

What is an eclipse?

Every 'body' in our Solar System gets its light from the sun. A body is totally or partially eclipsed if all or part of it **passes through the shadow cast by another body**.



What is an eclipse of the Sun?

An eclipse of the Sun occurs at the time of a New Moon. Our natural satellite passes between the Earth and the Sun, hiding the Sun from an observer on Earth.

The different types of eclipse of the Sun

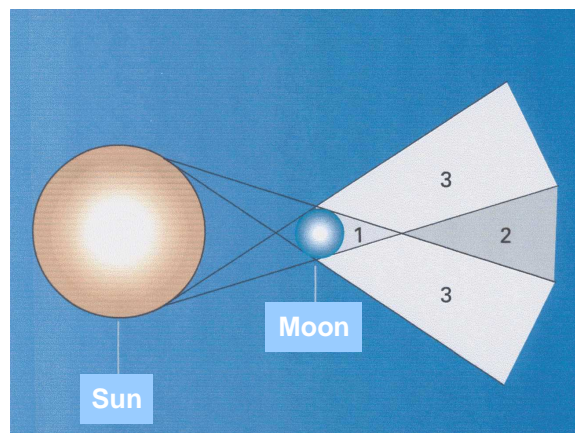
The Moon passes between the Earth and the Sun, projecting the cone of its shadow onto the surface of the Earth. By an extraordinary coincidence, the Moon is both 400 times smaller than the Sun and 400 times closer. This means that the apparent diameters of the two objects are practically identical to an observer on Earth.

When the Moon is sufficiently close to the Earth the result is a **total** eclipse. The Moon masks the Sun completely (as in the eclipse of 11 August 1999 seen in Europe).

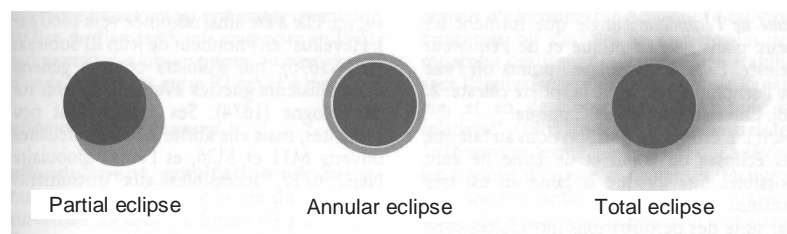
An eclipse is **partial** when the Moon masks part of the Sun but does not appear in the middle, leaving a ring.

An **annular** eclipse occurs when the apparent diameter of the Moon is less than that of the Sun, so that it does not mask the Sun completely. The visible part of the Sun appears as a brilliant ring around the dark disk of the Moon.

- ① total eclipse
- ② annular eclipse
- ③ partial eclipse



Source: [Encyclopaedia Universalis 2003](#)



Source: [Dictionnaire de l'Astronomie et de l'Espace. Larousse, 1999](#)

The frequency of eclipses

The *minimum* number of eclipses there can be in a year is four, with at least two eclipses of the Moon and two of the Sun. The *maximum* number of eclipses is seven: at least two each for the Sun and the Moon, while for the three others any combination is possible.

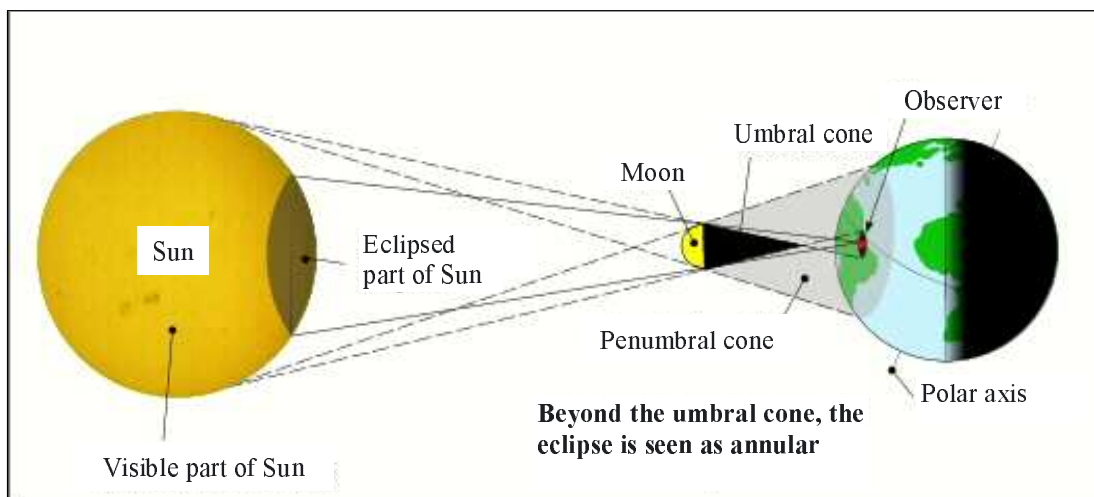
Eclipses are repeated every 6585.3 days, or 18 years and 10, 11 or 12 days depending on Leap Years. This is known as the Saros period. Thanks to the Saros, we can calculate the date of an eclipse that occurred several centuries ago or predict future eclipses. The eclipse of 11 August 1999 will therefore be repeated on 21 August 2017, but not at the same place nor at the same time on Earth. An eclipse only re-occurs at the same place about once every 370 years.

There are about 84 eclipses in a Saros period: 42 each for the Moon and the Sun. Most are partial. Since the Moon is moving away from the Earth by 3 cm a year, in a few hundred thousand years there will be no more total eclipses.

What is an annular eclipse of the Sun?

For an annular eclipse of the Sun, the Moon has to pass exactly between the Earth and our closest star. Since the Moon moves on an elliptical orbit, its distance from the Earth oscillates between 357,000 km and 407,000 km. Consequently, its apparent diameter varies. On 22 September, the Moon will not appear large enough to cover the Sun completely.

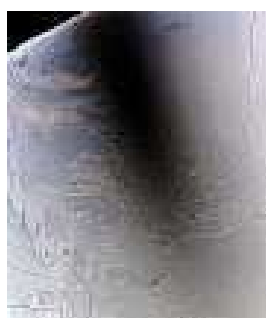
As with total eclipses, it is said to be central (the centres of the Sun and the Moon are perfectly aligned with the Earth).



Source: [Institut de mécanique céleste et de calcul des éphémérides](#) - Patrick ROCHER

The umbral path

During an eclipse, the shadow and the penumbra move across the Earth's surface. The umbral shadow traces a very narrow band (a few tens to a few hundreds of kilometres wide) called the **umbral path**. The line followed by the axis of the shadow cone is called the **central line**; the eclipse is at its maximum along this line.



Source: [NASA](#)

The image on the left clearly shows the shadow cast by the Moon on the surface of the Earth (eclipse captured by AQUA, an American Earth observation satellite).

The shadow can also be seen moving on images taken by Météosat 8 during the total solar eclipse of 29 March 2006:

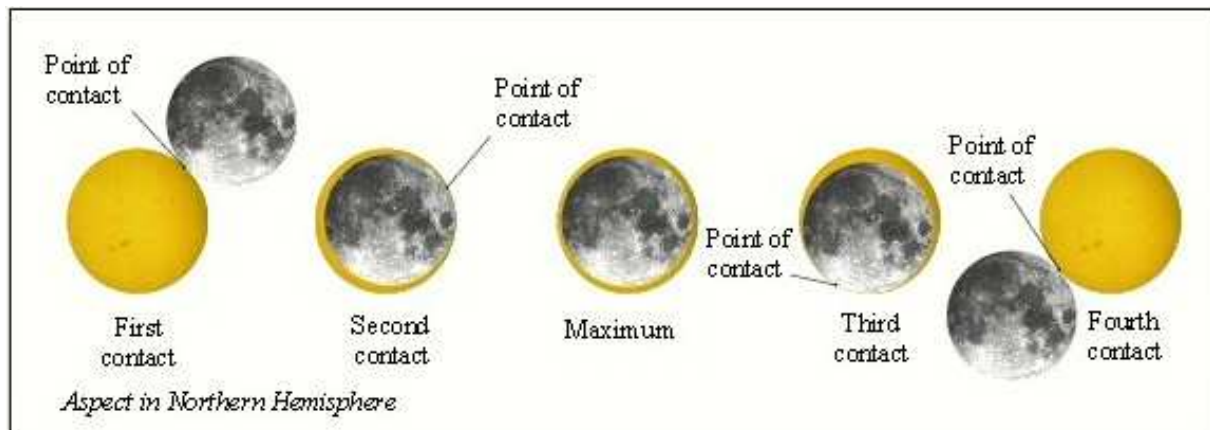
http://www.dlr.de/en/portaldata/1/resources/portal_news/newsarchiv2006/sonnenfinster_300306/eclipse_2006_2.gif

The phases of an annular eclipse

A solar eclipse is a heavenly event that takes place progressively. All observers on the umbral path first see a partial phase, then an annular phase and lastly a second partial phase.

Observers on the umbral path see a brilliant ring round the edge of the Moon, but not the solar corona.

The illustration below shows the different phases visible to an observer on the umbral path of an annular eclipse. The duration of the annular phase is the time between the second and third contacts. The duration of the local eclipse (partial and annular phases) is the time between the first and fourth contacts.



Source: [Institut de mécanique céleste et de calcul des éphémérides](#) - Patrick ROCHER

The principal phases of the eclipse of 22 September from Guyana to the Antarctic

These phases are the result of the relative movements of the Sun, the Moon and the Earth. They each correspond to a given place on Earth at a particular moment.

Over a six-hour period the umbra will have travelled from east to west at a speed of about 2000 km/h across an area extending from Guyana to the northern Antarctic.

From Guyana to the Antarctic		TU	Local time
<i>Start of general eclipse</i>	The Moon's penumbral cone starts its sweep across the Earth's surface	0839	0539
<i>Start of annular eclipse</i>	The umbral cone starts its sweep across the Earth's surface	0948	0648
<i>Start of central eclipse</i>	The axis of the umbral cone starts its sweep across the Earth's surface	0951	0651
<i>Greatest eclipse</i>	Instant when the greatest surface area of the Earth is in the umbra	1140	0840
<i>Geocentric conjunction (Central eclipse at true midday or midnight)</i>	Time and place where the eclipse is central and the Sun is at the meridian	1207	0907
<i>End of central eclipse</i>	The axis of the Moon's umbral cone leaves the earth's surface	1328	1028
<i>End of annular eclipse</i>	The Moon's umbral cone leaves the Earth's surface	1331	1031
<i>End of general eclipse</i>	The Moon's penumbral cone leaves the Earth's surface	1440	1140

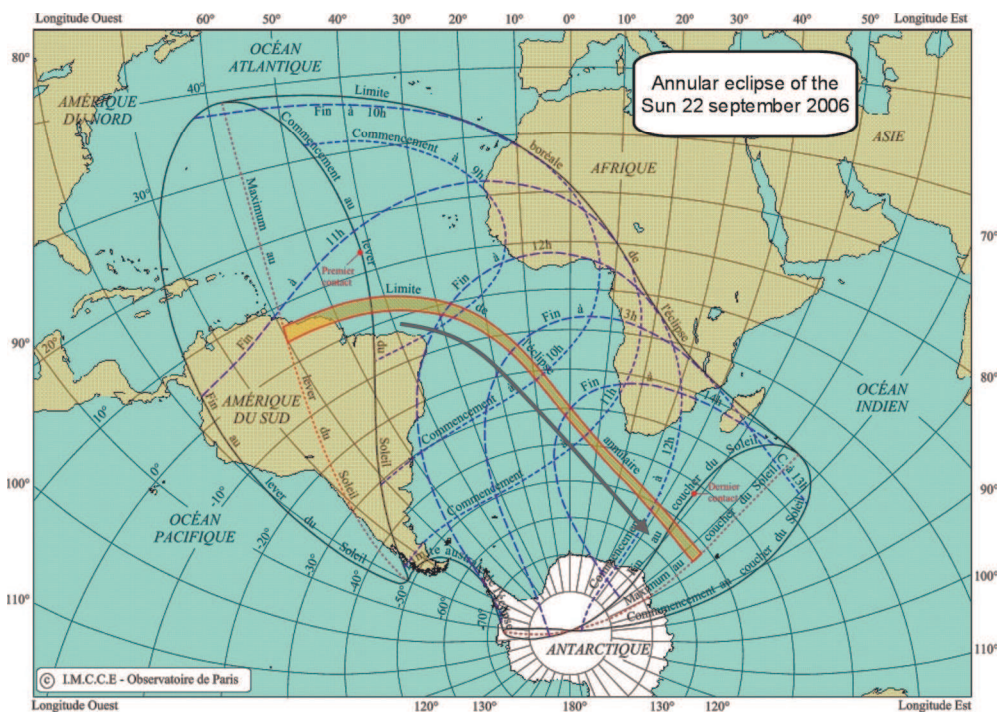
Source: [Observatoire de Nice](#) - Jean-Louis HEUDIER

Why is the eclipse of 22 September 2006 exceptional?

This eclipse, the fifth annular eclipse of the 21st Century, is **exceptional because it will be visible from French Guiana.**

Where will the eclipse be visible?

For the best view of the event, observers need to be on the central or umbral path. This will start in Guyana, the north of Surinam, French Guiana and the extreme north-east of Brazil. It will then cross the South Atlantic without making any landfall. It will end in the Indian Ocean just north of Antarctica.



Source: [Institut de mécanique céleste et de calcul des éphémérides](#)

In French Guiana

It will be visible at dawn in the northern third of French Guiana. The umbral shadow will cross the north of French Guiana from west to east.

The annular phase (the phase between the second and third contacts) will last for:

- 1 min 05 s at Maripasoula
- 5 min 25 s at Saint-Laurent-du-Maroni
- 5 min 38 s at Kourou
- 5 min 38 s at Cayenne
- 3 min 48 s at Saint-Georges

Throughout French Guiana, the eclipse will start before dawn. The first contact will therefore not be visible.

Since the eclipse will occur at a time when the Sun will not be very high above the horizon, appropriate observation sites should be chosen, ideally at a certain altitude and with a clear view of the rising sun (such as the Carapa site opened to the general public by CNES/CSG at Kourou).

The following table gives the observation times at different places in French Guiana.

Position	Duration of annular phase	Maximum eclipse	First contact	Last contact
Apatou	5 min 35 s	06:52:09	06:26:42	08:08:26
Camopi		06:54:30	06:18:48	08:12:41
Cayenne	5 min 38 s	06:52:46	06:18:42	08:10:33
Grand-Santi	4 min 34 s	06:52:52	06:26:53	08:09:20
Iracoubo	5 min 25 s	06:52:01	06:22:14	08:08:58
Kaw	5 min 16 s	06:53:19	06:17:32	08:11:24
Kourou	5 min 38 s	06:52:29	06:19:54	08:09:58
Macouria	5 min 38 s	06:52:48	06:18:48	08:10:32
Mana	5 min 10 s	06:51:43	06:24:32	08:08:13
Maripasoula	1 min 05 s	06:53:32	06:25:31	08:10:21
Matoury	5 min 36 s	06:52:52	06:18:43	08:10:39
Montsinéry	5 min 37 s	06:52:43	06:19:20	08:10:17
Ouanary	4 min 44 s	06:53:41	06:16:02	08:12:07
Régina	5 min	06:53:24	06:17:55	08:11:28
Rémire	5 min 37 s	06:52:50	06:18:05	08:10:39
Roura	5 min 32 s	06:52:28	06:18:43	08:10:49
Saül		06:53:54	06:22:12	08:11:20
Sinnamary	5 min 24 s	06:52:05	06:21:06	08:09:12
Saint-Georges	3 min 48 s	06:53:54	06:16:30	08:12:18
Saint Jean	3 min 52 s	06:53:10	06:26:11	08:09:48
Saint-Laurent du Maroni	5 min 25 s	06:51:51	06:25:32	08:08:14
Tonate	5 min 38 s	06:52:40	06:19:18	08:10:17

Source: *Rectorat* (Education Authority) of French Guiana

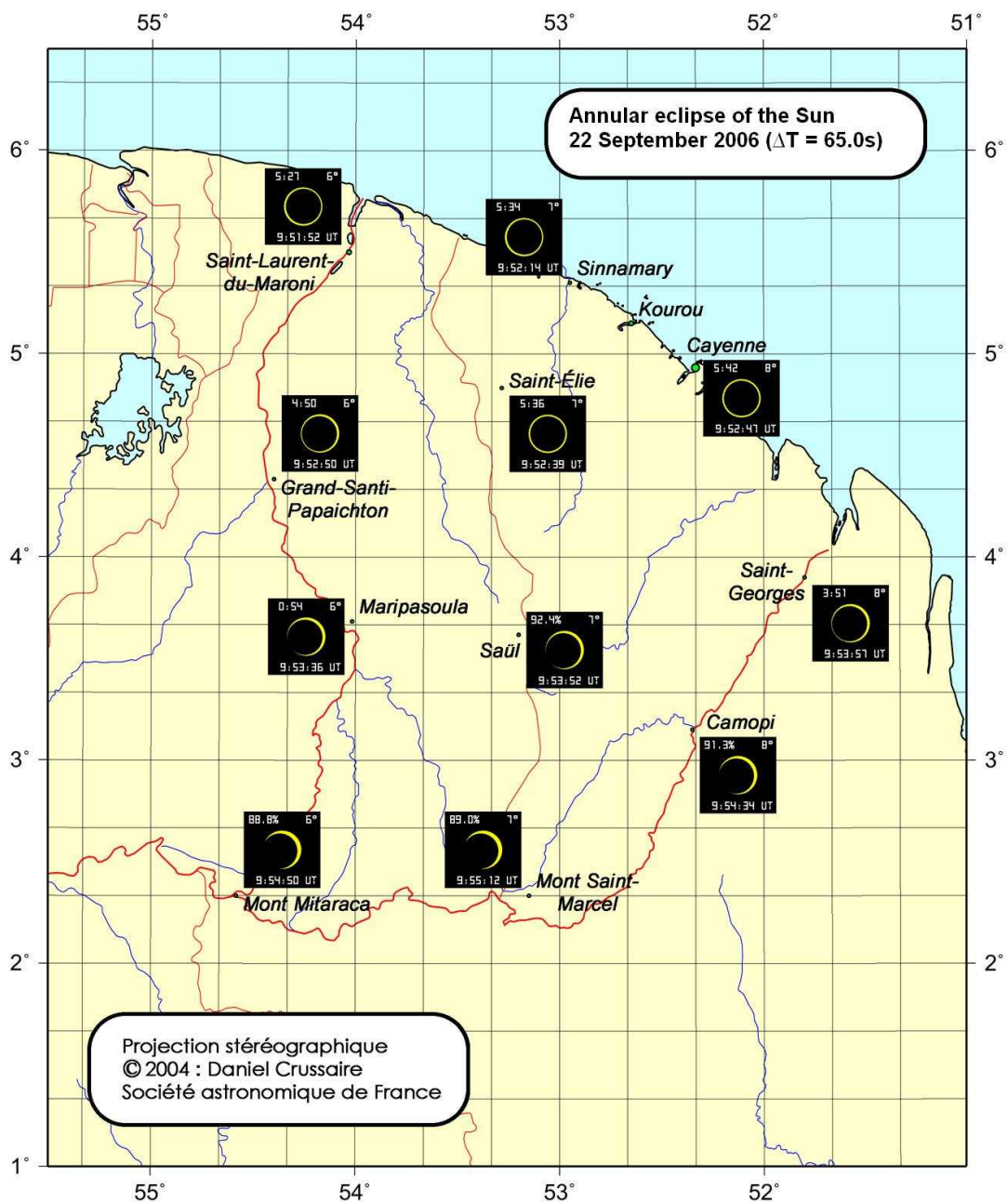
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For further details about observation times around French Guiana:

http://www.imcce.fr/fr/ephemerides/phenomenes/eclipses/soleil/pdf/sept2006_guyane.pdf

The eclipse magnitude, which is the percentage of the solar disk eclipsed by the Moon, will be approximately 85 % at the moment of maximum annular eclipse.

The map below summarises the way the solar disk will appear at the moment of greatest eclipse in a few places in French Guiana.



Crescents instead of rings for the not-so-lucky

The event will be visible as a partial eclipse throughout most of South America and West Africa. In particular, it will be visible as a partial eclipse in the French overseas departments and territories such as Martinique, Guadeloupe (and its ex-dependences Saint-Barthélemy and Saint-Martin), Reunion Island and certain Southern and Antarctic French possessions.

This solar eclipse will not be visible from mainland France.

Myths and popular beliefs about eclipses through History

Eclipse painted by Vincent Van Gogh



The Sun is our source of heat and light. It sets the pattern of our lives, rising each morning in the East and setting in the West. The seasons depend on how high it is in the sky.

Since the dawn of civilisation, men have studied the Sun's movements carefully for both practical and mystical purposes: they recognised the influence of the Sun on everyday life. In the past, eclipses were always seen as matters of great importance, sometimes striking terror into the hearts of observers.

In almost all ancient cultures and societies with no written records, eclipses of the Moon and, even more, eclipses of the Sun have been assumed to have supernatural causes, with a god, a demon or some malicious animal trying to extinguish or devour one of these two sources of light.

For many peoples, eclipses of the Moon and the Sun were explained by the extraordinary appetite of some wild or imaginary animal gobbling up one or other of these two heavenly bodies. Eclipses were also often seen as the manifestation of some divine or diabolical power. The Incas, for example, saw an eclipse of the Sun as the Sun god showing his anger. Like other impressive heavenly phenomena such as comets, eclipses were usually thought to be signs of impending calamity. In western Europe in classical times and the Middle Ages they were assumed to foretell death, war or some other catastrophe. In the same way, in South America, eclipses were associated with disease and epidemics.

An animal devouring the Sun ...

In Chinese, the word for eclipse is 'shi' which also means 'eat'. In China and several other Asian countries, the creature responsible was thought to be a dragon. Indeed, the peoples who had such myths usually imagined the animal threatening their Sun or Moon as terrifying or exotic. The same story was told in Siberia involving a vampire, in Paraguay a jaguar and in Vietnam a giant frog. In Scandinavia, two wolves were accused, one gobbling up the Moon and the other the Sun.



Driving away the creature and the malevolent spirits

Even today, in certain villages in the interior of French Guiana, and for certain peoples, it is believed that a great noise can prevent the evil that threatens. Shouting and clattering pots are supposed to frighten the creature away. Other methods were applied in other parts of the world. In India, the people would wade into the water up to their necks and splash the sky. Elsewhere, arrows would be shot at the sky to drive away the monster.

18th Century engraving

Love or hate

Although myths involving animals are the most common, there are other explanations for eclipses involving the Moon and the Sun meeting in the heavens. For some, an eclipse means a row between the Moon and the Sun, with one of them disappearing for a while. In Tahitian cosmology the opposite occurs. The Moon and the Sun are lovers and eclipses are their trysts; the result is the birth of new stars.

Myth or reality?

It is quite true that some eclipses really have changed the course of history. One such was the lunar eclipse of 20 September 330BC. Alexander the Great was fighting the Persians when the Moon went into eclipse. The Persians panicked and fled, handing victory to Alexander. On 22 May 1453, a similar story explains the fall of Constantinople and the Ottoman Empire. Finally, on 29 February 1504, Christopher Columbus predicted an eclipse of the Moon, which so impressed the Indians that they agreed to serve him.

Science explains all

Over the years, increasingly accurate predictions by scientists have helped conquer superstition. When an annular eclipse was forecast in France in 1764, village priests were encouraged, by an article in the *Gazette de France*, to “warn their parishioners that eclipses [...] caused neither sterility, nor contagion, nor war, nor any unfortunate event. They are the necessary consequences of the movements of heavenly bodies, as natural as the rising and setting of the Sun or Moon.”

But a certain ignorance remained. In the 18th Century, Monsieur Cassini (born in Paris in 1748) who was Director of the Paris Observatory sent out invitations to observe an eclipse. A young marquis was to bring the aristocratic guests to the Observatory, but dressing and powdering took so long that when the carriage arrived at the foot of the steps up to the Observatory, the eclipse had just finished. Seeing how disappointed the ladies were, the marquis cried: “Do come in, ladies, M. de Cassini is a great friend of mine, I’m sure he’ll do it again for us.”

Nowadays, scientific and technological progress means that eclipses are fully understood. In Europe, however, even if the great terrors of the past have been forgotten, eclipses continue to arouse fantasies and strange beliefs. The haute-couture designer Paco Rabanne, for instance, predicted that the MIR Space Station would fall on Paris during the eclipse of 11 August 1999. The persistence of certain beliefs puts into perspective the things people believed in the past, or still believe today in some places.