ASTRONOMICAL SOCIETY OF SOUTHERN AFRICA

'nDABA

Monthly Newsletter of the Durban Centre - November 2018

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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 Durban Centre, nor the Editor.

Chairman’s Chatter

By Piet Strauss

Dear Members,

I could unfortunately not be present at our meeting on 10 October, but gather that Nino Wunderlin’s talk on “Rocket Propulsion” was most interesting.

The Winterton Star Party is planned for Saturday 4 November and please remember the daytime “Wagtail” event on 10 November.

The course on Basic Astronomy will be held during March/April next year. Non-members are also welcome but ASSA members will get a discount on the course fees.

The Astrophotography course curriculum and presenters will be finalised shortly.

We have so far not had a good response from members paying their annual membership fees, but appreciate those who did. We appeal to those who have not done so to please pay. If you do not, you cannot enjoy the benefits that members get.

These include:

The Monthly ‘nDaba newsletter

Free dinner at the December meeting

A low price Sky Guide

Discounts on Courses

Exciting Outings with your fellow members

I would also like to thank John Visser for fixing a couple of telescopes for a school and in so doing attracted a reasonably good donation to our Society.

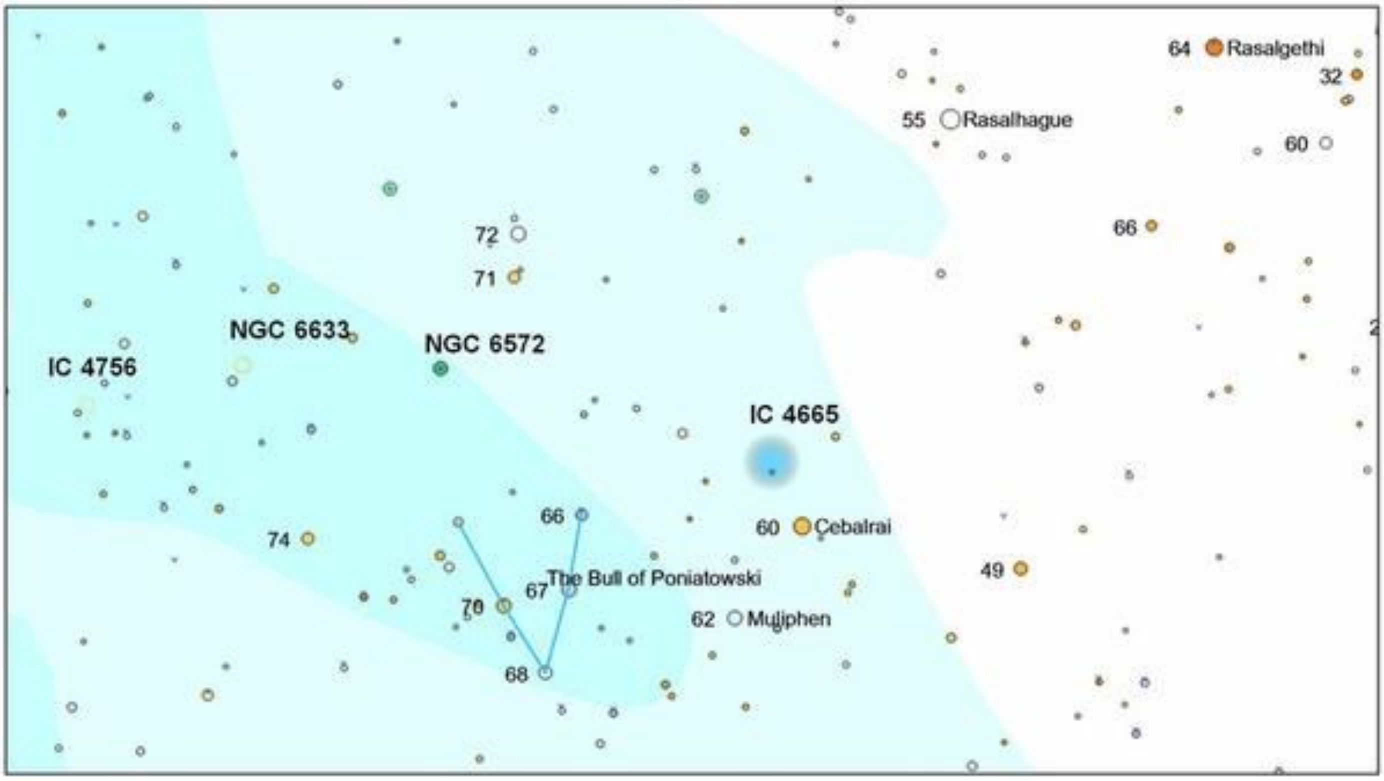
Trust you will enjoy the next meeting on 14 November.

Piet.

A Speedy Little Double Star In Ophiuchus

By Brian Ventrudo

Things move slowly in the cosmos, at least compared to a human lifetime. But there are a few exceptions. The nearby double star 70 Ophiuchi, for example, is close enough to show considerable motion in just a year or two, and it's one of the few stars to make a complete revolution during the span of a human lifetime. It's a pretty little star, too, one that's easy to find and see with nearly any small telescope.



When it comes to observing the stars and other sights beyond our solar system, there’s always something new to see. But once you see it, chances are it’s not going to chance much in the coming years. That’s because things move slowly in the cosmos, at least compared to a human lifetime.

There are, however, a few exceptions. One of the most important for astronomers is the nearby binary star called 70 Ophiuchi, a little gem in the asterism known as Taurus Poniatowski in the constellation Ophiuchus. It’s a beautiful star for casual stargazers armed with a small telescope. Serious stargazers can watch over the course of a year or two to detect the motion of the two components as they slowly revolve around each other during their 88-year period. It’s one of the few double stars that make a complete revolution within the course of a human lifetime.

At a distance of just 16 light years, 70 Oph is a relatively nearby star. Both components are small orange main sequence stars, each with a mass of about 90% that of our Sun. One shines about half as brightly as the Sun, while the other is just 1/7 as bright.

70 Oph was first cataloged by William Herschel in the late 18th century. An astute observer, Herschel noted the apparent motion of the two stars around each other, and subsequent studies showed the stars follow a motion predicted by Newton’s Law of Gravitation, a law discovered by examining the motion of the planets in our solar system. The measurements of 70 Oph helped astronomers show the same physical principles apply not just to our solar system, but to the galaxy as a whole.

… A Speedy Little Double Star

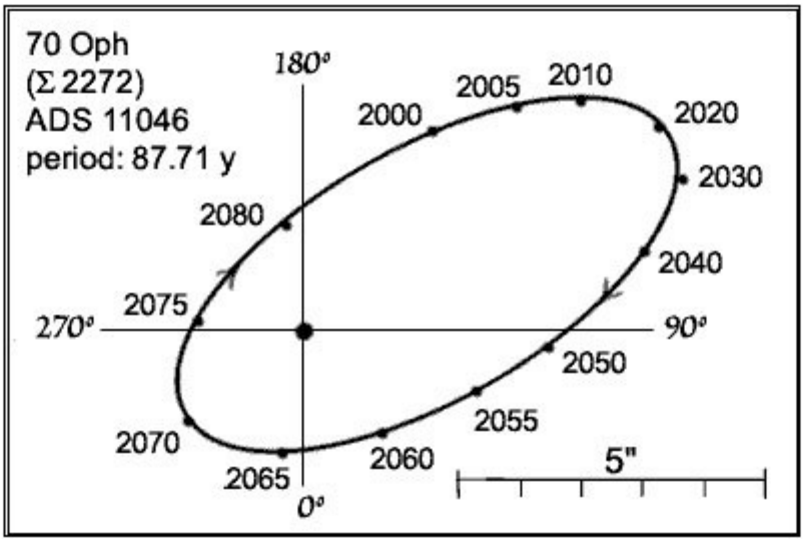
An image of 70 Ophiuchi by
Damian Peach.

Also, by carefully mapping out the motion of the components of 70 Oph, astronomers used Newton's principles to calculate the mass of the stars. This was a first step towards a deeper understanding of what makes stars tick.

From our vantage point, the two components of 70 Oph have an apparent magnitude 4.2 and 5.9, so the pair is visible to the unaided eye as a single point of light. In this second decade of the 21st century, the pair is separated by about 5″, which means you can resolve them in nearly any telescope using a magnification of 75x to 100x or so. The brighter star has a yellow-gold color while the fainter looks orange-red. Some observers report a tinge of violet in the fainter star.

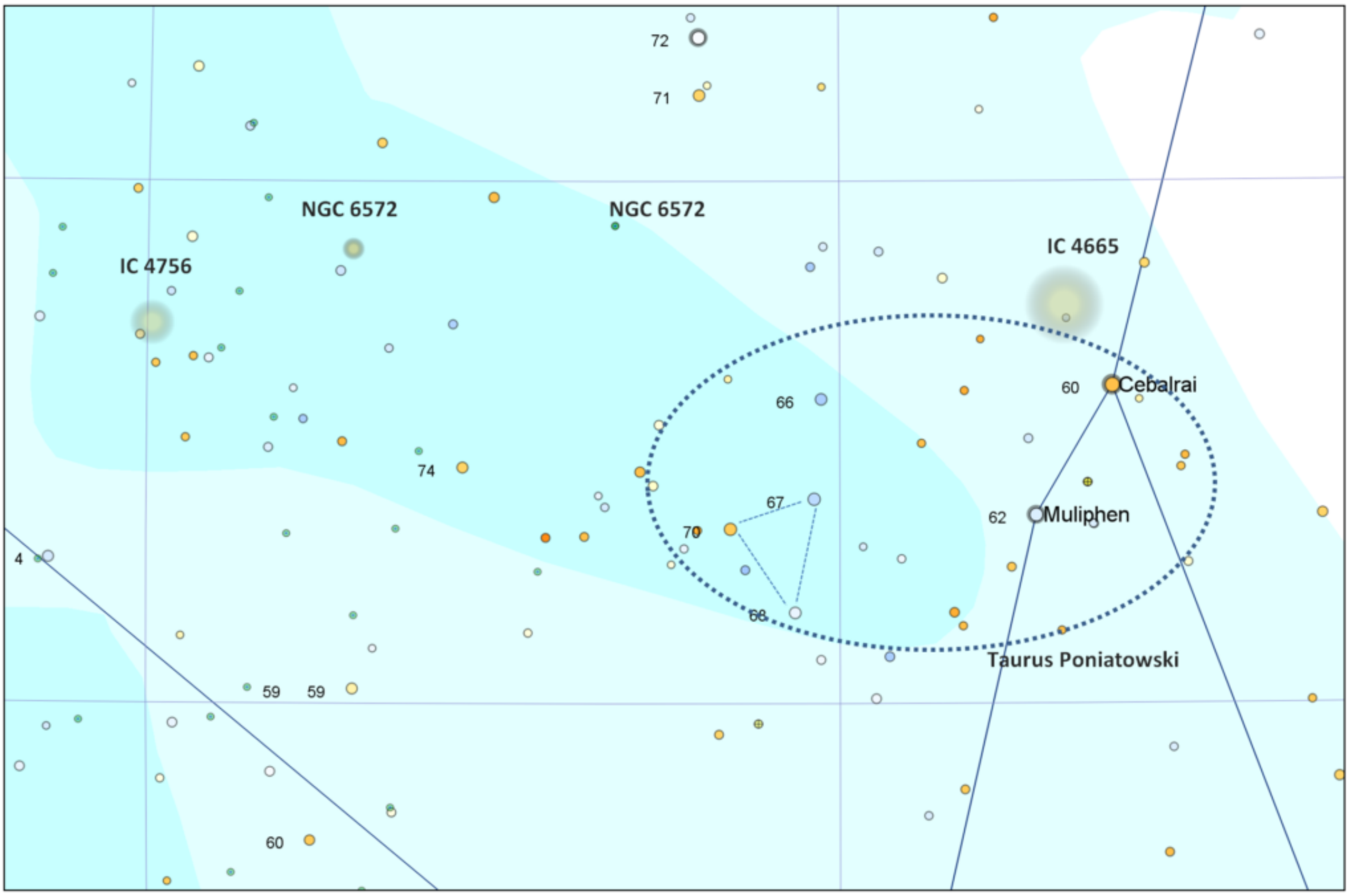
(Pro tip: to improve your visual perception of color when observing stars, move your telescope out of focus just a touch to expand the size of the image of the star on the back of your retina. Yes, this really works).

The average distance between the two components of 70 Oph is about the same as the distance between the Sun and Uranus. The stars made their most recent closest approach in 1989. Since then, their separation has quickly increased from a tight 1.7″ to a more spacious 5″. In many studies, astronomers suggested the indirect detection of planets around one of the components of 70 Oph. But so far, these detections remain unconfirmed.



… A Speedy Little Double Star

70 Ophiuchi lies at the tip of the horns of the little asterism known as Taurus Poniatowski in the constellation Ophiuchus. The area is a rich trove of fascinating objects for observers armed with a small telescope.



The region in and around Taurus Poniatowski in the constellation Ophiuchus. These maps show the asterism as well as the stars 67 Oph and 70 Oph and the star clusters IC 4665, IC 4756, NGC 6633, and planetary nebula NGC 6572.

At The Eyepiece

November 2018 by Ray Field

THE MOON is NEW on the 7th, First Quarter on the the 15th, FULL on the 23rd, and Last Quarter on the 30th. The Moon is near Regulus on the 2nd, Jupiter on the 8th, Saturn on the 11th, Mars on the 16th (occultation), Aldebaran on the 23rd and Regulus again on the 29th.

MERCURY is a bright evening object for the first 3 weeks of the month. After that it gets lost in the glare of the sunset. It is highest above the western horizon on the 6th. In a telescope Mercury looks like a thin crescent this month.

VENUS is a very bright object in the morning sky this month, becoming brighter and higher above the horizon as the month progresses. Venus is near the bright star Spica on the 15th. In a telescope Venus looks like a thin crescent this month.

MARS, passes from the constellation of Capricornus, into the constellation of Aquarius this month. Mars is a bright, orange-red coloured object and in a telescope it shows a small disc. Mars is occulted by the Moon on the 16th.

JUPITER is not well placed for observation this month as it sets soon after the Sun at the beginning of the month and then gets lost in the glare of the Sun for the rest of the month.

SATURN looks like a bright, yellowish "star" to the naked-eye. It is in Sagittarius all month and by the end of the month it is near the globular cluster M22, which is near the "lid" of the "Teapot" asterism. M22 lies in the same binocular field as Saturn and is 10000 light years away from us.

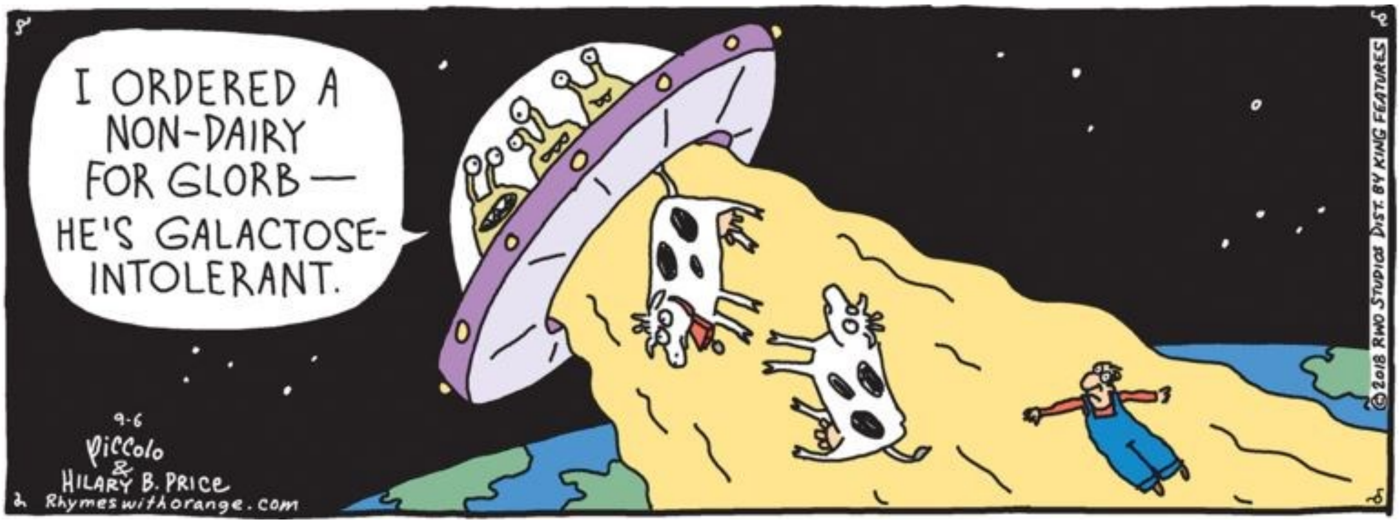
COMET 46P/ Wirtanen should be a good binocular object this month and next. It may even brighten enough to be seen with the naked-eye from a dark sky. It starts the month in the faint constellation of Fornax, which lies above the bright star Achernar and then moves into the constellation of Cetus. See pages 85 and 55 of ASSA SKYGUIDE 2018 for more details on this comet.

… At The Eyepiece

METEORS. Four meteor showers are given in SKYGUIDE 2018 on page 86 for this month. They are 1)Southern Taurids (max 5th), 2)Northern Taurids (max 12th), 3)LEONIDS (max 17th) and 4) Alpha Monocerotids (max 21st).

THE STARRY SKY for November mid-month 8 pm. The Southern Cross is at its lowest and the Square of Pegasus is well placed above the northern horizon. Scorpius is setting in the west and Orion is rising in the east. The Smaller Magellanic Cloud with the second brightest globular cluster in the sky, 47 Tucana, next to it, are well-placed. The bright star Fomalhaut and the constellation of Grus with its two bright stars have just passed their highest and are starting to descend toward the west.

REFERENCES: ASSA SKYGUIDE 2018, Philips' Planisphere for 35 DEG. S, Norton's Star Atlas 2000., Stars of the Southern Sky by Sir Patrick Moore.



The Cover Image - Sagittarius Star Cloud

Imaged by John Gill

The Sagittarius Star Cloud (also known as Messier 24 and IC 4715) is a star cloud in the constellation of Sagittarius, approximately 600 light years wide, which was discovered by Charles Messier in 1764. It is sometimes known as the Small Sagittarius Star Cloud to distinguish it from the Great Sagittarius Star Cloud located to the north of Gamma Sagittarii and Delta Sagittarii.

The stars, clusters and other objects comprising M24 are part of the Sagittarius or Sagittarius-Carina arms of the Milky Way galaxy. Messier described M24 as a "large nebulosity containing many stars" and gave its dimensions as being some 1.5° across. Some sources, improperly, identify M24 as the faint cluster NGC 6603.

M24 fills a space of significant volume to a depth of 10,000 to 16,000 light-years. This is the most dense concentration of individual stars visible using binoculars, with around 1,000 stars visible within a single field of view.

The star cloud can be seen visible when the Milky Way itself is visible as well. Without the dust and gas that conceals the Milky Way, M24 holds a collection of numerous kinds of stars that are placed along the Milky Way and through the galaxy's obscuring band of interstellar dust.

The location of the Sagittarius Star Cloud is near the Omega Nebula (also known as M17) and open cluster Messier 18, north of M24. M24 is one of only three Messier objects that are not deep sky objects.

HD 167356 is the brightest star that is located within the Sagittarius Star Cloud, a white supergiant with an apparent magnitude of 6.05. This star is an Alpha-2 Canum Venaticorum variable, showing small changes in brightness as it rotates. There are three other stars located in M24 with visual magnitudes between 6.5 and 7.0.

The star cloud incorporates two prominent dark nebulae which are vast clouds of dense, obscuring interstellar dust. This dust blocks light from the more distant stars, which keeps them from being seen from Earth. Lying on the northwestern side is Barnard 92, which is the darkest out of the two. Inside the field filled with stars, the nebula appears as an immense round hole that is devoid of any stars. American astronomer Edward Emerson Barnard discovered this dark nebula in 1913.

Along the northeast side contains Barnard 93, which is less obvious and large as the other dark nebula. There are also other dark nebulae within M24, including Barnard 304 and Barnard 307. Both Barnard 92 and 93 have the most significant features shown in M24 due to them both blocking out several stars and being the most visually prominent.

The Sagittarius Star Cloud also holds two planetary nebulae, M 1-43 and NGC 6567. Located within a spiral arm of the Milky Way, Messier 24 holds some similarities with NGC 206, a bright, large star cloud.

Tech Specs: APM APO 107/700 telescope on Celestron CGX mount and Canon 60Da Camera.

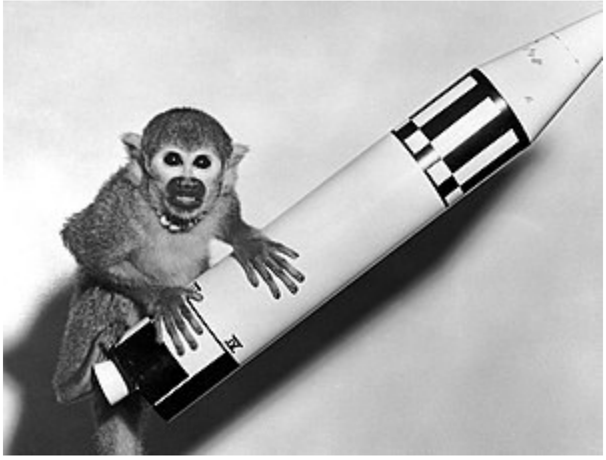
ZWO Optics for Auto-Guiding and processed in PixInsight.

14 Lights @ ISO 100 for 360 seconds

60 Bias & Flats and 20 Darks

Animals In Space

From Wikipedia, the free encyclopedia



Space pioneer Miss Baker, a squirrel monkey, rode a Jupiter IRBM into space in 1959.

Landmarks for animals in space
1947: First animal in space
1949: First monkey in space
1951: First dogs in space
1957: First animal in orbit
1968: First animals in deep space and to circle the Moon
2007: First animal survives exposure to space

Non-human animals in space originally served to test the survivability of spaceflight, before human spaceflights were attempted. Later, other non-human animals were flown to investigate various biological processes and the effects microgravity and space flight might have on them.

Bioastronautics is an area of bioengineering research which spans the study and support of life in space. To date, seven national space programs have flown animals into space: the Soviet Union, the United States, France, Argentina, China, Japan and Iran.

A wide variety of non-human animals have been launched into space, including monkeys, dogs, tortoises, and insects. The United States launched flights containing monkeys and primates primarily between 1948-1961 with one flight in 1969 and one in 1985. France launched two monkey-carrying flights in 1967. The Soviet Union and Russia launched monkeys between 1983 and 1996. During the 1950s and 1960s, the Soviet space program used a number of dogs for sub-orbital and orbital space flights.[1] Two tortoises and a variety of insects were the first inhabitants of Earth to circle the Moon, on the 1968 Zond 5 mission.

Background

Animals had been used in aeronautic exploration since 1783 when the Montgolfier brothers sent a sheep, a duck, and a rooster aloft in a hot air balloon (the duck serving as the experimental control). The limited supply of captured German V-2 rockets led to the U.S. use of high-altitude balloon launches carrying fruit flies, mice, hamsters, guinea pigs, cats, dogs, frogs, goldfish and monkeys to heights of up to 44,000 m (144,000 ft; 27 mi). These high-altitude balloon flights from 1947 to 1960 tested radiation exposure, physiological response, life support and recovery systems. The U.S. high-altitude manned balloon flights occurred in the same time frame, one of which also carried fruit flies.

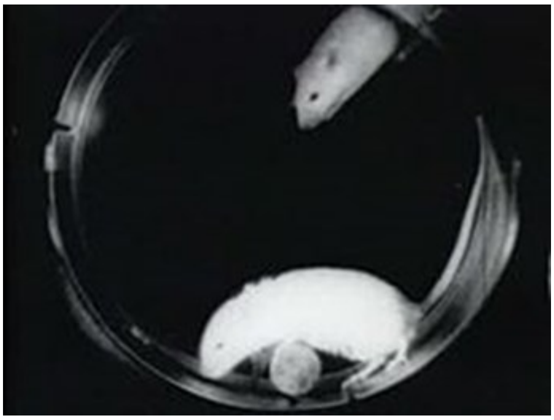
… Animals In Space

V2 launch No. 47 carried the monkey Albert II into space.

1940s

The first animals sent into space were fruit flies aboard a U.S.-launched V-2 rocket on 20 February 1947 from White Sands Missile Range, New Mexico. The purpose of the experiment was to explore the effects of radiation exposure at high altitudes. The rocket reached 68 miles (109 km) in 3 minutes and 10 seconds, past both the U.S. Air Force 50-mile and the international 100 km definitions of the boundary of space. The Blossom capsule was ejected and successfully deployed its parachute. The fruit flies were recovered alive. Other V-2 missions carried biological samples, including moss.

Albert II, a rhesus monkey, became the first monkey in space on 14 June 1949, in a U.S.-launched V-2, after the failure of the original Albert's mission on ascent. Albert I reached only 30–39 miles (48–63 km) altitude; Albert II reached about 83 miles (134 km). Albert II died on impact after a parachute failure. Numerous monkeys of several species were flown by the U.S. in the 1950s and 1960s. Monkeys were implanted with sensors to measure vital signs, and many were under anesthesia during launch. The death rate among monkeys at this stage was very high: about two-thirds of all monkeys launched in the 1940s and 1950s died on missions or soon after landing.



Animals In Rocket Flight, a 1953 US Air Force film

1950s

On 31 August 1950, the U.S. launched a mouse into space (137 km) aboard a V-2 (the Albert V flight, which, unlike the Albert I-IV flights, did not have a monkey), but the rocket disintegrated because the parachute system failed. The U.S. launched several other mice in the 1950s.
On 22 July 1951, the Soviet Union launched the R-1 IIIA-1 flight, carrying the dogs Tsygan (Russian: Цыган, "Gypsy") and Dezik (Russian: Дезик) into space, but not into orbit. These two dogs were the first living higher organisms successfully recovered from a spaceflight. Both space dogs survived the flight, although one would die on a subsequent flight. The U.S. launched mice aboard spacecraft later that year; however, they failed to reach the altitude for true spaceflight.

On 3 November 1957, the second-ever orbiting spacecraft carried the first animal into orbit, the dog Laika, launched aboard the Soviet Sputnik 2 spacecraft (nicknamed 'Muttnik' in the West). Laika died during the flight, as was intended because the technology to return from orbit had not yet been developed. At least 10 other dogs were launched into orbit and numerous others on sub-orbital flights before the historic date of 12 April 1961, when Yuri Gagarin became the first human in space.

On 13 December 1958, a Jupiter IRBM, AM-13, was launched from Cape Canaveral, Florida, with a United States Navy-trained South American squirrel monkey named Gordo on board. The nose cone recovery parachute failed to operate and Gordo was lost. Telemetry data sent back during the flight showed that the monkey survived the 10 g of launch, 8 minutes of weightlessness and 40 g of reentry at 10,000 miles per hour (16,000 km/h). The nose cone sank 1,302 nautical miles (2,411 km) downrange from Cape Canaveral and was not recovered.

… Animals In Space

Monkeys Able and Baker became the first monkeys to survive spaceflight after their 1959 flight. On 28 May 1959, aboard Jupiter IRBM AM-18, were a 7-pound (3.18 kg) American-born rhesus monkey, Able, from Independence, Kansas, and an 11-ounce (310-gram) squirrel monkey from Peru, Baker. The monkeys rode in the nose cone of the missile to an altitude of 360 miles (579 km) and a distance of 1,700 miles (2,735 km) down the Atlantic Missile Range from Cape Canaveral, Florida. They withstood forces 38 times the normal pull of gravity and were weightless for about 9 minutes. A top speed of 10,000 mph (16,000 km/h) was reached during their 16-minute flight.

The monkeys survived the flight in good condition. Able died four days after the flight from a reaction to anesthesia, while undergoing surgery to remove an infected medical electrode. Baker was the center of media attention for the next several months as she was watched closely for any ill-effects from her space flight. She was even mated in an attempt to test her reproductive system. Baker lived until 29 November 1984, at the US Space and Rocket Center in Huntsville, Alabama.

On 2 July 1959, a launch of a Soviet R2 rocket, which reached 212 kilometers (132 mi), carried two space dogs and Marfusa, the first rabbit to go into space. A 19 September 1959 launch, Jupiter AM-23, carried 2 frogs along with 12 mice but the rocket was destroyed during launch.

1960s

On 19 August 1960 the Soviet Union launched Sputnik 5 (also known as Korabl-Sputnik 2) which carried the dogs Belka and Strelka, along with a gray rabbit, 40 mice, 2 rats, and 15 flasks of fruit flies and plants. It was the first spacecraft to carry animals into orbit and return them alive. One of Strelka's pups, Pushinka, bred and born after her mission, was given as a present to Caroline Kennedy by Nikita Khrushchev in 1961, and many descendants are known to exist.

The United States sent 3 black mice Sally, Amy and Moe 1,000 km up and 8,000 km distance from Cape Canaveral on 13 October 1960 using an Atlas D 71D launch vehicle. The mice were retrieved from the nosecone near Ascension Island and were said to be in good condition.
On 31 January 1961, Ham the Chimp was launched in a Mercury capsule aboard a Redstone rocket. Ham's mission was Mercury-Redstone 2. The chimpanzee had been trained to pull levers to receive rewards of banana pellets and avoid electric shocks. His flight demonstrated the ability to perform tasks during spaceflight. A little over 3 months later the United States sent Alan Shepard into space. Enos the chimp became the first chimpanzee in orbit on 29 November 1961, in another Mercury capsule, an Atlas rocket, Mercury-Atlas 5.

On 9 March 1961 the Soviet Union launched the Korabl-Sputnik 4 that carried a dog named Chernushka, some mice, frogs and, for the first time into space, a guinea pig. All were successfully recovered.

France flew their first rat (Hector) into space on 22 February 1961. Two more rats were flown in October 1962. On 18 October 1963, France launched Félicette the cat aboard Veronique AGI sounding rocket No. 47. The launch was directed by the French Centre d'Enseignement et de Recherches de Médecine Aéronautique (CERMA). Félicette was recovered alive after a 15-minute flight and a descent by parachute. Félicette had electrodes implanted into her brain, and the recorded neural impulses were transmitted back to Earth. A second cat was sent to space by CERMA on 24 October 1963, but the flight ran into difficulties that prevented recovery. The final French animal launches were of two monkeys in March 1967.

China launched mice and rats in 1964 and 1965, and two dogs in 1966.

… Animals In Space

During the Voskhod program, two Soviet space dogs, Veterok (Ветерок, Little Wind) and Ugolyok (Уголёк, Blackie), were launched on 22 February 1966, on board Cosmos 110 and spent 22 days in orbit before landing on 16 March. This spaceflight of record-breaking duration was not surpassed by humans until Soyuz 11 in 1971 and still stands as the longest space flight by dogs.

The United States launched Biosatellite I in 1966 and Biosatellite I/II in 1967 with fruit flies, parasitic wasps, flour beetles and frog eggs, along with bacteria, amoebae, plants and fungi.
On 11 April 1967, Argentina also launched the rat Belisario, atop a Yarará rocket, from Cordoba military range, which was recovered successfully. This flight was followed by a series of subsequent flights using rats. It is unclear if any Argentinean biological flights passed the 100 km limit of space.

The first two tortoises in space were launched on Zond 5 on 14 September 1968 by the Soviet Union. The Horsfield's tortoises were sent on a circumlunar voyage along with wine flies, meal worms, and other biological specimens. These were the first animals in deep space and the first inhabitants of earth to travel around the moon. The capsule overshot its terrestrial landing site but was successfully recovered at sea on 21 September. The animals survived but suffered some weight loss.

On 28 June 1969, the United States launched the monkey Bonny, a macaque, on Biosatellite 3 in what was intended to have been a 30-day orbit around the Earth, with the monkey being fed by food pellets from a dispenser that he had been trained to operate. However, Bonny's health deteriorated rapidly and he was returned to Earth on July 7, but died the next day after the Biosatellite capsule was recovered in the Pacific Ocean.

In total in the 1950s and 1960s, the Soviet Union launched missions with passenger slots for at least 57 dogs. The actual number of dogs in space is smaller, because some dogs flew more than once.

On 23 December 1969, as part of the 'Operación Navidad' (Operation Christmas), Argentina launched Juan (a cai monkey, native of Argentina's Misiones Province) using a Canopus II rocket. It ascended 82 kilometers and then was recovered successfully. Later, on 1 February 1970 the experience was repeated with a female monkey of the same species using a X-1 Panther rocket. It reached a higher altitude than its predecessor, but it was lost after the capsule's parachute failed.

1970s

First spider web built in space

Two bullfrogs were launched on a one-way mission on the Orbiting Frog Otolith satellite on 9 November 1970, to understand more about space motion sickness.
Apollo 16 on 16 April 1972 carried nematodes, and Apollo 17, launched on 7 December 1972 carried five pocket mice, although one died on the circumlunar trip. Skylab 3 carried pocket mice and the first fish in space (a mummichog), and the first spiders in space (garden spiders named Arabella and Anita). Mummichog were also flown by the U.S. on the Apollo-Soyuz joint mission, launched 15 July 1975.
The Soviets flew several Bion program missions which consisted of satellites with biological cargoes. On these launches they flew tortoises, rats, and mummichog. On Soyuz 20, launched 17 November 1975, tortoises set the duration record for an animal in space when they spent 90.5 days in space. Salyut 5 on 22 June 1976, carried tortoises and a fish (a zebra danio).

… Animals In Space

1980s

The Soviet Union sent eight monkeys into space in the 1980s on Bion flights. In 1985, the U.S. sent two squirrel monkeys aboard Spacelab 3 on the Space Shuttle with 24 male albino rats and stick insect eggs. Bion flights also flew zebra danio, fruit flies, rats, stick insect eggs and the first newts in space.
Bion 7 (1985) had 10 newts (*Pleurodeles waltl*) on board. The newts had part of their front limbs amputated, to study the rate of regeneration in space, knowledge to understand human recovery from space injuries.

After an experiment was lost in the Space Shuttle *Challenger* disaster, chicken embryos (fertilized eggs) were sent into space in an experiment on STS-29 in 1989. The experiment was designed for a student contest.

1990s

Four monkeys flew aboard the last Bion flights of the Soviet Union as well as frogs and fruit flies. The Foton program flights carried dormant brine shrimp (*Artemia franciscana*), newts, fruit flies, and sand desert beetles (*Trigonoscelis gigas*).

China launched guinea pigs in 1990.

Toyohiro Akiyama, a Japanese journalist carried Japanese tree frogs with him during his trip to the *Mir* space station in December 1990. Other biological experiments aboard Mir involved quail eggs.

Japan launched its first animals, a species of newt, into space on 18 March 1995 aboard the Space Flyer Unit.
During the 1990s the U.S. carried crickets, mice, rats, frogs, newts, fruit flies, snails, carp, medaka, oyster toadfish, sea urchins, swordtail fish, gypsy moth eggs, stick insect eggs, brine shrimp (*Artemia salina*), quail eggs, and jellyfish aboard Space Shuttles.

Astronaut Donald Thomas examines a newt on the Space Shuttle *Columbia during a 1994 mission.*

2000s

The last flight of *Columbia* in 2003 carried silkworms, garden orb spiders, carpenter bees, harvester ants, and Japanese killifish (medaka). Nematodes (*C. elegans*) from one experiment were found still alive in the debris after the Space Shuttle *Columbia* disaster.
C. elegans are also part of experiments aboard the International Space Station as well as research using quail eggs.

Earlier shuttle missions included grade school, junior high and high school projects; some of these included ants, stick insect eggs and brine shrimp cysts. Other science missions included gypsy moth eggs.

… Animals In Space

On 12 July 2006, Bigelow Aerospace launched their *Genesis I* inflatable space module, containing many small items such as toys and simple experiments chosen by company employees that would be observed via camera. These items included insects, perhaps making it the first private flight to launch animals into space. Included were Madagascar hissing cockroaches and Mexican jumping beans — seeds containing live larvae of the moth *Cydia deshaisiana*. On 28 June 2007, Bigelow launched *Genesis II*, a near-twin to *Genesis I*. This spacecraft also carried the Madagascar hissing cockroaches and added South African flat rock scorpions (*Hadogenes troglodytes*) and seed-harvester ants (*Pogonomyrmex californicus*).

In September 2007, during the European Space Agency's FOTON-M3 mission, tardigrades, also known as water-bears, were able to survive 10 days of exposure to open-space with only their natural protection.

On the same mission, a number of cockroaches were carried inside a sealed container and at least one of the females conceived during the mission. After they were returned to earth, the one named Nadezhda became the first earth creature to produce young that had been conceived in space.

On 15 March 2009, during the countdown of the STS-119, a free-tailed bat was seen clinging to the fuel tank. NASA observers believed the bat would fly off once the shuttle started to launch, but it did not. Upon analyzing the images, a wildlife expert who provided support to the center said it likely had a broken left wing and some problem with its right shoulder or wrist. The animal most likely perished quickly during Discovery's climb into orbit.

In November 2009, STS-129 took painted lady and monarch butterfly larvae into space for a school experiment as well as thousands of *C. elegans* roundworms for long-term weight loss studies.

2010s

On 3 February 2010, on the 31st anniversary of its revolution, Iran became the latest country to launch animals into space. The animals (a mouse, two turtles and some worms) were launched on top of the Kavoshgar 3 rocket and returned alive to Earth.

In May 2011, the last flight of *Endeavour* (STS-134) carried two golden orb spiders, named Gladys and Esmeralda, as well as a fruit fly colony as their food source in order to study the effects of microgravity on spiders' behavior. Tardigrades and other extremophiles were also sent into orbit.

In November 2011, the Living Interplanetary Flight Experiment on the Fobos-Grunt mission planned to carry tardigrades to Mars and back; however, the mission failed to leave Earth orbit. In October 2012, 32 medaka fish were delivered to the International Space Station by Soyuz TMA -06M for the new Aquatic Habitat in the Kibo module.

On 28 January 2013, Iranian news agencies reported that Iran sent a monkey in a "Pishgam" rocket to a height of 72 miles (116 km) and retrieved a "shipment". Later Iran's space research website uploaded an 18-minute video. The video was uploaded later on YouTube. In January 2014, the search strategies of pavement ants were studied on the ISS.

On 19 July 2014, Russia announced that they launched their Foton-M4 satellite into low earth orbit (575 kilometers) with 1 male and 4 female geckos (possibly gold dust day geckos) as the payload. This was an effort to study the effects of microgravity on reproductive habits of reptiles. On 24 July 2014, it was announced that Russia had lost control of the Foton-M4 satellite, leaving only two months to restore contact before the geckos' food supply was exhausted. Control of the satellite was subsequently restored on 28 July 2014.

… Animals In Space

On 1 September 2014 Russia confirmed the death of all five geckos, stating that their mummified bodies seem to indicate they froze to death. Russia is said to have appointed an emergency commission to investigate the animals' deaths.

On 23 September 2014, the SpaceX CRS-4 mission delivered 20 mice to live on the ISS for study of the long-term effects of microgravity on the rodents.

On 14 April 2015, the SpaceX CRS-6 delivered 20 C57BL/6NTAC mice to live on the ISS for evaluating microgravity as the extreme opposite of a healthy active lifestyle. In the absence of gravity, astronauts are subject to a decrease in muscle, bone, and tendon mass. "Although, we’re not out to treat couch potatoes," states head Novartis Institute for Biomedical Research (NIBR) scientist on the project Dr. Sam Cadena, "we’re hoping that these experiments will help us to better understand muscle loss in populations where physical activity in any form is not an option; e.g., in the frail elderly or those subjected to bed rest or immobilization due to surgery or chronic disease."

On 8 April 2016, Rodent Research 3 delivered 20 mice on SpaceX CRS-8. The experiment sponsored by Eli Lilly and Co. was a study of myostatin inhibition for the prevention of skeletal and muscle atrophy and weakness. Mice are known to suffer from rapid loss of muscle and bone mas after as little as 12 days of space flight exposure. The mice were euthanized and dissected on the station and then frozen for eventual return to Earth for further study.

On 29 June 2018, a SpaceX Dragon spaceship blasted off from Florida carrying 20 mice. The rodent crew arrived at the ISS on 2 July 2018. Their record-breaking journey — this was the longest mice have been off the planet — was part of a study on how Earth-dwellers' guts and sleep schedules responded to the stress of being in space.

Astronomy

Term of the Day

The Secrets of the Universe

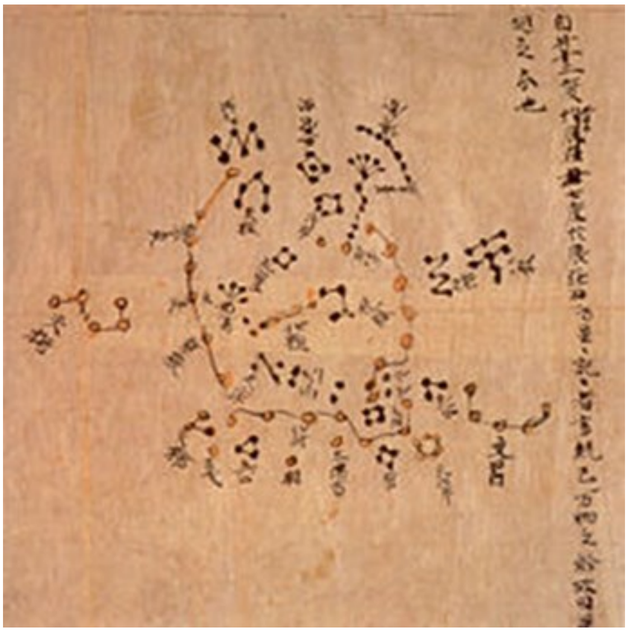
Mira Stars

Field: Stellar Astrophysics

Mira stars are a class of pulsating variable stars that are named after their prototype Mira. Any star that changes its brightness periodically is known as variable star. The Mira variables have a period of over 100 days. They are red giant stars in very late stage of evolution and within few million years, the outer envelope of variable these stars will be expelled as planetary nebula and what'll be left behind is a white dwarf.

Chinese Astronomy

From Wikipedia, the free encyclopedia



The Dunhuang map from the Tang Dynasty (North Polar region). This map is thought to date from the reign of Emperor Zhongzong of Tang (705–710). Founded in Dunhuang, Gansu. Constellations of the three schools were distinguished with different colors: white, black and yellow for stars of Wu Xian, Gan De and Shi Shen respectively. The whole set of star maps contained 1,300 stars.

Astronomy in China has a long history, beginning from the Shang Dynasty (Chinese Bronze Age). Star names later categorized in the twenty-eight mansions have been found on oracle bones unearthed at Anyang, dating back to the middle Shang Dynasty, and the mansion (xiù:宿) system's nucleus seems to have taken shape by the time of the ruler Wu Ding (1339-1281 BCE) Detailed records of astronomical observations began during the Warring States period (fourth century BCE) and flourished from the Han period onward. Chinese astronomy was equatorial, centered as it was on close observation of circumpolar stars, and was based on different principles from those prevailing in traditional Western astronomy, where heliacal risings and settings of zodiac constellations formed the basic ecliptic framework. Needham has described the ancient Chinese as the most persistent and accurate observers of celestial phenomena anywhere in the world before the Islamic astronomers.

Some elements of Indian astronomy reached China with the expansion of Buddhism after the Eastern Han Dynasty (25–220 CE), but the most detailed incorporation of Indian astronomical thought occurred during the Tang Dynasty (618-907 CE), when numerous Indian astronomers took up residence in the Chinese capital, and Chinese scholars, such as the Tantric Buddhist monk and mathematician Yi Xing, mastered its system. Islamic astronomers collaborated closely with their Chinese colleagues during the Yuan Dynasty, and, after a period of relative decline during the Ming Dynasty, astronomy was revitalized under the stimulus of Western cosmology and technology after the Jesuits established their missions. The telescope was introduced in the seventeenth century. In 1669, the Peking observatory was completely redesigned and refitted under the direction of Ferdinand Verbiest. Today, China continues to be active in astronomy, with many observatories and its own space program.

Purpose of astronomical observations in the past

One of the main functions was for the purpose of timekeeping. The Chinese used a lunisolar calendar, but, because the cycles of the sun and the moon are different, intercalation had to be done.

The Chinese calendar was considered to be a symbol of a dynasty. As dynasties would rise and fall, astronomers and astrologers of each period would often prepare a new calendar to be made, with observations for that purpose.

Astrological divination was also an important part of astronomy. Astronomers took careful note of guest stars, which suddenly appeared among the fixed stars. The supernova that created the Crab Nebula observed in 1054, now known as the SN 1054, is an example of a guest star observed by Chinese astronomers, recorded also by the Arab astronomers, although it was not recorded by their European contemporaries. Ancient astronomical records of phenomena like comets and supernovae are sometimes used in modern astronomical studies.

… Chinese Astronomy

Wide view of the
Crab Nebula

Indian influence

Indian astronomy reached China with the expansion of Buddhism during the Later Han (25–220 CE). Further translation of Indian works on astronomy was completed in China by the Three Kingdoms era (220–265 CE). However, the most detailed incorporation of Indian astronomy occurred only during the Tang Dynasty (618–907 CE) when a number of Chinese scholars—such as Yi Xing— were versed both in Indian and Chinese astronomy. A system of Indian astronomy was recorded in China as *Jiuzhi-li* (718 CE), the author of which was an Indian by the name of Qutan Xida—a translation of Devanagari Gotama Siddha—the director of the Tang dynasty's national astronomical observatory. During the 8th century, the astronomical table of sines by the Indian astronomer and mathematician, Aryabhatta (476-550), were translated into the Chinese astronomical and mathematical book of the *Treatise on Astrology of the Kaiyuan Era* (*Kaiyuan Zhanjing*), compiled in 718 CE during the Tang Dynasty. The *Kaiyuan Zhanjing* was compiled by Gautama Siddha, an astronomer and astrologer born in Chang'an, and whose family was originally from India. He was also notable for his translation of the Navagraha calendar into Chinese. Gautama Siddha introduced Indian numerals with zero (○) in 718 in China as a replacement of counting rods.

In 3rd-century C.E, the Matanaga avadha was translated into Chinese.although the original is believed to date earlier. It gives the lengths of monthly shadows of a 12-inch gnomon, which is the standard parameter of Indian astronomy.The work also mentions the 28 Indian nakshatras. In the beginning of the second century, Sardulakarnavadana was translated into Chinese several times, This work contains the usual Sanskrit names of the 28 nakshatras. starting with krttika.

From the 1st century onward Lalitavistara was translated into Chinese several times. It is in this work that the famous Buddhist centesimal-scale counting occurs during the dialogue between Prince Gautamaand and the mathematician Arjuna. The first series of counts ends with tallaksana (= 10^{53}), beyond which eight more ganana series are mentioned.Atomic-scale counting is also mentioned.The Mahaprajnaparamita Sastra (of Nagarjuna, second century) was translated into Chinese by Kumarajiva in the early fifth century.16 The astronomical parameters mentioned in this translation are comparable to those given in the Vedanga Jyotisha.Indian system of numeration appeared in the Chinese work Ta PaoChi Ching (Maharatnakuta Sutra), translated by Upasunya (in 541 c.e.) The Chinese translations of the following works are mentioned in the Sui Shu, or Official History of the Sui Dynasty (seventh century):

- Po-lo-men Thien Wen Ching (Brahminical Astronomical Classic) in 21 books.

Po-lo-men Chieh-Chhieh Hsien-jen Thien Wen Shuo (Astronomical Theories of Brahman.a Chieh-Chhieh Hsienjen) in 30 books.

- Po-lo-men Thien Ching (Brahminical Heavenly Theory) in one book.
- Mo-teng-Chia Ching Huang-thu (Map of Heaven and Earth in the Matangi Sutra) in one book.
- Po-lo-men Suan Ching (Brahminical Arithmetical Classic) in three books.
- Po-lo-men Suan Fa (Brahminical Arithmetical Rules) in one book.
-

Po-lo-men Ying Yang Suan Ching (Brahminical Method of Calculating Time)
Although these translations are lost, they were also mentioned in other sources.

… Chinese Astronomy

Cosmology

The Chinese developed three cosmological models:

The Gai Tian, or hemispherical dome, model conceived the heavens as a hemisphere lying over a dome-shaped earth.

The second cosmological model, associated with the Hun Tian school, saw the heavens as a celestial sphere not unlike the spherical models developed in the Greek and Hellenistic traditions.

The third cosmology, associated with the Xuan Ye school, viewed the heavens as infinite in extent and the celestial bodies as floating about at rare intervals, and "the speed of the luminaries depends on their individual natures, which shows they are not attached to anything."

Constellations

The divisions of the sky began with the Northern Dipper and the 28 mansions.
In 1977, a lacquer box was excavated from the tomb of Yi, the marquis of Zeng, in Suixian, Hubei Province. Names of the 28 lunar mansions were found on the cover of the box, proving that the use of this classification system was made before 433 BCE.

As lunar mansions have such an ancient origin, the meanings of most of their names have become obscure. Even worse, the name of each lunar mansion consists of only one Chinese word, the meaning of which could vary at different times in history. The meanings of the names are still under discussion.

Besides the 28 lunar mansions, most constellations are based on the works of Shi Shen-fu and Gan De, who were astrologists during the period of Warring States (481 BCE - 221 BCE) in China.

In the late period of the Ming Dynasty, the agricultural scientist and mathematician Xu Guangqi (1562 - 1633 CE) introduced 23 additional constellations near to the Celestial South Pole, which are based on star catalogues from the West.

Star catalogues and maps

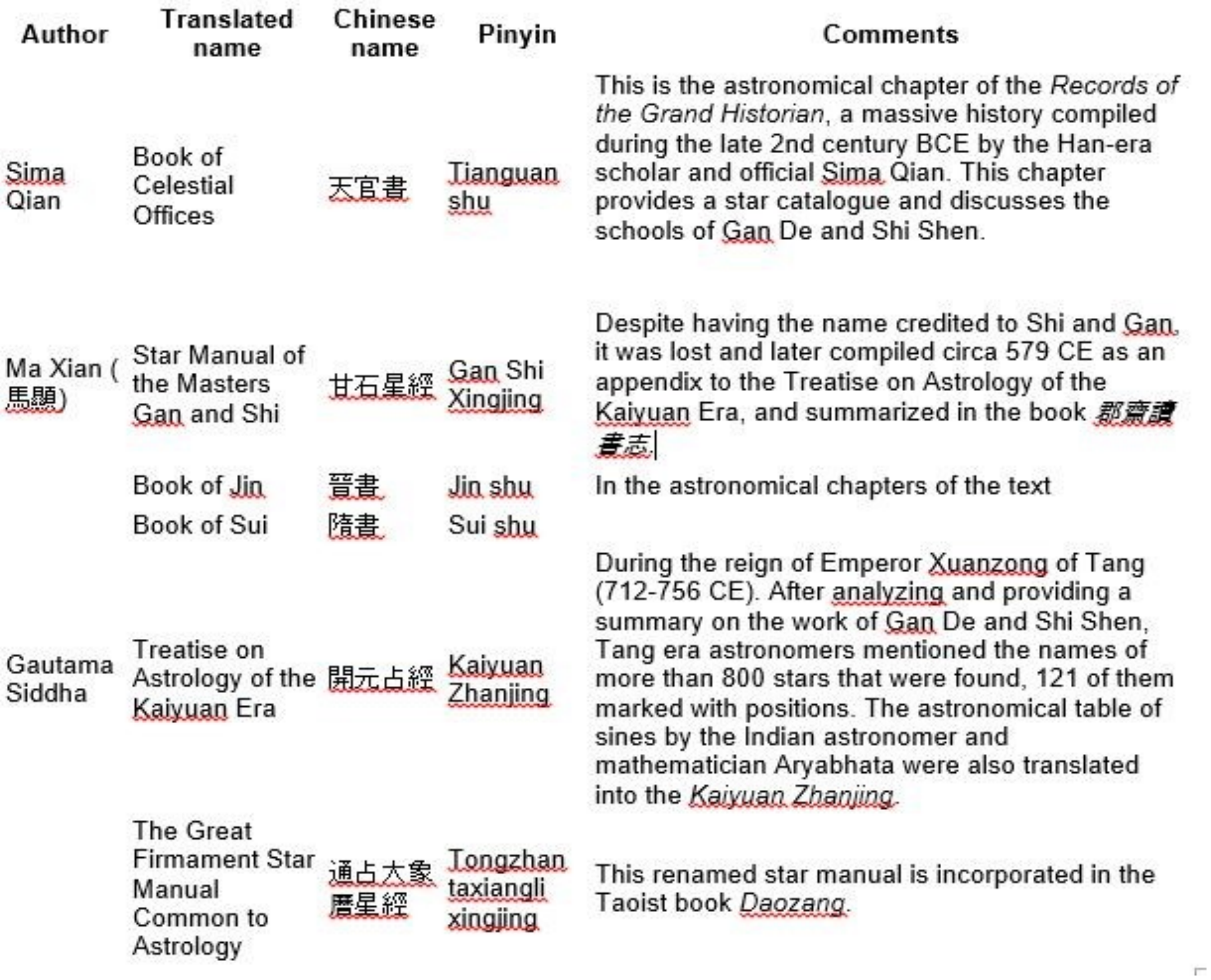
Star catalogues

In the fourth century BCE, the two Chinese astronomers responsible for the earliest information going into the star catalogues were Shi Shen and Gan De of the Warring States period.

Author	Translated name	Chinese catalogue name	Pinyin
Shi Shen	Shi Shen astronomy	石申天文	Shi Shen tianwen
Gan De	Astronomic star observation	天文星占	Tianwen xingzhan

These books appeared to have lasted until the sixth century, but were lost after that. A number of books share similar names, often quoted and named after them. These texts should *not* be confused with the original catalogues written by them. Notable works that helped preserve the contents include:

… Chinese Astronomy



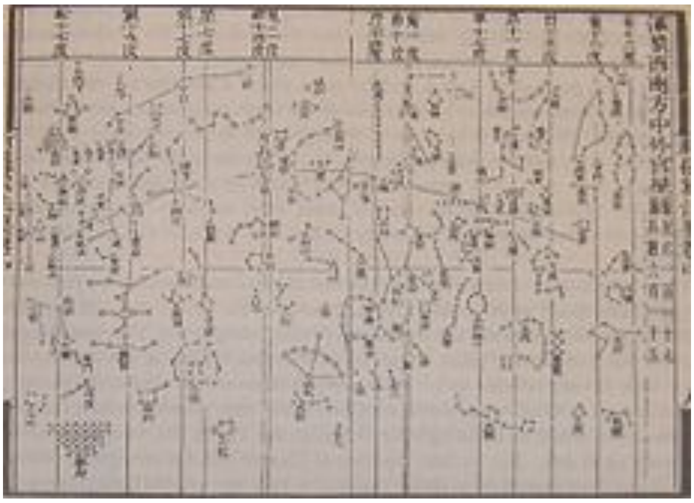
Author	Translated name	Chinese name	Pinyin	Comments
Sima Qian	Book of Celestial Offices	天官書	Tianguan shu	This is the astronomical chapter of the *Records of the Grand Historian*, a massive history compiled during the late 2nd century BCE by the Han-era scholar and official Sima Qian. This chapter provides a star catalogue and discusses the schools of Gan De and Shi Shen.
Ma Xian (馬顯)	Star Manual of the Masters Gan and Shi	甘石星經	Gan Shi Xingjing	Despite having the name credited to Shi and Gan, it was lost and later compiled circa 579 CE as an appendix to the Treatise on Astrology of the Kaiyuan Era, and summarized in the book *郡齋讀書志*
	Book of Jin	晉書	Jin shu	In the astronomical chapters of the text
	Book of Sui	隋書	Sui shu	
Gautama Siddha	Treatise on Astrology of the Kaiyuan Era	開元占經	Kaiyuan Zhanjing	During the reign of Emperor Xuanzong of Tang (712-756 CE). After analyzing and providing a summary on the work of Gan De and Shi Shen, Tang era astronomers mentioned the names of more than 800 stars that were found, 121 of them marked with positions. The astronomical table of sines by the Indian astronomer and mathematician Aryabhata were also translated into the *Kaiyuan Zhanjing*.
	The Great Firmament Star Manual Common to Astrology	通占大象曆星經	Tongzhan taxiangli xingjing	This renamed star manual is incorporated in the Taoist book *Daozang*.

Wu Xian (巫咸) has been one of the astronomers in debate. He is often represented as one of the "Three Schools Astronomical tradition" along with Gan and Shi. The Chinese classic text *Star Manual of Master Wu Xian* (巫咸星經) and its authorship is still in dispute, because it mentioned names of twelve countries that did not exist in the Shang Dynasty, the era of which it was supposed to have been written. Moreover, it was customary in the past for the Chinese to forge works of notable scholars, as this could lead to a possible explanation for the inconsistencies found. Wu Xian is generally mentioned as the astronomer who lived many years before Gan and Shi.

The Han Dynasty astronomer and inventor Zhang Heng (78-139 CE) not only catalogued some 2500 different stars, but also recognized more than 100 different constellations. Zhang Heng also published his work *Ling Xian*, a summary of different astronomical theories in China at the time. In the subsequent period of the Three Kingdoms (220-280 CE), Chen Zhuo (陳卓) combined the work of his predecessors, forming another star catalogue. This time, 283 constellations and 1464 stars were listed. The astronomer Guo Shoujin of the Yuan Dynasty (1279-1368 CE) created a new catalogue, which was believed to contain thousands of stars. Unfortunately, many of the documents of that period were destroyed, including that of Shoujin. *Imperial Astronomical Instruments* (儀象考成) was published in 1757 and contains 3083 stars exactly.

… Chinese Astronomy

Star maps



A star map with a cylindrical projection. Su Song's star maps represent the oldest existent ones in printed form

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The Chinese drew many maps of stars in the past centuries. It is debatable as to which counts as the oldest star maps, since pottery and old artifacts can also be considered star maps. One of the oldest existent star maps in printed form is from Su Song's (1020-1101 CE) celestial atlas of 1092 CE, which was included in the horological treatise on his clocktower. The most famous one is perhaps the Dunhuang map found in Dunhuang, Gansu. Uncovered by the British archaeologist Marc Aurel Stein in 1907, the star map was brought to the British Museum in London. The map was drawn on paper and represents the complete sky, with more than 1,350 stars. Although ancient Babylonians and Greeks also observed the sky and catalogued stars, no such complete record of the stars may exist or survive. Hence, this is the oldest chart of the skies at present.

According to recent studies, the map may date the manuscript to as early as the seventh century CE (Tang Dynasty). Scholars believe the star map dating from 705 to 710 CE, which is the reign of Emperor Zhongzong of Tang. There are some texts (Monthly Ordinances, 月令) describing the movement of the sun among the sky each month, which was not based on the observation at that time.

Solar and lunar eclipses

Chinese astronomers recorded 1,600 observations of solar and lunar eclipses from 750 BCE. The ancient Chinese astronomer Shi Shen (fl. fourth century BCE) was aware of the relation of the moon in a solar eclipse, as he provided instructions in his writing to predict them by using the relative positions of the moon and the sun. The radiating-influence theory, where the moon's light was nothing but a reflection of the sun's, was supported by the mathematician and music theorist Jing Fang (78–37 BCE), yet opposed by the Chinese philosopher Wang Chong (27–97 CE), who made clear in his writing that this theory was nothing new.

Jing Fang wrote: The moon and the planets are Yin; they have shape but no light. This they receive only when the sun illuminates them. The former masters regarded the sun as round like a crossbow bullet, and they thought the moon had the nature of a mirror. Some of them recognized the moon as a ball too. Those parts of the moon which the sun illuminates look bright, those parts which it does not, remain dark.

The ancient Greeks had known this as well, since Parmenides and Aristotle supported the theory of the moon shining because of reflected light. The Chinese astronomer and inventor Zhang Heng (78–139 CE) wrote of both solar eclipse and lunar eclipse in the publication of *Ling Xian* (靈憲), 120 CE:

… Chinese Astronomy

The sun is like fire and the moon like water. The fire gives out light and the water reflects it. Thus the moon's brightness is produced from the radiance of the sun, and the moon's darkness (pho) is due to (the light of) the sun being obstructed (pi). The side which faces the sun is fully lit, and the side which is away from it is dark. The planets (as well as the moon) have the nature of water and reflect light. The light pouring forth from the sun (tang jih chih chhung kuang) does not always reach the moon owing to the obstruction (pi) of the earth itself—this is called 'an-hsü', a **lunar eclipse**. When (a similar effect) happens with a planet (we call it) an occulation (hsing wei); when the moon passes across (kuo) (the sun's path) then there is a **solar eclipse** (shih).

The later Song Dynasty scientist Shen Kuo (1031–1095 CE) used the models of lunar eclipse and solar eclipse in order to prove that the celestial bodies were round, not flat. This was an extension of the reasoning of Jing Fang and other theorists as early as the Han Dynasty. In his *Dream Pool Essays* of 1088 CE, Shen related a conversation he had with the director of the Astronomical Observatory, who had asked Shen if the shapes of the sun and the moon were round like balls or flat like fans. Shen Kuo explained his reasoning for the former:

If they were like balls they would surely obstruct each other when they met. I replied that these celestial bodies were certainly like balls. How do we know this? By the waxing and waning of the moon. The moon itself gives forth no light, but is like a ball of silver; the light is the light of the sun (reflected). When the brightness is first seen, the sun (-light passes almost) alongside, so the side only is illuminated and looks like a crescent. When the sun gradually gets further away, the light shines slanting, and the moon is full, round like a bullet. If half of a sphere is covered with (white) powder and looked at from the side, the covered part will look like a crescent; if looked at from the front, it will appear round. Thus we know that the celestial bodies are spherical.

When he asked Shen Kuo why eclipses occurred only on an occasional basis while in conjunction and opposition once a day, Shen Kuo wrote: I answered that the ecliptic and the moon's path are like two rings, lying one over the other, but distant by a small amount. (If this obliquity did not exist), the sun would be eclipsed whenever the two bodies were in conjunction, and the moon would be eclipsed whenever they were exactly in opposition. But (in fact) though they may occupy the same degree, the two paths are not (always) near (each other), and so naturally the bodies do not (intrude) upon one another.

Equipment and innovation

Armillary sphere (渾儀)

A method of making observation instruments at the times of Qing Dynasty

… Chinese Astronomy

The earliest development of the armillary sphere in China goes back to the 1st century BCE, as they were equipped with a primitive single-ring armillary instrument. This would have allowed them to measure the north polar distance (去極度, the Chinese form of declination) and measurement that gave the position in a *hsiu* (入宿度, the Chinese form of right ascension). During the Western Han Dynasty (202 BC-9 CE), additional developments made by the astronomers Luo Xiahong (落下閎), Xiangyu Wangren, and Geng Shouchang (耿壽昌) advanced the use of the armillary in its early stage of evolution. In 52 BCE, it was the astronomer Geng Shou-chang who introduced the fixed equatorial ring to the armillary sphere. In the subsequent Eastern Han Dynasty (23-220 CE) period, the astronomers Fu An and Jia Kui added the elliptical ring by 84 CE. With the famous statesman, astronomer, and inventor Zhang Heng (78-139 CE), the sphere was totally completed in 125 CE, with horizon and meridian rings. It is of great importance to note that the world's first hydraulic (i.e., water-powered) armillary sphere was created by Zhang Heng, who operated his by use of an inflow clepsydra clock (see Zhang's article for more detail).

Abridged armilla (簡儀)

Designed by famous astronomer Guo Shoujing in 1276 AD, it solved most problems found in armillary spheres at that time.

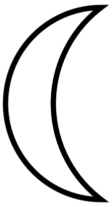
The primary structure of abridged armilla contains two large rings that are perpendicular to each other, of which one is parallel with the equatorial plane and is accordingly called "equatorial ring", and the other is a double ring that is perpendicular to the center of the equatorial ring, revolving around a metallic shaft, and is called "right ascension double ring".

The double ring holds within itself a sighting tube with crosshairs. When observing, astronomers would aim at the star with the sighting tube, whereupon the star's position could be deciphered by observing the dials of the equatorial ring and the right ascension double ring.
A foreign missionary melted the instrument in 1715 CE. The surviving one was built in 1437 CE and was taken to what is now Germany. It was then stored in a French Embassy in 1900, during the Eight-Nation Alliance. Under the pressure of international public discontent, Germany returned the instrument to China. In 1933, it was placed in Purple Mountain Observatory, which prevented it from being destroyed in the Japanese invasion of China. In the 1980s, it had become seriously eroded and rusted down and was nearly destroyed. In order to restore the device, the Nanjing government spent 11 months to repair it.

Celestial globe (渾象) before Qing Dynasty

Celestial globe from Qing Dynasty

Besides star maps, the Chinese also made celestial globes, which show stars' positions like a star map and can present the sky at a specific time. Because of its Chinese name, it is often confused with the armillary sphere, which is just one word different in Chinese (渾象 vs. 渾儀).



… Chinese Astronomy

According to records, the first celestial globe was made by Geng Shou-chang (耿壽昌) between 70 BC and 50 BCE. In the Ming Dynasty, the celestial globe at that time was a huge globe, showing the 28 mansions, celestial equator and ecliptic. None of them have survived.

Celestial globe (天體儀) in the Qing Dynasty

Celestial globes were named 天體儀 ("Miriam celestial bodies") in the Qing Dynasty. The one in Beijing Ancient Observatory was made by Belgian missionary Ferdinand Verbiest (南懷仁) in 1673 CE. Unlike other Chinese celestial globes, it employs 360 degrees rather than the 365.24 degrees (which is a standard in ancient China). It is also the first Chinese globe that shows constellations near to the Celestial South Pole.

The water-powered armillary sphere and celestial globe tower (水運儀象台)

The inventor of the hydraulic-powered armillary sphere was Zhang Heng (78-139 CE) of the Han Dynasty. Zhang was well known for his brilliant applications of mechanical gears, as this was one of his most impressive inventions (alongside his seismograph to detect the cardinal direction of earthquakes that struck hundreds of miles away).

Started by Su Song (蘇頌) and his colleagues in 1086 CE and finished in 1092 CE, his large astronomical clock tower featured an armillary sphere (渾儀), a celestial globe (渾象) and a mechanical chronograph. It was operated by an escapement mechanism and the earliest known chain drive. However, 35 years later, the invading Jurchen army dismantled the tower in 1127 CE upon taking the capital of Kaifeng. The armillary sphere part was brought to Beijing, yet the tower was never successfully reinstated, not even by Su Song's son.
Fortunately, two versions of Su Song's treatise written on his clock tower have survived the ages, so that studying his astronomical clock tower is made possible through medieval texts.

True north and planetary motion

The polymath Chinese scientist Shen Kuo (1031–1095 CE) was not only the first in history to describe the magnetic-needle compass, but also made a more accurate measurement of the distance between the pole star and true north that could be used for navigation. Shen achieved this by making nightly astronomical observations along with his colleague Wei Pu, using Shen's improved design of a wider sighting tube that could be fixed to observe the pole star indefinitely. Along with the pole star, Shen Kuo and Wei Pu also established a project of nightly astronomical observation over a period of five successive years, an intensive work that even would rival the later work of Tycho Brahe in Europe. Shen Kuo and Wei Pu charted the exact coordinates of the planets on a star map for this project and created theories of planetary motion, including retrograde motion.

Foreign influences

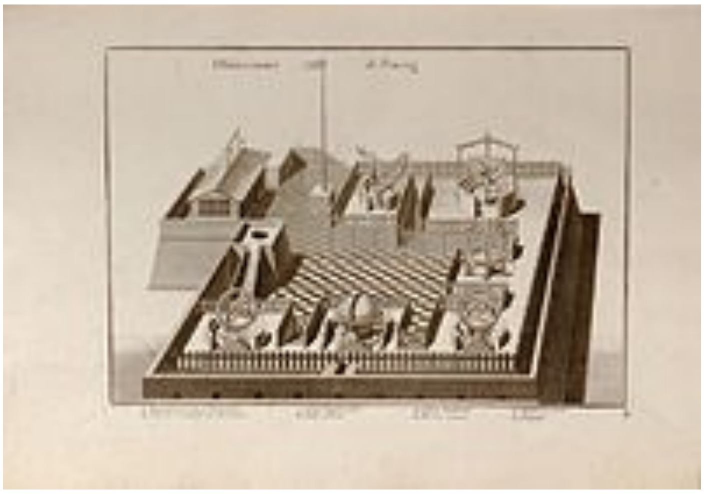
Indian astronomy

Buddhism first reached China during the Eastern Han Dynasty, and translation of Indian works on astronomy came to China by the Three Kingdoms era (220–265 CE). However, the most detailed incorporation of Indian astronomy occurred only during the Tang Dynasty (618-907), when a number of Chinese scholars—such as Yi Xing—were versed both in Indian and Chinese astronomy. A system of Indian astronomy was recorded in China as *Jiuzhi-li* (718 CE), the author of which was an Indian by the name of Qutan Xida—a translation of Devanagari Gotama Siddha—the director of the Tang dynasty's national astronomical observatory.

… Chinese Astronomy

The astronomical table of sines by the Indian astronomer and mathematician Aryabhatan was translated into the Chinese astronomical and mathematical book *Treatise on Astrology of the Kaiyuan Era* (*Kaiyuan Zhanjing*), compiled in 718 CE during the Tang Dynasty.[6] The *Kaiyuan Zhanjing* was compiled by Gautama Siddha, an astronomer and astrologer born in Chang'an, and whose family was originally from India. He was also notable for his translation of the Navagraha calendar into Chinese.

Islamic astronomy in East Asia



Early European drawing of the Beijing Ancient Observatory.

Islamic influence on Chinese astronomy was first recorded during the Song dynasty when a Hui Muslim astronomer named Ma Yize introduced the concept of 7 days in a week and made other contributions.

Islamic astronomers were brought to China in order to work on calendar making and astronomy during the Mongol Empire and the succeeding Yuan Dynasty. The Chinese scholar Yelü Chucai accompanied Genghis Khan to Persia in 1210 and studied their calendar for use in the Mongol Empire. Kublai Khan brought Iranians to Beijing to construct an observatory and an institution for astronomical studies.

Gaocheng Astronomical Observatory. It was built in 1276.

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Several Chinese astronomers worked at the Maragheh observatory, founded by Nasir al-Din al-Tusi in 1259 under the patronage of Hulagu Khan in Persia. One of these Chinese astronomers was Fu Mengchi, or Fu Mezhai.

… Chinese Astronomy

In 1267, the Persian astronomer Jamal ad-Din, who previously worked at Maragha observatory, presented Kublai Khan with seven Persian astronomical instruments, including a terrestrial globe and an armillary sphere, as well as an astronomical almanac, which was later known in China as the *Wannian Li* ("Ten Thousand Year Calendar" or "Eternal Calendar"). He was known as "Zhama Luding" in China, where, in 1271, he was appointed by Khan as the first director of the Islamic observatory in Beijing, known as the Islamic Astronomical Bureau, which operated alongside the Chinese Astronomical Bureau for four centuries. Islamic astronomy gained a good reputation in China for its theory of planetary latitudes, which did not exist in Chinese astronomy at the time, and for its accurate prediction of eclipses.

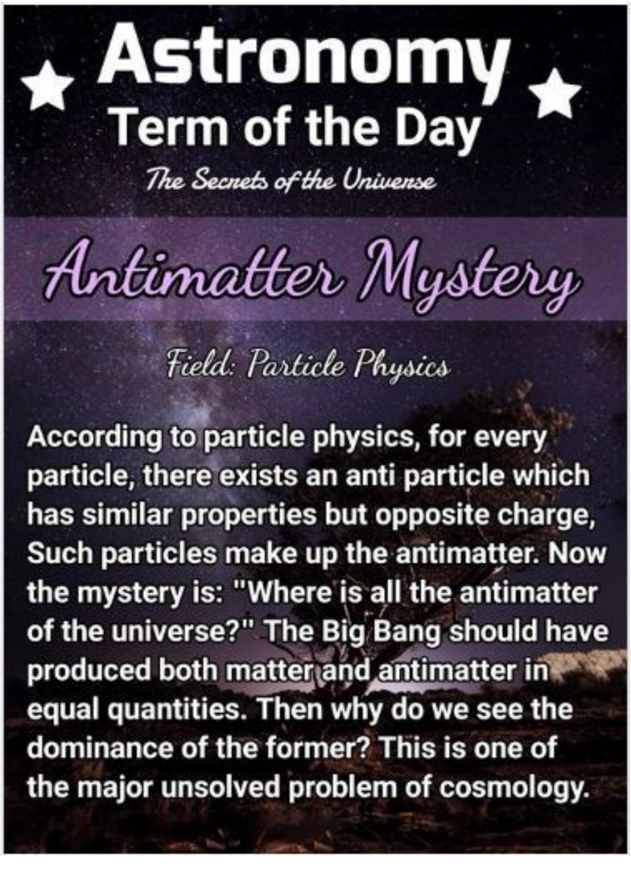
Some of the astronomical instruments constructed by the famous Chinese astronomer Guo Shoujing shortly afterwards resemble the style of instrumentation built at Maragheh. In particular, the "simplified instrument" (*jianyi*) and the large gnomon at the Gaocheng Astronomical Observatory show traces of Islamic influence. While formulating the Shoushili calendar in 1281, Shoujing's work in spherical trigonometry may have also been partially influenced by Islamic mathematics, which was largely accepted at Kublai's court. These possible influences include a pseudo-geometrical method for converting between equatorial and ecliptic coordinates, the systematic use of decimals in the underlying parameters, and the application of cubic interpolation in the calculation of the irregularity in the planetary motions.

Emperor Taizu (r. 1368-1398) of the Ming Dynasty (1328–1398), in the first year of his reign (1368), conscripted Han and non-Han astrology specialists from the astronomical institutions in Beijing of the former Mongolian Yuan to Nanjing to become officials of the newly established national observatory.

That year, the Ming government summoned for the first time the astronomical officials to come south from the upper capital of Yuan. There were fourteen of them. In order to enhance accuracy in methods of observation and computation, Emperor Taizu reinforced the adoption of parallel calendar systems, the Han and the Hui. In the following years, the Ming Court appointed several Hui astrologers to hold high positions in the Imperial Observatory. They wrote many books on Islamic astronomy and also manufactured astronomical equipment based on the Islamic system. The translation of two important works into Chinese was completed in 1383: Zij (1366) and al-Madkhal fi Sina'at Ahkam al-Nujum, Introduction to Astrology (1004).

In 1384, a Chinese astrolabe was made for observing stars based on the instructions for making multi-purposed Islamic equipment. In 1385, the apparatus was installed on a hill in northern Nanjing.

Around 1384, during the Ming Dynasty, Emperor Zhu Yuanzhang ordered the Chinese translation and compilation of Islamic astronomical tables, a task that was carried out by the scholars Mashayihei, a Muslim astronomer, and Wu Bozong, a Chinese scholar-official. These tables came to be known as the *Huihui Lifa* (*Muslim System of Calendrical Astronomy*), which was published in China a number of times until the early 18th century, though the Qing Dynasty had officially abandoned the tradition of Chinese-Islamic astronomy in 1659. The Muslim astronomer Yang Guangxian was known for his attacks on the Jesuit's astronomical sciences.



Astronomy

Term of the Day

The Secrets of the Universe

Antimatter Mystery

Field: Particle Physics

According to particle physics, for every particle, there exists an anti particle which has similar properties but opposite charge, Such particles make up the antimatter. Now the mystery is: "Where is all the antimatter of the universe?" The Big Bang should have produced both matter and antimatter in equal quantities. Then why do we see the dominance of the former? This is one of the major unsolved problem of cosmology.

… Chinese Astronomy

Jesuit activity in China

The introduction of Western science to China by Jesuit priest astronomers was a mixed blessing during the late sixteenth century and early seventeenth century.

The telescope was introduced to China in the early seventeenth century. The telescope was first mentioned in Chinese writing by Manuel Dias the Younger (Yang Manuo), who wrote his *Tian Wen Lüe* in 1615. In 1626, Johann Adam Schall von Bell (Tang Ruowang) published the Chinese treatise on the telescope known as the *Yuan Jing Shuo* (*The Far-Seeing Optic Glass*). The Chongzhen Emperor (r 1627–1644) of the Ming dynasty acquired the telescope of Johannes Terrentius (or Johann Schreck; Deng Yu-han) in 1634, ten years before the collapse of the Ming Dynasty. However, the impact on Chinese astronomy was limited.

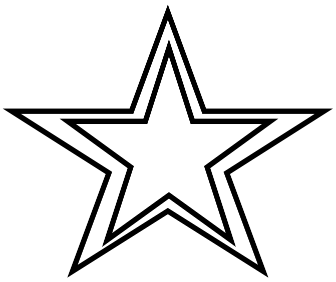
The Jesuit China missions of the sixteenth and seventeenth centuries brought Western astronomy, then undergoing its own revolution, to China and—via João Rodrigues's gifts to Jeong Duwon—to Joseon Korea. After the Galileo affair early in the seventeenth century, the Roman Catholic Jesuit order was required to adhere to geocentrism and ignore the heliocentric teachings of Copernicus and his followers, even though they were becoming standard in European astronomy. Thus, the Jesuits initially shared an Earth-centered and largely pre-Copernican astronomy with their Chinese hosts (i.e., the Ptolemaic-Aristotelian views from Hellenistic times). The Jesuits (such as Giacomo Rho) later introduced Tycho's geoheliocentric model as the standard cosmological model. The Chinese often were fundamentally opposed to this as well, since the Chinese had long believed (from the ancient doctrine of Xuan Ye) that the celestial bodies floated in a void of infinite space. This contradicted the Aristotelian view of solid concentric crystalline spheres, where there was not a void, but a mass of air between the heavenly bodies

Of course, the views of Copernicus, Galileo, and Tycho Brahe would eventually triumph in European science, and these ideas slowly leaked into China despite Jesuit efforts to curb them in the beginning. In 1627, the Polish Jesuit Michael Boym (Bu Mige) introduced Johannes Kepler's Copernican Rudolphine Tables with much enthusiasm to the Ming court at Beijing. In Adam Schall von Bell's Chinese-written treatise of Western astronomy in 1640, the names of Copernicus (Ge-Bai-Ni), Galileo (Jia-li-lüe), and Tycho Brahe (Di-gu) were formally introduced to China. There were also Jesuits in China who were in favor of the Copernican theory, such as Nicholas Smogulecki and Wenceslaus Kirwitzer. However, Copernican views were not widespread or wholly accepted in China during this time.

Ferdinand Augustin Hallerstein (Liu Songling) created the first spherical astrolabe as the Head of the Imperial Astronomical Bureau from 1739 until 1774. The former Beijing Astronomical observatory, now a museum, still hosts the armillary sphere with rotating rings, which was made under Hallerstein's leadership and is considered the most prominent astronomical instrument. While in Edo Japan, the Dutch aided the Japanese with the first modern observatory of Japan in 1725, headed by Nakane Genkei, whose observatory of astronomers wholly accepted the Copernican view. In contrast, the Copernican view was not accepted in mainstream China until the early nineteenth century, with the Protestant missionaries such as Joseph Edkins, Alex Wylie, and John Fryer.

Famous Chinese astronomers

Gan De
Guo Shoujing
Shen Kuo
Shi Shen
Su Song
Xu Guangqi
Yu Xi
Zhang Heng



The Month Ahead

MEETINGS:

The next meeting will be on Wednesday 14 November 2018 @ 19:30 and the speaker has not yet been finalised

MNASSA:

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

NIGHTFALL:

Fantastic astronomy magazine. Available from the ASSA website.

MEMBERSHIP FEES & BANKING:

Members - R 170 Family Membership - R 200 Joining Fee - R 35

EFT: **The Astronomical Society of Southern Africa - Natal Centre**.

Nedbank Account No. **1352 027 674** Durban North Branch Code **135 226**

Please include your initial and surname in the reference line.

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Observatory Director: Mike Hadlow (+27) 83 326 4085

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Librarian: Clair Odhav (+27) 83 395 5160

Special Projects: Corinne Gill (+27) 84 777 0208

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Emails can be sent to AstronomyDurban@gmail.com

ASSA Durban - Minutes of the Meeting

10 October 2018

Welcome: In the absence of Chairman, Piet Strauss, Vice Chair Debbie Abel welcomed all attendees.

Present: 32 members and 14 visitors.

Apologies: 6 Apologies received as per attendance book. Confirmation of previous minutes of 12 September 2018 meeting, proposed by Richard Rowland, seconded by Logan Govender and approved. Matters arising from previous minutes: Nil.

Treasurer`s Report: Financial Balances as follows :

Current a/c	R 74 407
Savings a/c	R 30 000 approx.
Cash on hand	R 1 347

All members who have not paid their 2018/19 subscriptions requested to do so urgently so as to keep us solvent.

Special Projects:
Planetarium: No further update

Northern Lights Tour now proposed for September 2019

Basic Astronomy Course to be run in March/April 2019. Names to Logan Govender please.

Astrophotography Courses, both basic and advanced, proposed for November 2018.

Outreach Events : Cato Manor event - still being pursued. Orient Islamic School awaiting response. Wagtail Event – 9/10 November, Chatsworth Youth Centre – awaiting response, Winterton - planning in progress.

Observatory: Next public viewings 12 October and 9 November (subject to weather). A further call was made for volunteers to be trained to operate our main telescope and assist with the Public Viewing evenings. Names to Secretary please.

Publicity: P.R./Press course being prepared. Names of interested persons to Logan Govender please.

General: Orders for Society shirts (approx. R200), Caps / Beanies (approx. R60) to Treasurer asap.

Speakers : Debbie Abel gave her usual NASA Report and Logan Govender reported on the Oct/November Sky. Our main speaker was Nino Wunderlin , who gave a most interesting presentation on the various types of Rocket propulsion systems and their relative advantages/ disadvantages.

The meeting closed at about 21:30 for tea/coffee and biscuits

Members Moments

Mike Watkeys chats to Nino Wunderlin. Nino spoke about rocket technology at the October meeting.

Public Viewing Roster

Name	Phone	Name	Phone	Assistant	New Moon	Public Viewing
John Gill	083 378 8797	Debbie Abel	083 326 4084	Sheryl Venter	13 June 2018	15 June 2018
Brian Finch	082 924 1222	Ooma Rambilass	083 739 3178	John Gill	13 July 2018	13 July 2018
Maryanne Jackson	082 882 7200	Johnny Visser	082 357 3091	Susan Knight	11 August 2018	10 August 2018
Star Party	Botanical	Gardens				7 September
Brian Finch	**082 924 1222**	**Debbie Abel**	**083 326 4084**	**Mike Hadlow**	**9 October 2018**	**12 October 2018**
John Gill	**083 378 8797**	**Ooma Rambilass**	**083 739 3178**	**Susan Knight**	**7 November 2018**	**9 November 2018**
Maryanne Jackson	082 882 7200	Johnny Visser	082 357 3091	Ooma Rambilass	7 December 2018	7 December 2018

Pre-Loved Astronomical Equipment

MEADE ETX 70 FOR SALE

COMPLETE TELESCOPE, SOFTWARE, FIELD TRIPOD WITH BAG, IN ORIGINAL PACKAGING

ASKING R 2000

CONTACT HARRY ON 072 2602725 OR 033 2390651

Tasco 46-114500
Diameter = 114mm
Focal Length = 1000mm
Coated optics
Extra eyepieces
hasn’t been used much
Paid R 4 500

Asking Price R 2 000

Hoddy Hudson

Green Laser Pointers

50mW — R 450 each
Contact Piet 083 703 1626
on WhatsApp or SMS.

Will also be available at next ASSA meeting.

Celestron 6SE

I still have all of the original packaging. Telescope is in excellent condition (Optically and mechanically) and is still used for Astrophotography and outreach projects. The imaging cameras for Astrophotography are not included in the package. The telescope runs on an external 12v supply, either using an AC adapter (not included) or a 12v cigarette lighter port (cable included).

Contact Amith Rajpal 083 335 8800

Amith.Rajpal@coretecit.co.za

Retail Price is over R 23 000 **Asking Price: R 17 500**

Standard items (included):
1. Original 2" Steel tripod.
2. 1.25" Diagonal.
3. 1.25" 25mm ELux Eyepiece.
4. Red Dot Finder.
5. Tripod Spreader.
6. Cover for Corrector Plate
7. Optical Tube Assembly
8. Fully GoTo 6SE mount

Plus loads of extra equipment