

OCCURRENCE OF THE CONICS

Mathematicians have a habit of studying, just for the fun of it, things that seem utterly useless; then centuries later their studies turn out to have enormous scientific value.

There is no better example of this than the work done by the ancient Greeks on the curves known as the conics: the circle, the ellipse, the parabola, and the hyperbola.

They were first studied by one of Plato's pupils.

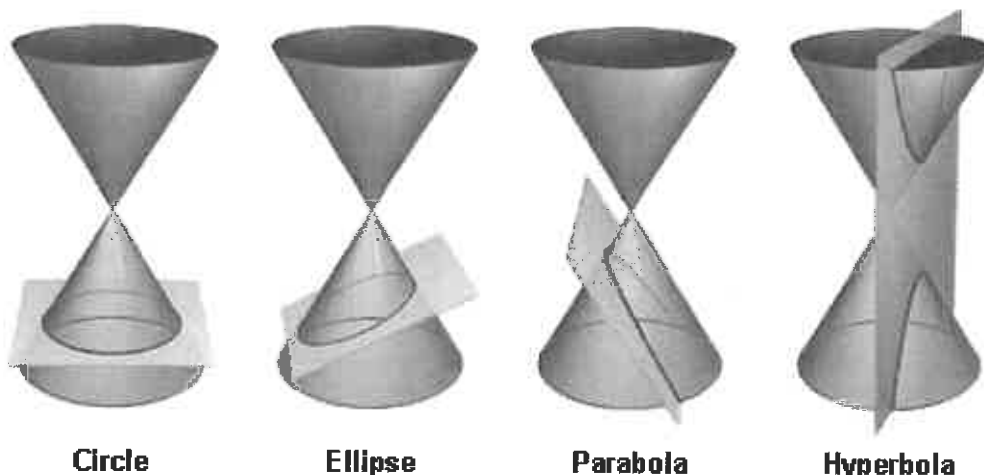
No important scientific applications were found for them until the 17th century, when

Kepler discovered that planets move in ellipses

and

Galileo proved that projectiles travel in parabolas .

"Conics" could be obtained by slicing the same right circular cone at varying angles.



Circle

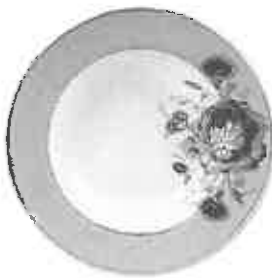
Ellipse

Parabola

Hyperbola

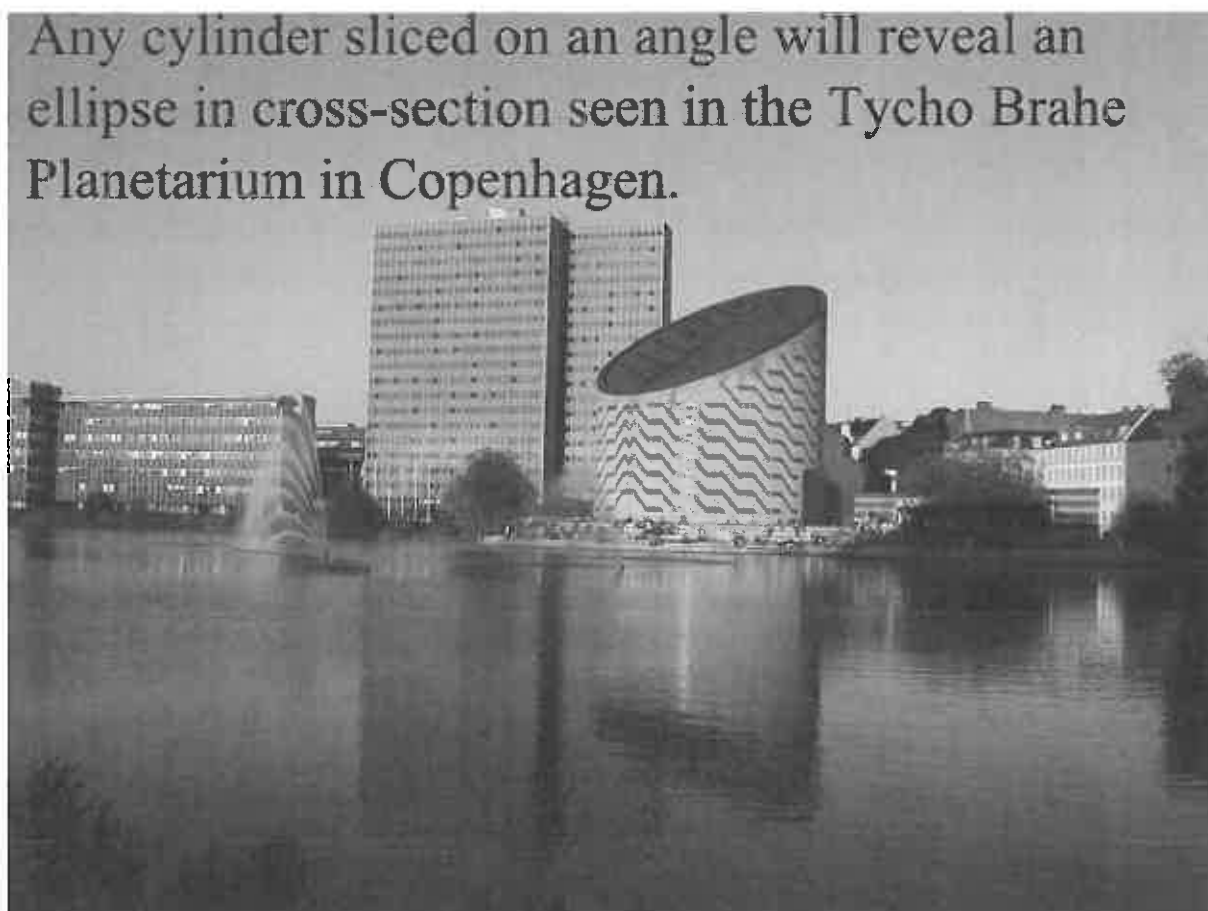
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CIRCLE

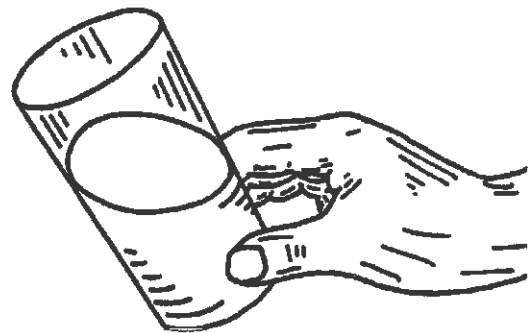


ELLIPSE

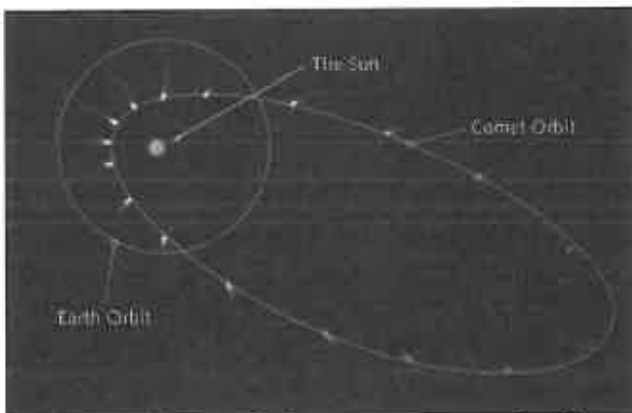
Any cylinder sliced on an angle will reveal an ellipse in cross-section seen in the Tycho Brahe Planetarium in Copenhagen.



Tilt a glass of water and the surface of the liquid acquires an elliptical outline. Salami is often cut obliquely to obtain elliptical slices which are larger.



The early Greek astronomers thought that the planets moved in circular orbits about an unmoving earth, since the circle is the simplest mathematical curve.

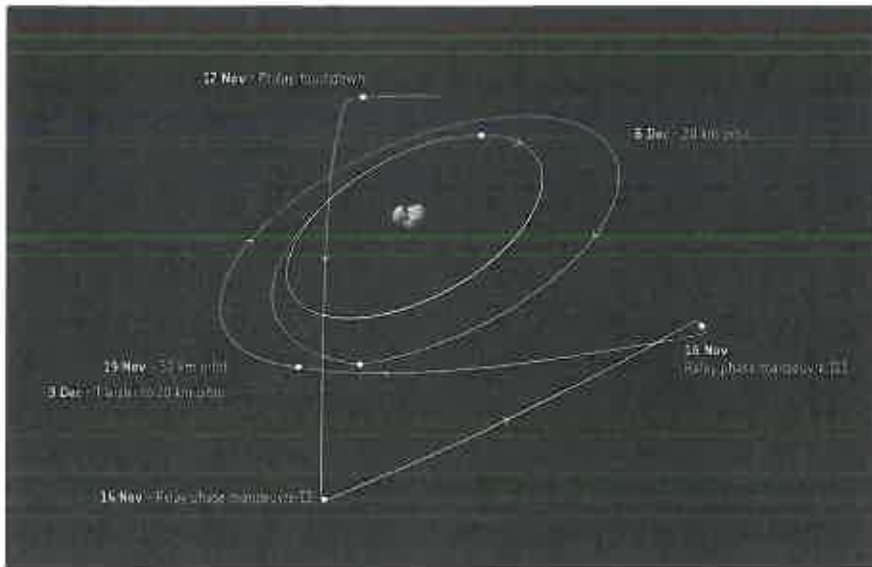


In the 17th century, Johannes Kepler eventually discovered that each planet travels around the sun in an elliptical orbit with the sun at one of its foci.

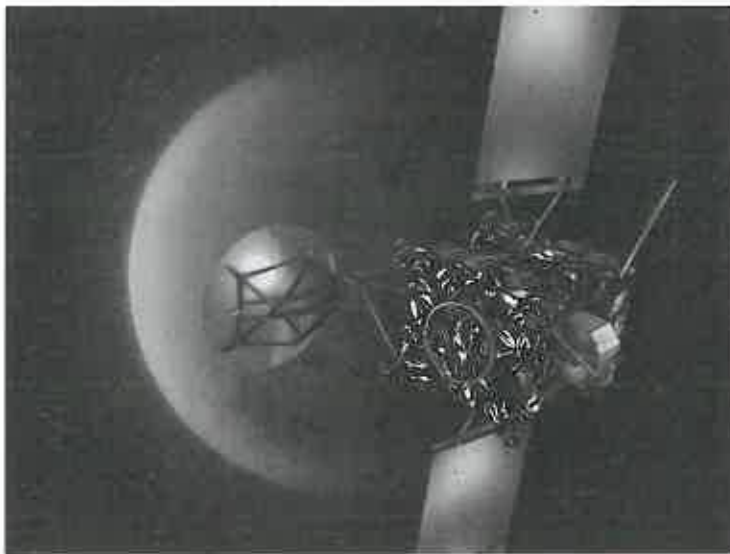
The orbits of the moon and of artificial satellites of the earth are also elliptical as are the paths of comets in permanent orbit around the sun.

Halley's Comet takes about 76 years to travel around our sun. Edmund Halley saw the comet in 1682 and correctly predicted its return in 1759. Although he did not live long enough to see his prediction come true, the comet is named in his honour.

Rosetta path after 12 November

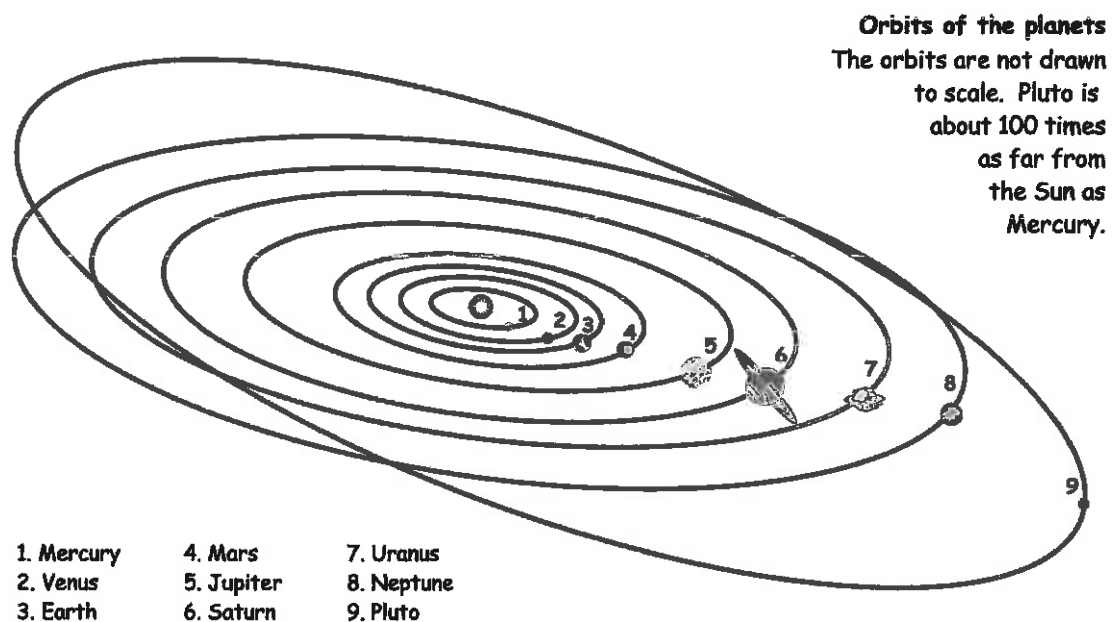


Rosetta swings by Mars

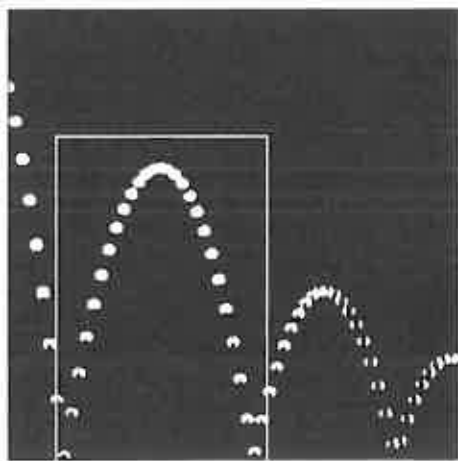


[http://blogs.esa.int/rosetta/2014/12/02/the-quest-for-organic-molecules-on-the-surface-of-67p-](http://blogs.esa.int/rosetta/2014/12/02/the-quest-for-organic-molecules-on-the-surface-of-67p/)

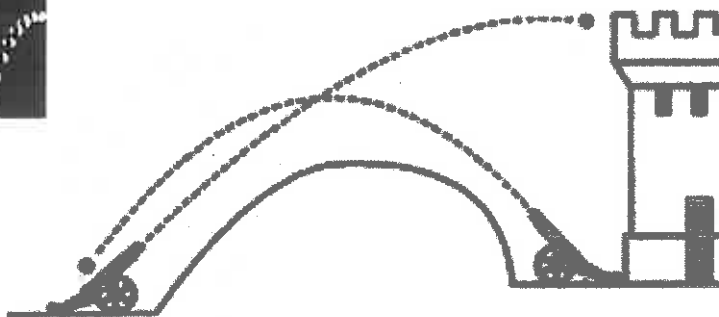




PARABOLA

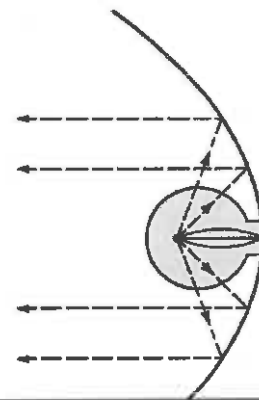
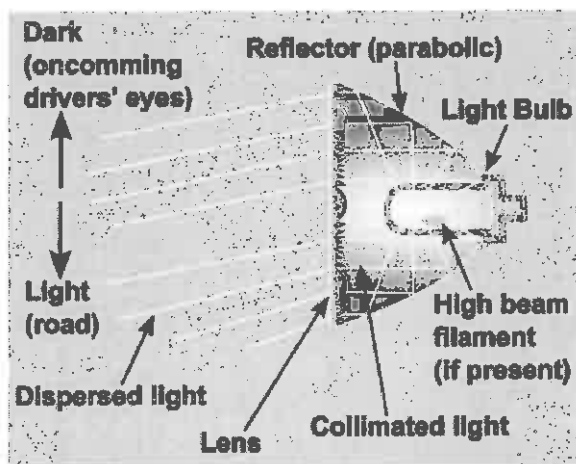


One of nature's best known approximations to parabolas is the path taken by a body projected upward and affected by the pull of gravity, as in the parabolic trajectory.

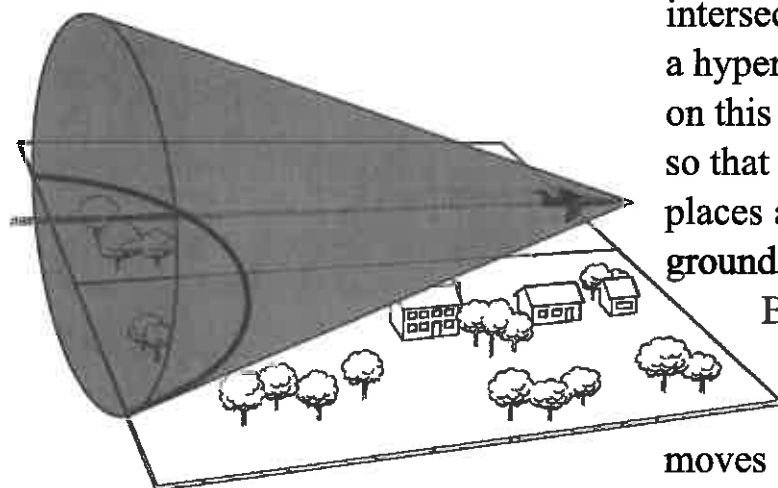




Parabolas exhibit unusual and useful reflective properties. If a light is placed at the focus of a parabolic mirror, the light will be reflected in rays parallel to said axis. In this way a straight beam of light is formed. It is for this reason that parabolic surfaces are used for headlamp reflectors.



HYPERBOLA



A sonic boom shock wave has the shape of a cone, and it intersects the ground in part of a hyperbola. It hits every point on this curve at the same time, so that people in different places along the curve on the ground hear it at the same time.

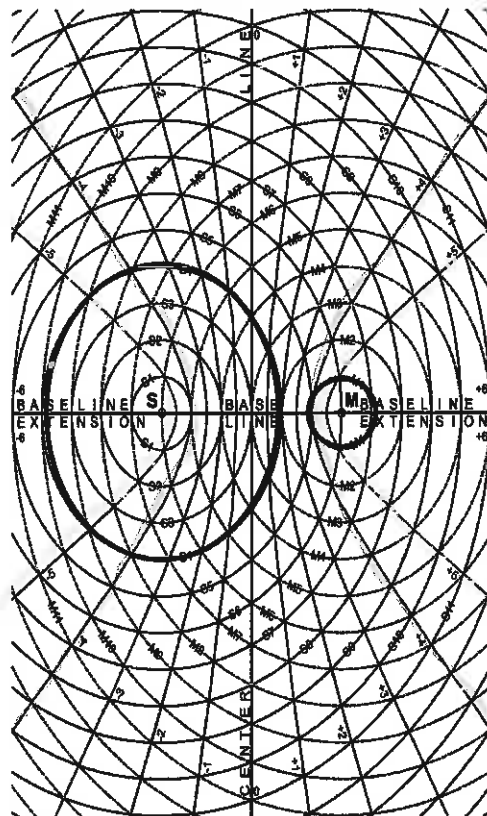
Because the airplane is moving forward, the hyperbolic curve moves forward and eventually the boom can be heard by everyone in its path.

A hyperbola revolving around its axis forms a surface called a hyperboloid. The cooling tower of a steam power plant has the shape of a hyperboloid, as does the architecture of the James S. McDonnell Planetarium of the St. Louis Science Center.



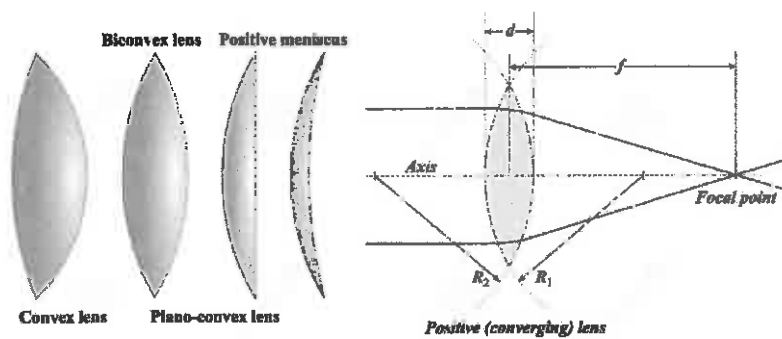
Conic sections can be characterized by moiré patterns. If the center of each of two sets of concentric circles is the source of a radio signal, the synchronized signals would intersect one another in associated hyperbolas.

This principle forms the basis of a hyperbolic radio navigation system known as **Loran** (Long Range Navigation).



Some real life applications and occurrences of conic sections:

1. The paths of the planets around the sun are ellipses with the sun at one focus
2. Parabolic mirrors are used to converge light beams at the focus of the parabola
3. Parabolic microphones perform a similar function with sound waves
4. The parabola is used in the design of car headlights and in spotlights because it aids in concentrating the light beam
5. The trajectory of objects thrown or shot near the earth's surface follow a parabolic path
6. Some astronomical objects take around the sun are hyperbolic (they do not revolve around the sun over and over, they approach, get close then leave in a hyperbolic path)
7. Hyperbolas are used in a navigation system known as LORAN (long range navigation)
8. Hyperbolic as well as parabolic mirrors and lenses are used in systems of telescopes



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