

The poet and the almanac

A FEATURE OF THE NIGHT SKY REFERRED TO IN AN ANCIENT POEM MAY HELP FIX THE DATE IT WAS WRITTEN, SAYS ANANTHANARAYANAN

Mention of well known astronomical phenomena in ancient records has helped fix the date of the records or, alternately, the date of the event. Even records of the going and coming of ships at ports and the cargo handled has helped determine the dates of harvests or even periods of droughts or floods, which, in turn, has helped fix the date of other happenings in ancient times. The record of eclipses in ancient lore has similarly helped date event associated with the eclipse. An eclipse being seen at a place different from what was expected has even helped detect changes in the speed of rotation of the earth and, hence, possible variations in sea levels!

Manfred Cuntz and Levent Gurdemir from the University of Texas at Arlington and Martin George from the National Astronomical Research Institute of Thailand, Chiang Ma, and University of Southern Queensland, Australia, describe in the *Journal of Astronomical History and Heritage* their work of fixing the time of year of a celebrated poem by Sappho, a Greek woman lyric poet, with the help of information about setting of a star formation in the night sky, which the poet used as an image of the abandonment she felt.

Sappho was from the city of Lesbos, a Greek island in the Aegean Sea, and was among the greatest of lyric poets of antiquity. She is believed, based on various writings and also some of her own, to have lived in the seventh and sixth centuries BCE (630-570 BCE). Most of her work, which was collected into nine volumes by the Library of Alexandria (third century to 30 BCE), has, however, been lost and only scraps remain.

But what remains is still a major corpus and has been widely acclaimed. "... The skill with which she placed her vowels and consonants... is evidenced by almost any stanza; the music to which she sang them has gone, but the spoken sounds may still enchant," says noted translator and editor David A Campbell. "Her images are sharp — the sparrows that draw Aphrodite's chariot, the full moon in a starry sky, the solitary red apple at the treetop..." Campbell goes on to say.

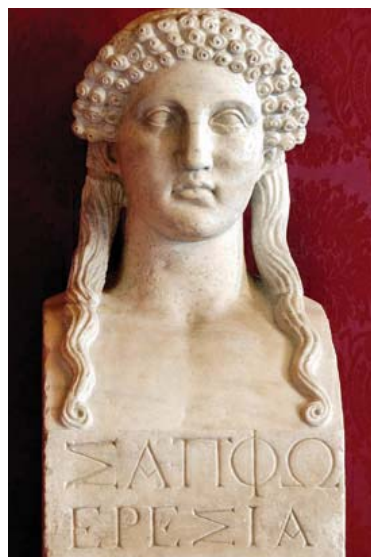
Her use of symbols of the moon and the stars, the sun and planets is seen in many places in her work and the example that the authors of the paper in the *Journal of Astronomical History and Heritage* took up, is a poem, fragment No 52, known as the *Midnight Poem*, which goes:

*The Moon hath left the sky:
Lost is the Pleiades' light;
It is midnight
And time slips by;
But on my couch I lie.
(Symonds, 1873-1876.)*

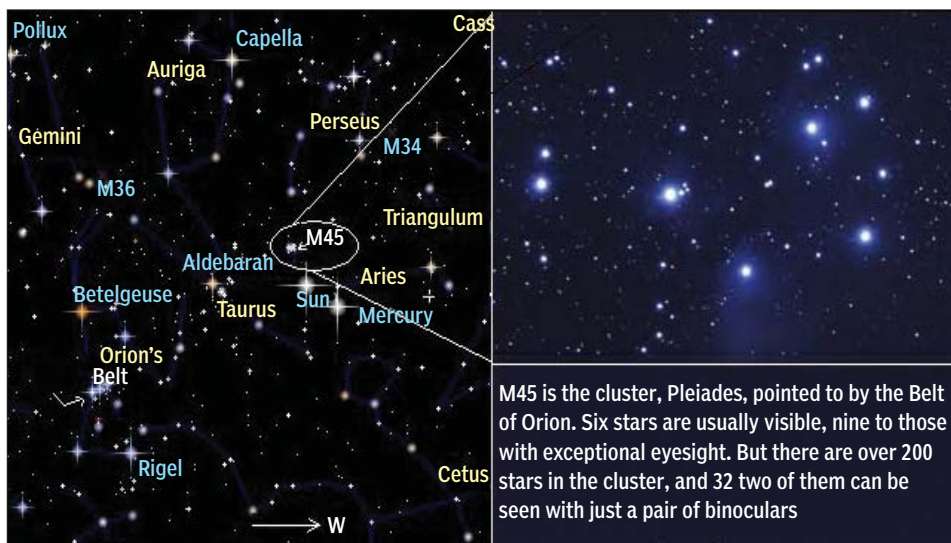
The verse makes three observations of the sky and then of her own isolation as time goes by. The physical image is that while it is midnight, the moon has set and so has Pleiades, an important cluster of stars that is visible in the Northern hemisphere. From the fact that Pleiades has set just at midnight, we can work out the time of the year the lines may have been written.

Pleiades

Also known as *Seven Sisters* and denoted as *Messier 45* or *M 45*, Pleiades is a bright formation of six main stars that can be seen for most of the night during the winter months. The position of the group in the sky is in the constellation Taurus, and towards Pisces (it is most easily located in the sky by first tracing the three bright stars that form the "belt of Orion" and then



Sappho Erisia or Sappho of Eresos.



M45 is the cluster, Pleiades, pointed to by the Belt of Orion. Six stars are usually visible, nine to those with exceptional eyesight. But there are over 200 stars in the cluster, and 32 two of them can be seen with just a pair of binoculars

following the stars to the west about eight times the length of the belt). The position within Taurus places the cluster in line with the sun and hence not visible during April-May and at the zenith at midnight in October-November.

The bright grouping of stars has been observed and named by most ancient cultures of the world. These include the Celts, M'oris, Aboriginal Australians, the Persians, the Arabs, the Chinese, the Japanese, the Mayans, the Aztecs and the American Indians, the Sioux and Cherokee. In Hinduism, the Pleiades are known as Krittika, a reference to six sisters who raised Kartikeya, the son of Shiva. There are also references to the Pleiades in records from Babylonia, over 20 centuries BCE, and even in a 3,600-year-old bronze disk of the Unetice culture, discovered in Germany.

The Pleiades cluster is also of interest in formal astronomy and astrophysics as being a cluster, and not merely stars along nearly the same line of sight. It had been worked out in 1767 that the probability of a chance alignment of so many bright stars was only one in 500,000, which strongly suggests that the Pleiades must be physically related. This has since been confirmed, by comparison of the apparent motion of the stars with reference to the Solar System, that they were moving together.

The group of stars is now known to be a relatively young formation of hot blue and very luminous stars in the early stages of development. The Pleiades are also among the nearest cluster to earth, which makes them so clearly visible to the naked eye. This feature has also made it possible to estimate their distance from earth. As there is a relationship between the real brightness of a star and its colour, which indicates its temperature, knowing the distance of the Pleiades helps estimate the distances of other stars of which we know only the colour and the brightness as apparent here on earth.

Exact date

The aim of the study by the Texas and Thailand trio, they say in their paper, was to take a fresh look at the seasonal dating of Sappho's *Midnight Poem*. Earlier estimates were based on

considerations like "it is in early spring that poets' thought turn towards love", or the study by Herschberg and Mebius in 1990, largely based on descriptive arguments. The effect of precession of the equinoxes, or the cyclic change in the orientation of the axis of the earth, or reference to the plane of its orbit around the sun, was also taken into account by them, but they did not employ modern astronomical software to accurately estimate the local time of the sighting.

The present study is based on working out the exact date on which the Pleiades formation would have set, taking the year 570 BCE as reference. The researchers used the software package *Starrynight*, which produces sky maps of any year of choice, like the sky over Bethlehem on the first Christmas or of asteroid near-hits predicted even centuries from now. And along with this they also used the night sky snapshots for 570 BCE using the *Digistar 5* software, which works out the night sky for projection on the dome of the planetarium.

The result of the work was that the earliest date the Pleiades could have set at midnight in 570 BCE was 25 January. On earlier dates, the Pleiades would have set after midnight. As we are not sure of the timekeeping device that Sappho may have used to know when it was midnight, the researchers also checked out till what date the Pleiades would have been visible at all, after dusk, at night. This date was found to be 6 April. The conclusion is hence only that the time the poem refers to is between midwinter and early spring, a result which is in keeping with earlier estimates, including that of Herschberg and Mebius. That the astronomical record by Sappho in the course of a poetic sally should be confirmed as scientifically accurate is to build a bridge between ancient literary and scientific creativity. "Sappho should be considered an informal contributor to early Greek astronomy as well as to Greek society at large," Manfred Cuntz says.

"Not many ancient poets comment on astronomical observations as clearly as she does."

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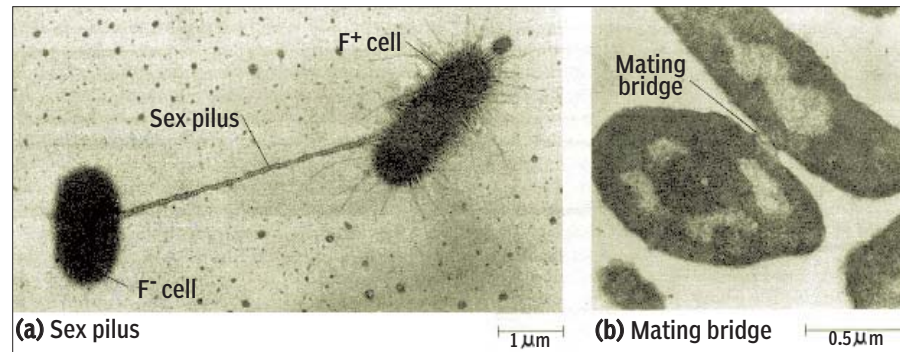


Manfred Cuntz, Levent Gurdemir and Martin George.

DONORS & RECIPIENTS

CONJUGATION IS A MODIFIED SEXUAL ACTIVITY THAT FACILITATES GENETIC RECOMBINATION IN BACTERIA, WRITES TAPAN KUMAR MAITRA

In addition to transformation and transduction, some bacteria also transfer DNA from one cell to another by conjugation. As the name suggests, conjugation resembles a mating process in which one bacterium is clearly identifiable as the donor (often called a "male") and another as the recipient ("female"). Although conjugation resembles a sexual process, the mode of DNA transfer is not an inherent part of the bacterial life cycle and usually involves only a portion of the genome; therefore, it does not qualify as true sexual reproduction. Its existence was postulated in 1946 by Joshua Lederberg



The cellular apparatus for bacterial conjugation: The donor bacterial cell (a) on the right, an F+ cell, has numerous slender appendages, called pili, on its surface. Some of these pili are sex pili, including the very long pilus leading to the other cell, an F- cell. Made of protein encoded by a gene on the F factor, sex pili enable a donor cell to attach to a recipient cell; subsequently, a cytoplasmic mating bridge (b) forms, through which DNA is passed from the donor cell to the recipient cell (TEMs).

and Edward L Tatum who were the first to show that genetic recombination occurs in bacteria.

The presence of a DNA sequence called the F factor (F stands for fertility) enables an E coli cell to act as a donor during conjugation. The F factor can take the form of either an independent, replicating plasmid or a segment of DNA within the bacterial chromosome. Donor bacteria containing the F factor in its plasmid form are designated F⁺, whereas recipient cells, which usually lack the same completely, are designated F⁻. Donor cells develop long, hair-like projections called sex pili (singular, pilus) that emerge from the cell surface. The end of each sex pilus contains molecules that selectively bind to the surface of recipient cells, thereby leading to the formation of a transient cytoplasmic mating bridge through which DNA is transferred.

When a donor cell contains an F factor in its plasmid form, a copy of the plasmid is quickly transferred to the recipient cell during conjugation, converting it from F⁻ to F⁺. Transfer always begins at a point on the plasmid called its *origin of transfer*, represented in the figure by an arrowhead. During transfer of an F factor, the donor cell does not lose its F⁺ status because the F factor is replicated in close association with the transfer process, allowing a copy of the F plasmid to remain behind in the donor cell. As a result, mixing an F⁺ population of bacte-

ria with F⁻ cells will eventually lead to a population of cells that is entirely F⁺.

Thus far, one has seen that donor and recipient cells are defined by the presence or absence of the F factor. But how do recombinant bacteria arise by those means? The answer is that the F factor, usually present as a plasmid, can sometimes become integrated into the bacterial chromosome. Chromosomal integration of the F factor converts an F⁺ donor cell into an Hfr cell, which is capable of producing a high frequency of recombination in further mating because it can now transfer genomic

DNA during conjugation. When an Hfr bacterium is mated to an F⁻ recipient, DNA is transferred into the recipient cell but instead of transferring just the F factor itself, the Hfr cell transfers at least part (and occasionally all) of its chromosomal DNA, retaining a copy, as in F⁺ DNA transfer. Transfer begins at the origin of transfer within the integrated F factor and proceeds in a direction dictated by the orientation of the F factor within

the chromosome. Once a portion of the Hfr chromosome has been introduced into a recipient cell by conjugation, it can re-combine with regions of the recipient cell's chromosomal DNA that are homologous (similar) in sequence. The recombinant bacterial chromosomes generated by this process contain some genetic information derived from the donor cell and some from the recipient. Only donor DNA sequences that are successfully integrated by this recombination mechanism survive in the recipient cell and its progeny.

The correlation between the position of a gene within the bacterial chromosome and its likelihood of transfer can be used to map genes with respect to the origin of transfer and therefore with respect to one another. Moreover, since the daughter cells of the recipient bacterium are recombinants, they can be used for genetic analysis. Typically, a cross is made between Hfr and F⁻ strains that differ in two or more genetic properties. After conjugation has taken place, the cells are plated on a nutrient medium on which recombinants can grow but "parent" strains cannot, thereby allowing the recombinants to be detected and their frequencies, calculated.

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A different chronicle

WILL WORLEY REPORTS ON A FLORIDA SINKHOLE DISCOVERY THAT SUGGESTS HUMANS LIVED IN AMERICA 1,500 YEARS EARLIER THAN PREVIOUSLY THOUGHT

Archaeologists investigating a Florida sinkhole have unearthed evidence suggesting humans lived in the Americas around 14,500 years ago. On the Aucilla river, near Tallahassee, the eight-metre deep Page-Ladson sinkhole was found to contain a stone knife and animal bones that had apparently been marked by humans.

The finds add further weight to arguments against the theory that the Americas were first populated by the "Clovis" people 13,000 years ago, which has been the mainstream archaeological consensus for many years.

The team, led by Dr Jessi Halligan, an anthropology professor of Florida State University, found a "biface" — a rudimentary knife-like object made from stone with a blade chipped into one side. "There is absolutely no way it is not made by people," Dr Halligan told the *Smithsonian Magazine*. "There is no way that's a natural artefact in any shape or form."

Bones of a mastodon — a mammoth-like creature that became extinct more than 10,000 years ago — were also found at the site, which was believed to have been a watering hole in the period the artefacts date from. The bones were engraved with groove-like marks that the team said were made by people, perhaps while dismembering a carcass for meat.

The site would have been an ideal hunting ground, according to the researchers, and attracted other creatures, too — canine bones were also discovered, though it is unknown if the animals were companions to the humans or just scavengers. The findings, published in the journal *Science Advances*, present "unequivocal" evidence of a pre-Clovis population in the Americas, according to senior researcher Dr Michael Waters of Texas A&M University. "We have clear artefacts, they were excavated meticulously, and they were in place," Dr Waters told *National Geographic*. "They were in a solid geological context, covered by four metres of sediment, and a shell layer that sealed the complete deposit, and itself dated to 14,400 years ago. We have 71 radiocarbon dates throughout the entire sequence. If people don't believe this site, they're not going to believe anything."

Dr Michael Faught, an underwater archaeologist and reviewer of the team's report, said the findings were "unassailable".

Until recently, it was considered extremely controversial to dispute the Clovis theory — that the Americas were first populated by Paleo-Indians around 13,000 years ago. Clovis is the name of a town in New Mexico where early stone tools were found in the early 20th century.

"Fifteen years ago, if you proposed a pre-Clovis site, you had to expect that everybody thought you were a quack," Dr Halligan said. "Ten years ago, some people would have been supportive and most people would have thought you were a quack." She added that the findings were a "big deal" because "it means we were wrong about Clovis being first and we need to start figuring out what the real story is".

The Clovis narrative held that the first people to populate the Americas entered the continent from Alaska. However, this theory now seems less viable, as ice sheets that covered the north of the American continent are only believed to have melted into an "ice-free" corridor around 14,000 years ago, 500 years after the estimated date of the new discoveries.



Neil Puckett, a PhD student from Texas A&M University involved in the excavations, surfaces with the limb bone of a juvenile mastodon at the sinkhole.

THE INDEPENDENT

PLUS POINTS

Better viewing

According to a recent IANS report, social media giant Facebook will turn panoramas on users' phones into "360 Photos" both on News Feed and the Oculus-powered Samsung Gear VR for a better viewing experience. The company also released Gear VR usage figures for the first time, announcing that it has one million monthly users who spend nearly 25 minutes a day on the device.

Facebook's "360 Photos" feature would let users upload flat panoramas taken on iPhones, Google Photo Spheres or photos from 360 cameras. "Facebook will then morph them into 360 Photos for News Feed where users will be able to hold and drag to pan around the photos, or move their heads to look around them on the Gear VR," techcrunch.com reported.

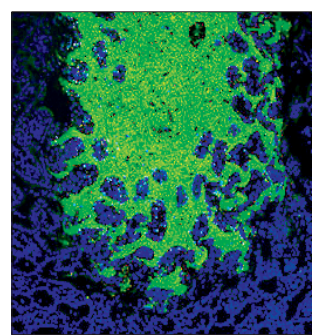


People can click these photos with no special equipment but an iPhone running iOS 6 or later, an Android 4.2 or one of several 360 photo apps available for download. The company said that more than one million people used the Gear VR last month and developers had built more than 250 apps for it.

Microbiome Initiative

Last Friday the White House announced the launch of a National Microbiome Initiative to support research on the micro-organisms that live in or on the human body, plants and other ecosystems to provide a better understanding of their role in human and environmental health. The project's goals are to support fundamental research, develop new technologies, and engage more people in this field, according to the Office of Science and Technology Policy.

"This is a great day of celebration for everybody in this field," J Craig Venter,



founder and CEO of the J Craig Venter Institute, said during a press briefing held at the White House. Heeding a call from scientists

last year for a moonshot effort akin to the Brain Initiative, the federal government plans to invest \$121 million in the new microbiome initiative for fiscal 2016 and 2017. This amount includes \$20 million from the National Institutes of Health, \$16 million from the National Science Foundation, \$12.5 million from the National Aeronautics and Space Administration, \$10 million from the Department of Energy and a total of \$23.9 million from the Department of Agriculture, according to the statement.

In response to a call to action issued by the White House in January, dozens of other non-profits, companies and research institutions are investing an additional \$400 million in support of the new initiative.

THE SCIENTIST

Still counting...

New data collected during the Kepler Space Telescope's prime planet-hunting mission shows that 1,284 candidates are confirmed exoplanets, boosting the current tally of worlds beyond the solar system to 3,264. A team of astronomers led by Princeton University's Tim Morton has developed a new type of statistical analysis that can assess many candidates simultaneously. "Imagine planet candidates as bread crumbs. Our broom here is a new analysis technique that enables us to quantify the probability that any given signal is in fact caused by planet, without requiring any follow-up observations," he said.

Kepler spent more than four years staring at the light coming from about 150,000 target stars. Scientists then combed the data, searching for slight changes in the amount of light that may be caused by orbiting planets passing by,



relatively to the telescope's line of sight. Nine of the newly classified planets are believed to be rocky worlds orbiting their parent stars at the right distances for liquid surface water, a condition that scientists believe bolsters the chance for life.

The analysis technique showed that an additional 1,327 candidates are more likely than not to be actual planets, but they did not meet the 99 percent threshold and will require additional study, Nasa said.

DISCOVERY NEWS