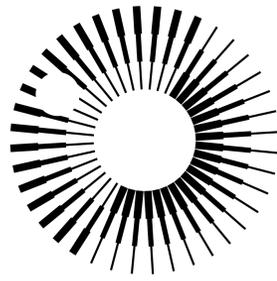


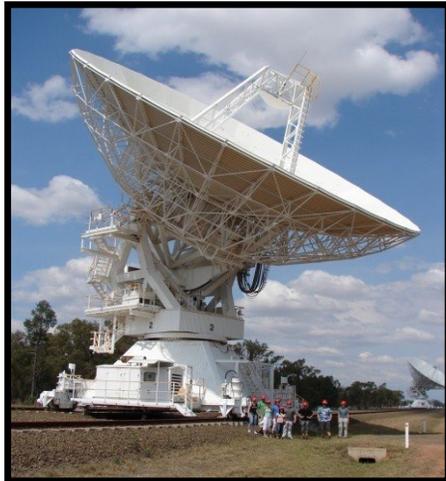
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Society

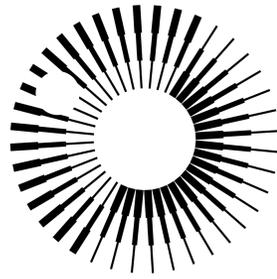
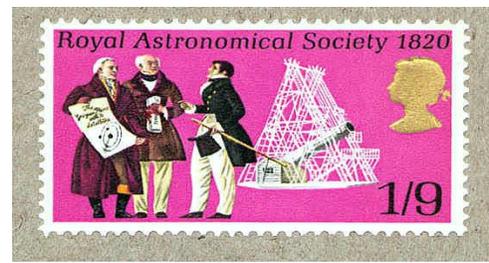
# On Caroline and Comets

Dr Sheila Kanani



Royal  
Astronomical  
Society

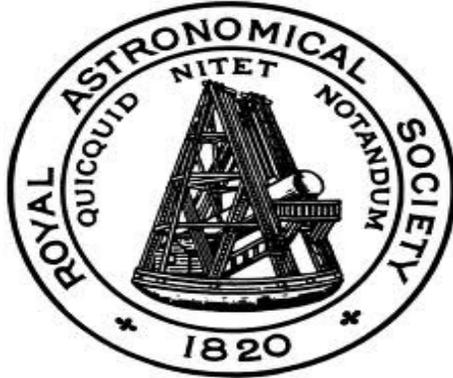




# Royal Astronomical Society



“Quicquid nitet notandum”





The Herschel Family Tree

## Nebular Aproximations.



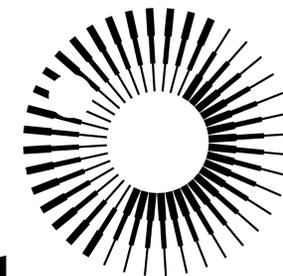
**CAROLINE HERSCHEL**  
1750 - 1848

AS A STELLAR OBSERVER, DISCOVERED EIGHT COMETS.

HER REVISION OF FLAMSTEED'S BRITISH CATALOGUE OF STARS WAS THE KEY REFERENCE WORK FOR 19TH CENTURY ASTRONOMY.

TOGETHER WITH HER BROTHER WILLIAM, MAPPED THE NEBULAE OF THE NORTHERN SKY, CATALOGUING 2500 NEBULAR OBJECTS IN HALF A CENTURY OF OBSERVATION.

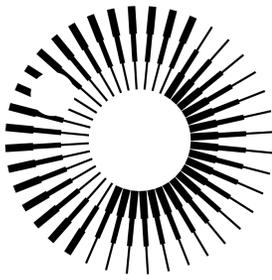
WAS THE FIRST PROFESSIONAL FEMALE ASTRONOMER AFTER GEORGE III GRANTED HER A YEARLY SALARY FOR HER WORK AS A COMPILER, CALCULATOR, AND OBSERVER.



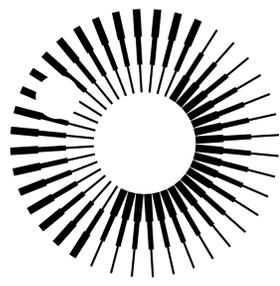
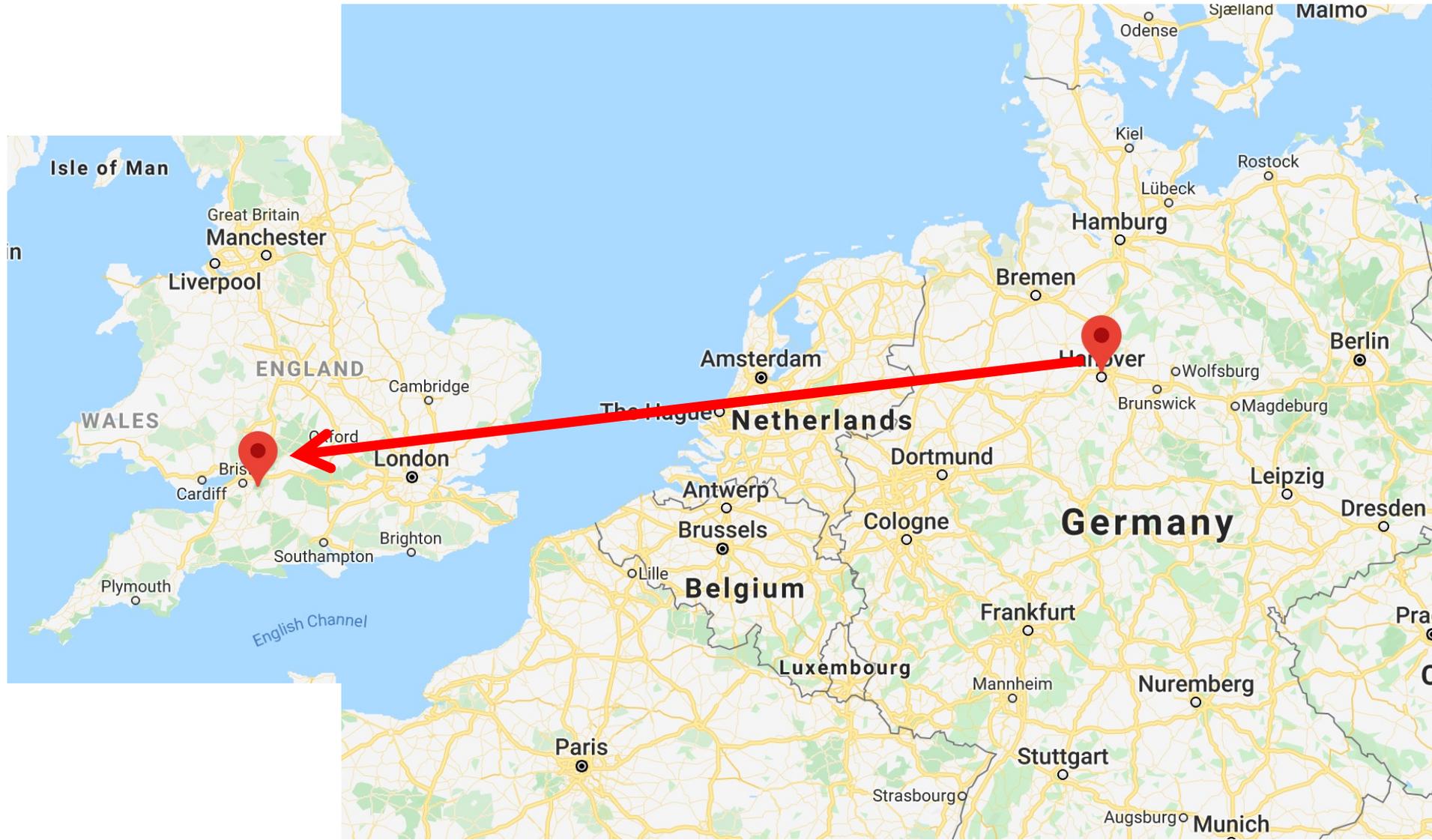
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From the Herschel Family Archive, this simple muslin dress would have been worn by Caroline when she was about fifty.

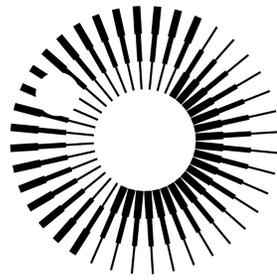
It is strikingly small for a grown woman, as Lina's height was stunted due to poor health when she was a child.



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Astronomical  
Society



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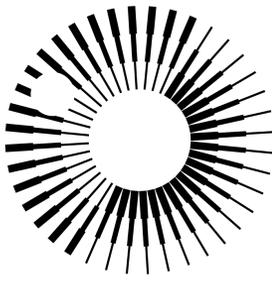
# Royal Astronomical Society

19 New King Street.

The house has been fully restored in the authentic style of the period.

Dr Brian May is the Museum's patron – like William Herschel before him, both a musician and an astronomer.





# Royal Astronomical Society

The music room where William Herschel tutored his students is one of the highlights of the Herschel Museum of Astronomy.

A Catch

Sup pose - - - - we sing a catch sup pose we sing a  
 with all - - - - my heart, with all my heart, what shall we  
 No! no! we'll have no such stuff No no  
 why not? why not? why not? why not, A good!

Catch we sing a Catch  
 have what shall we have  
 no no no we'll have no such stuff  
 - - - Catch is no bad thing

A Catch

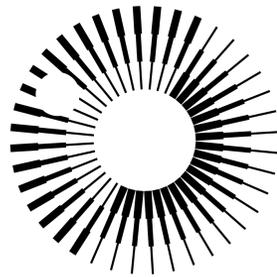
Landlord, Landlord, Landlord Landlord, this is  
 Sir Sir Sir Sir 'tis the  
 Tray, Tray, Tray Tray you're a  
 Kick him, kick him, kick him, kick him, kick him

very bad wine  
 best I have  
 Sir - - - - - by dirty Dog!  
 out, kick him out of the room

A Catch

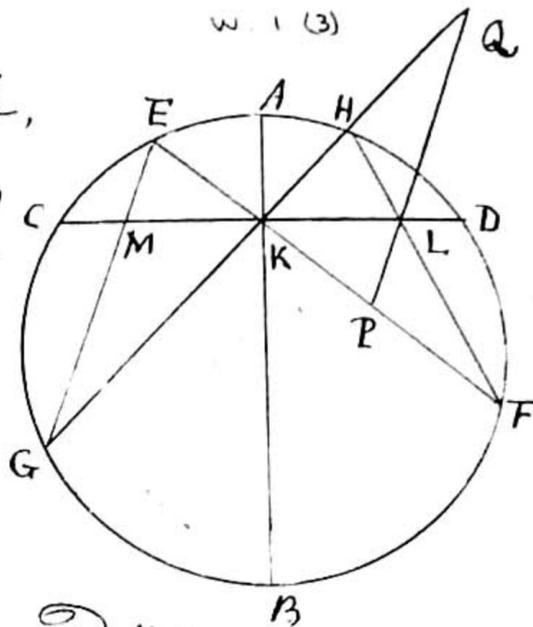
To day I am, I am I am I am I  
 Then let us drink many happy many  
 I wish this waiter would bring - would bring  
 He is he, it's a scoundrel, a scoundrel a scoundrel

am I am just thirty five  
 happy re turn of this glorious day  
 would bring - would bring the wine  
 a scoundrel he is a scoundrel for his Laggie nap!



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Problem.  $AB$  is the diameter of a Circle,  
 a chord cutting it at right angles in  $K$ ,  
 and  $HG$  two other chords drawn anyhow  
 through the point  $K$ , and  $HF$ ,  $EG$  chords  
 joining the extremes of  $EF$ ,  $HG$ .  
 It is required to prove that  $MK$  is  
 perpendicular to  $KL$ .

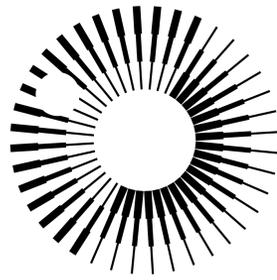


*Demonstration*  
 Through  $L$  draw  $PQ$  <sup>parallel to  $GE$ ,</sup> meeting  $KF$  in  $P$  and  $KH$  in  $Q$ .  
 Because of the parallels the angle  $HQP$  is equal to  $HGE$ , but  
 is equal to  $HFE$ , or to  $HFP$ , for they are in the same segor  
 hence the angles  $HQP$ ,  $HFP$  are equal, and hence the points  
 are on the circumference of a circle, wherefore  $PL \times LQ = FL \times$   
 ~~$KL$ .  $\therefore KFC$   $KPR$  are similar and similarly divided.~~

### Z ANGLES

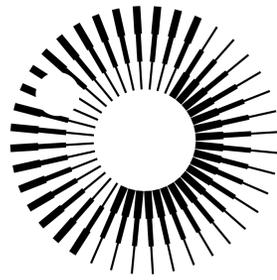
Copy each Picture. Draw on a big Z. Find all the missing angles

- 
- 
- 
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-



# Royal Astronomical Society

Globes,  
telescopes and  
lens making  
equipment at the  
Herschel Museum



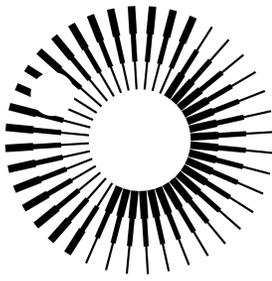
# Royal Astronomical Society

Mirror polishing machine



The workshop in Bath



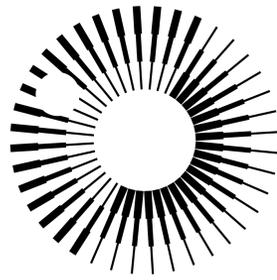


# Royal Astronomical Society

Caroline Herschel taking notes as her brother William observes, the night William discovered Uranus. Credit: **Paul Fouché**

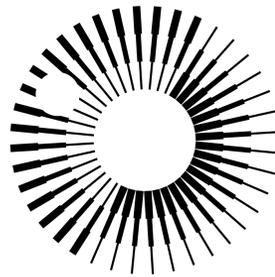
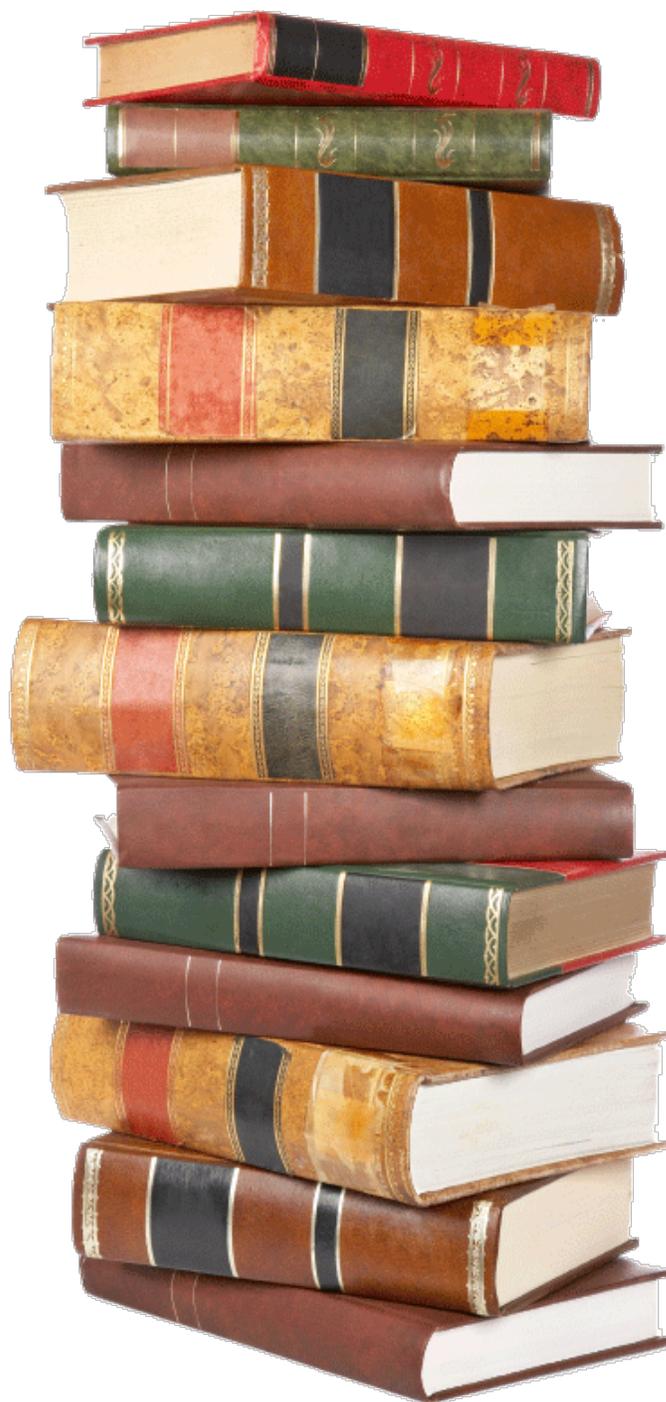


*CAROLINE (LINA) LUCRETIA HERSCHEL*



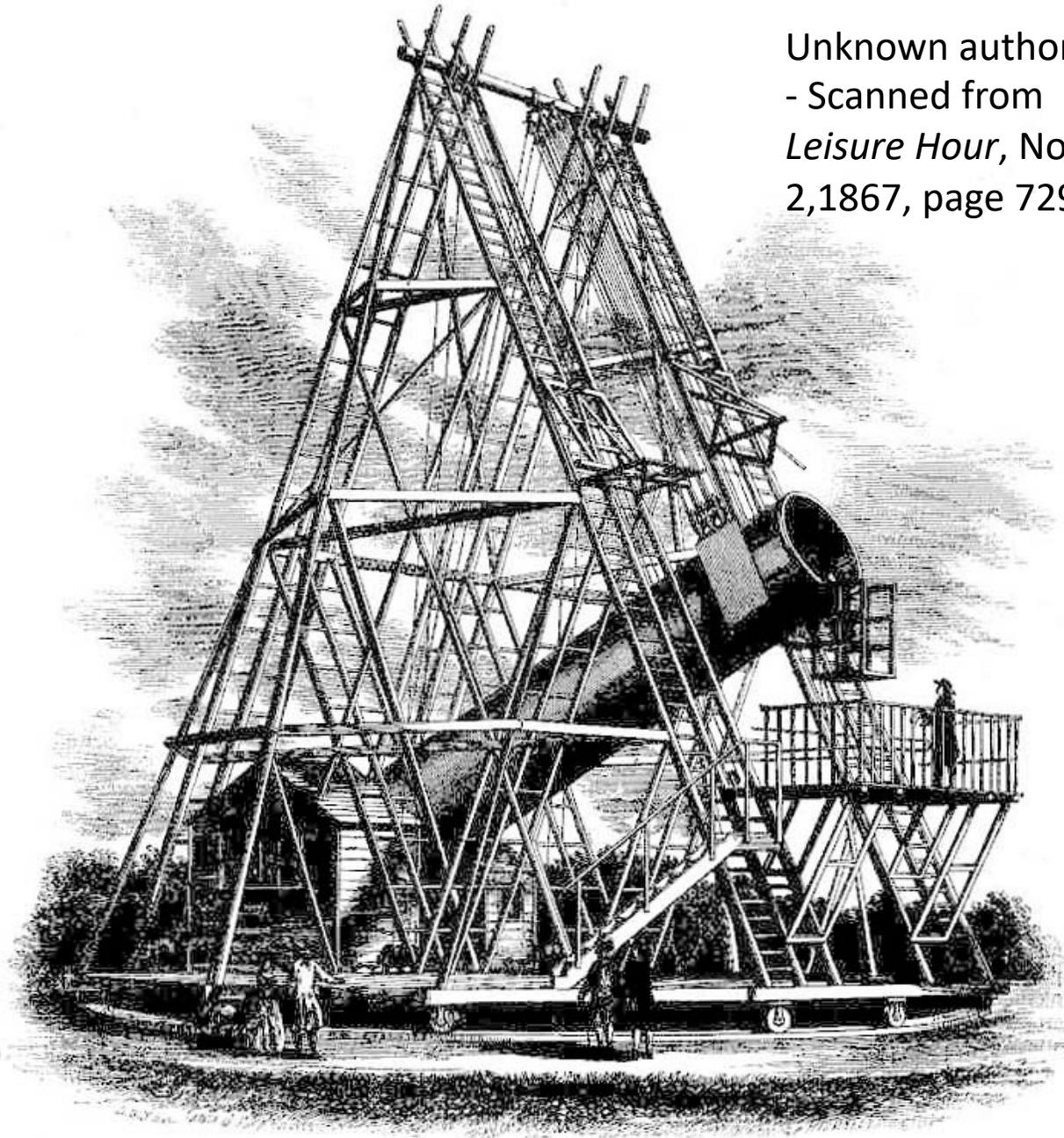
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Caroline Herschel as  
Portrayed By K. Lynn King



Royal  
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Society

Unknown author  
- Scanned from  
*Leisure Hour*, Nov  
2, 1867, page 729





# METEORS,

**METEROID**  
(In Space)

**METEOR**  
(In Atmosphere)

**METEORITE**  
(On Earth)



243 Ida - 58.8 x 25.4 x 1 km  
Galileo, 1993



9969 Braille - 2.1 x 1 x 1 km  
Deep Space 1, 1999

5535 Annefrank - 6.6 x 5.0 x 3.4 km  
Stardust, 2002

286 - 5.0 km  
Ries



433 Eros - 33 x 13 km  
NEAR, 2000



253 Mathilde - 66 x 48 x 44 km  
NEAR, 1997



951 Gaspra - 18.2 x 10.5 x 8.9 km  
Galileo, 1991

21 Lutetia - 132 x 101 x 76 km  
Rosetta, 2010



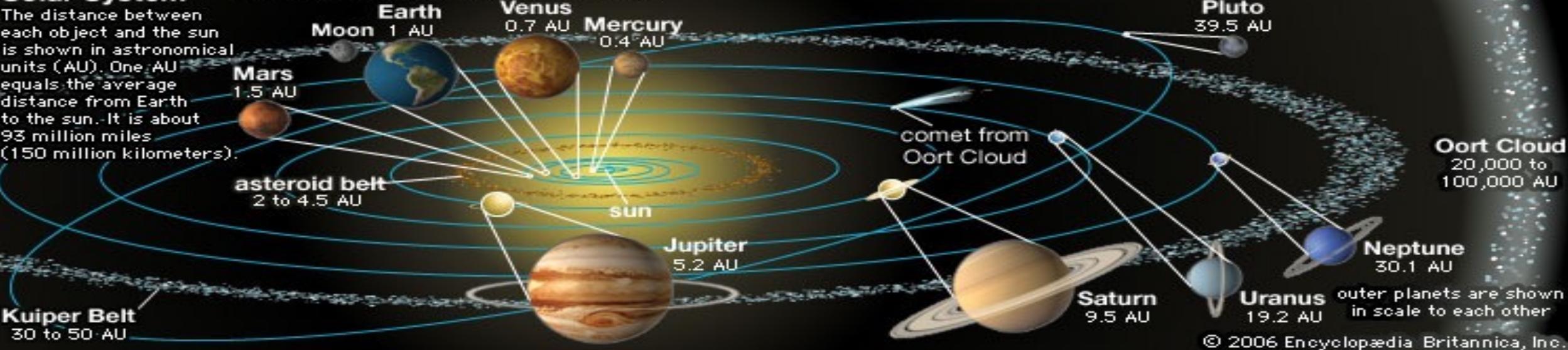
n envelope

il

# Solar System

The distance between each object and the sun is shown in astronomical units (AU). One AU equals the average distance from Earth to the sun. It is about 93 million miles (150 million kilometers).

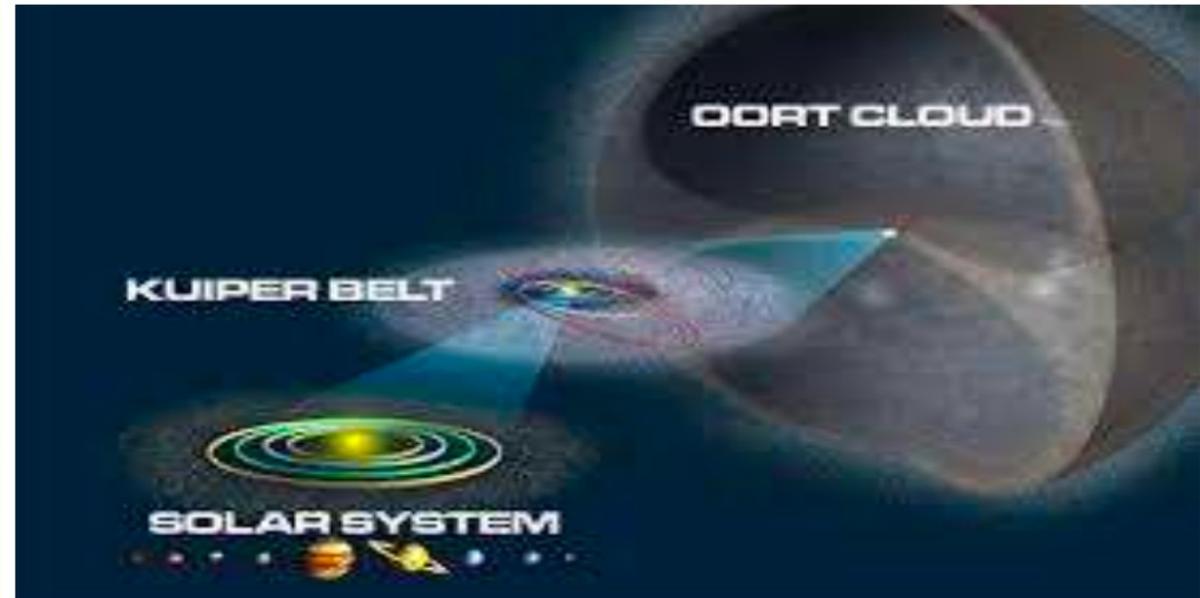
inner planets are shown in scale to each other

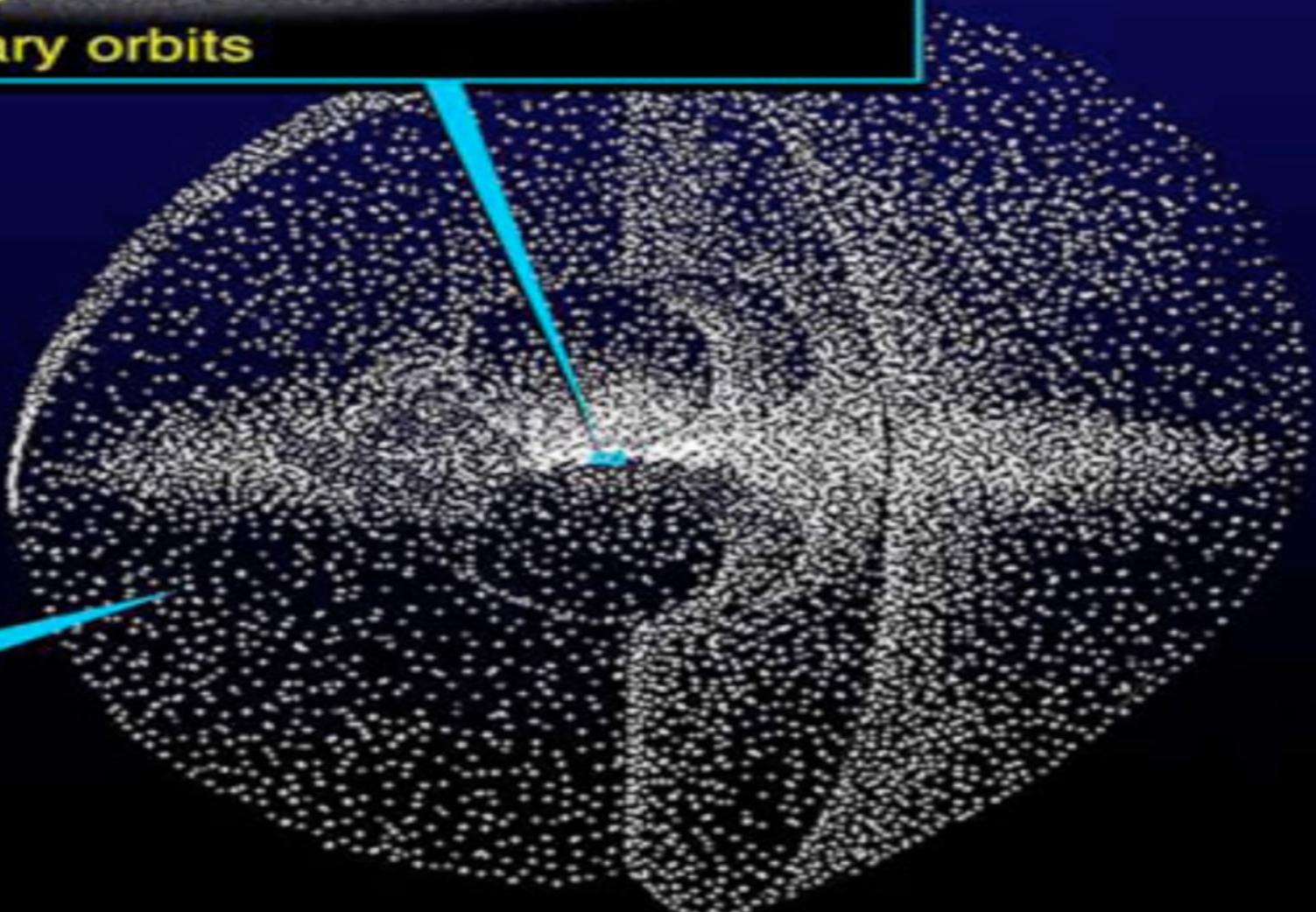


© 2006 Encyclopædia Britannica, Inc.

# The Oort Cloud

- Objects found in the Oort Cloud are known as trans-Neptunian objects. This applies to all objects beyond the orbit of Neptune and includes the Kuiper Belt objects as well.
- The Oort cloud comprises two regions. There is a spherical outer Oort cloud, and a disc shaped inner cloud called the Hills cloud.
- Objects in the Oort Cloud are mostly composed of water ice, ammonia and methane.
- The estimated number of objects believed to be in the Oort Cloud is around 2 trillion – although there is currently no way to verify this theory.
- Long-period comets (with orbit paths of over 200 years) are believed to originate from the Oort Cloud, according to many astronomers.





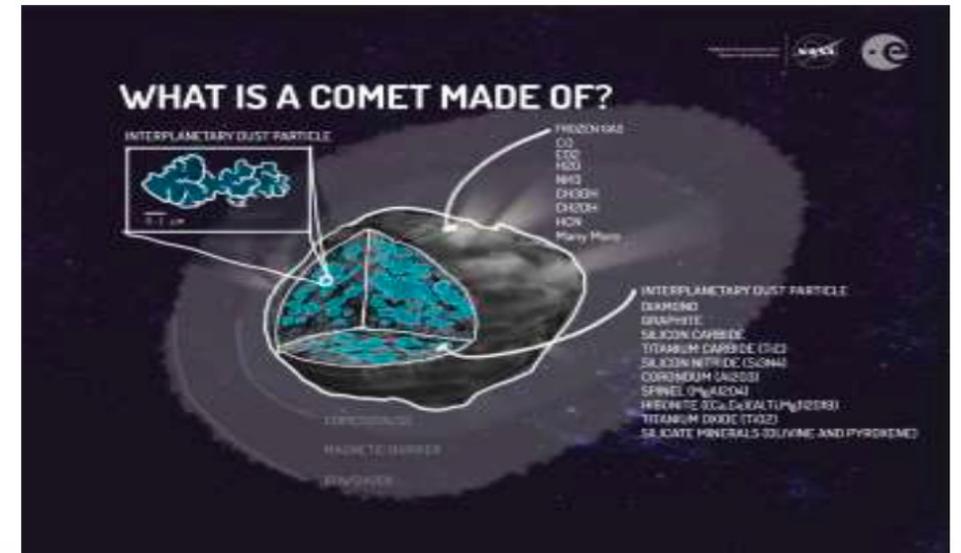
**The Oort Cloud**  
(comprising many billions of comets)

*Oort Cloud cutaway drawing adapted from Donald K. Yeoman's illustration (NASA, JPL)*

# What are comets?



- Comets are often referred to as "dirty snowballs."
- They are left over from the formation of stars and planets billions of years ago.
- They are composed of rock, dust, ice and frozen gases such as carbon monoxide, carbon dioxide, methane, and ammonia.





# Comets tails



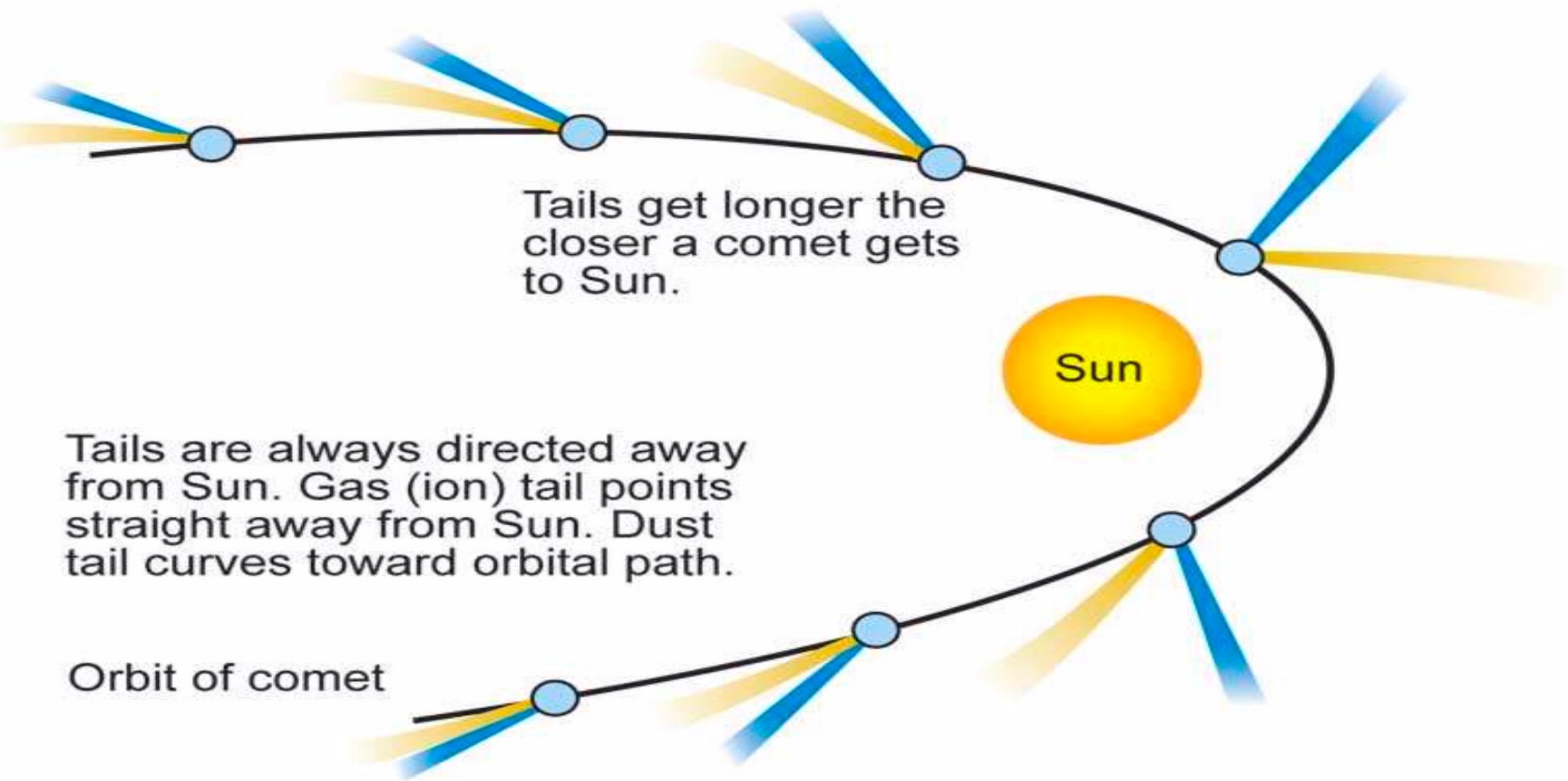
## Comets have two tails:

- Dust tail
- Ion tail

As a comet gets closer to the sun, the ice on the surface of the nucleus begins turning into gas, forming a cloud known as the coma. Radiation from the sun pushes dust particles away from the coma, forming a dust tail.



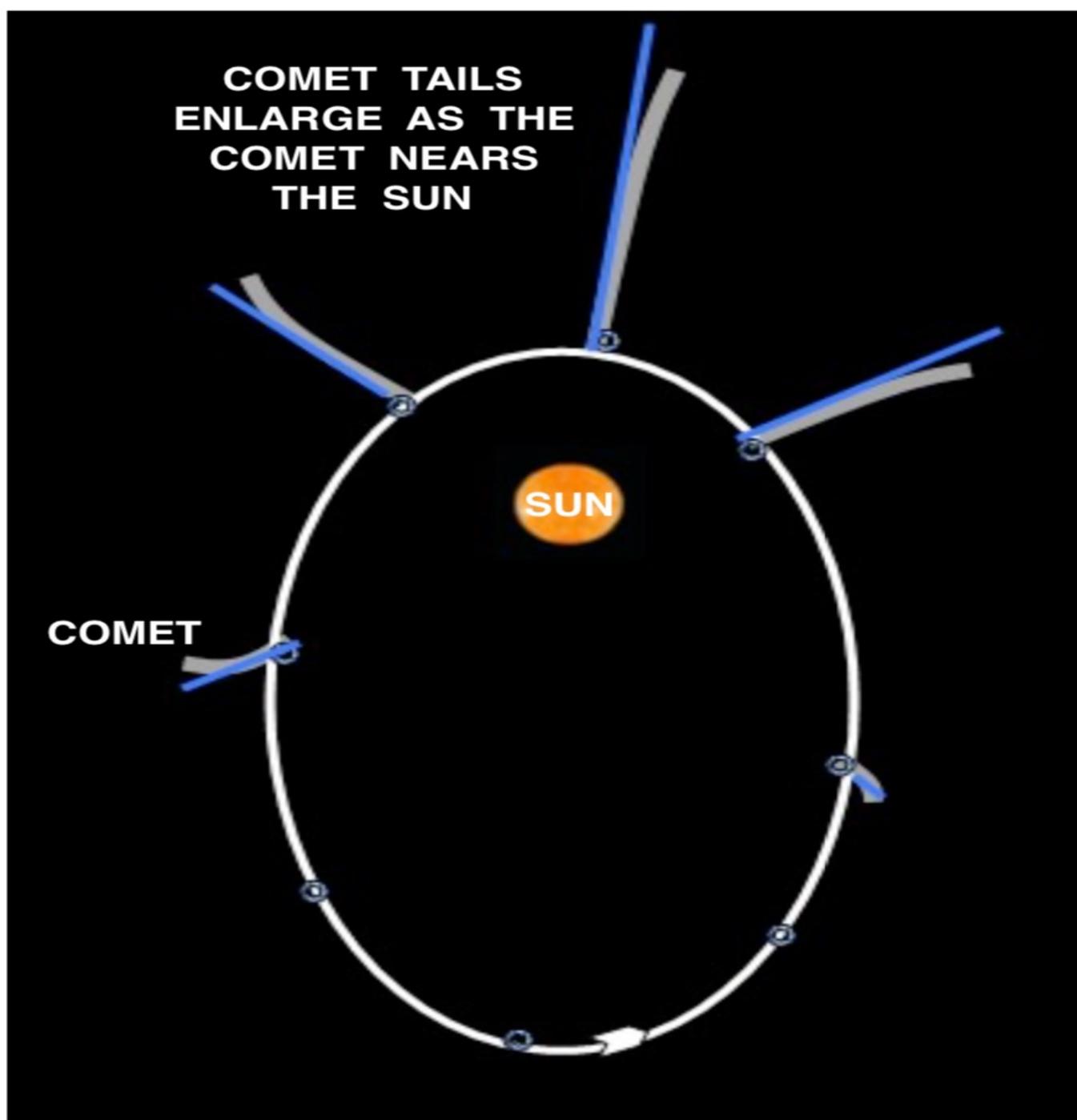
while charged particles from the sun convert some of the comet's gases into ions, forming an ion tail



Tails get longer the closer a comet gets to Sun.

Tails are always directed away from Sun. Gas (ion) tail points straight away from Sun. Dust tail curves toward orbital path.

Orbit of comet



**COMET TAILS  
ENLARGE AS THE  
COMET NEARS  
THE SUN**

**COMET FAST  
MOVING WHEN  
CLOSE TO THE  
SUN**

**COMET**

**SUN**

**COMET SLOW  
MOVING WHEN FAR  
FROM THE SUN**

kometes = 'the hairy one'



Bringers of  
doom or a  
good omen?





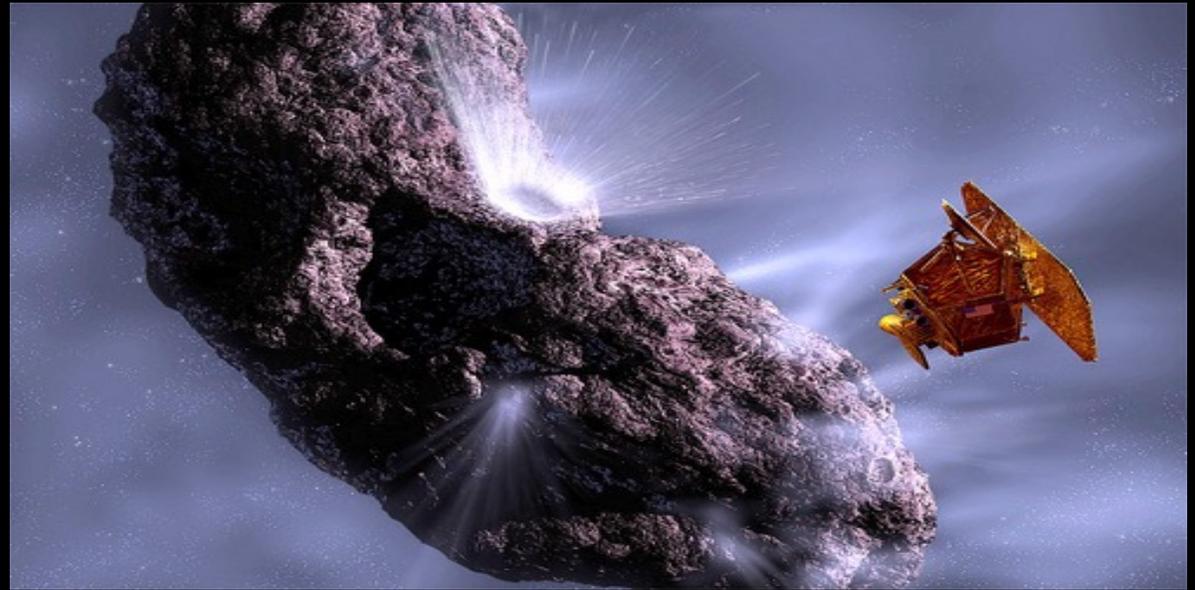
Comet Lovejoy is visible near Earth's horizon in this night time image photographed by NASA astronaut Dan Burbank, Expedition 30 commander, on board the International Space Station on Dec. 22, 2011





Giotto

Star Dust



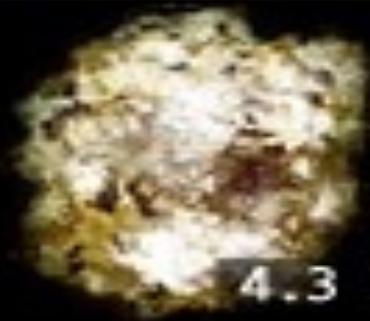
Deep Impact







# Now and Then...



4.3 Billion Years Ago

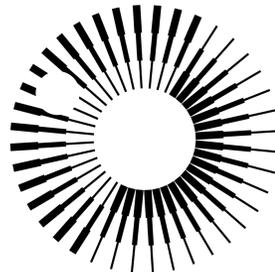


1/2 Billion Years Ago



Today





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Society



→ LONDON



Big Ben

Tower of London

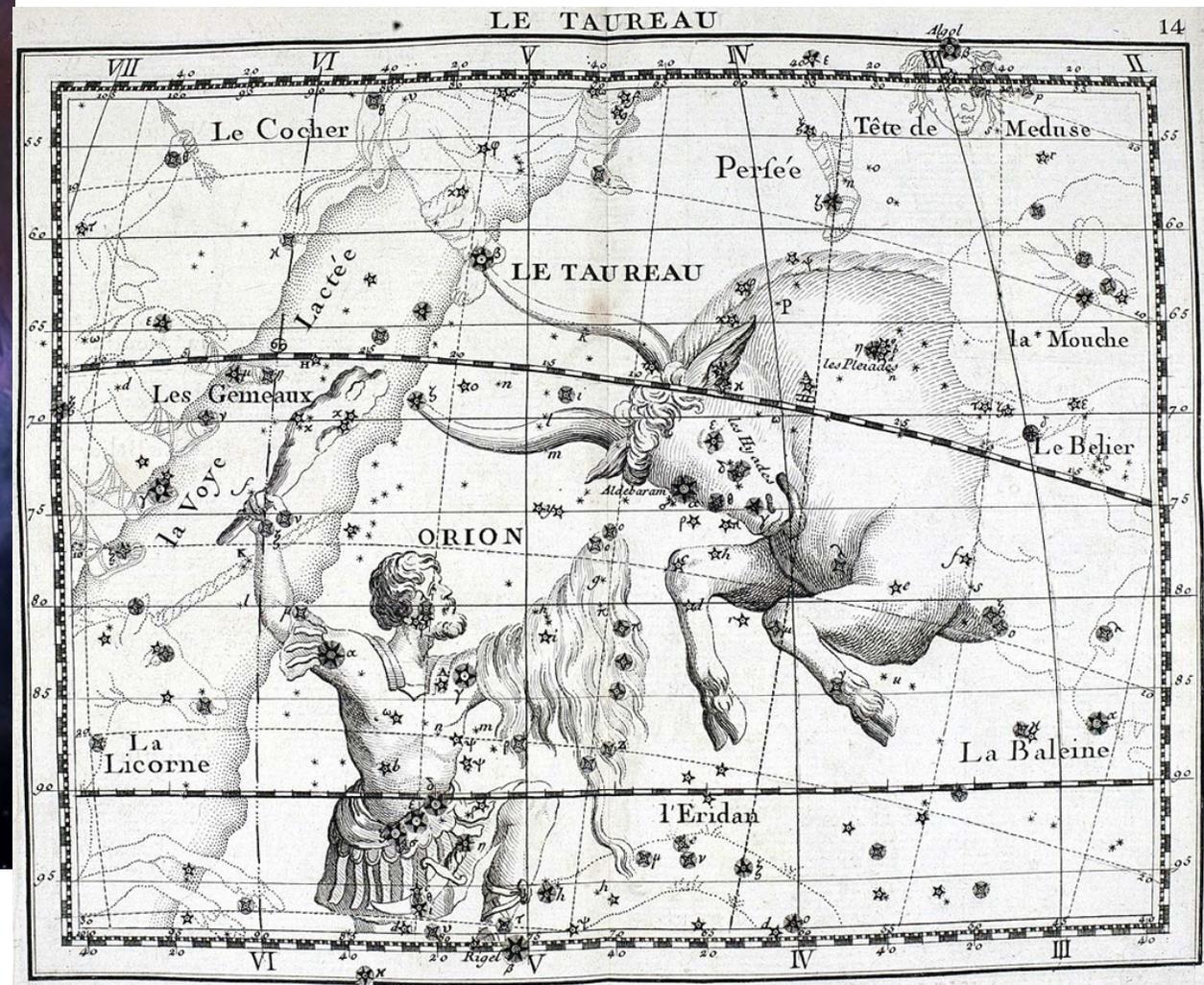
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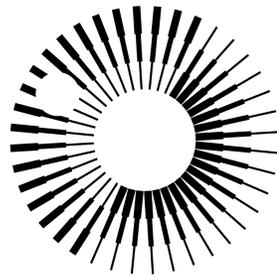


©-JDrudis-DGoldman, 2019

M42: Orion Nebula

### Orion and Taurus from John Flamsteed's Atlas Coelestis





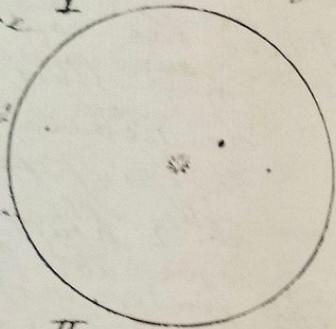
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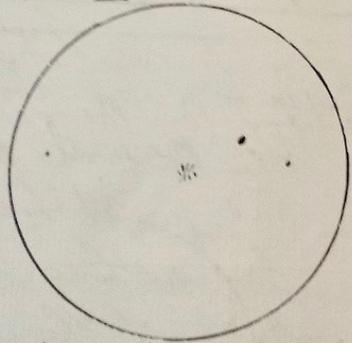
Sally Kindberg, from The Comic Book History of Space

Aug: 1<sup>st</sup> 1786. L.H. 1<sup>st</sup> Comet

9<sup>h</sup> 50' I saw the object in the center of fig 1 like a star out of focus while the others were perfectly clear. the princ. star is very faint but the weather is hazy, and in a clearer night undoubtedly some more will be visible

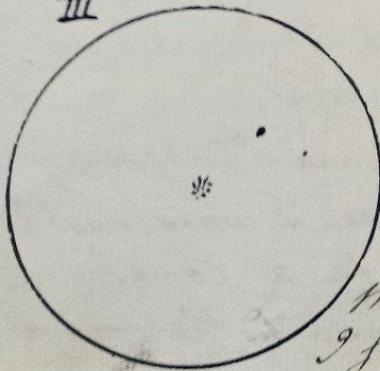


II



10<sup>h</sup> 33' They make now a perfect fee faint this figure is right

III



I think the situation is now like in Fig 3 but it is so hazy that I could only imagine I saw the second star &

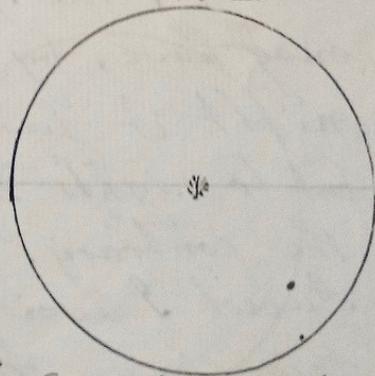
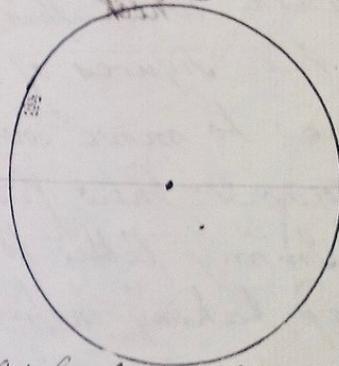
the preceding I could not see at all comet is ab. half way between 53 & 54 Ursa maj. and some stars which I found after looking over the map at leisure, to be 14. 15. & 16 Coma Ber. by the obtuse angle it makes with those stars in H. I conclude it to be ab. 1° above the parallel of the 15 of Coma.

Aug: 2 1786.

10<sup>h</sup> 9' I saw the red star in the center with the following faint one, in the same posit.

Fig I

Fig II



as last night, the comet was just

# Caroline Herschel



German/British. 1750-1848. Astronomer.

Innovation 4

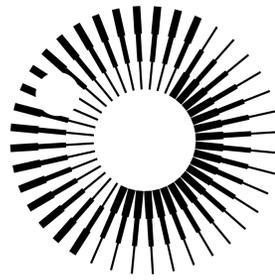
Impact 6

Obscurity 6

Badassery 6

When Caroline was 22 her brother William took her to Bath to work as his housekeeper. William trained her to become a music teacher and taught her mathematics as well as sharing his love of astronomy. Caroline worked with William on all of his astronomy projects, sometimes taking the lead in the calculations to catalogue the position of the stars. She was awarded The Royal Astronomical Society Gold Medal in 1828 for her work cataloguing nebulae, and was the first woman ever to discover a comet.

Made by the Science Hour on XpressionFM at Exeter University



Royal  
Astronomical  
Society



# Wonder Woman



## Wonder Women of History

**CAROLINE HERSCHEL**  
(1750 - 1848)

IN THE STUDY OF THE SKIES, WHERE MEN HAVE PRIMARILY DOMINATED THE FIELD, THERE GLITTERS A STAR IN THE FIRMAMENT THAT MARKS THE OUTSTANDING ACHIEVEMENTS OF CAROLINE HERSCHEL -- THE DISTAFF MEMBER OF A REMARKABLE ASTRONOMICAL FAMILY.



CAROLINE'S EARLY LIFE IN THE PROVINCE OF HANOVER, GERMANY, WAS NOT A PARTICULARLY HAPPY ONE...

MUST YOU MAKE THE POOR GIRL WORK SO HARD, DEAR? PERHAPS IF I SENT HER TO SCHOOL--

NONSENSE! EDUCATION WON'T PREPARE CAROLINE FOR LIFE--HARD HOUSE-WORK WILL!



THE YEAR 1772 MARKED A TURNING POINT IN CAROLINE'S LIFE, WHEN HER BROTHER WILLIAM SENT FOR HER TO KEEP HOUSE FOR HIM IN BATH, ENGLAND...

I'VE FOUND A NEW EXCITEMENT IN LIFE, CAROLINE -- ASTRONOMY! I'M GOING TO GIVE UP MY MUSICAL ENGAGEMENTS AND SPEND ALL MY TIME SCANNING THE SKIES!



BUT CAROLINE'S GREATEST ENJOYMENT CAME FROM HELPING HER BROTHER IN HIS ASTRONOMICAL WORK...

ACCORDING TO MY COMPUTATIONS, THERE SHOULD BE AN UNDISCOVERED PLANET BEYOND SATURN. \* TAKE DOWN THESE FIGURES, CAROLINE...



\* LATER IDENTIFIED AS THE PLANET URANUS.



# Wonder Woman



WHILE WILLIAM WAS MAKING REVOLUTIONARY OBSERVATIONS ON DOUBLE STARS, CAROLINE POLISHED HIS TELESCOPIC MIRRORS AND READ TO HIM...

I DISCOVERED AN INTERESTING NEW BOOK TODAY, CALLED FERGUSON'S ASTRONOMY. IT GIVES SOME WITHERED UNPUBLISHED INFORMATION...



UPON THE TRAGIC DEATH OF WILLIAM IN 1822, CAROLINE ABANDONED HER ASTRONOMICAL RESEARCH, AND PRESENTED ALL HER SAVINGS TO WILLIAM'S SON, JOHN -- WHO LATER WAS TO ECLIPSE EVEN HIS FATHER'S FAME AS AN ASTRONOMER.

SIR JOHN HAS JUST SENT ME HIS NEW BOOK -- A CATALOGUE OF ALL THE STARS SEEN IN THE SKIES. I'M AS THRILLED AS IF I HAD DONE THE WORK MYSELF!



IN DUE TIME, THE LURE OF THE STARS TOOK HOLD OF CAROLINE AND SHE MADE SOME IMPORTANT ASTRONOMICAL 'DISCOVERIES' IN HER OWN RIGHT. USING A NEWTONIAN TELESCOPE, SHE DETECTED THREE PREVIOUSLY UNDISCOVERED NEBULAE AND PLOTTED THE COURSES OF EIGHT NEW COMETS...



UPON HER DEATH IN 1848 -- AT THE AGE OF 98 -- SHE WAS HONORED BY ALL THE GREAT MEN OF EUROPE...

HER FAME WILL LIVE IN THE STARS. SHE WAS ONE OF THE GREAT WOMEN OF OUR TIME!



FROM A HUMBLE BEGINNING, IN WHICH THE BENEFITS OF EDUCATION WERE DENIED HER, CAROLINE HERSCHEL GRASPED A FORTUNATE OPPORTUNITY TO MAKE HER MARK IN THE WORLD. AMBITIOUS, INDUSTRIOUS, SHE SET HER COURSE IN THE STARS AND WAS REVERED AS "ONE OF THE CLEVEREST AND MOST LOVABLE WOMEN THAT EVER LIVED." ACCORDINGLY, A PROMINENT PLACE AMONG THE WONDER WOMEN OF HISTORY IS SET ASIDE FOR CAROLINE HERSCHEL.

*Diana Prince*  
WONDER WOMAN

ADVERTISEMENT

## RIDDLE ME THIS by Necco

WHAT HAS A BED BUT NEVER SLEEPS AND A BANK BUT NEVER SAVES?

GIVE UP? SEE BELOW\*



\* ANSWER: A RIVER

WHAT CANDY TREAT CAN YOU ALWAYS BANK ON FOR DEE-LICIOUS ENJOYMENT?

ANSWER... Necco WAFERS!



8 DELICIOUS FLAVORS!



ical

DC Wonder Woman comic strip featuring Caroline Herschel

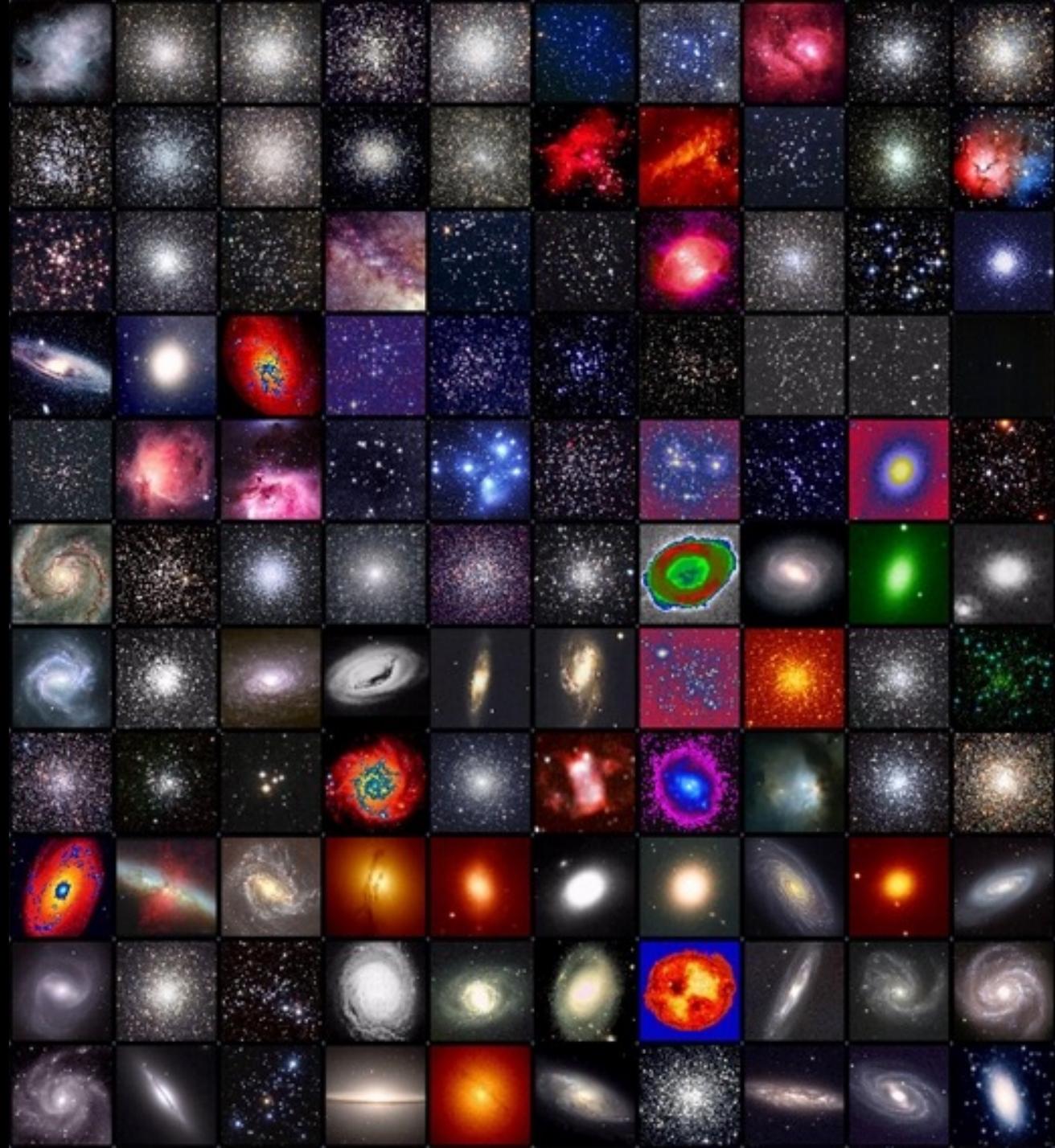
Comet 2P Encke, a periodic comet which Caroline observed on November 7, 1795 © 2003 by Gerald Rhemann and Michael Jäger

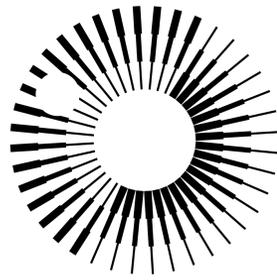


NGC 253, which Caroline discovered



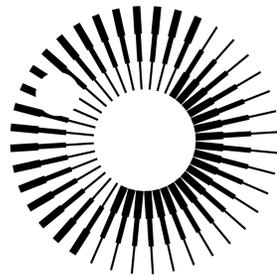
A comic poking fun at Caroline “smelling out” a comet. At the time of its publishing, she was by far the most famous female astronomer in the world.





# Royal Astronomical Society

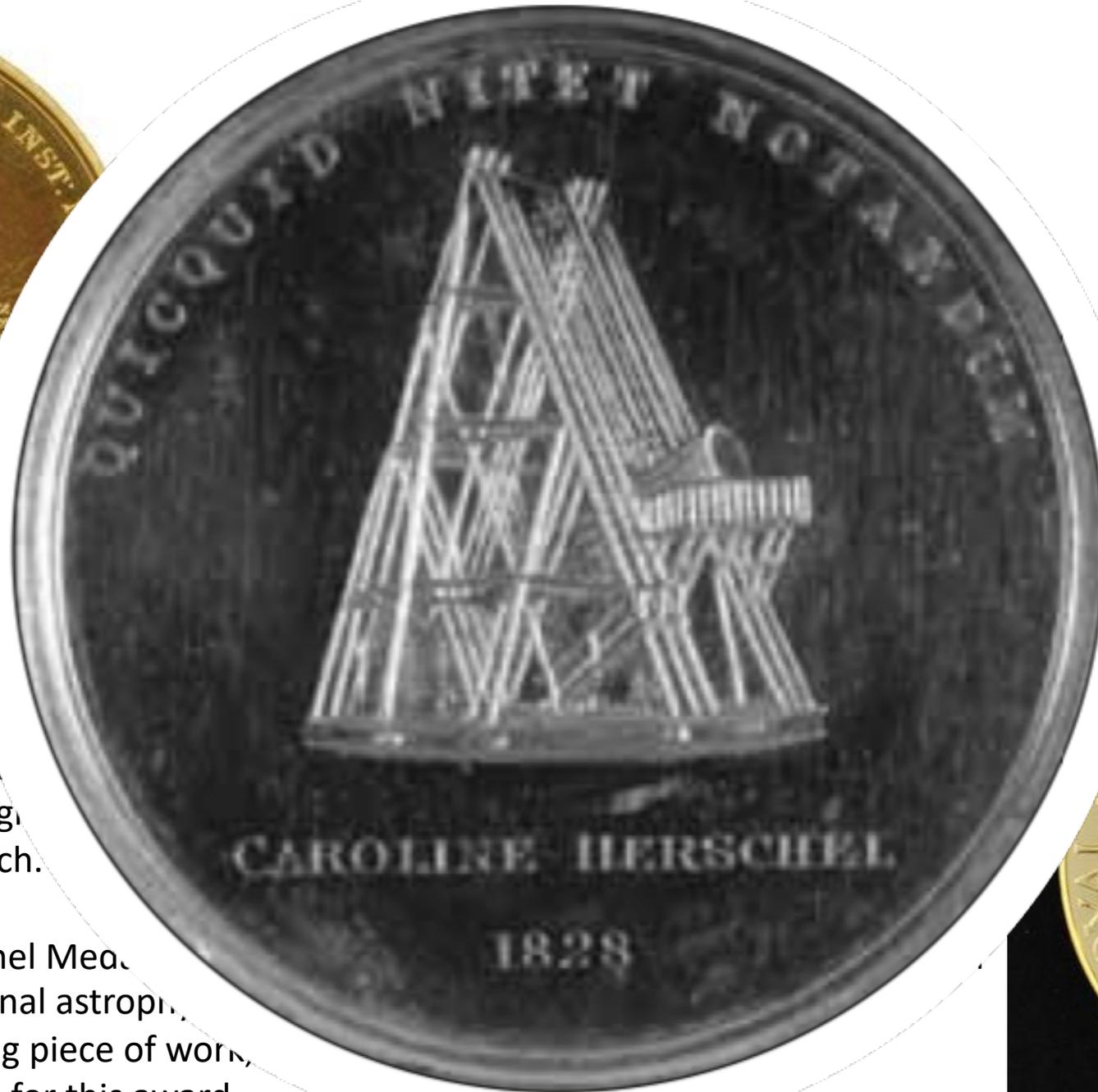
Caroline Herschel at 78, one year after  
winning the Gold Medal of the Royal  
Astronomical Society in 1828



Royal  
Astronomical  
Society

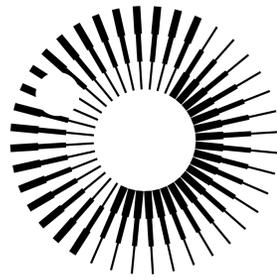


The Gold Medal is the highest honor of the Society. It is awarded by the Council complete freedom of action. In the past the Council has taken no action in the fields of astronomy, but it has often been awarded as recognition for a specific piece of research.



The Herschel Medal is awarded for an outstanding piece of work in observational astronomy. Candidates for this award.





# Royal Astronomical Society



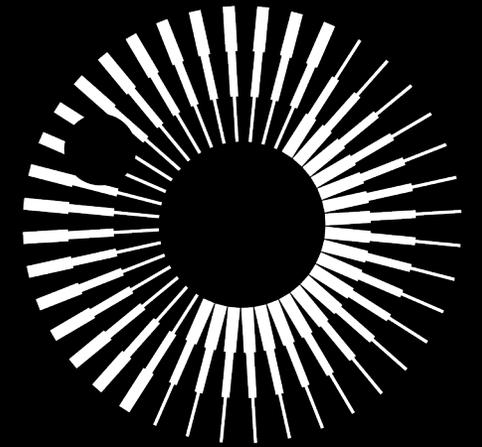
1847 lithograph of Caroline Herschel around 97 years of age.

(Caroline Herschel, geb. d. 16ten März 1750.  
Nach dem Leben gez. und gest. v. G. Busse,  
Hannover 1847)

Google







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Astronomical  
Society

# On Caroline and Comets

Dr Sheila Kanani