

# PLANETARIUM - SMOLYAN B U L G A R I A

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## THE KIRCH COMET IN ART AND ASTRONOMY

**The project was developed by:**

Vassilena Krasimir Kondova – a student at the Foreign Language High School "Ivan Vazov"

Hristina Kalaydzhieva - a physicist at the Planetarium – Smolyan

SMOLYAN  
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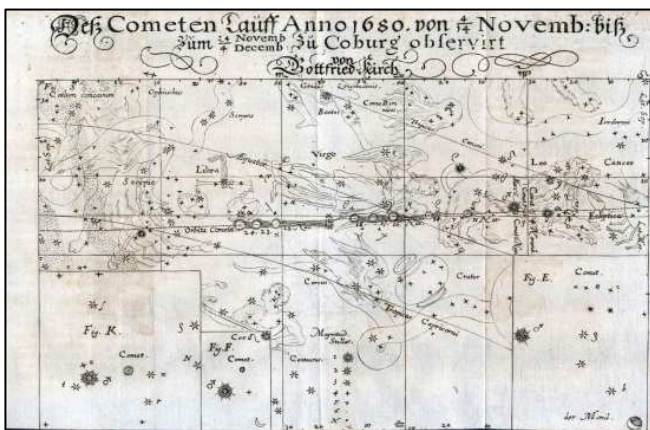
## Introduction

From the ancient past to modern times the sky has always attracted people. The appearance of something extraordinary in the heavens caused curiosity and even fear. Particularly intriguing for the people was the appearance of comets or “tailed stars”, as they were known, which were thought to have been portents of disasters, wars or the death of rulers. When those comets were exceptionally bright and impressive, they were known as “Great comets”. One of those “Great comets”, which had remarkable influence in history and art, was the Great Comet of 1680 - C/1680 V1 (Kirch Comet). It was the first comet discovered with a telescope. Its unusual brightness and long tail drew the attention of current spectators, as well as scholars and artists from later periods. Therefore, the comet was represented in literature and art. It was depicted in numerous paintings and engravings by different artists. Also, it was described in memories, written by some observers and recorded in scientific works.

The task that we want to carry out within this project is to describe and analyze the paintings, which we could find, and, on the basis of descriptions, schemes and maps of the comet's orbit made by its observers, determine whether those painting reliably show its position in the sky or not.

### About the Kirch Comet and its Observers

The Kirch Comet was discovered on 4<sup>th</sup> of November 1680 (14<sup>th</sup> of November New Style) by the German astronomer Gottfried Kirch and was named after him. It was the first comet discovered with a telescope. The comet was visible from the Northern hemisphere from the end of 1680 until the beginning of 1681. Its last observation was made on 9<sup>th</sup> of March 1681 (19<sup>th</sup> of March N. S.). It reached its perihelion on 8<sup>th</sup> of December 1680 (18<sup>th</sup> December) passing at a distance of 0,0062 AU (around 930000 km) from the Sun, and its closest approach to the Earth was on 20<sup>th</sup> of November (30<sup>th</sup> November N. S.) of 0,42 AU. The Kirch Comet was visible with naked eye before sunrise and after sunset, and by the end of 1680, as it reached its highest brightness on 29<sup>th</sup> December N. S., it could be seen at noon. On the chart below, made by Kirch, is shown its path among the stars.

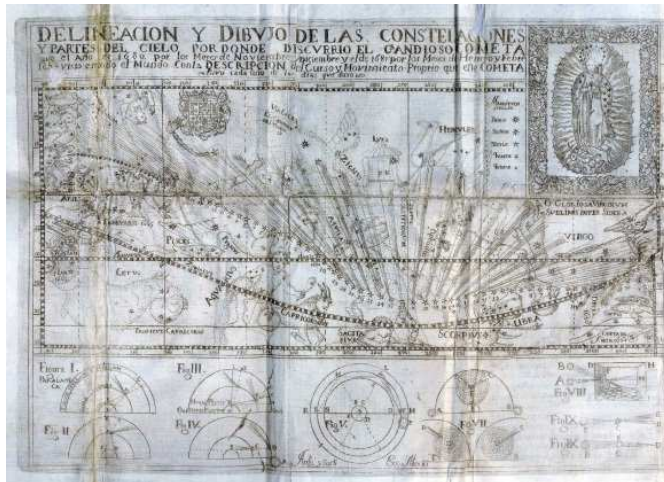


Current calculations indicate that in September 2012 the comet was at a distance of around 253 AU from the Sun.

The witnesses of the comet thought that the comet of 1680 and 1681 was actually two different comets because for a brief period of time it was not visible. In fact they are one comet before and after perihelion. The comet was exceptionally bright and with a tail, having reached impressive length, estimated at about 48 000 000 km (90°). The people regarded it as a bad omen, a God's punishment and they were

afraid of it. Also, they thought that it would crash into the Earth and destroy everything. Despite that, the comet drew the attention of a lot of scientists and artists of that period.

One of the explorers of the comet was its discoverer, Gottfried Kirch. He observed its motion upon the sky, and registered it by charting its path and the constellations it passed through. Another explorer was Eusebio Kino, a Spanish Jesuit priest, who also determined its path. Kino started its observations in Cadiz by the end of 1680. When he arrived in Mexico City, he published his work in the book „Exposición astronómica de la cometa“.

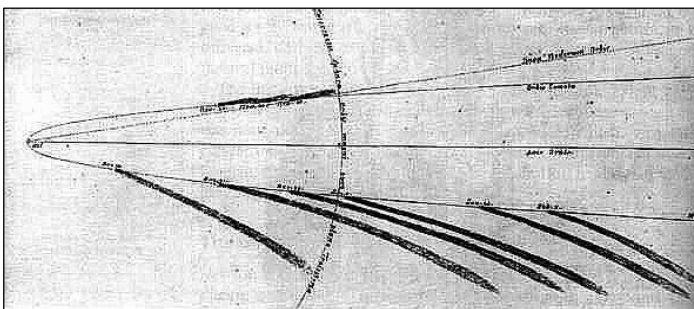


Scheme of the path of the comet made by E.Kino



“Exposition astronomica da la cometa” by Eusebio Kino

The great scientist Isaac Newton used the appearance of the Comet of 1680 in the sky to try to prove the Kepler’s laws considering the planets’ motion, as long as his theory of gravitation. He considered that the comets were merely small, solid and durable objects, similar to the planets.



It was thought that when the comet was at its closest approach to the Sun, its surface was heated to a very high temperature, but nevertheless it was not vaporized by the heat and turned up in the sky again. It was assumed that in its next approach to the Sun it would disintegrate under the heat of the star. In addition, having watched its motion, Dörfel, a German astronomer,

discovered that the comet’s orbit was a parabola, in the focus of which was the Sun. Edmund Haley, on the grounds of Newton’s theory of gravitation, determined the exact form of the orbit of the comet, according to his observations.

Today the eccentricity of the Kirch Comet is calculated to be 0,999986. In other words, the comet’s orbit was almost round. Considering the information about the comet, discovered by its explorers, the Great Comet of 1680 is compared with other bright comets, having been observed in the past. Some of them are the comet of the year of 44 BC, concerned with the death of Gaius Julius Caesar, the comet of 531 and the comet of 1106, which was observed during the reign of King Henry I. The years of their appearances above the Earth differ with the same period of time – 575 years. This makes scientist reckon that those comets are likely to be one comet with a period of about 575 years. If this suggestion is verified, then its next approach will be in the year of 2255. In spite of this idea, many other scientists agree that the Kirch Comet’s real orbital period is 9356 years.

Another comet, which the Great Comet of 1680 is often compared with by contemporary astronomers, is C/2012 S1 (ISON). It is estimated that the orbital elements of the two comets have a lot in common and because of this there are speculations that they are one comet or have a common origin. However, there is no evident proof about that.

Characteristics	Comet Kirch C/1680 V1	Comet ISON C/2012 S1
Discovery date	14 November 1680	21 September 2012
Closest approach to Earth	29 November 1680	14 December 2013
Perihelion	0.00622 AU	0.01244 AU
Eccentricity	0.999986	0.9999947
Orbital period	~9,400 yr	hyperbolic orbit
Inclination	60.7°	62.4°
Last perihelion	18 December 1680	28 November 2013

### Descriptions Made by Witnesses and Explorers

The Kirch Comet is one of the brightest comets during the 17<sup>th</sup> century, visible even during the day. Because of this, many stories were preserved by its spectators and observers. In America it caused an unusual stir. Here is an extract of the book “History of Kingston” by Marius Schoonmaker: *“On the 9<sup>th</sup> of December 1680, there appeared an extraordinary comet, which caused very great consternation throughout the province, with forebodings of dreadful happenings and divine punishments. It is described, in letter dated January 1<sup>st</sup>, 1681, as having “appeared in the Southwest on the ninth of December last, about two o’clock in the afternoon, fair sunshine weather, a little above the sun, which takes its course more northerly, and was seen the Sunday night, right after about twilight, with a very fiery tail or streamer in the west, to the great astonishment of all spectators, and is now seen every night with clear weather. Undoubtedly, God threatens us with dreadful punishments if we do not repent.””*

In his book, “The Dutch and Quaker Colonies in America”, John Fiske describes the observation of the comet made by the Dutch settlers of Manhattan: *“At first it was tailless and dim, like a nebulous cloud, but at the end of a week the tail began to show itself and in a second week had attained a length of 30 degrees; in the third week it extended to 70 degrees, while the whole mass was growing brighter. After five weeks it seemed to be absorbed into the intense glare of the sun, but in four days more it reappeared like a blazing sun itself in the throes of some giant convulsion and threw out a tail in the opposite direction...”*

A report from Albany, New York, indicates that the Kirch Comet was visible in daylight, passing above the Sun. At the end of December it appeared again in the Western night sky and showed its long tail, looking like a narrow beam of light of 70 degrees in length. The comet started to fade at the beginning of February, 1681 and was lastly seen on 19<sup>th</sup> of March the same year.

The presbyter Robert Law described the appearance of the Great Comet over Glasgow, Scotland: *“This comet, seen in December 1680, was seen on Friday [10 December], ... and was perspicuously seen on Tuesday the 14th day [of December]; ... the night being clear and frosty, between 5 at night and 7, it set in the west, and was seen in the south-east in the morning of the following days. This above-mentioned comet had a great blazing the root of it, was pointed as it came from the star, and then spread itself; was of a broad and large ascent up to the heavens,... yet did the stream of it amount near to our zenith, and it kept the course of the moon...”*

Apart from the detailed descriptions of the comet, made by Gottfried Kirch and Eusebio Kino, information about it was also recorded by astronomers from all parts of Europe: Frederick Bunter from Gdansk (Poland), Jean de Fontaine from Paris (France), Johan Johann Heinrich Voigt from Hamburg (Germany), Jacob Honold from Ulm (Germany) and many others.

### “The Great Comet of 1680 over Rotterdam”



“The Great Comet of 1680 over Rotterdam”  
By Lieve P. Verschuier

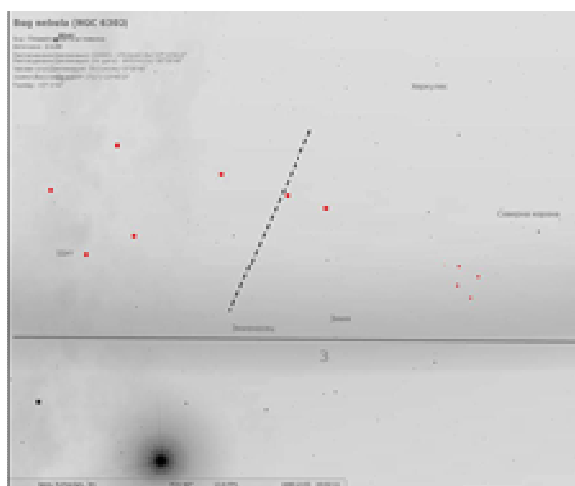


Chart made with *Stellarium 0.10.2*

Lieve Pietersz Verschuier (1627-1686) was a Dutch Golden Age artist and a close friend of Jan Vermeer from Utrecht. His paintings have mainly marine motifs and today are regarded as historical illustrations of shipbuilding during the 17<sup>th</sup> century. This painting depicts an observation of the Kirch Comet from Rotterdam. We see a group of people along with scientists at the front of the painting, gathered on the bridge over the river Rotte. Some of them are holding Cross-staffs, which are used for measuring the altitude of the objects situated above the horizon. In the painting the scientists are measuring the length of the comet's tail and are estimating its position in the sky. The spectators, women and children among them, are curious and obviously not afraid of this phenomenon. On the horizon we can see a red-orange glow. The comet's tail is double and impressive in length. We can clearly see the outline of its dust and gas components. Verschuier is famous for his extreme accuracy in depicting different objects. Due to their authenticity, his paintings are used by historians to identify ships of that period. For this reason, we consider the painted stars to accurately reflect their true positions in the sky at the time of this painting.

We used the computer program *Stellarium 0.10.2* to visualize the sky of the period between the 4<sup>th</sup> and 8<sup>th</sup> of December 1680 (14<sup>th</sup> - 18<sup>th</sup> of December N. S.), when the comet could be seen after sunset, and seen on the latitude of Rotterdam, The Netherlands. We compared our schematic to the charts and maps of the comet's path made by Gottfried Kirch and Eusebio Kino. According to the last available information, the comet passed its perihelion on the 8<sup>th</sup> of December 1680 (18<sup>th</sup> of December N. S.), and its tail pointed toward the Northern Pole. The comet's position confirms that this painting was drawn at night before the 8<sup>th</sup> of December 1680 (18<sup>th</sup> of December N. S.). In winter the Sun sets in the South-East, but the red-orange glow on the horizon (astronomical twilight) indicates that the painting was drawn 1 - 1.5 hour after sunset at about 6:30 – 7 p.m. After examining the sky visible above the Western horizon at this hour of the day, we determined that the stars in the painting best resemble the stars of the region of the constellations Serpens, Ophiuchus and Scutum. On the scheme above on the right, the stars of this region, which, according to us,

represent those drawn by Verschuier, are marked in red. In addition, the artist showed their brightness by painting them with different colours, sizes and intensities.

Upon our examination of all the details, we can conclude that the painting “The Great Comet of 1680 over Rotterdam” by Verschuier was drawn between the 4<sup>th</sup> and the 8<sup>th</sup> of December, 1680 (14<sup>th</sup> - 18<sup>th</sup> of December N. S.), shortly before the comet's perihelion when it was very bright. The painting describes a real observation of the Kirch Comet made around an hour after sunset and shows the comet's position among the stars, as well as the nature of its tail authentically.

### “The Great Comet of 1680”



„The Great Comet of 1680”, Rotterdam  
A painting from the Atlas Van Stolk

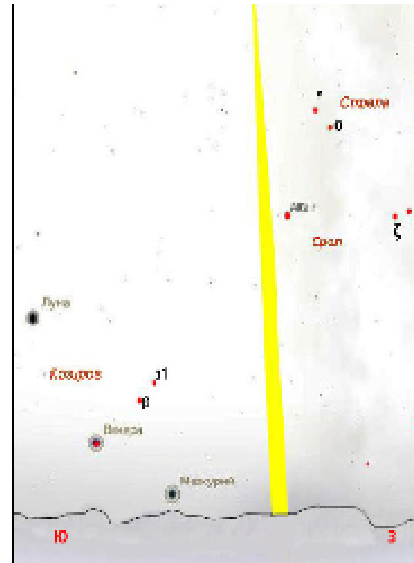


Chart made with Stellarium 0.10.2  
24<sup>th</sup> of December 1680

Abraham van Stolk (1814-1896) was a creator of a collection of wood-cuts, photographs, maps, posters and other items concerned with the history of The Netherlands from the arrival of the Batavians (ancient German tribes who lived at the time of the Roman Empire in the land of today's Holland) until then. Later his heirs, also passionate collectors, continued his work. Nowadays the collection is public and contains more than 250000 pictures. It is housed in Schielandshuis, Rotterdam.

The artist who painted this painting is unknown. In the painting there is a beautiful comet with a long, golden tail. By comparing the length of the tail to the height of the buildings in the background, it can be judged that it is exceptionally long.

In the description about the comet in this painting the time of its observation was not mentioned. It was only mentioned that the comet was so bright that it could be seen during the day. The Moon in the painting, whose right part is illuminated, is growing, probably 2-3 days after New Moon. However, the position of the depicted Moon does not correspond to its real position in the sky during this phase. The illuminated part must be to the side of the Sun, which, obviously according to the picture, is below the horizon, i.e. it has already set. At the end of 1680 the Moon was in New Moon phase on 21<sup>st</sup> of November and 21<sup>st</sup> of December (N.S.). The descriptions of eyewitnesses indicate that the comet was in its peak brightness at the end of December, 1680. The eyewitnesses estimated that the head of the comet looked as a star with a magnitude of 2, and the comet's tail was golden with spreading of up to 70-90 degrees. We hypothesize that the painting depicts the position

of the Kirch Comet exactly on these days, 23<sup>rd</sup> - 24<sup>th</sup> of December, 1680 (N.S.). Then the Moon was in Capricorn and the comet's tail was passing through Aquila, and on its right there was Altair ( $\alpha$  Aql). On the right there were the stars of Sagitta, and Venus was situated below the Moon. When we compared the stars in the painting with the stars of this region on the celestial map, we noticed some differences, mostly in the latitude between the stars. One of the possible explanations for this discrepancy could be that the artist may have wanted to show the greatness of the comet and the depicted stars only emphasize on the facts that it was very bright and could be seen at daylight. It is also possible that the painting was made in a later period and that it did not express the artist's recollections of the comet and probably he just used descriptions of its witnesses. The Atlas Van Stolk was created 170 years after the comet's appearance in the sky and probably this is a very reasonable explanation.

### An Image of the Kirch Comet in "Ethica Naturalis"



Christophoro Weigelio, *Ethica Naturalis seu Documenta Moriale*, Norimbergae (Nürnberg), ca. 1690, page XCII, COMETA

Christoph Weigel was a German engraver, a tradesman of paintings and a publisher who published many books about the crafts, weapons and accouterments during that period.

Around 1690 Christoph Weigel published his book „Ethica Naturalis” under his Latin name Christophoro Weigelio. This is an illustrated book containing 100 pictures and each of them is accompanied by a short description. The Great Comet of 1680 viewed from Nuremberg, Germany is shown on page 92. The picture is a copy of an etching which depicts several groups of people gathered on a square situated in the city. They are obviously talking and discussing the appearance of the bright comet which is spreading its long tail in the sky. With their gestures some people express their fear of this phenomenon. At the front of the picture there is a man who is showing to his wife and their two children the fearful object in the sky.

Weigel's wish was to make his readers contemplate upon moral themes, concerned with the picture and the text below. From this description about the comet we learn that it was a threat for the people's lives and that its appearance in the sky would bring nothing good to the Earth.

The rough translation of the text from Dutch is:

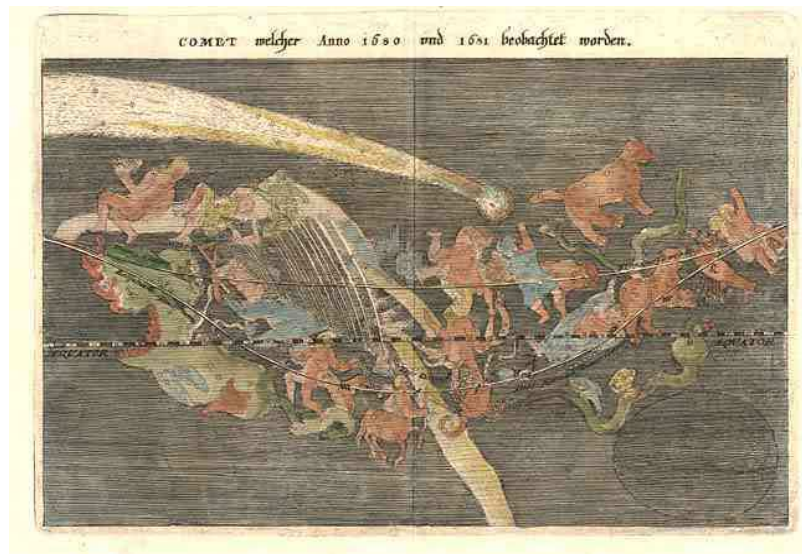
*“Fear, my child, the fiery scourge of The Lord.  
 Behold, a new fire dispels the night by the blaze of a rare heavenly body.  
 After all, The Comet has spread its scarlet rays,  
 Its light disconcerts The Heavens.  
 Let the mortals comprehend those signs,  
 And fear the cressets of the war,  
 And dread the death of Great Kings,  
 The extermination of mankind and deadly maladies.  
 It is certain that comets shine rarely and remain unpunished.  
 Know that this is the wrath of God.  
 Why do they (comets) cast rays instead of tears?  
 For this fire cannot be extinguished with other water.”*

In our opinion, the etching does not depict an actual observation of the Great Comet of 1680. The figures at the front are casting shadows, which means that the Sun has not set yet and at the same time there are stars in the sky spread chaotically. These stars cannot be identified or compared to the constellations of the comet’s path. The position of the comet’s tail does not coincide with what other witnesses had seen. The comet’s viewers and explorers described it as a long tail situated high up in the sky and the comet’s tail from the picture above is almost parallel to the horizon.



Another image of the Kirch Comet, as seen from Nuremberg, is an illustration in the pamphlet of Simon Bornmeister published in 1681. The etching is from the 17<sup>th</sup> century, German school. The text above the illustration indicates that the comet’s observation started on 16<sup>th</sup> of December 1680 (26<sup>th</sup> December N.S.) and continued until the end of the year. There are people in the etching watching the comet with interest, while some of them are using sextants to measure its altitude above the horizon. Also, we can notice the Moon’s crescent half-hidden on the left. The etching probably depicts the comet during the period when it was in the peak of its brightness, at the end of December, 1680.

## “A Comet Which has Been Observed in 1680 and 1681” (Berlin)



“The Comet which has Been Observed in 1680 and 1681”,  
A coloured etching by Friedrich Madewais

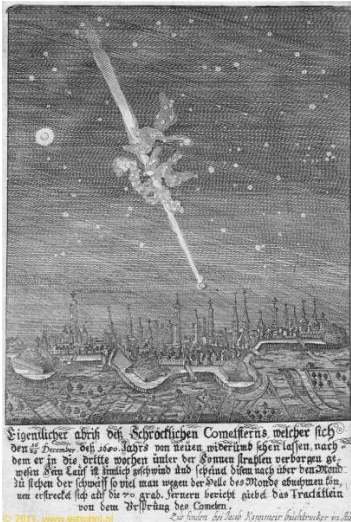
Friedrich Madewais (1648 - 1705) was a German mathematician, artist and engraver. He was the headmaster of the Berlin Gymnasium and created an Academy for teaching mathematics, physics, natural sciences, medicine, law, policy and statistics.

The etching is a star map showing the passing of the Great Comet of 1680 through the constellation. The image of the comet is depicted above the map as an addition to it. The path of the comet is drawn amongst the stars and it represents its passing through the constellations in the period between 6<sup>th</sup> of November 1680 and 23<sup>rd</sup> of January 1681 (16<sup>th</sup> of November 1680 and 2<sup>nd</sup> of February 1681 N.S.) when, according to descriptions, the “long trailing robe of its tail disappears.” The constellations are depicted according to the traditions in the classical mythology. In a rectangle below the etching the author, astonished by the comets, which periodically come back, wrote poetically: “The hen of Rome gives birth to this egg anew, thus behold the birthing!” The comet’s path is depicted in the form of an ellipse in the bottom right corner.

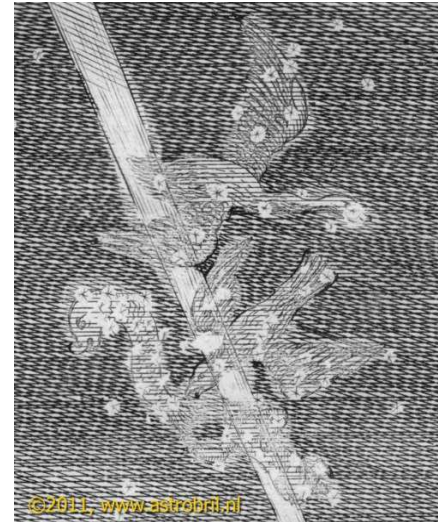
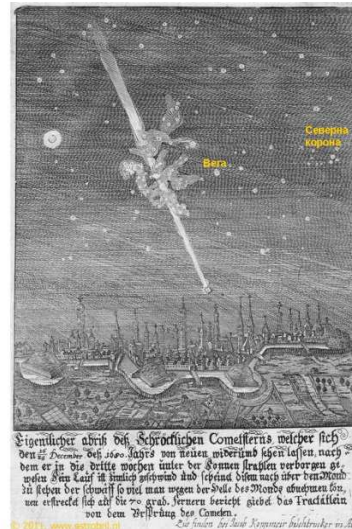
This etching was published in “Theatri Europaei, Zwölffter Theil” by Matheus Merian in 1691. On pages 259 and 260 Merian wrote: “*Of all the marvellous signs visible in the Heavens and on Earth none of the least is the dreadful comet which showed himself Thursday December 16, 26 just after the fall of night. The star itself was not seen a lot, and considered as bright as the stars of the second of third brightness, but very fiery but also gloomy was its tail, that when the star stood just about on the horizon would stretch from South-West tot North-East and would cover most part of the sky. The tail was bright and clear, but transparent, so that the fixed stars underneath it were clearly visible and recognisable. It rose, as stated, during nightfall and set about 10 or 12 during Night. At that time the comet stood 46 Degrees from the bright star of Lyra (Vega), from the star of Cygnus (Deneb) 50 and from the neck of Pegasus the Horse (Markab) 75 Degrees. 3 Days passed in which nothing could be seen, but on January 1st it appeared 11 Degrees and 10 Minutes from the heart of Aquila (Altair), 39 degrees from Lyra (Vega), and also that far from the Neck of Pegasus the Horse (Markab), so that it had moved already 11 degrees. Nevertheless its tail had lost a little of its length, because it stretched for about 67 degrees to the star Cassiopeia (Schedar).*”

This text is followed by a detailed description of the comet's position on 7<sup>th</sup> of January 1681 and a note that until the end of February the comet was visible from different areas in Germany, Denmark, Sweden, Poland and Russia (Moscow), even in Turkey.

### The Kirch Comet in Augsburg, Austria



The Kirch Comet visible above Augsburg, Austria



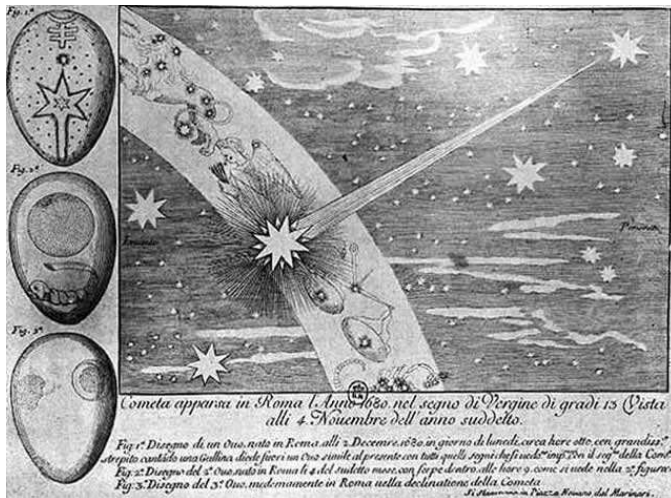
A fragment of the drawing

The description and the drawing of the comet, which was being observed, were published by Jacob Koppmeir, a book-publisher in Augsburg. The text bellow the drawing says: *“True depiction of the Terrible Comet star, which appeared again on 16/26 December of the Year 1680, after it had been hidden behind the Sun's beams for three weeks. Its Course is quite speedy and it seems to stand above the Moon. The tail as far as one can estimate because of the Brightness of the Moon stretches over 70 degrees. More is reported in the Leaflet on the origin of Comets. Obtainable at Jacob Koppmeir, book printer in Aug.”*

The tractate mentioned in the text above was made by Johann Christoph Wagner (1640 - ?) and is titled *“A thorough report on the origin of comets, their nature, shape, colour, size. What they are and what they attribute. Written on the occasion of the comet, which saw the November/December 1680”*.

The drawing shows the path of the comet, traced through the constellations Delphinus, Cygnus, Aquila and Antinous, which are depicted with their classical figures. Today the last constellation does not exist and now it is part of Aquila. After a careful examination of the painting it can be concluded that the stars, which outline this constellations, correspond to their real position in the sky. Among the other stars there can be identified Vega from Lyra, the bright star on the right of the figures. At the same altitude Hercules can be seen and almost at the end of the drawing there is the chain of Corona Borealis. The Moon's age is approximately 5 days after New Moon (the New Moon was on 21<sup>st</sup> of December N.S.) and is in Aquarius. Its illuminated part and its position towards the Sun correspond to the Moon's phase. We reckon that the drawing represents the position of the comet at the end of December, 1680 authentically.

## The Kirch Comet over Rome



comet and several noticed singularities are marked.

This copy from the etching of the Kirch Comet is found in an Italian manuscript from 17<sup>th</sup> century. The appearance of the comet in the sky coincided with extraordinary events, which happened in Rome and caused great interest. The same year an Italian artist engraved a special etching of a comet, depicting the so called “eggs”, as well as the passing of the comet through Virgo. The text below indicates: “The comet that appeared in Rome in the year of 1680 in the sign of Virgo at 15 degrees. Discovered on 4<sup>th</sup> of November the same year.” On “the eggs” on the left there are moments of the observation of the

## Commemorative Medal for the Kirch Comet



None of the comets which appeared until the beginning of the 20<sup>th</sup> century was so carefully observed as the Kirch Comet. This comet was studied by many scientists and Sir Isaac Newton developed his comet theory in his work “Principia” mainly on the basis of its observation. The pre-history of this bright comet and the reason for the elaboration of the medal above were described in the “American Journal of Numismatics”, Volume XXV, No.2 in October, 1890 by David L. Walter.

There are 20 stars depicted on the front of the medal, which the comet is passing through, including one very small star situated between the second and the third diagonal stars. The inscription at bottom of the medal says: “1680. 16<sup>th</sup> of December | 1680. January”. During this period the comet was passing through Aquila, Sagitta and Delphinus and for this reason it can be claimed that exactly these constellations were engraved on the medal. Two of the stars are visible in the comet’s tail, which confirms the fact that it was transparent and did not conceal them. However, it is not clear whether this is merely a coincidence or the engraver really observed the phenomenon. The inscription on the reverse of the medal says: “The star threatens with evil. It passed in November. God will do good!” (“Der Stern droht boese sachen. Trav. nVr! Gott WIRD SWOL MACHEN”)

The appearance of a Great comet in the sky is a puzzling, staggering and comparatively rare astronomical phenomenon which has made people attach great importance to it for centuries, mostly

negative. However, there are well-known examples, in which the comets were regarded as harbingers of a good augury, for instance as a divine guidance in Giotto's painting "Adoration of the Magi" (Halley's Comet) or as a symbol of authority ("The Bayeux Tapestry"). Some artists used them as grounds of philosophical and moral thoughts while others looked on the satiric side of comets in general.

The Kich Comet of 1680 is one of the Great comets, which remains in history for its brightness, astonishing tail and unique grandeur. That is why it was represented in the art of this age in numerous paintings, etchings and wood-cuts. According to us, some of these works show its real position among the stars, such as it was observed by its explorers and described by its witnesses. Other works merely present its greatness and its influence upon the people. Within this project we could not cover the overall impact of the Kirch Comet on art, but we made a small attempt to reveal the inspiration, which the artists have drawn from it.

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