ASTRONOMICAL SOCIETY OF SOUTHERN AFRICA

Durban 'nDaba

Monthly Newsletter of the Durban Centre - February 2020

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Member Submissions Disclaimer

The views expressed in 'nDaba are solely those of the writer and are not necessarily the views of the ASSA Durban Centre, nor that of the Editor.

Chairman's Chatter

By Piet Strauss

Dear members,

We are now into the shortest month of the year, this year with an extra day. Did you know that, even in a leap year, we cannot have a "Blue Moon" ever in February? If you are interested you can read more facts on https://www.space.com/15455-blue-moon.html.

What we will have is a perigee moon on 10 February when it is 360 500 km from earth. It moves even closer in March and April, the largest full moon this year occurring on 8 April when it will be 357 034 km away. If you have not done it yet, try to take a photo of the full moon rising with a person or landscape in the foreground and see the amazing optical illusion.

Our "new" telescope is being installed in the dome with the help of John Gill and John Visser. We thank you for this and look forward to our first viewing. The date will be announced soon.

Our main speaker at the next meeting on 12 February will be one of our members, Prof Francesco Petruccione. As you know, he is heading up the Quantum Research Group at UKZN. We look forward to hearing more about the amazing world of Quantum Physics. We will have another member talking to us soon and will reveal more in due course. If you would like to give a talk to members or have any suggestions, please let me know. We try to cover a variety of subjects to cater for all interests.

Our trip to Sutherland is now finalised as detailed in the previous "Chatter". We have a group of 24 leaving on Friday 24 April, the day after new moon. The sky in Sutherland promises to be magnificent. This is of course if they do not get some desperately needed rain.

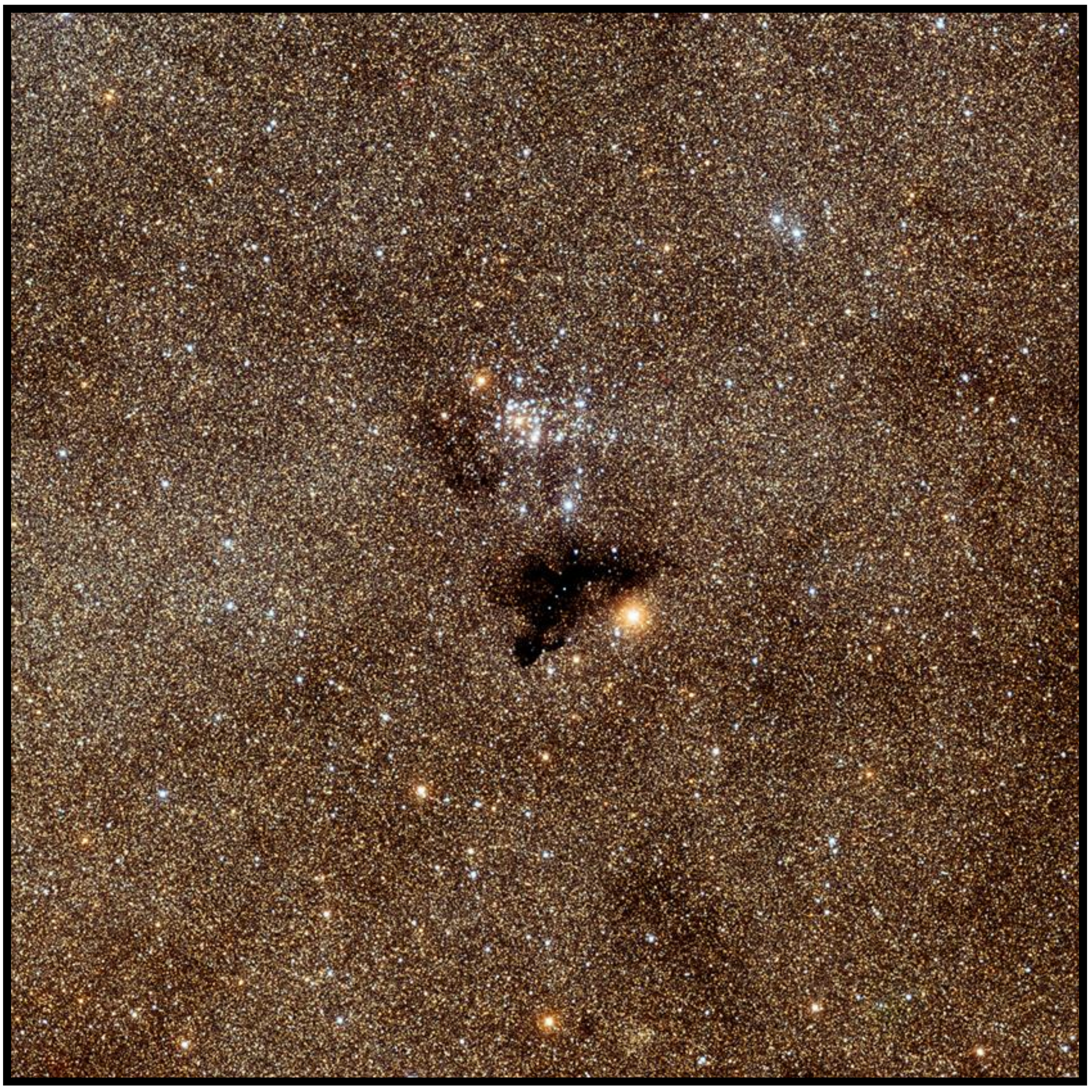
Clear skies,

Piet

The moon from Perth, taken by Peter Dormehl with a handheld Nikon P510

The Castaway Cluster

By Brian Ventrudo



The open star cluster NGC 6520, the “Castaway Cluster”, and the dark foreground nebula Barnard 86. Credit: NOAO

The Castaway Cluster, catalogued as NGC 6520, is located just above the spout in the “Teapot” of Sagittarius. This is a rich region of the Milky Way containing many gas clouds and star clusters, including the Lagoon and Trifid Nebulae. NGC 6520, a tiny jewel of a cluster, is often forgotten amongst these more famous sites

NGC 6520 is easy to find… just 3 degrees or so north of Alnasl, the star at the tip of the spout in the Teapot. Just west of the cluster, in good sky, you can also see the conspicuous dark nebula Barnard 86.

This open cluster is only 800 million years old and contains many hot blue stars. Within the field of view, you will also see bright red stars that are likely not associated with the cluster but simply share the same line of sight.

The Castaway Cluster is some 5,300 light years from Earth. Its 60 or so stars span 8 light years. On a good night, you’ll see perhaps 15-30 of these stars in a small scope.

… The Castaway Cluster

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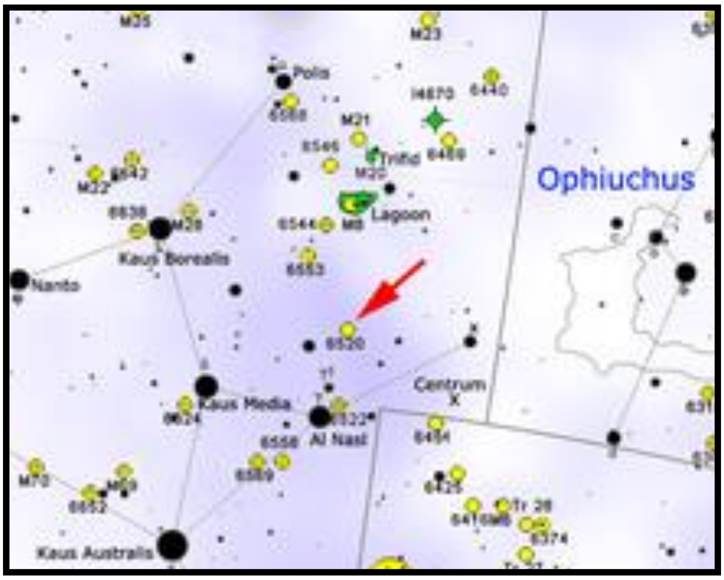
The Castaway Cluster is some 5,300 light years from Earth. Its 60 or so stars span 8 light years. On a good night, you'll see perhaps 15-30 of these stars in a small scope.

NGC 6520 is also a distant cluster. That means it appears quite tiny in our skies. While you can see it in binoculars, you'll need a telescope with at least 150-200x to resolve this tight family of fairly new stars. The dark splotch of Barnard 86 is located between the cluster and the bright star to the west. Try averted vision… you may see more dark nebulae.

The Castaway Cluster was so named by astronomy writer Stephen J. O'Meara because it looks like a tiny island in a tempestuous sea of stars. It reminded him of the story of the castaway Robinson Crusoe, shipwrecked on a small island near the coast of Venezuela in 1659.



NGC 6520 & B86

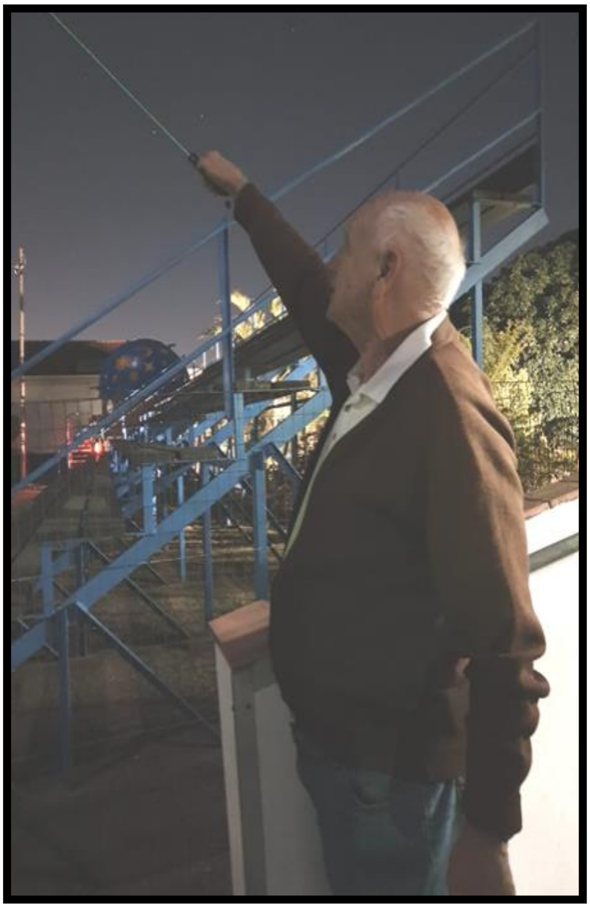
NGC 6520

Observation data (J2000 epoch)	
Constellation	Sagittarius
Right ascension	$18^h\ 3.4^m$[1]
Declination	−27° 53′[1]
Apparent magnitude (V)	9.0
Apparent dimensions (V)	5′

Coordinates: $18^h\ 03^m\ 24^s$, −27° 53′ 00″

At The Eyepiece

February by Ray Field



The MOON is First quarter on the 2nd, Full on the 10th, Last quarter on the 16th and New on the 23rd. The Moon is near Aldebaran on the 4th, the Beehive Cluster, M44, in Cancer on the 8th, Mars on the 18th, Jupiter on the 19th and Saturn on the 20th. On the 27th the Moon is near Venus in the evening twilight, but very low down.

MERCURY can be seen low over the West in the evening twilight until the middle of the month. After that it will be too close to the Sun for observation.

VENUS sets about 2 hours after the Sun this month. Its phases can easily be seen in a telescope. The Moon is near Venus on the 27th.

MARS is a very bright object over the East this month at dawn. The Moon will be near Mars on the 18th. Mars, orange-red in colour, will brighten this year, until it is brighter than Jupiter between mid-September and early November.

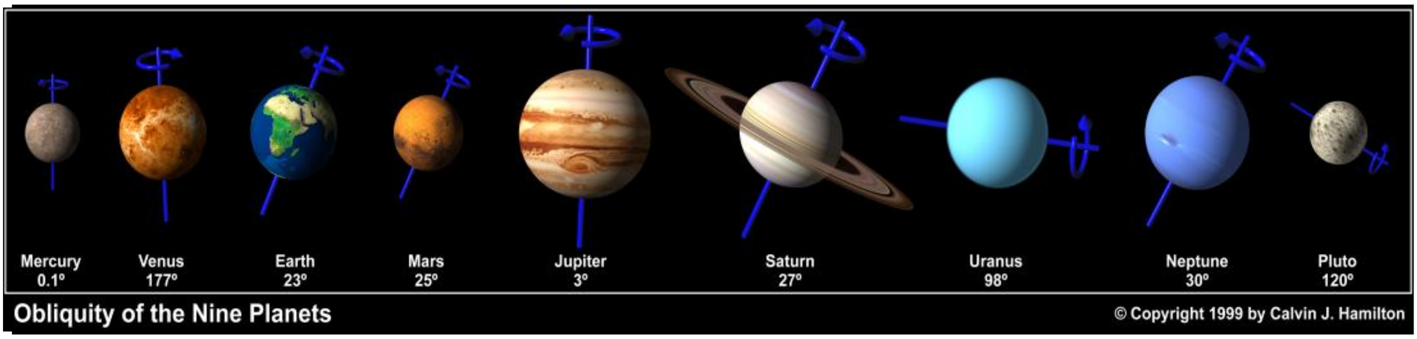
JUPITER, in Sagittarius in the morning sky, rises at about 03:00 on the 1st and at 01:00 at the end of the month. All four Galilean moons are on the same side on the 12th and 26th of the month. The Moon is near Jupiter on the 19th.

SATURN, also in the morning sky over the East, rises at 04:00on the 1st and at 02:30 on the 29th. It is about as bright as Mars looks now. Later in the year Saturn will be more suitably placed for observation in the evening sky. The Moon is near Saturn on the 20th.

URANUS, in Aries, is barely visible to the naked eye. It sets at 23:00 on the 1st and at 21:00 on the 29th. Uranus is about 19 times as far from the Sun as the Earth is.

NEPTUNE, in Aquarius, is too near the Sun for observation this month. It is even fainter than Uranus and is 30 times further from the Sun than the Earth is.

COMETS, there are no known bright comets predicted to be visible this month from South Africa. See page 85 of the Sky Guide 2020 for more details.



… At The Eyepiece

METEOR SHOWERS:

a.Centaurids duration 28 January to 21 February with a maximum on 7 Feb. The ZHR is 5 and starting time is 22:00 to 03:30 but with unfavourable viewing. The Gamma Normids duration is from 25 February to 22 March and a ZHR of 8. The starting time is 00:00 to 04:30 but with poor observing prospects.

The starry sky, as seen from Durbanat 21:00 mid-month. The Southern Cross rising over the Southeast whilst Orionis high over the North-west. Canis Major, with its bright star Sirius, is to Orion's right. Leo, the lion, is low over the North-east. The three crosses region lies above the Southern Cross and the Pointers. Canopus, the second brightest star in the sky, is well up over the South. Achenar is starting to sink towards the South-west horizon. Taurus with its Hyades and Pleiades clusters is low over the North-west.

References include: ASSA Sky Guide 2020 for Africa South, Philips Planisphere for 35°South and Norton Star Atlas and Handbook .

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10 Minutes of Space and Time

By John Gill

For all the insomniacs or early risers, on the 11 February at 04:48, the ISS will make an appearance over the horizon close to Canopus in the SSW. The International Space Station has a magnitude of about -1.66 and an altitude of around 430km/h. At 04:50 the ISS will pass in front of 47 Tucana and at 04:53 it will be just below Saturn while Jupiter is a little higher up. At 04:56 the ISS will disappear near to the star Altair in the East and at 04:58 the Sun will be rising.

The Cover Image – NGC 3532

Image by John Gill

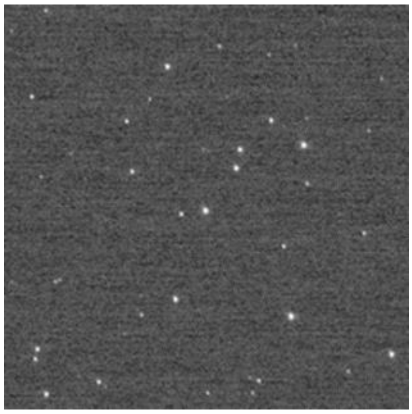
NGC 3532 (Caldwell 91), also commonly known as the Pincushion Cluster, Football Cluster, and the Wishing Well Cluster, is an open cluster some 405 parsecs from Earth in the constellation Carina. Its population of approximately 150 stars of 7th magnitude or fainter includes seven red giants and seven white dwarfs. On 20 May 1990 it became the first target ever observed by the Hubble Space Telescope. A line from Beta Crucis through Delta Crucis passes somewhat to the north of NGC 3532. The cluster lies between the constellation Crux and the larger but fainter "False Cross" asterism. The 4th-magnitude Cepheid variable star x Carinae (V382 Car) appears near the southeast fringes, but it lies between the Sun and the cluster and is not a member of the cluster.

The cluster was first catalogued by Nicolas Louis de Lacaille in 1751. It was admired by John Herschel, who thought it one of the finest star clusters in the sky, with many double stars (binary stars).

NGC 3532

Observation data (J2000 epoch)	
Constellation	Carina
Right ascension	$11^h\ 05^m\ 33^s$
Declination	−58° 43.8′
Distance	1,321 ly (405 pc)
Physical characteristics	
Other designations	NGC 3532, C 1104-584, Cl* 1104-584, CL 1104-584, Caldwell 91, Melotte 103, name=DOCdb-LacII10/> Lacaille II.10, Lac II.10, Football Cluster, Wishing Well Cluster.

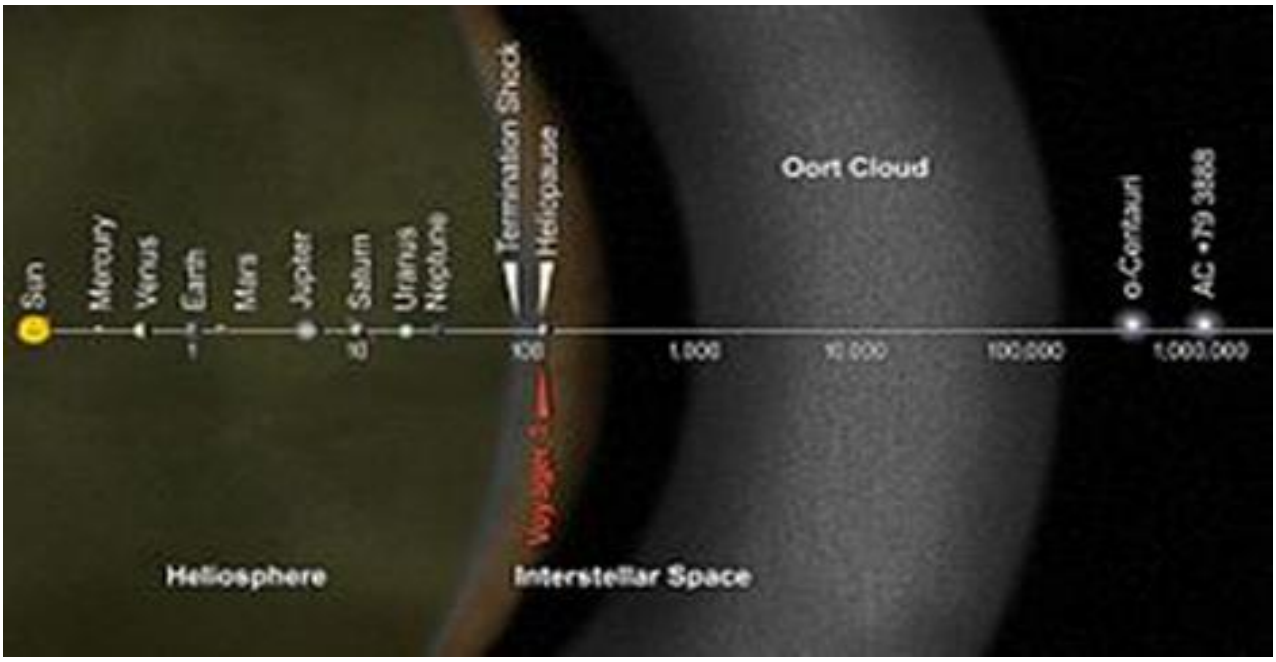
The above is the first light image for the Wide Field and Planetary Camera of the Hubble Space Telescope, taken in May 1990; this view is near star HD96755 in the open cluster NGC 3532. This view is 11 by 14 arcseconds of the sky



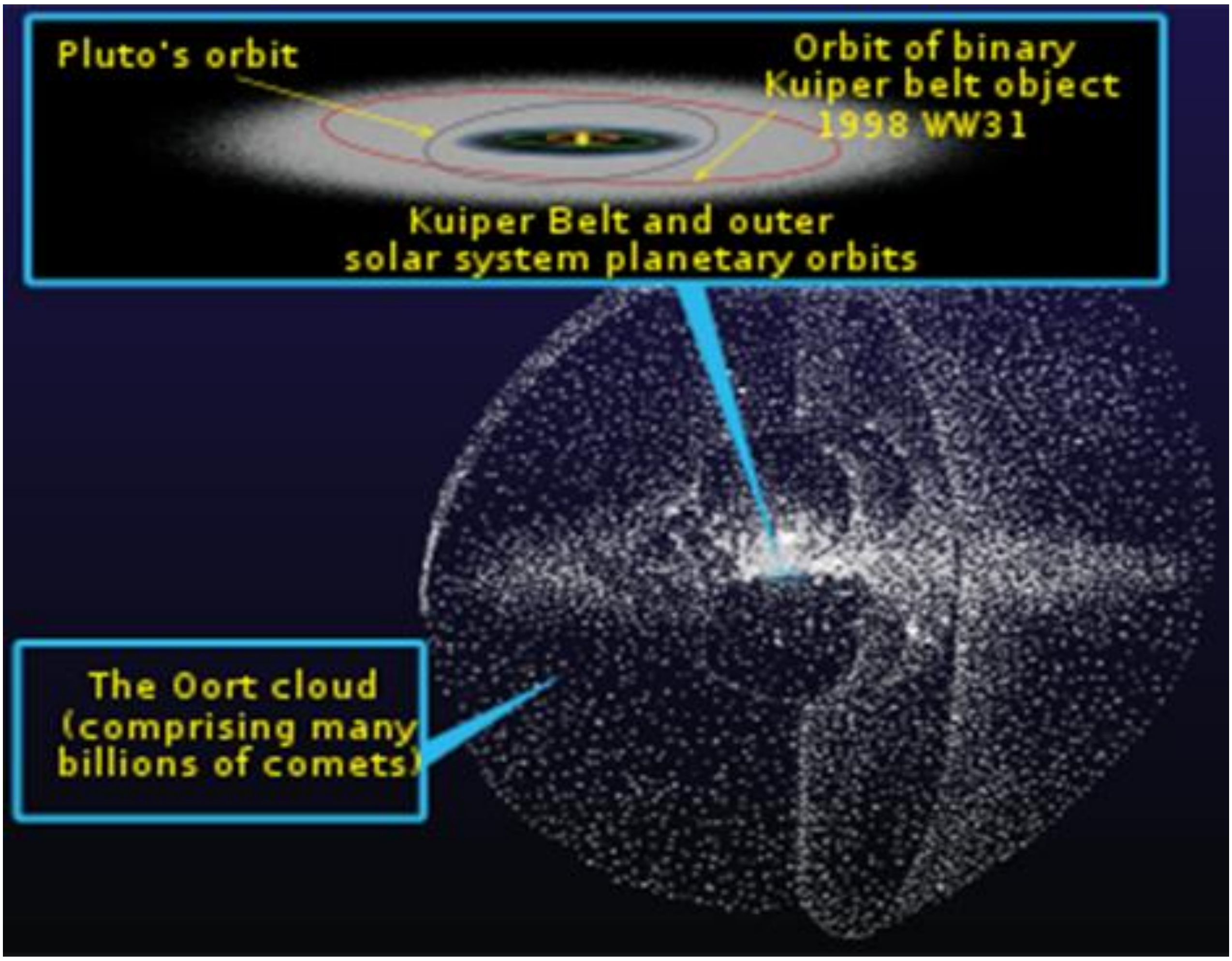
The above is the New Horizons image, taken with the LORRI instrument and captured on December 5, 2017, broke the record for an image taken at the greatest distance from Earth, surpassing Pale Blue Dot taken by Voyager 1.

The Oort Cloud

From Wikipedia, the free encyclopedia



The distance from the Oort cloud to the interior of the Solar System, and two of the nearest stars, is measured in astronomical units. The scale is logarithmic; each indicated distance is ten times farther out than the previous distance. The red arrow indicates the location of the space probe Voyager 1, which will reach the Oort cloud in about 300 years



An artist's impression of the Oort cloud and the Kuiper belt (inset); the sizes of objects are over-scaled for visibility.

… The Oort Cloud

The Oort cloud (/ɔːrt, ʊərt/), named after the Dutch astronomer Jan Oort, sometimes called the Öpik–Oort cloud, is a theoretical cloud of predominantly icy planetesimals proposed to surround the Sun at distances ranging from 2,000 to 200,000 au (0.03 to 3.2 light-years). It is divided into two regions: a disc-shaped inner Oort cloud (or Hills cloud) and a spherical outer Oort cloud. Both regions lie beyond the heliosphere and in interstellar space. The Kuiper belt and the scattered disc, the other two reservoirs of trans-Neptunian objects, are less than one thousandth as far from the Sun as the Oort cloud.

The outer limit of the Oort cloud defines the cosmographical boundary of the Solar System and the extent of the Sun's Hill sphere. The outer Oort cloud is only loosely bound to the Solar System, and thus is easily affected by the gravitational pull both of passing stars and of the Milky Way itself. These forces occasionally dislodge comets from their orbits within the cloud and send them toward the inner Solar System. Based on their orbits, most of the short-period comets may come from the scattered disc, but some may still have originated from the Oort cloud.

Astronomers conjecture that the matter composing the Oort cloud formed closer to the Sun and was scattered far into space by the gravitational effects of the giant planets early in the Solar System's evolution. Although no confirmed direct observations of the Oort cloud have been made, it may be the source of all long-period and Halley-type comets entering the inner Solar System, and many of the centaurs and Jupiter-family comets as well.

The existence of the Oort cloud was first postulated by Estonian astronomer Ernst Öpik in 1932. Oort independently proposed it in 1950.

Hypothesis

There are two main classes of comet: short-period comets (also called ecliptic comets) and long-period comets (also called nearly isotropic comets). Ecliptic comets have relatively small orbits, below 10 au, and follow the ecliptic plane, the same plane in which the planets lie. All long-period comets have very large orbits, on the order of thousands of au, and appear from every direction in the sky.

A.O. Leuschner in 1907 suggested that many comets believed to have parabolic orbits, and thus making single visits to the solar system, actually had elliptical orbits and would return after very long periods. In 1932 Estonian astronomer Ernst Öpik postulated that long-period comets originated in an orbiting cloud at the outermost edge of the Solar System. Dutch astronomer Jan Oort independently revived the idea in 1950 as a means to resolve a paradox:

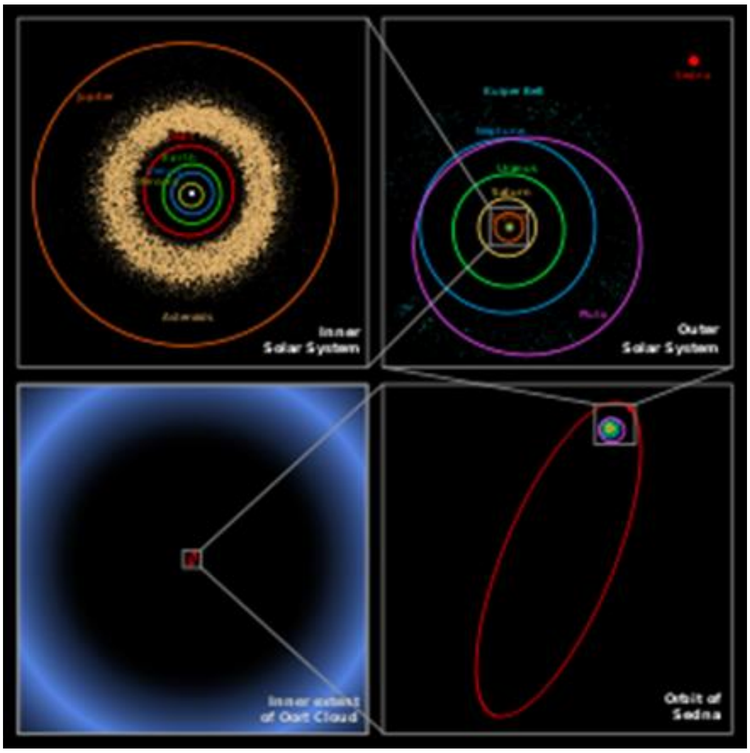
Over the course of the Solar System's existence the orbits of comets are unstable, and eventually dynamics dictate that a comet must either collide with the Sun or a planet or be ejected from the Solar System by planetary perturbations.

Moreover, their volatile composition means that as they repeatedly approach the Sun, radiation gradually boils the volatiles off until the comet splits or develops an insulating crust that prevents further outgassing.

Thus, Oort reasoned, a comet could not have formed while in its current orbit and must have been held in an outer reservoir for almost all of its existence. He noted that there was a peak in numbers of long-period comets with aphelia (their farthest distance from the Sun) of roughly 20,000 au, which suggested a reservoir at that distance with a spherical, isotropic distribution. Those relatively rare comets with orbits of about 10,000 au have probably gone through one or more orbits through the Solar System and have had their orbits drawn inward by the gravity of the planets.

… The Oort Cloud

Structure and composition



The presumed distance of the Oort cloud

The Oort cloud is thought to occupy a vast space from somewhere between 2,000 and 5,000 au (0.03 and 0.08 ly) to as far as 50,000 au (0.79 ly) from the Sun. Some estimates place the outer edge at between 100,000 and 200,000 au (1.58 and 3.16 ly). The region can be subdivided into a spherical outer Oort cloud of 20,000–50,000 au (0.32–0.79 ly), and a torus-shaped inner Oort cloud of 2,000–20,000 au (0.0–0.3 ly). The outer cloud is only weakly bound to the Sun and supplies the long-period (and possibly Halley-type) comets to inside the orbit of Neptune. The inner Oort cloud is also known as the Hills cloud, named after Jack G. Hills, who proposed its existence in 1981. Models predict that the inner cloud should have tens or hundreds of times as many cometary nuclei as the outer halo; it is seen as a possible source of new comets to resupply the tenuous outer cloud as the latter's numbers are gradually depleted. The Hills cloud explains the continued existence of the Oort cloud after billions of years.

The outer Oort cloud may have trillions of objects larger than 1 km (0.62 mi), and billions with absolute magnitudes brighter than 11 (corresponding to approximately 20-kilometre (12 mi) diameter), with neighboring objects tens of millions of kilometres apart. Its total mass is not known, but, assuming that Halley's Comet is a suitable prototype for comets within the outer Oort cloud, roughly the combined mass is $3×10^{25}$ kilograms ($6.6×10^{25}$ lb), or five times that of Earth. Earlier it was thought to be more massive (up to 380 Earth masses), but improved knowledge of the size distribution of long-period comets led to lower estimates. No known estimates of the mass of the inner Oort cloud have been published.

If analyses of comets are representative of the whole, the vast majority of Oort-cloud objects consist of ices such as water, methane, ethane, carbon monoxide and hydrogen cyanide. However, the discovery of the object 1996 PW, an object whose appearance was consistent with a D-type asteroid in an orbit typical of a long-period comet, prompted theoretical research that suggests that the Oort cloud population consists of roughly one to two percent asteroids.

Analysis of the carbon and nitrogen isotope ratios in both the long-period and Jupiter-family comets shows little difference between the two, despite their presumably vastly separate regions of origin. This suggests that both originated from the original protosolar cloud, a conclusion also supported by studies of granular size in Oort-cloud comets and by the recent impact study of Jupiter-family comet Tempel 1.

… The Oort Cloud

Origin

The Oort cloud is thought to have developed after the formation of planets from the primordial protoplanetary disc approximately 4.6 billion years ago. The most widely accepted hypothesis is that the Oort cloud's objects initially coalesced much closer to the Sun as part of the same process that formed the planets and minor planets. After formation, strong gravitational interactions with young gas giants, such as Jupiter, scattered the objects into extremely wide elliptical or parabolic orbits that were subsequently modified by perturbations from passing stars and giant molecular clouds into long-lived orbits detached from the gas giant region.

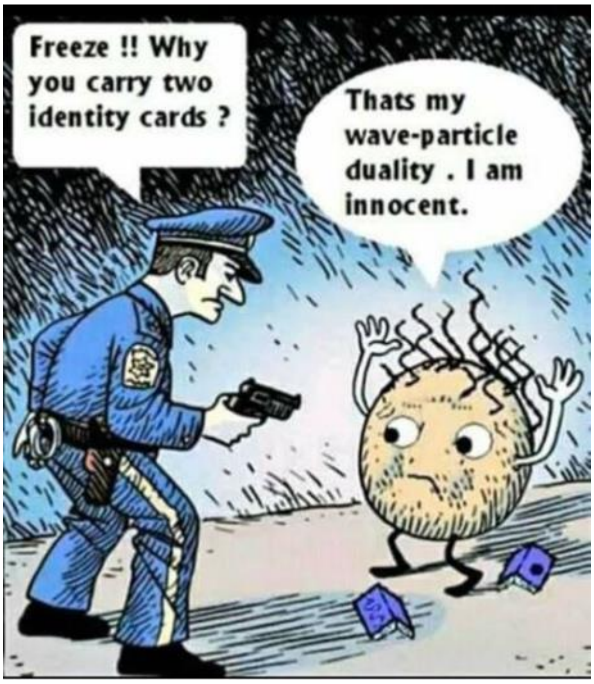
Recent research has been cited by NASA hypothesizing that a large number of Oort cloud objects are the product of an exchange of materials between the Sun and its sibling stars as they formed and drifted apart and it is suggested that many—possibly the majority—of Oort cloud objects did not form in close proximity to the Sun. Simulations of the evolution of the Oort cloud from the beginnings of the Solar System to the present suggest that the cloud's mass peaked around 800 million years after formation, as the pace of accretion and collision slowed and depletion began to overtake supply.

Models by Julio Ángel Fernández suggest that the scattered disc, which is the main source for periodic comets in the Solar System, might also be the primary source for Oort cloud objects. According to the models, about half of the objects scattered travel outward toward the Oort cloud, whereas a quarter are shifted inward to Jupiter's orbit, and a quarter are ejected on hyperbolic orbits. The scattered disc might still be supplying the Oort cloud with material. A third of the scattered disc's population is likely to end up in the Oort cloud after 2.5 billion years.

Computer models suggest that collisions of cometary debris during the formation period play a far greater role than was previously thought. According to these models, the number of collisions early in the Solar System's history was so great that most comets were destroyed before they reached the Oort cloud. Therefore, the current cumulative mass of the Oort cloud is far less than was once suspected. The estimated mass of the cloud is only a small part of the 50–100 Earth masses of ejected material.

Gravitational interaction with nearby stars and galactic tides modified cometary orbits to make them more circular. This explains the nearly spherical shape of the outer Oort cloud. On the other hand, the Hills cloud, which is bound more strongly to the Sun, has not acquired a spherical shape. Recent studies have shown that the formation of the Oort cloud is broadly compatible with the hypothesis that the Solar System formed as part of an embedded cluster of 200–400 stars. These early stars likely played a role in the cloud's formation, since the number of close stellar passages within the cluster was much higher than today, leading to far more frequent perturbations.

In June 2010 Harold F. Levison and others suggested on the basis of enhanced computer simulations that the Sun "captured comets from other stars while it was in its birth cluster." Their results imply that "a substantial fraction of the Oort cloud comets, perhaps exceeding 90%, are from the protoplanetary discs of other stars."



… The Oort Cloud

Comets

Comet Hale–Bopp, an archetypical Oort-cloud comet

Comets are thought to have two separate points of origin in the Solar System. Short-period comets (those with orbits of up to 200 years) are generally accepted to have emerged from either the Kuiper belt or the scattered disc, which are two linked flat discs of icy debris beyond Neptune's orbit at 30 au and jointly extending out beyond 100 au from the Sun. Long-period comets, such as comet Hale–Bopp, whose orbits last for thousands of years, are thought to originate in the Oort cloud. The orbits within the Kuiper belt are relatively stable, and so very few comets are thought to originate there. The scattered disc, however, is dynamically active, and is far more likely to be the place of origin for comets. Comets pass from the scattered disc into the realm of the outer planets, becoming what are known as centaurs. These centaurs are then sent farther inward to become the short-period comets.

There are two main varieties of short-period comet: Jupiter-family comets (those with semi-major axes of less than 5 AU) and Halley-family comets. Halley-family comets, named for their prototype, Halley's Comet, are unusual in that although they are short-period comets, it is hypothesized that their ultimate origin lies in the Oort cloud, not in the scattered disc. Based on their orbits, it is suggested they were long-period comets that were captured by the gravity of the giant planets and sent into the inner Solar System. This process may have also created the present orbits of a significant fraction of the Jupiter-family comets, although the majority of such comets are thought to have originated in the scattered disc.

Oort noted that the number of returning comets was far less than his model predicted, and this issue, known as "cometary fading", has yet to be resolved. No dynamical process are known to explain the smaller number of observed comets than Oort estimated. Hypotheses for this discrepancy include the destruction of comets due to tidal stresses, impact or heating; the loss of all volatiles, rendering some comets invisible, or the formation of a non-volatile crust on the surface. Dynamical studies of hypothetical Oort cloud comets have estimated that their occurrence in the outer-planet region would be several times higher than in the inner-planet region. This discrepancy may be due to the gravitational attraction of Jupiter, which acts as a kind of barrier, trapping incoming comets and causing them to collide with it, just as it did with Comet Shoemaker–Levy 9 in 1994. An example of typical Oort cloud comet could be C/2018 F4.

Tidal effects

Most of the comets seen close to the Sun seem to have reached their current positions through gravitational perturbation of the Oort cloud by the tidal force exerted by the Milky Way. Just as the Moon's tidal force deforms Earth's oceans, causing the tides to rise and fall, the galactic tide also distorts the orbits of bodies in the outer Solar System. In the charted regions of the Solar System, these effects are negligible compared to the gravity of the Sun, but in the outer reaches of the system, the Sun's gravity is weaker and the gradient of the Milky Way's gravitational field has substantial effects. Galactic tidal forces stretch the cloud along an axis directed toward the galactic centre and compress it along the other two axes; these small perturbations can shift orbits in the Oort cloud to bring objects close to the Sun. The point at which the Sun's gravity concedes its influence to the galactic tide is called the tidal truncation radius. It lies at a radius of 100,000 to 200,000 au, and marks the outer boundary of the Oort cloud.

… The Oort Cloud

Some scholars theorise that the galactic tide may have contributed to the formation of the Oort cloud by increasing the perihelia (smallest distances to the Sun) of planetesimals with large aphelia (largest distances to the Sun). The effects of the galactic tide are quite complex, and depend heavily on the behaviour of individual objects within a planetary system. Cumulatively, however, the effect can be quite significant: up to 90% of all comets originating from the Oort cloud may be the result of the galactic tide. Statistical models of the observed orbits of long-period comets argue that the galactic tide is the principal means by which their orbits are perturbed toward the inner Solar System.

Stellar perturbations and stellar companion hypotheses

Besides the galactic tide, the main trigger for sending comets into the inner Solar System is thought to be interaction between the Sun's Oort cloud and the gravitational fields of nearby stars or giant molecular clouds. The orbit of the Sun through the plane of the Milky Way sometimes brings it in relatively close proximity to other stellar systems. For example, it is hypothesized that 70 thousand years ago, perhaps Scholz's star passed through the outer Oort cloud (although its low mass and high relative velocity limited its effect). During the next 10 million years the known star with the greatest possibility of perturbing the Oort cloud is Gliese 710. This process could also scatter Oort cloud objects out of the ecliptic plane, potentially also explaining its spherical distribution.

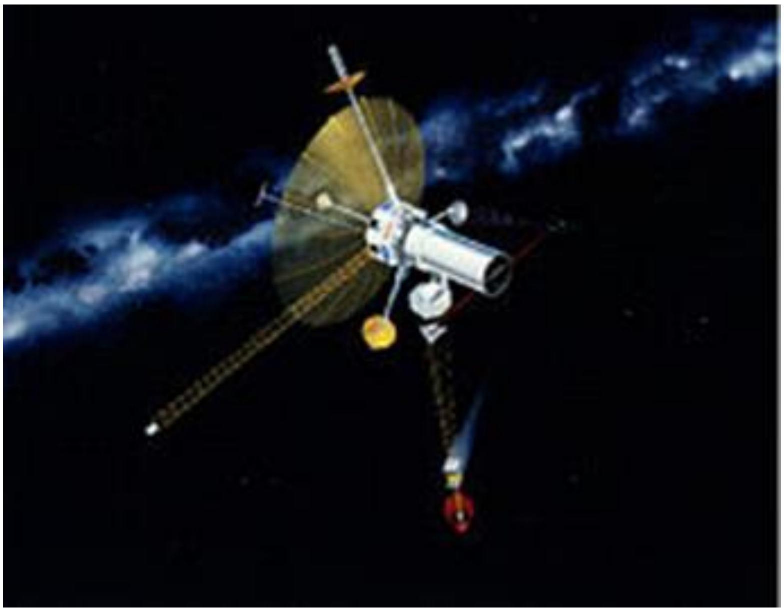
In 1984, Physicist Richard A. Muller postulated that the Sun has a heretofore undetected companion, either a brown dwarf or a red dwarf, in an elliptical orbit within the Oort cloud. This object, known as Nemesis, was hypothesized to pass through a portion of the Oort cloud approximately every 26 million years, bombarding the inner Solar System with comets. However, to date no evidence of Nemesis or the Oort cloud have been found, and many lines of evidence (such as crater counts), have thrown their existence into doubt. Recent scientific analysis no longer supports the idea that extinctions on Earth happen at regular, repeating intervals. Thus, the Nemesis hypothesis is no longer needed to explain current assumptions.

A somewhat similar hypothesis was advanced by astronomer John J. Matese of the University of Louisiana at Lafayette in 2002. He contends that more comets are arriving in the inner Solar System from a particular region of the postulated Oort cloud than can be explained by the galactic tide or stellar perturbations alone, and that the most likely cause would be a Jupiter-mass object in a distant orbit. This hypothetical gas giant was nicknamed Tyche.

The WISE mission, an all-sky survey using parallax measurements in order to clarify local star distances, was capable of proving or disproving the Tyche hypothesis. In 2014, NASA announced that the WISE survey had ruled out any object as they had defined it.

… The Oort Cloud

Future exploration

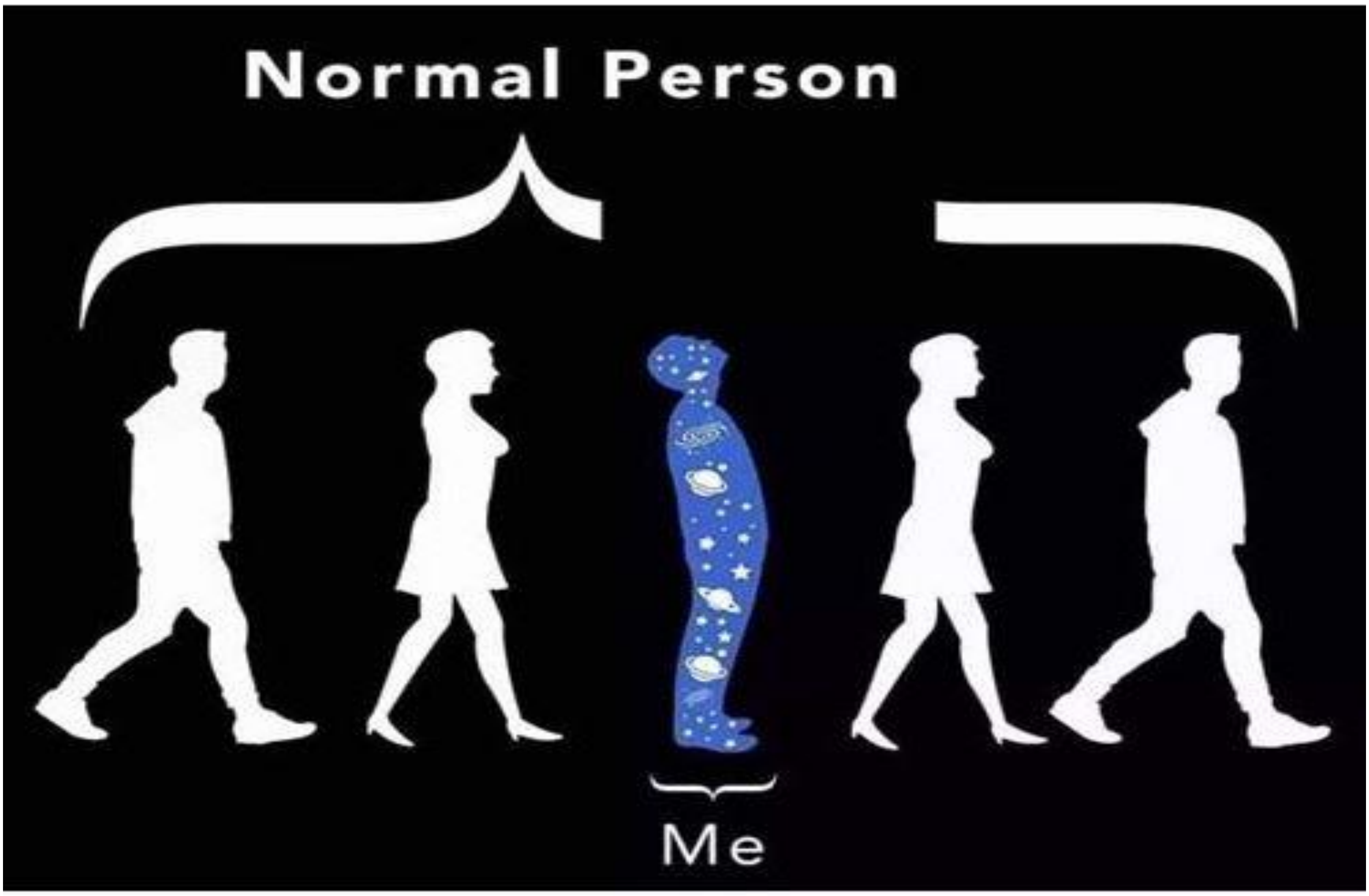


Artist's impression of the *TAU spacecraft*

Space probes have yet to reach the area of the Oort cloud. *Voyager 1*, the fastst and farthest of the interplanetary space probes currently leaving the Solar System, will reach the Oort cloud in about 300 years and would take about 30,000 years to pass through it. However, around 2025, the radioisotope thermoelectric generators on *Voyager 1* will no longer supply enough power to operate any of its scientific instruments, preventing any further exploration by *Voyager 1.* The other four probes currently escaping the Solar System either are already or are predicted to be non-functional when they reach the Oort cloud; however, it may be possible to find an object from the cloud that has been knocked into the inner Solar System.

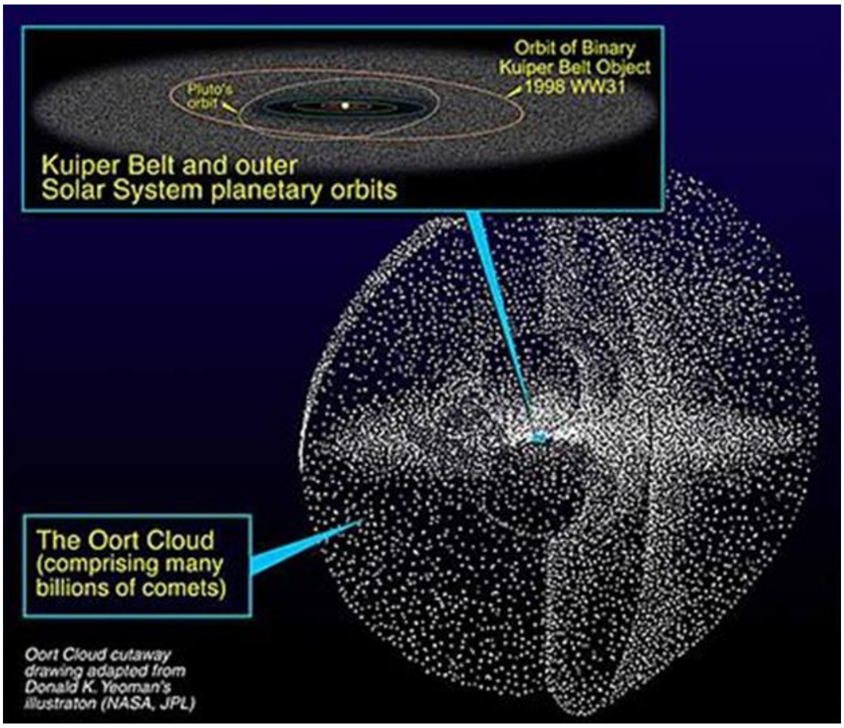
In the 1980s there was a concept for a probe to reach 1,000 au in 50 years called *TAU*; among its missions would be to look for the Oort cloud.

In the 2014 Announcement of Opportunity for the Discovery program, an observatory to detect the objects in the Oort cloud (and Kuiper belt) called the "Whipple Mission" was proposed. It would monitor distant stars with a photometer, looking for transits up to 10,000 au away. The observatory was proposed for halo orbiting around L2 with a suggested 5-year mission. It was also suggested that the Kepler observatory could have been capable of detecting objects in the Oort cloud.



… The Oort Cloud

Original Oort cloud model

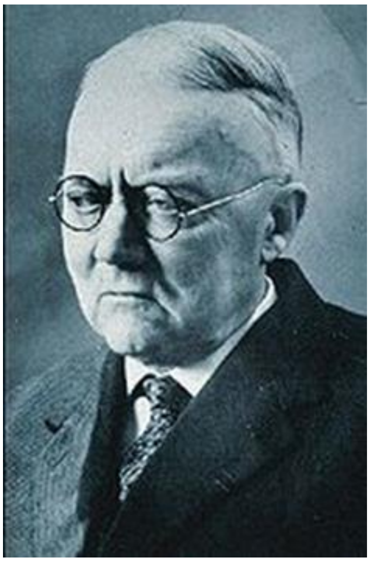


In astronomy, the Hills cloud (also called the inner Oort cloud and inner cloud) is a vast theoretical circumstellar disc, interior to the Oort cloud, whose outer border would be located at around 20,000 to 30,000 astronomical units (AU) from the Sun, and whose inner border, less well-defined, is hypothetically located at 250–1500 AU, well beyond planetary and Kuiper Belt object orbits - but distances might be much greater. If it exists, the Hills cloud contains roughly 5 times as many comets as the Oort cloud.

Oort cloud comets are continually perturbed by their environment. A non-negligible fraction leave the Solar System or find their way into the inner system. It should therefore have been depleted long ago, but it has not. The Hills cloud theory addresses the longevity of the Oort cloud by postulating a densely populated inner Oort region. Objects ejected from the Hills cloud are likely to end up in the classical Oort cloud region, maintaining the Oort cloud. It is likely that the Hills cloud has the largest concentration of comets in the whole Solar System.

The existence of the Hills cloud is plausible, since many bodies have been found already. It would be denser than the Oort cloud. Gravitational interaction with the closest stars and tidal effects from the galaxy have given circular orbits to the comets in the Oort cloud, which may not be the case for the comets in the Hills cloud. The Hills cloud's total mass is unknown; some scientists think it would be more massive than the Oort cloud.

History



Ernst Öpik

Between 1932 and 1981, astronomers believed that the Oort cloud (theorized by Ernst Öpik and Jan Oort) and the Kuiper belt were the only comet reserves in the Solar System.

In 1932, Estonian astronomer Ernst Öpik hypothesized that comets were rooted in a cloud orbiting the outer boundary of the Solar System. In 1950, this idea was revived independently by Dutch astronomer Jan Oort to explain an apparent contradiction: comets are destroyed after several passes through the inner Solar System, so if any had existed for several billion years (since the beginning of the Solar System), no more could be observed now.

Oort selected 46 comets for his study that were best observed between 1850 and 1952. The distribution of the inverse of the semi-major axes showed a maximum frequency which suggested the existence of a reservoir of comets between 40,000 and 150,000 AU (0.6 and 2.4 ly) away. This reservoir, located at the limits of the Sun's sphere of influence (astrodynamics), would be subject to stellar disturbances, likely to expel cloud comets outwards or inwards.

… The Oort Cloud

New model

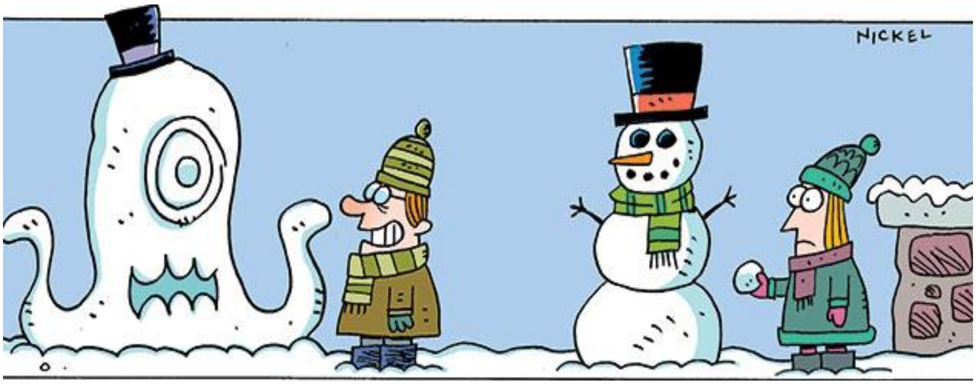
Jack G. Hills, the astronomer who first proposed the Hills cloud

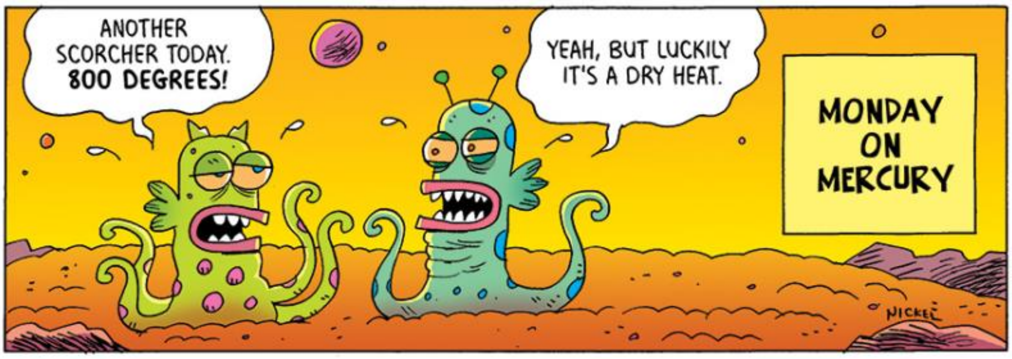
In the 1980s, astronomers realized that the main cloud could have an internal section that would start at about 3,000 AU from the Sun and continue up to the classic cloud at 20,000 AU. Most estimates place the population of the Hills cloud at about 20 trillion (about five to ten times that of the outer cloud), although the number could be ten times greater than that.

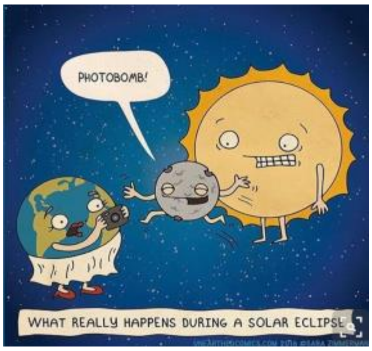
The main model of an "inner cloud" was proposed in 1981 by the astronomer J.G. Hills, from the Los Alamos Laboratory, who gave the region its name. He calculated that the passage of a star near the Solar System could have caused extinctions on Earth, triggering a "comet rain". Indeed, his research suggested that the orbits of most cloud comets have a semi-major axis of 10,000 AU, much closer to the Sun than the proposed distance of the Oort cloud. Moreover, the influence of the surrounding stars and that of the galactic tide should have sent the Oort cloud comets either closer to the Sun or outside of the Solar System. To account for these issues, he proposed the presence of an inner cloud, which would have tens or hundreds of times as many cometary nuclei as the outer halo. Thus, it would be a possible source of new comets to resupply the tenuous outer cloud.

In the following years other astronomers searched for the Hills cloud and studied long-period comets. This was the case with Sidney van den Bergh and Mark E. Bailey, who each suggested the Hills cloud's structure in 1982 and 1983 respectively. In 1986, Bailey stated that the majority of comets in the Solar System were located not in the Oort cloud area, but closer and in an internal cloud, with an orbit with a semi-major axis of 5,000 AU. The research was further expanded upon by studies of Victor Clube and Bill Napier in 1987 and those of 1988 RB Stothers.

However, the Hills cloud regained major interest in 1991, when scientists resumed Hills' theory (excluding documents written by Martin Duncan, Thomas Quinn and Scott Tremaine in 1987, which included Hills' theory and contained additional research).





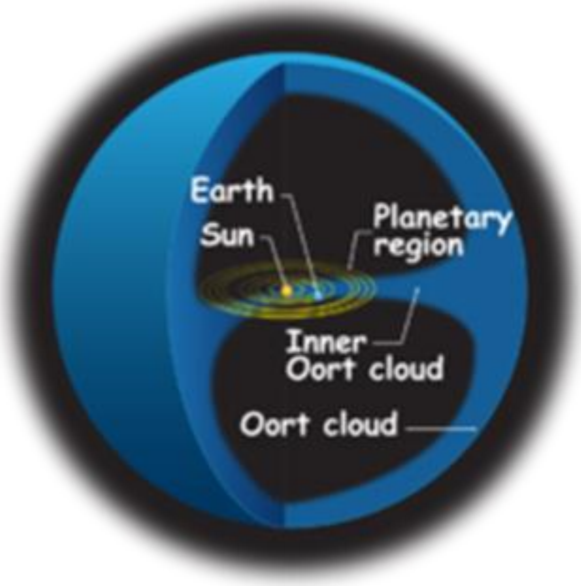


… The Oort Cloud

Characteristics

Structure and composition

Interior and exterior Oort cloud



Oort cloud comets are constantly disturbed by their surroundings and distant objects. A significant number either leave the Solar System or go much closer to the Sun. The Oort cloud should therefore have broken apart long ago, but it still remains intact. The Hills cloud theory could provide an explanation; JG Hills and other scientists suggest that it could replenish the comets in the outer Oort cloud.

It is also likely that the Hills cloud is the largest concentration of comets across the Solar System. The Hills cloud is much denser than the outer Oort cloud; it is somewhere between 5,000 and 20,000 AU in size. In contrast, the Oort cloud is between 20,000 and 50,000 AU (0.3 and 0.8 ly) in size.

The mass of the Hills cloud is not known. Some scientists believe it could be five times more massive than the Oort cloud. Mark E. Bailey estimates the mass of the Hills cloud to be 13.8 Earth masses, if the majority of the bodies are located at 10,000 AU.

If the analyzes of comets are representative of the whole, the vast majority of Hills cloud objects consists of various ices, such as water, methane, ethane, carbon monoxide and hydrogen cyanide. However, the discovery of the object 1996 PW, an asteroid on a typical orbit of a long-period comet, suggests that the cloud may also contain rocky objects.

The carbon analysis and isotopic ratios of nitrogen firstly in the comets of the families of the Oort cloud and the other in the body of the Jupiter area shows little difference between the two, despite their distinctly remote areas. This suggests that both come from a protoplanetary disk, a conclusion also supported by studies of comet cloud sizes and the recent impact study of Comet Tempel 1.

Formation

Many scientists think that the Hills cloud formed from a close (800 AU) encounter between the Sun and another star within the first 800 million years of the Solar System, which could explain the eccentric orbit of 90377 Sedna, which should not be where it is, being neither influenced by Jupiter nor Neptune, nor tidal effects. It is then possible that the Hills cloud would be "younger" than the Oort cloud. But only Sedna bears those irregularities; for 2000 OO_{67} and 2006 SQ_{372} this theory is not necessary, because both orbit close to the Solar System's gas giants.

… The Oort Cloud

Possible Hills cloud objects

Name	Diameter (km)	Perihelion (AU)	Aphelion (AU)	Discovery
2012 VP113	315 to 640	80.5	445	2012
Sedna	995 to 1,060	76.1	935	2003
2000 OO_{67}	28 to 87	20.8	1,014.2	2000
2006 SQ_{372}	50 to 100	24.17	2,005.38	2006

Bodies in the Hills cloud are made mostly of water ice, methane and ammonia. Astronomers suspect many long-period comets originate from the Hills cloud, such as Comet Hyakutake.

In their article announcing the discovery of Sedna, Mike Brown and his colleagues asserted that they observed the first Oort cloud object. They observed that, unlike scattered disc objects like Eris, Sedna's perihelion (76 AU) was too remote for the gravitational influence of Neptune to have played a role in its evolution. The authors regarded Sedna as an "inner Oort cloud object", located on the disk placed between the Kuiper belt and the spherical part of the cloud. However, Sedna is much closer to the Sun than expected for objects in the Hills cloud and its inclination is close to that of the planets and the Kuiper belt.

Considerable mystery surrounds 2008 KV42, with its retrograde orbit that could make it originate from the Hills cloud or perhaps the Oort cloud. The same goes for damocloids, whose origins are doubtful, such as the namesake for this category, 5335 Damocles .

Comets

Comet McNaught

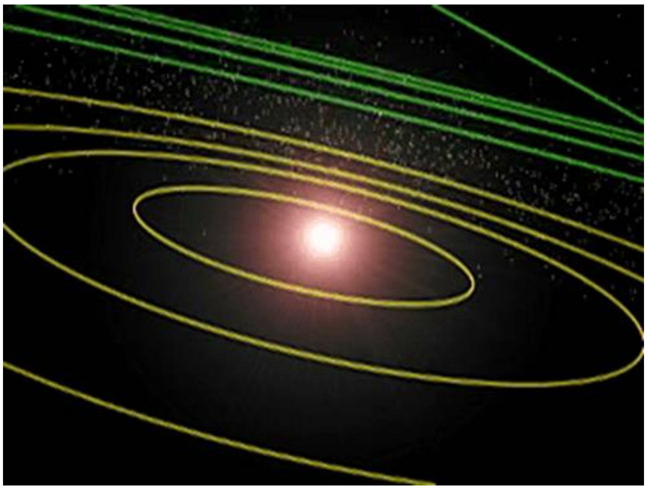
Astronomers suspect that several comets come from the same region as the Hills cloud; in particular, they focus on those with aphelia greater than 1,000 AU (which are thus from a farther region than the Kuiper belt), but less than 10,000 AU (or they would otherwise be too close to the outer Oort cloud).

Some famous comets reach great distances and are candidates for Hills cloud objects. For example, Comet Lovejoy, discovered on 15 March 2007 by Australian astronomer Terry Lovejoy, reached an aphelion distance of 2,850 AU. Comet Hyakutake, discovered in 1996 by amateur astronomer Yuji Hyakutake, has an aphelion of 3,410 AU. Comet Machholz, discovered on 27 August 2004 by amateur astronomer Donald Machholz, goes even further, to 4,787 AU.

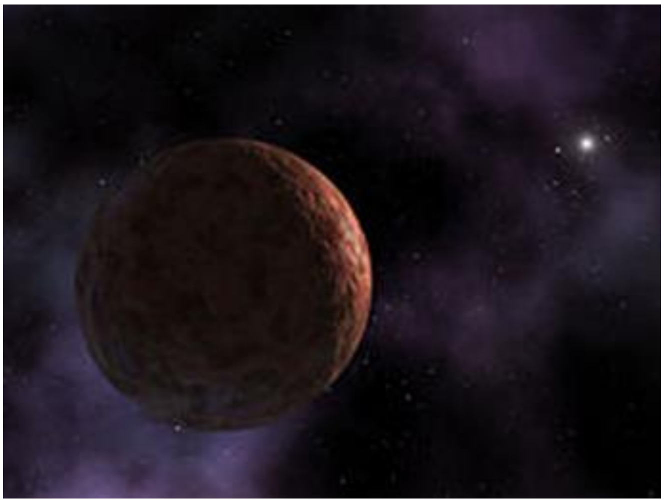
Comet McNaught, discovered on 7 August 2006 in Australia by Robert H. McNaught, became one of the brightest comets of recent decades, with an aphelion of 4,100 AU. Finally, one of the farthest-known comets is Comet West, discovered by Danish astronomer Richard Martin West at the La Silla Observatory in Chile on 10 August 1975; it reaches 13,560 AU.

… The Oort Cloud

Sedna, the first candidate



Sedna's orbit (in red) with the Hills cloud (in blue)



Artist's impression of Sedna

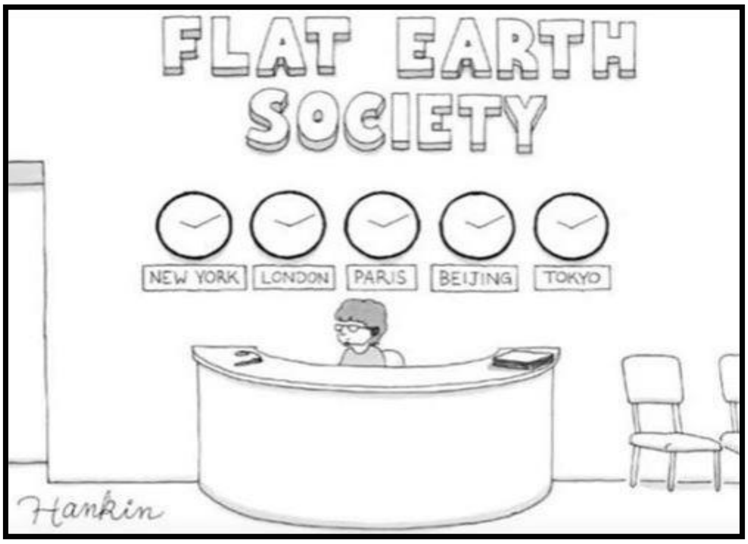
Sedna is a minor planet discovered by Michael E. Brown, Chad Trujillo and David L. Rabinowitz on 14 November 2003. Spectroscopic measures show that its surface composition is similar to that of other trans-Neptunian objects: it is mainly composed of a mixture of water ices, methane and nitrogen with Tholin. Its surface is one of the reddest in the Solar System.

This may be the first detection of a Hills cloud object, depending on the definition used. The area of the Hills cloud is defined as any objects with orbits measuring between 2,000 and 15,000 AU. Sedna is however much closer than the supposed distance of the Hills cloud. The planetoid discovered at a distance of about 13 billion kilometers (90 AU) from the Sun, travels in an elliptical orbit of 11,400 years with a perihelion point of only 76 AU from the Sun during its closest approach (the next to occur in 2076), and travels out to 936 AU at its farthest point.

However, Sedna cannot be considered a Kuiper belt object because its path does not bring it into the region of the Kuiper belt at 50 AU. Sedna is a detached object and thus is not in a resonance with Neptune.

2012 VP113

Trans-Neptunian object 2012 VP_{113} was announced on March 26, 2014 and has a similar orbit to Sedna with a perihelion point significantly detached from Neptune. Its orbit lies between 80 and 400 AU from the Sun.



Nicole-Reine Lepaute

From Wikipedia, the free encyclopedia

Portrait of Nicole-Reine Lepaute

Nicole-Reine Lepaute (née Étable de la Briere; also known as Hartense Lepaute or Hortense Lepaute), (5 January 1723 – 6 December 1788) was a French astromomer and mathematician. Lepaute predicted the return of Halley's Comet by calculating the timing of a solar eclipse and constructing a group of catalogs for the stars.

The asteroid 7720 Lepaute is named in her honour, as is the lunar crater Lepaute. She was also a member of the Scientific Academy of Béziers.

Biography

Nicole-Reine Lepaute was born on Jan. 5th, 1723 in the Luxembourg Palace in Paris as the daughter of Jean Etable, valet in the service of Louise Élisabeth d'Orléans. Her father had worked for the royal family for a long time, both in the service of the duchess de Berry and her sister Louise. She was the sixth of nine children. As a child she was described as precocious and intelligent, being mostly self-taught. She stayed up all night "devouring" books and read every book in the library, with Jerome Lalande saying of her once that even as a child "she had too much spirit not to be curious". In August 1749, she married Jean-André Lepaute, who was a royal clockmaker in the Luxembourg Palace. He quickly became famous all over Europe for his exceptional work

Early career

Nicole Lepaute constructed a clock with an astronomical function together with her spouse. The clock was constructed on her suggestion, and she also participated in its construction. The clock was presented to the French Academy of Science in 1753, where it was inspected and approved by Jérôme Lalande.

After completing the clock with her husband, she worked with both him and Lalande on a book titled "Traite d'horlogerie (Treatise of Clockmaking) that was published in 1775 under her husband's name. Though she did not receive authorship, Lalande sang her praises later, saying, "Madame Lepaute computed for this book a table of numbers of oscillations for pendulums of different lengths, or the lengths for each given number of vibrations, from that of 18 lignes, that does 18000 vibrations per hour, up to that of 3000 leagues."

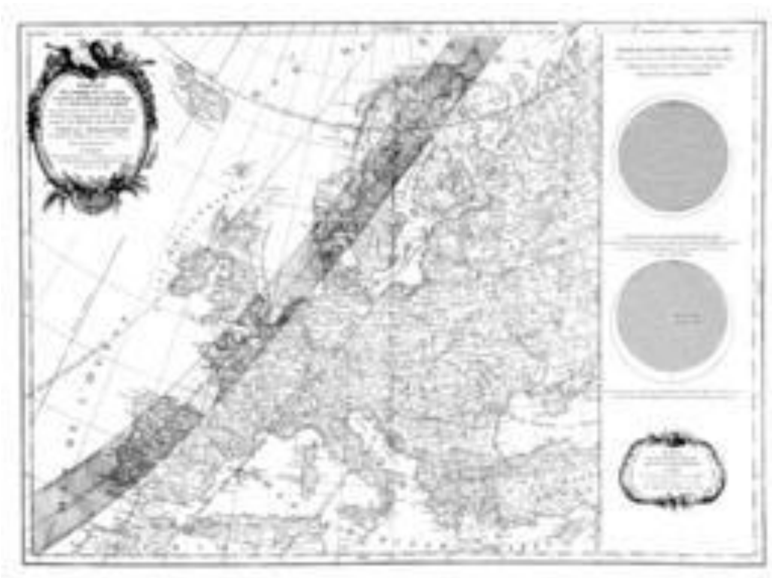
… Nicole-Reine Lepaute

Halley's Comet

Jérôme Lalande recommended her along with the mathematician Alexis Clairault to calculate the predicted return of Halley's Comet, as well as to calculate the attraction of Jupiter and Saturn of the Halley's comet. The team worked on the calculations for more than six months straight, barely stopping for food. In November 1758, the team presented their conclusion that the comet would arrive on 13 April 1759. They were almost correct, as the comet arrived on 13 March 1759. As a result of their calculations, this was the first time scientists had successfully predicted when the comet would cross the perihelion, i.e. the point of the comet orbit closest to the Sun. Clairault did not recognize her work at all in his work, which upset Lalande who considered Lepaute the "most distinguished female French astronomer ever." Jérôme Lalande acknowledged her help in an article.

Later mathematical accomplishments

In 1759, she was again a part of Lalande's team and worked with him to calculate the ephemens of the transit of Venus. It is not documented what should be attributed to her personally, but in 1761, she was acknowledged by being inducted as an honorary member of the distinguished Scientific Academy of Béziers. Lalande also collaborated with Lepaute for fifteen years on the Academy of Science's annual guides for astronomers and navigators by developing ephemerides: tables that predict the location of the stars on each day of the year, and after her death, wrote a brief biography about her contributions to astronomy.



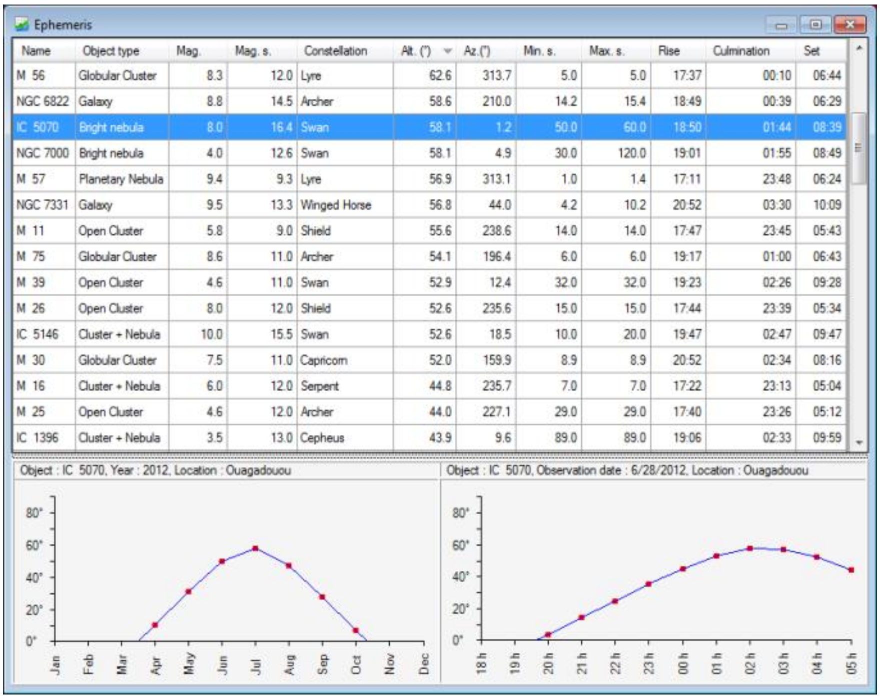
Solar Eclipse Drawing

In 1762, Lepaute calculated the exact time of a solar eclipse that occurred on 1 April 1764. She wrote an article in which she gave a map of the eclipse's extent in 15-minute intervals across Europe and predicted the time and percentage each area in Europe would experience. The article was published in *Connaissance des temps* (*Knowledge of the times*). She also created a group of catalogs of the stars which were useful for the future of astronomy. She calculated the ephemeris of the Sun, the Moon and the planets for the years 1774–1784.

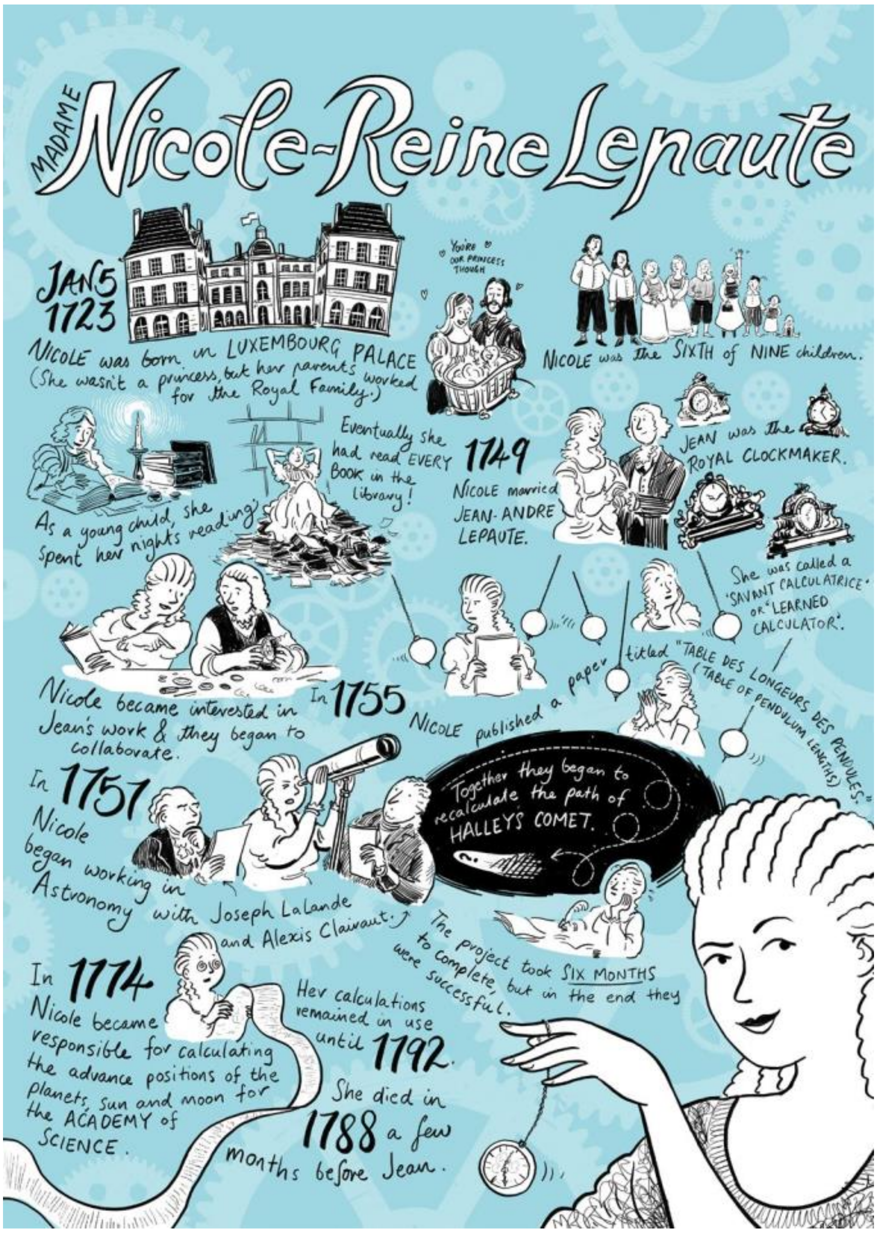
Personal life

While childless herself, she adopted her husband's nephew, Joseph Lepaute Dagelet, a future member of the French Academy of Science, in 1768. She trained him in astronomy and advanced mathematics so well that he became a math professor at the French Military School at age 26 before being elected deputy astronomer eight years later in 1785 at the French Royal Academy of Sciences. Nicole Lepaute took care of her terminally ill husband from 1767 until her death in Paris on December 6th, 1788. She had gone blind herself just a few short months before.

… Nicole-Reine Lepaute



Name	Object type	Mag.	Mag. s.	Constellation	Alt. (°)	Az.(°)	Min. s.	Max. s.	Rise	Culmination	Set
M 56	Globular Cluster	8.3	12.0	Lyre	62.6	313.7	5.0	5.0	17:37	00:10	06:44
NGC 6822	Galaxy	8.8	14.5	Archer	58.6	210.0	14.2	15.4	18:49	00:39	06:29
IC 5070	Bright nebula	8.0	16.4	Swan	58.1	1.2	50.0	60.0	18:50	01:44	08:39
NGC 7000	Bright nebula	4.0	12.6	Swan	58.1	4.9	30.0	120.0	19:01	01:55	08:49
M 57	Planetary Nebula	9.4	9.3	Lyre	56.9	313.1	1.0	1.4	17:11	23:48	06:24
NGC 7331	Galaxy	9.5	13.3	Winged Horse	56.8	44.0	4.2	10.2	20:52	03:30	10:09
M 11	Open Cluster	5.8	9.0	Shield	55.6	238.6	14.0	14.0	17:47	23:45	05:43
M 75	Globular Cluster	8.6	11.0	Archer	54.1	196.4	6.0	6.0	19:17	01:00	06:43
M 39	Open Cluster	4.6	11.0	Swan	52.9	12.4	32.0	32.0	19:23	02:26	09:28
M 26	Open Cluster	8.0	12.0	Shield	52.6	235.6	15.0	15.0	17:44	23:39	05:34
IC 5146	Cluster + Nebula	10.0	15.5	Swan	52.6	18.5	10.0	20.0	19:47	02:47	09:47
M 30	Globular Cluster	7.5	11.0	Capricorn	52.0	159.9	8.9	8.9	20:52	02:34	08:16
M 16	Cluster + Nebula	6.0	12.0	Serpent	44.8	235.7	7.0	7.0	17:22	23:13	05:04
M 25	Open Cluster	4.6	12.0	Archer	44.0	227.1	29.0	29.0	17:40	23:26	05:12
IC 1396	Cluster + Nebula	3.5	13.0	Cepheus	43.9	9.6	89.0	89.0	19:06	02:33	09:59



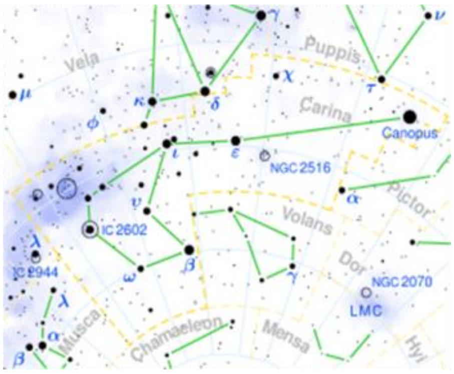
Miaplacidus

Beta Carinae (Latinised from **β Carinae**, abbreviated **Beta Car**, **β Car**), officialy named Miiaplacidus /maɪəˈplæsɪdəs/, is the second-brightest star in the constellation of Carina and one of the brightest stars in the night sky, with apparent magnitude 1.68. It is the brightest star in the southern asterism known as the Diamond Cross, marking the southwestern end of the asterism. It lies near the planetary nebula IC 2448. Parallax measurements place it at a distance of 113.2 light-years (34.7 parsecs) from the Sun.

Nomenclature

β Carinae (Latinised to *Beta Carinae*) is the star's Bayer designation. The star's historical name *Miaplacidus* made its debut on star maps in 1856 when the star atlas *Geography of the Heavens*, composed by Elijah Hinsdale Burritt, was published. The meaning and linguistic origin of the name remained an enigma for many decades, until William Higgins, a great scholar and expert on star names, surmised that the name *Miaplacidus* is apparently a bilingual combination of Arabic *miyāh* for 'waters' and Latin *placidus* for 'placid'. The IAU Working Group on Star Names first bulletin of July 2016 included a table of the first two batches of names approved by the WGSN; which included *Miaplacidus* for this star.

In Chinese, 南船（*Nán Chuán*), meaning *Southern Boat*, refers to an asterism consisting of β Carinae, V337 Carinae, PP Carinae, θ Carinae and ω Carinae. Consequently, β Carinae it's self is known as 南船五（*Nán Chuán wǔ*, English: the Fifth Star of Southern Boat.)



Physical properties

The stellar classification of A1 III suggests this is an evolved giant star, although Malagnini and Morossi (1990) rated it as an A2 IV subgiant star. It has an estimated age of 260 million years. This star does not show an excess emission of infrared radiation that might otherwise suggest the presence of a debris disk. It has about 3.5 times the Sun's mass and has expanded to almost seven times the radius of the Sun. Presently is it radiating 288 times as much luminosity as the Sun from its outer envelope at an effective temperature of 8,866 K. Despite its enlarged girth, this star still shows a rapid rotation rate, with a projected rotational velocity of 146 km/s.

The Month Ahead

MEETINGS:

- The next meeting will be held on Wednesday 12 February 2020 @ 19:30.
- The speaker will be Prof. Francesco Petruccione

MNASSA:

- Monthly Notes of the Astronomical Society of Southern Africa.
- Available at www.mnassa.org.za to download your free monthly copy.

NIGHTFALL:

- Fantastic astronomy magazine, go check it out.
- Available from the ASSA website assa.saao.ac.za/sections/deep-sky/nightfall/

MEMBERSHIP FEES & BANKING:

- Members : R 170
- Family Membership: R 200
- Cheques: **Please note no cheques will be accepted - Please pay by an EFT**
- EFT: **The Astronomical Society of Southern Africa - Natal Centre**.
- Bank: **Nedbank**
- Account No. **1352 027 674**
- Branch: **Durban North**
- Code **135 226**
- Reference: **Please include your initials and surname**

RESIGNATIONS from ASSA - Please send an email immediately notifying the Secretary.

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- Instagram: astronomydurban
- Facebook: Astronomical Society of Southern Africa, Durban Centre

ASSA Durban - Minutes of the Meeting

8 January 2020

Welcome: Chairman, Piet Strauss welcomed all attendees.

Present: 24 Members and 3 Visitors were present.

Apologies: 5 apologies were received as per attendance book.

Confirmation of previous minutes: Minutes of January meeting to be confirmed.

Matters Arising from previous minutes: There were no matters.

Treasurer's Report: Balances of the accounts are as follows:

32 day notice investment account	R 56 000
Cheque account	R 8 880
Cash	R 600

The Treasurer requested members to pay outstanding subscriptions.

A new telescope was purchased for the observatory.

Members can purchase a Sky Guide for R80.

General: The library is open and members may loan out books.

Speakers: Debbie Abel presented the NASA and COS Space update.

Mike Hadlow presented Astronomy Highlights for 2020.

Piet Strauss presented a talk on Cosmology and informed members of the trip to Sutherland.

ASSA Attire: New shirts, caps and beanies to be ordered.

Special Projects: Nothing to report.

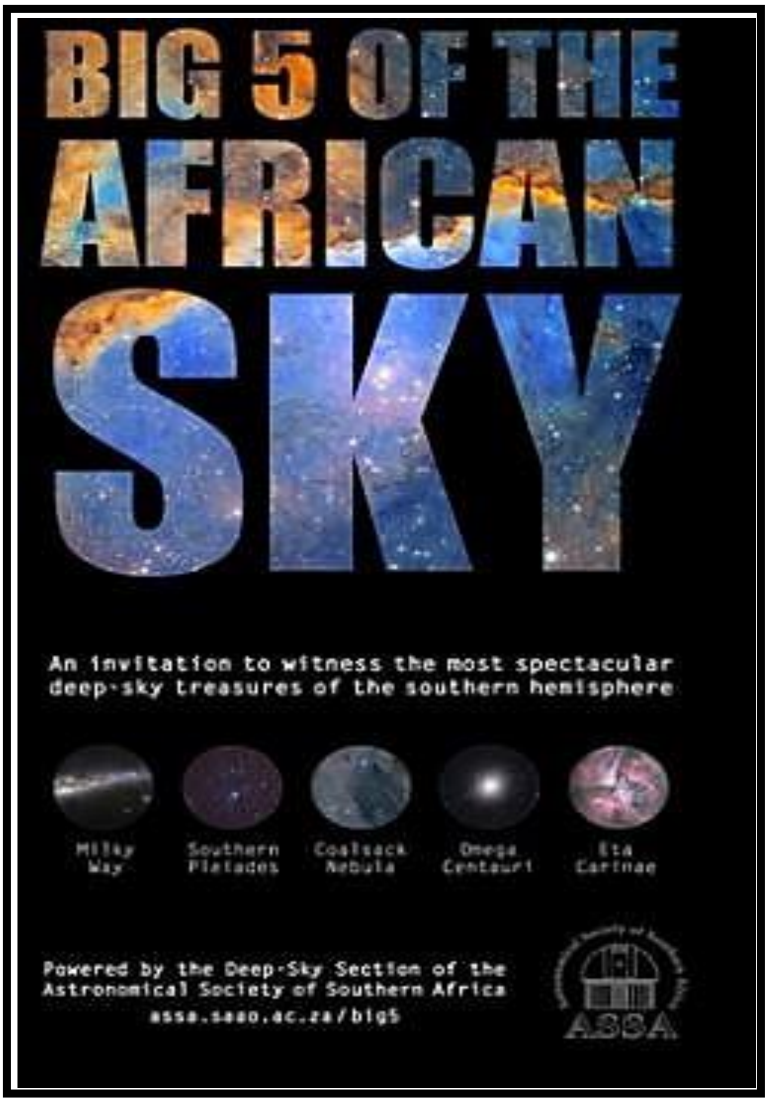
Outreach Events: Nothing to report - VOLUNTEERS URGENTLY REQUIRED.

Observatory: Closed until further notice due to installation of new telescope.

Publicity: Nothing to report.

General: There were no items.

Meeting closed at 20h57 and refreshments were served.



THE BIG 5 OF THE AFRICAN SKY

The magnificent southern sky is a starry realm richly sown with a treasury of deep-sky objects: star clusters, bright and dark gas clouds, and galaxies.

From this (sometimes bewildering) array five specimens of each class of object have been selected by a special Deep-Sky Task Force and are presented here as the celestial Big Five.

The representative of open star clusters is the **Southern Pleiades**. First amongst the globular star clusters is the overwhelming **Omega Centauri**. Bright nebulae are represented by the majestic **Eta Carinae Nebula**. The mysterious dark nebulae are represented by the **Coal Sack**. And the most splendid galaxy of them all is our own **Milky Way Galaxy**.

Your mission is to observe each of these beautiful objects and report back on what you have witnessed.

All submitted observations will be carefully evaluated and feedback will be given.

The names of all participants will be acknowledged on the ASSA website. Observing certificates will be awarded only on merit and issued by the Deep-Sky Section of the Astronomical Society. Have fun, and keep looking up!

Public Viewing Roster ASSA Durban

Name	Phone	Name	Phone	New Moon	Public Viewing
OBSERVATORY CLOSED DUE TO REVAMP & INSTALLATION OF THE NEW TELESCOPE					

Pre-Loved & Astronomical Equipment

Celestron 80LCM Telescope for Sale.

Consisting of:

2 eyepieces
2 x Barlow
GPS Sky Sync
Mains adaptor

Telescope only been used twice.
Paid R 15,000.00 Selling for **R 9,000.00**

Selling it as had the best intentions of getting interested in astronomy but, unfortunately, that never happened.

I am based in Pennington and if anybody is interested in it I can deliver it to the Durban area.

Please contact:

- **martynw@mymtnmail.co.za**
- **Phone +27(0)39 975 7015**
- **Cell No +27(0)83 377 5628**

Additional Items for Sale from

ASSA National website

https://assa.saao.ac.za/how-to-observe/equipment/second-hand-equipment/

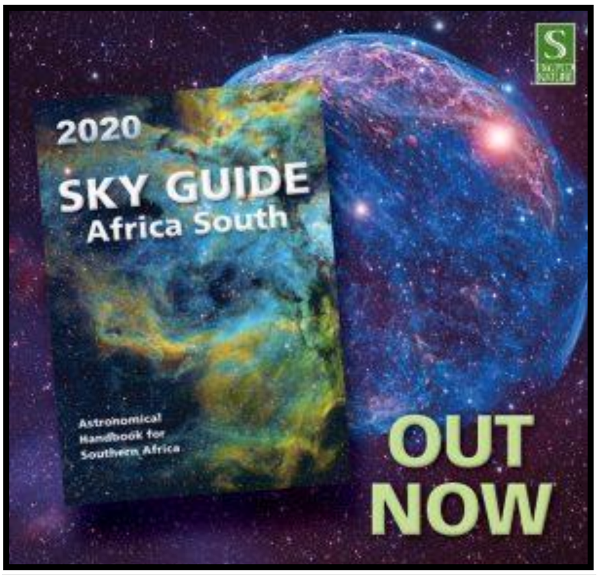
2020 Special

Green Laser Pointers50mW

R 350.00

Contact : Piet 083 703 1626
on WhatsApp or SMS.

Available at next ASSA meeting



Price For Members: R 80.00

Sky Guide 2020

The *Sky Guide* is the astronomical handbook for southern Africa, and is an invaluable practical resource for anyone who has even a passing interest in the night skies of southern Africa.

Prepared yearly by the Astronomical Society of Southern Africa as a reference work for the novice, amateur and professional astronomer, it continues the tradition of the well-established Astronomical Handbook for Southern Africa.

It presents a wealth of information about the Sun, Moon, planets, comets, meteors and bright stars in a clear and accessible way, accompanied by a number of diagrams to support the text.

The current edition (2020) is its 74th year of publication.

Help a PhD Student

Amélia Wassenaar, a Ph.D student is working on a project exploring the feasibility of astrotourism activities in South African Parks and need more input from the stargazing community. Please to take the survey?

South African National Parks (SANParks) recognised the need to diversify and expand their current tourist activities to provide meaningful experiences to its visitors.

Astrotourism has been identified as a potential activity with minimal environmental impact, while providing visitors with the opportunity to experience the natural environment in a unique way.

The primary objective of this study is to determine the feasibility of stargazing activities in SANParks.

Participation in the research process is voluntary and all information will remain confidential and anonymous.

Your contribution to the study is important and its success depends on the number of respondents who complete the survey. For more information, contact Amélia Wassenaar at starsandparks@gmail.com

Click here to start the survey: https://www.surveymonkey.com/r/83FGGXR