuate, and snow was seen in the middle of summer. Famine was widespread, and in the midst of the turmoil, the Emperor abandoned the capital.

Bad luck tends to get bunched together, and thus came the plague. The Justinian Plague, named after the Byzantine Emperor of the time, is reported to have begun in central Asia, spread into Egypt, and then made its way through Europe. By some accounts, it was as bad as the Black Death which "plagued" Europe in the Middle Ages.

A Different Branch Of The Picture

Mike Baillie is Professor of Palaeoecology at Queens University, Belfast, Northern Ireland. He is an authority on tree rings and their use in dating ancient events (every year, a tree adds a "ring" to its trunk as it grows - good years are represented by thick rings while bad years are represented by thin rings). He conducted a complete

(and continuous) review of annual global tree growth patterns over the last 5,000 years and found that there were five major environmental shocks that were witnessed worldwide. These shocks were reflected in the ring widths being very thin. Wanting to know more, he turned to human historical records, and found that the years in question (between 2354 and 2345 BC, 1628 and 1623 BC, 1159 and 1141 BC, 208 and 204 BC, and AD 536 and 545) all corresponded with "dark ages" in civilisation.

The minimal growth of trees around 2350 BC has been associated in the past with the eruption of a volcano in Iceland. Yet, the period in question is also associated with floods, the creation of new lakes, and even the start of Chinese history. Furthermore, Marie-Agnes Courty, an archaeologist from France, has claimed new data regarding a catastrophe said to have occurred in the Middle East. Samples from three separate regions all appear to contain a calcite material found only in meteorites, and analysis of debris show what seems to be a combination of "*a burnt surface horizon and air blast.*"

Indeed, some 40 cities throughout North Africa, the Middle East, Europe, and Asia are thought to have been devastated, or even disappeared, about the same time in a series of catastrophes.

The twelfth century BC is associated with the "Greek Dark Ages", the end of the Hittite civilisation in the Near East, the end of Bronze Age Israel, and the end of the Bronze Age Shang dynasty in China. Ancient Chinese history has the notion of "mandate from heaven", where the rulers were essentially subject to the whims of the sky above. Strange sights in the sky would not be seen as good news for Chinese Emperors. Indeed, around this time, Chinese records speak of :

> "*...many gods and spirits were annihilated in this battle, and several stellar dignitaries were replaced by newcomers to the celestial domains.*"

What could cause such global shocks? A likely answer, which has a good fit to the evidence, was what the European and Chinese observers described at the time as "dragons in the sky" - comets! We're not talking about an intact large comet (if that had hit in the last several millennia, we would not be here today), but rather fragments from a disintegrating comet or asteroid (small pieces like that which hit Tunguska in 1908). These would throw up dust that would envelope the world and dim our view of the Sun and skies.

All this sounds like an interesting theory, but is there any evidence "above us" that fits in with the scenario. How do we account for so many impacts over the last several millennia when the consensus today in astronomy is that impacts causing global consequences (mild as well as major) are very rare?

Enter The Astronomers

Independently of Baillie's studies, British astronomers were putting together an explanation of the Taurid meteors that we see. The Taurids are related to comet Encke, as first shown by Fred Whipple, best known for proposing the "dirty snowball" model of comets. Mark Bailey, Victor Clube (brother of my rugby coach at school!), and Bill Napier put forward the theory that Encke and the Taurid meteors originated from a giant comet that fragmented some 40,000 years ago after entering the inner Solar System. The idea of a comet splitting up into smaller pieces is nothing new (witness Shoemaker-Levy 9 in 1994 and the return this year of the fragmented periodic comet Machholz 2), and indeed Dr. Brian Marsden of the Smithsonian Astrophysical Observatory is the originator of the idea that the bulk of sungrazing comets we see come from a large comet that perhaps originally split a few centuries before Christ, and has split again - this family of comets is known as the Kreutz sungrazers.

The astronomers noted that Chinese records of meteor observations over the last two thousand years revealed significant surges in the number of meteors observed every few centuries. These tended to be observed at the same time every year - we now know of them as the Taurids, which has a nighttime display in October/November (the Taurids South and Taurids North - see the end of the article), and a daytime appearance in June (Beta Taurids). Both meteor showers are linked. The Taurids South and Taurids North are what Earth encounters as the Taurid meteor stream heads towards perihelion, whilst the Beta Taurids are encountered as the meteor stream heads away from perihelion.

Unlike the most prominent annual meteor showers, the Taurids are not known for being spectacular because the stream is too broad. Whatever caused the Taurids must have been huge, as it was suggested many years ago as the primary source for dust in the inner Solar System. It is argued that comet Encke itself is a fragment of this larger, inactive comet.

Such a scenario implies that there are other objects in the Taurid stream, much larger than dust, that are unobserved because they are inactive. Is there any evidence for large objects in the Taurids hitting Earth in recent history? Consider the following :

- In late June, 1178, an English monk reported the observation by five men of what is believed to have been

an impact on the Moon. The American astronomer-geologist Jack Hartung has argued that this reported impact created the Giordano Bruno crater, known to be one of the youngest craters on the Moon. The timing of this event, late June, is consistent with the Beta Taurids.

- In his book "Rogue Asteroids and Doomsday Comets", former AAO astronomer Duncan Steel describes the fall of a meteorite on 25th June, 1890 near Farmington, Kansas. Besides its obvious timing with the Beta Taurids, the meteorite is most notable for being the youngest meteorite known (in terms of exposure to space). Dating of the meteorite has revealed it was separated from its parent less than 25,000 years ago (a factor of ten younger than the next youngest meteorite).
- Tunguska : On 30th June, 1908, a fragment believed to be less than 100m in diameter exploded over the Tunguska river in Siberia. It is the most well-known impact we know of in modern times. It is generally believed that the timing of the impact is consistent with it originating from the Beta Taurids.
- When the astronauts went to the Moon, they placed seismometers on the Moon's surface. At the end of June, 1975, they registered their major series of lunar impacts. The impacts were detected only when the nearside of the Moon (where the astronauts landed) was facing the Beta Taurid radiant. At the same time, there was a lot of activity detected in Earth's ionosphere, which has been linked with meteor activity.

Obviously, given the presence of comet Encke, and the additional fact of various known Apollo-class asteroids which are observed to have orbits that resemble those of the Taurids, there is more in the Taurid meteor stream than just dust. According to Duncan Steel, some of the discovered Apollo-class asteroids that are in the Taurid meteor stream have diameters in excess of one kilometre. How many other Tunguska-type bodies are in it? Are they isolated, or do they exist in swarms?

Meteor streams orbit the Sun, like the planets, but their orbits tend to be perturbed by the planets. The astronomers calculated how the orbit of the Taurids has changed over the centuries.

In "*Lessons from Jupiter*" (*Southern Sky* magazine, January/February 1995), Clube and David Asher wrote :

> "*Calculations based on an orbit related to that of P/Encke reveal intersections with the Earth's orbit around AD 600 and before that AD 400, so that a swarm would have been near the Earth's orbit for a duration of a few centuries around that epoch, the time of the European Dark Age. This then is a critical extended period when we might well expect several multi megaton [explosive] events, indeed a great many if we consider the globe as a whole. The perspective is evidently one in which we expect the Roman Empire to have gone into decline owing to multiple-Tunguska bombardment causing great tracts of land to be deserted and whole communities or nations to be suddenly dislocated. Of necessity, the period becomes one of barbaric movements.*"

Chinese historical records of AD 540 say :

> "*Dragons fought in the pond of the K'uh o. They went westward....In the places they passed, all the trees were broken.* "

The calculations for the Taurids suggest that we pass through the core of the meteor stream approximately every 2,500 years - today, we are passing through the outer edges. The last two occasions when we passed through the core were in 2200 - 2000 BC and in AD 400 - 600. The epoch around AD 3000 looks like being a fun time too - the Y2K doomsayers can always say they just got the millennium wrong.

In 1983, the orbiting IRAS infra-red satellite discovered cometary "trails" (not tails), representing debris along the path of various short-period comets. These trails consist of debris, most of which would be microscopic in size, but how many large objects are there in the trails? If there are many large objects in these trails, then Duncan Steel notes in his above-mentioned book :

> *"A large fraction of the objects on Earth-crossing orbits, of all dimensions, are the daughter products from the break-up of a giant comet some time during the past 100,000 years, dynamical studies suggesting around 20,000 years as likely. All that is suggested here is a break-up similar to that undergone by P/Shoemaker-Levy 9 in 1992, except by a comet at least 100 kilometres across and in an orbit crossing from Jupiter to the Earth.*
>
> *The core of the complex...evolves to have a node near 1 AU every millennium or so, at which time the Earth is bombarded by many [large] objects in episodes at certain times of year. It is these events that dominate the hazard to humankind. Such an episode [illegible] a century or two."*

Concluding Thoughts

Ben Rudder, an anthropologist who reviewed in New Scientist magazine a recently published book by Baillie on the subject, wrote :

> "*If Baillie is right, history has overlooked probably the single most important explanation for the intermittent progress of civilisation. Worse, our modern confidence in benign skies is foolhardy, and our failure to appreciate the constant danger of comet "swarms" is the result of a myopic trust in a mere 200 years of "scientific" records.*"

Baillie himself notes that :

> "*There is, I feel, a strong case for the contention that we do not inhabit a benign planet. This planet is bombarded relatively often. If this story is correct, we have been bombarded at least three times - and probably five times - since the birth of civilisation some 5,000 years ago. And each time, the world was changed.*"

In their book "*The Origin Of Comets*", Bailey, Clube, and Napier write :

> "*the destruction and chaos accompanying the fate of the Roman empire [midway through the First Millennium] was all but total, the almost complete breakdown of the old order leading to a loss of the accumulated knowledge and wisdom of antiquity which was far from temporary.*"

Some of these ideas you may have heard of before. In the 1950s, Immanuel Velikovsky published a number of books, in particular "*Worlds In Collision*", which suggested that a huge comet had come near to Earth, and had indeed settled into an orbit around the Sun between Mercury and Earth. Velikovsky was claiming that Venus was a large comet!

Naturally, his ideas were rubbished. They had no scientific foundation. The problem today, as Duncan Steel notes, is that astronomers have become so entrenched in their rightful criticism of Velikovsky's nonsense, they are rejecting today's scientifically-founded discoveries that the myths and records of ancient civilisations may contain important information about what was happening in the sky.

Only now are we seriously contemplating the view that "near-Earth space" is anything but safe. Is it possible that the ancients were not entirely ignorant in their beliefs of the appearance of comets being a bad omen? Fragments hitting the ground would cause earthquakes and blast damage, as well as start forest fires (fire storms?) and perhaps volcanoes - which in turn would amplify the environmental effects through the release of soot into the air. Fragments hitting the water would generate tsunamis which would flood coastal and inland regions. Would it surprise you to learn that, according to Baillie, the ancient Celtics had an oath which translates as :

> "*We will not move from this place until the stars fall from the sky, the earth quakes and the sea comes over the land.*"

In "*Lessons from Jupiter*", Clube and Asher wrote :

> "*We do not of course deny a general background of [Earth-crossing asteroids] from the asteroid belt but it is these meteoroidal streams, harbouring swarms of super-Tunguska debris, which are now perceived as the source of high-level dust veils and low-level airbursts in the atmosphere, essentially controlling climate and extinction on Earth and punctuating the course of evolution.*"

If our eyes weren't opened to the danger of fragmenting bodies after we saw Shoemaker-Levy 9, they should be now. Observatories are conducting surveys of the sky to discover and track near-Earth asteroids. The consensus of the astronomical community, however, still remains that the threat to Earth comes from random asteroids and comets. The idea of the inner Solar System being different now to from what it was 50,000 years ago has not been widely accepted. Nevertheless, more astronomers are open to the dangers associated with an object (currently known or to be discovered) that fragments in the future. Dealing with any incoming fragments, however, still remains a problem. You might think that "planetary defence" is a recent idea. Yet, readers of the poetry of Lord Byron might be interested to know that in 1822, when he was living in Pisa, he wrote :

> "*Who knows whether, when a comet shall approach this globe to destroy it, as it often has been and will be destroyed, men will not tear rocks from their foundations by means of steam, and hurl mountains, as the giants are said to have done, against the flaming mass? And then we shall have traditions of Titans again, and of wars with Heaven.*"

An Observing Postscript

Although Comet Encke is only visible every 3.3 years (it returns next year), we can observe the Taurid meteor stream every year. As mentioned above, they have a broad display rather than a well-defined peak. Although their activity spans the period 1st October to 25th November, there are two separate maxima. The Taurids South maximmum lasts for about a week around 5th November, while the Taurids North maximum similarly

lasts for about a week around 12th November - the two virtually overlap each other to produce a plateau.

The rates aren't high (at best, about 5 per hour) but they are easily seen, slow moving, and they have a reputation for producing very bright fireballs - a fact that has apparently been observed for thousands of years! The Taurids are visible during this period from late evening onwards, and with New Moon occurring on Monday 8th November, there will be no moonlight interference - the shower is well timed for the Society's monthly star party at Wiruna. Regardless of whether you're at Wiruna or elsewhere, if the weather is good, why not step outside and keep an eye on the sky - it will only be a week or two before the Leonids.

One thing is for certain : debris from the Solar System does hit Earth. If it didn't, we wouldn't see meteors every night! The astronomical community (in particular, those who specialise in comets and/or asteroids) is not yet convinced as a whole about the notion of the inner Solar System currently suffering from periodic bombardment from the remains of a fragmented giant comet. Nevertheless, David Morrison, principal author of NASA's Spaceguard Survey Reports in 1992 and 1995, and a critic of the British viewpoint, does admit that :

> "*While I believe that the British neo-catastrophists are wrong about the threat to Earth, their work is science, not pseudoscience. They are making their case to other scientists, and time will sort out who is right and who is wrong.*"

Regardless of whether the specific theories referred to in this article turn out to be correct, observing comet debris hitting Earth's atmosphere now seems to take on a whole new perspective in our "enlightened ages".
