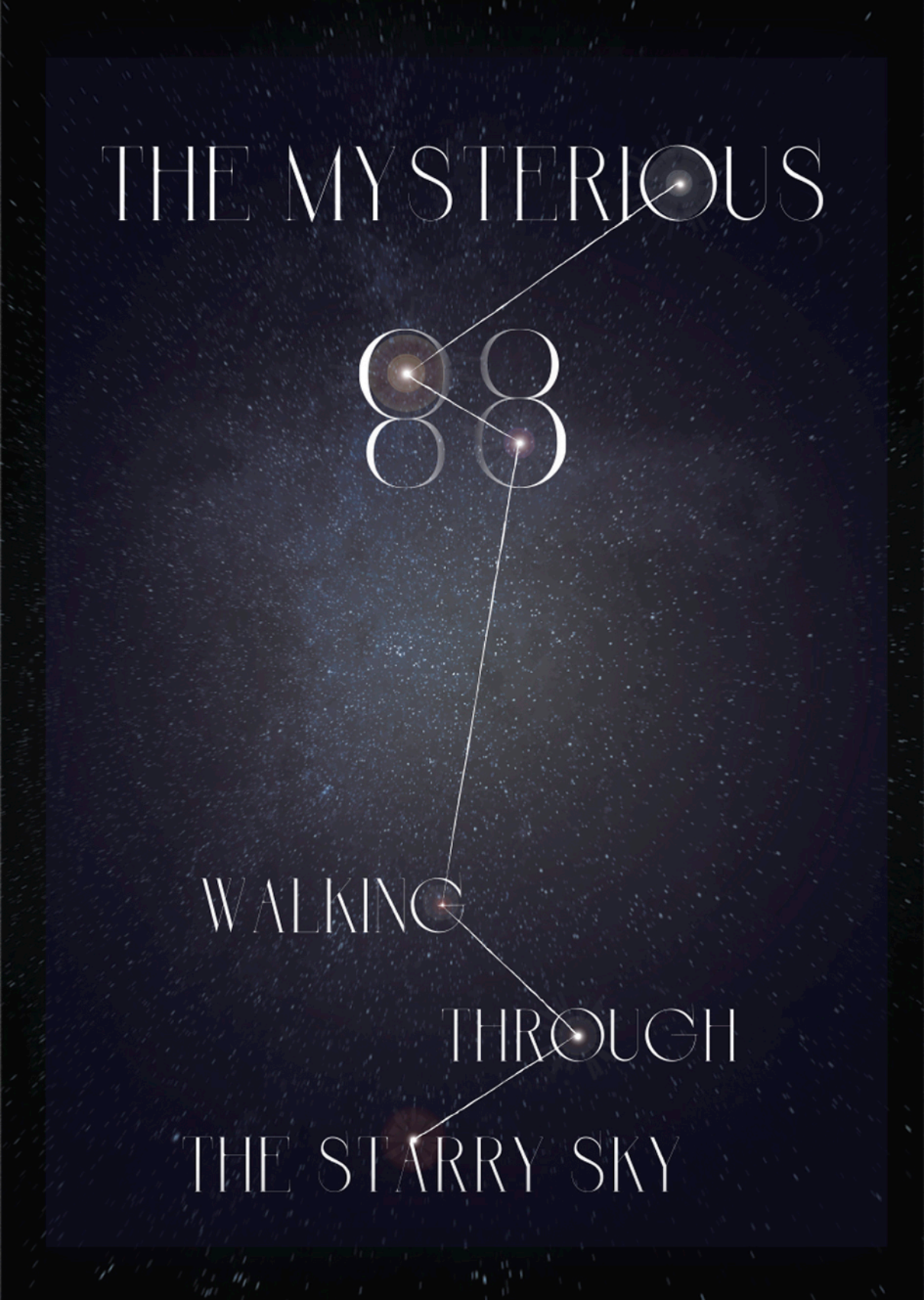
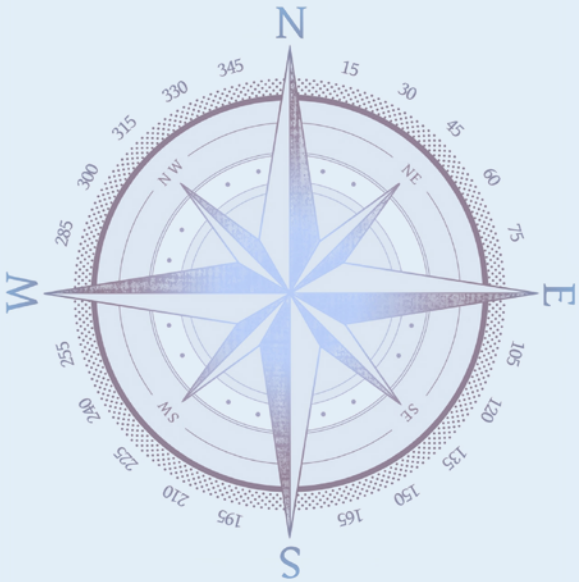

THE MYSTERIOUS
88
WALKING
THROUGH
THE STARRY SKY

Valentyna Bondarenko

THE MYSTERIOUS EIGHTY-EIGHT

Walks in the Starry Sky



Ukraine
2024

Bondarenko Valentyna

The mysterious eighty-eight. Walks in the Starry Sky/Bondarenko V.
Ukraine, 2024 – 508 c.

This book is about the most mysterious and captivating things in this world: the stars and the amazing constellation patterns they make. Here are 88 interesting stories with historical facts, adventures, myths, and even with precise calculations making it easier for you to orient yourself and to imagine their place in the boundless and enigmatic Universe. Read and get absorbed, and you will not regret a single minute spent alone with the book!

ISBN 978-617-8040-75-8

Contents

Preface

...There have always been such people: those who froze at the sight of bright luminaries in the dark canvas of the sky, those who admired and contemplated omens and predictions in the star rays. It didn't matter who they were: shepherds, hunters or fishermen, in a flowering steppe or a sweltering desert, everywhere there have been those who got fascinated and enraptured by the stars.

Each one of them saw their own sky: in the north or in the south, in the tropics or among glaciers, at midnight or in the predawn haze. And each one tried in their mind to connect the stars with imaginary lines — in order to create a familiar picture and to make the sky feel closer and more intelligible. That was how it became populated with weird-looking beasts, magical birds, fair maidens, and courageous heroes. Every constellation has its own history, or even a few ones. Modern astronomy knows eighty-eight constellations, and the number of stories about them is by an order of magnitude greater, or even by two orders.

...Time passed, and scientists compiled star charts of both hemispheres, calculated the distances between the constellations and the stars in them, determined the stars' size and brightness, as well as their age.

The first astronomers believed that the Sun, the Moon, the planets and stars orbited around the Earth, and that our planet was a special

and unique place in the Universe. Later they realized that the laws of physics in effect on the Earth were the same all over the Universe. When Isaac Newton discovered the law of gravity, he understood that the same force caused the Moon's rotation around the Earth and the planets' rotation around the Sun – or, for example, that the light from the Sun was the same phenomenon as the light from the other stars.

Even though we do not live in a special place of the Universe, we do live in a special time. In the distant future, galaxies will move at such speed that their light will never reach the Earth. Gravity waves will be shifted so far that it will be impossible to detect them. One will not be able to observe space objects outside the Milky Way. The astronomers of the future will be deprived of such a vision of the cosmic history as what we have nowadays.

Do you know that in the Universe there exists a tendency toward an increase in the percentage of stars whose mass is less than 0.2 of the solar mass (red dwarfs), they are already as many as 70% of the stellar population in our Galaxy and in our time? The specific feature about these stars is that because of the nebulousness they cannot be seen with the naked eye even from a distance of a couple of light-years. So, in the distant future, the night sky will be totally black without a telescope.

Have you imagined this picture, dear reader?..

And in the meantime, you have a unique opportunity to feast your eyes on the stars, to admire them, to create your own celestial patterns, grouping them into your own constellations, and to recognize those shaped for you by Ptolemy, Hevelius, de Lacaille...

And if, dear reader, after getting acquainted with this book you will wish to make out the baby goats in the Charioteer's arms, the wreath at the Archer's feet, or the stellar remains of the Argonauts' wrecked ship – we'll assume our mission has been accomplished. We've achieved the goal – to get you interested.

This is exactly the reason why this book has been written..

Author

SHORT REFERENCE GUIDE

Asterism is an easily discernible group of stars which has a historically established proper name. A constellation is not an asterism.

Light-year is an arbitrary unit of length equal to the distance light travels in one year. As recommended by the International Astronomical Union, a Julian year is used as the numerical value of a year, unless otherwise specified.

The northern and southern latitudes. It is common practice to measure off the latitude from the equator northward. This way, the points lying in the Northern hemisphere have positive latitude values, and those in the Southern hemisphere have negative ones. The latitude of any point is equal to: 0°on the equator, +90° at the North Pole, −90° at the South Pole. All points of one parallel have the same latitude.

Designations of stars. Bright stars forming a constellation are listed from the brightest star to the faintest ones under different designations: by Bayer, Flamsteed, the Henry Draper catalogue, or the Hipparcos catalogue.

- Bayer's designation is a Greek letter is added to the genitive form to designate a star: Alpha (the constellation's short name).
- Flamsteed's designation adds a number to the genitive form to name a star: 1 (the constellation's name).
- The Henry Draper designation – the abbreviation HD, which is added to the genitive form to designate a star.
- The Hipparcos designation allocates the abbreviation HIP to the genitive to name a star.

Constellation names in star names are usually used in abbreviated form. These abbreviations are defined by the International Astronomical Union: not Leonis, but Leo, for example.

Apparent stellar magnitude. The apparent stellar magnitude tells us how bright an object in the sky is, which is observed from here, from the Earth. This may be a star, or any deep-sky object. The apparent magnitude depends on:

- the object's luminosity (the energy radiated by the star's surface),
- the distance between the object and the Earth,
- anything located between the object and the observer.

The lesser the stellar magnitude, the brighter the object appears from Earth. The brightest star, Sirius, even has a negative apparent stellar magnitude equal to -1.46.

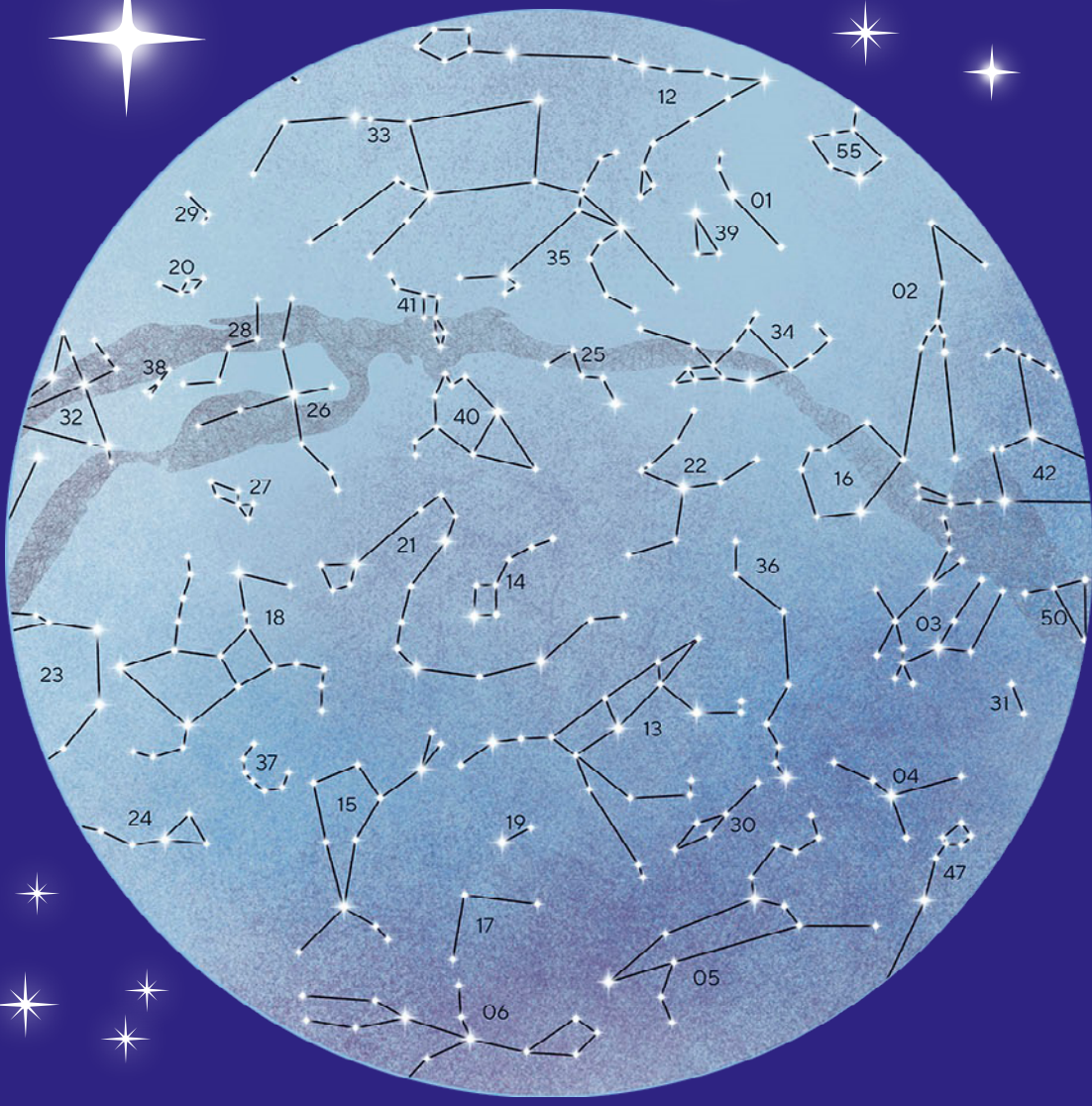
m is the apparent stellar magnitude, M is the absolute stellar magnitude, which can be defined as the stellar magnitude that the star would have if it were 10 parsecs away.

Spectral classes. A star's color can tell us something about its age and temperature.

- Blue stars (Class O) are the hottest and the youngest ones.
- Red stars (Class M) are the coldest and the oldest ones. M-type stars don't have so much hydrogen left for burning, so they aren't as hot anymore as blue ones. There are as many as 7 spectral classes.

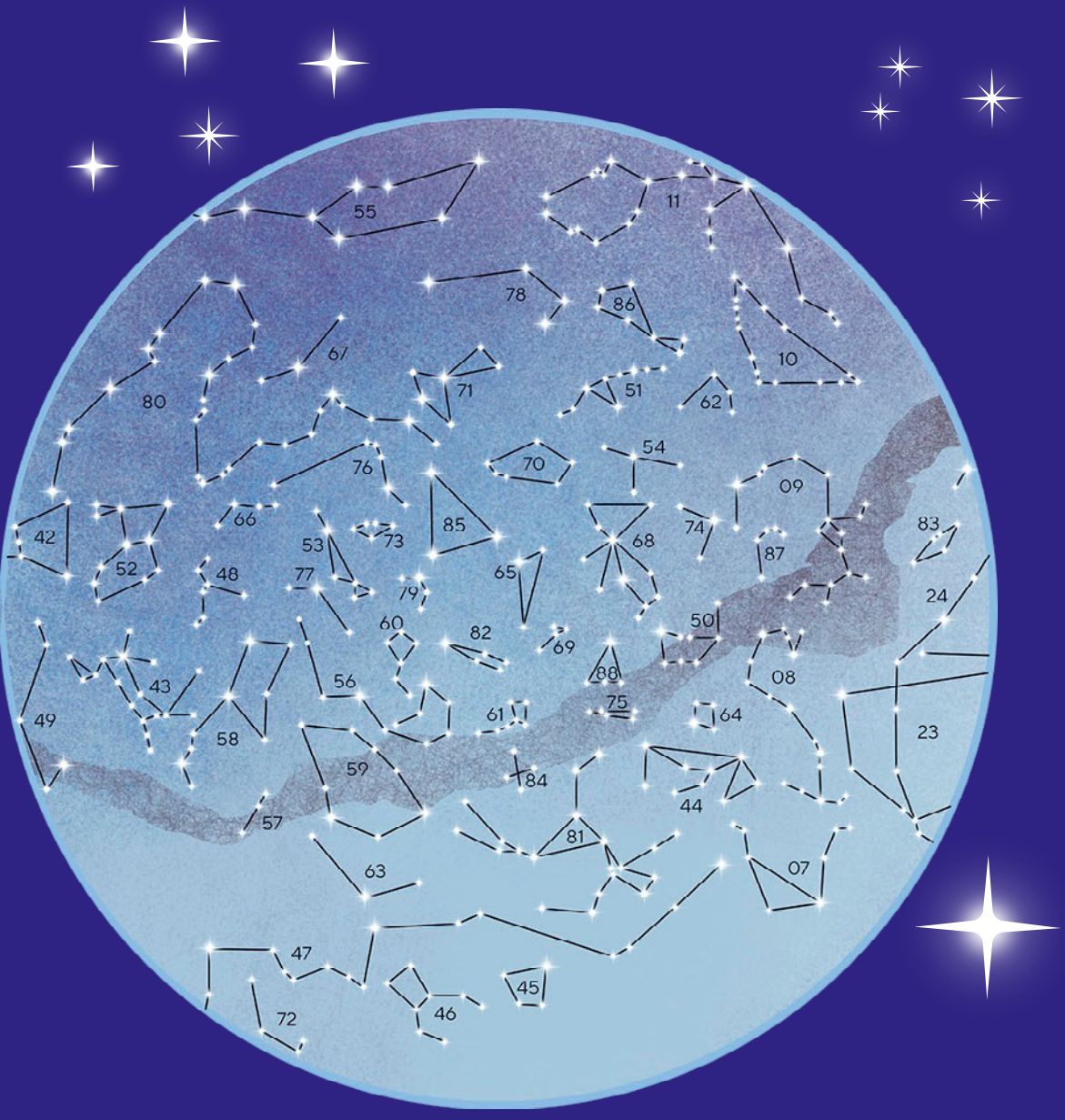
Messier objects are a list of 110 astronomical objects.

During our travel across the northern starry sky we now and then have to mention bright and faint stars. When you stare into the sky at night you can notice that the stars differ in their brightness like, for instance, 60-watt, 70-watt or 100-watt light bulbs. This has also been discovered by the astronomers. They refer to this degree of the star's luminosity as stellar brightness. The astronomers have agreed to call the brightest luminaries first magnitude stars; those 2.5 times fainter were named second magnitude stars; and stars 2.5 times fainter than second magnitude are third magnitude ones.



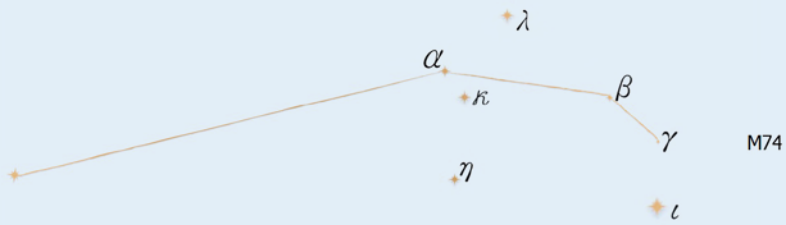
Hemisphere boreal

01. Aries 05. Leo 06. Virgo 07. Libra 08. Scorpius 09. Sagittarius 10. Capricornus
11. Aquarius 12. Pisces 13. Ursa Major 14. Ursa Minor 15. Boötes 17. Coma Berenices
18. Hercules 19. Canes Venatici 20. Delphinus 21. Draco 22. Camelopardalis
23. Ophiuchus 24. Serpens 25. Cassiopeia 26. Cygnus 27. Lyra 28. Vulpecula
30. Leo Minor 31. Canis Minor 32. Aquila 33. Pegasus 34. Perseus 35. Andromeda
36. Lynx 37. Corona Borealis 38. Sagitta 39. Triangulum 40. Cepheus 41. Lacerta
44. Lupus 45. Corvus 46. Crater 50. Ara 51. Grus



Hemisphere austral

02. Taurus 03. Gemini 04. Cancer 16. Auriga 29. Equuleus 42. Orion 43. Canis Major 47. Hydra 48. Columba 49. Monoceros 52. Lepus 53. Dorado 54. Indus 55. Cetus 56. Carina 57. Pyxis 58. Puppis 59. Vela 60. Volans 61. Musca 62. Microscopium 63. Antlia 64. Norma 65. Octans 66. Caelum 67. Fornax 68. Pavo 69. Apus 70. Tucana 71. Phoenix 72. Sextans 73. Reticulum 74. Telescopium 75. Circinus 76. Horologium 77. Pictor 78. Sculptor 79. Mensa 80. Eridanus 81. Centaurus 82. Chamaeleon 83. Scutum 84. Crux 85. Hydrus 86. Piscis Austrinus 87. Corona Australis 88. Triangulum Australe



ARIES

01. The zodiac constellations are the most famous and ancient ones; they lie in the path of the Sun, and the Sun stays in each of them for several weeks. The path taken by the Sun from one constellation to another during the year is called the Zodiac, which means, translated from Greek, ‹the circle of little animals›, although the constellations got their names in honor of mythical characters and real-life animals, and the prototype of one of them was not even a creature but an object. There are 12 constellations in the astrological Zodiac: Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpius, Sagittarius, Capricorn, Aquarius, and Pisces. But there are 13 characters in the group of zodiacal constellations, including Ophiuchus, which is ignored by astrologers.

...When you just stare into the night sky, it isn't so easy to spot him — a stubborn, uncompromising ram, one who will tolerate no competition. He is relaxing right over there, not far from the Square of Pegasus. His horned head adorned with one of the brightest stars in the zodiacal constellations is turned towards the Pleiades, as if the stellar ram is feasting his eyes on the bright celestial nymphs' twinkling.

Aries is the 39th largest constellation in the sky, covering an area of 441 square degrees. It lies in the first quadrant of the Northern hemisphere and is surrounded by five constellations: Taurus to the east, Pisces to the West, Perseus to the northwest, Triangulum to the north, and Cetus to the south.

It is one of the oldest constellations identified in the night sky. The first mentions of it were found on some boundary stones dated back to between 1350 and 1000 B.C. As early as in the Babylonian times, people believed that Aries was the last station in the Sun's way. It is indeed one of the twelve constellations of the Zodiac, lying along the path the Sun travels in the sky during the year.

Egyptians called it the ‹Indicator of the Reborn Sun›, because the constellation was the location of the vernal equinox in those times. It is the ‹First Point of Aries›, where the Sun crosses the celestial equator's imaginary line. The time of crossing signals the beginning of the spring

season in the Northern hemisphere. However, because of the precession, or the Earth's slow wobble, this point is now in Pisces.

Another title related to Aries is the Lord of the Head. That was how the Arabs called it, whose name for the constellation was Al Hamal. It served as the basis of the formal name for its alpha star, Hamal.

Aries is one of the 48 Greek constellations listed by Claudius Ptolemy in his Almagest. The modern boundaries of the constellation were defined in 1920 by Belgian astronomer Eugene Delporte, and the International Astronomical Union recognized and formalized them in 1928.

As for the figure of a ram in the sky, it doesn't come as unexpected that it appeared there. They say the first astronomers on the earth were shepherds who spent nights in the steppes, admired the starry sky, and looked for familiar outlines among the stars. A male sheep (ram) heading a flock of sheep is a meaningful and symbolic figure. It is also the reason why rams were often sacrificed. But that didn't stop astronomers with imagination from seeing the outlines of entirely different figures in the constellation.

In the area occupied by this constellation there used to be a presently non-existent one, Musca Borealis (the Northern Fly), suggested by astronomer Plancius in 1612 and denoted as Apes (the Bees). Its brightest star is now known as 41 Arietis.

In the 1627 star atlas by German lawyer and astronomer Julius Schiller, the constellation of Aries went by the name of Apostle Peter.

And there's more. It was associated with a farmhand by the Babylonians, with twins collecting taxes by the Chinese, with a porpoise by the Marshall Islands' inhabitants. And the ancient Greeks saw it as a ram and his golden fleece, from the story of Jason and the Argonauts.

Do you remember how this story began? Ino, daughter of the King of Thebes, was eager to get rid of her stepchildren, Phrixus and Helle, and organized a conspiracy that was to result in Phrixus being sacrificed to save the harvest. When Athamas brought his son

to the top of Mount Laphystium to sacrifice him to Zeus, the cloud goddess Nephele interfered by sending a winged ram with golden wool from the sky. Phrixus, together with Helle, climbed onto the ram's back and flew eastward to the land of Colchis. But Helle lost her grip on the way, and fell into the strait between Europe and Asia, which the Greeks named Hellespont after her. Upon reaching Colchis, Phrixus gave the Golden Fleece to the formidable Colchian king who married him to his daughter Chalciope.

The king got the fleece, and the ram flew to the sky. That's why, according to the mythologists, the constellation turned out to be rather weak. If the Golden Fleece had remained in place, Aries would have shone brighter. But in the end, the fleece was stolen from the Colchian king by his daughter Medea and Jason who covered their wedding bed with it. So, as a result, we can see a short-haired Ram among the stars.

As a matter of fact, the constellation is indeed not very bright, but it has a second magnitude star, which is a legend in itself, and 6 stars with proper names, which aren't the case so often in constellations.

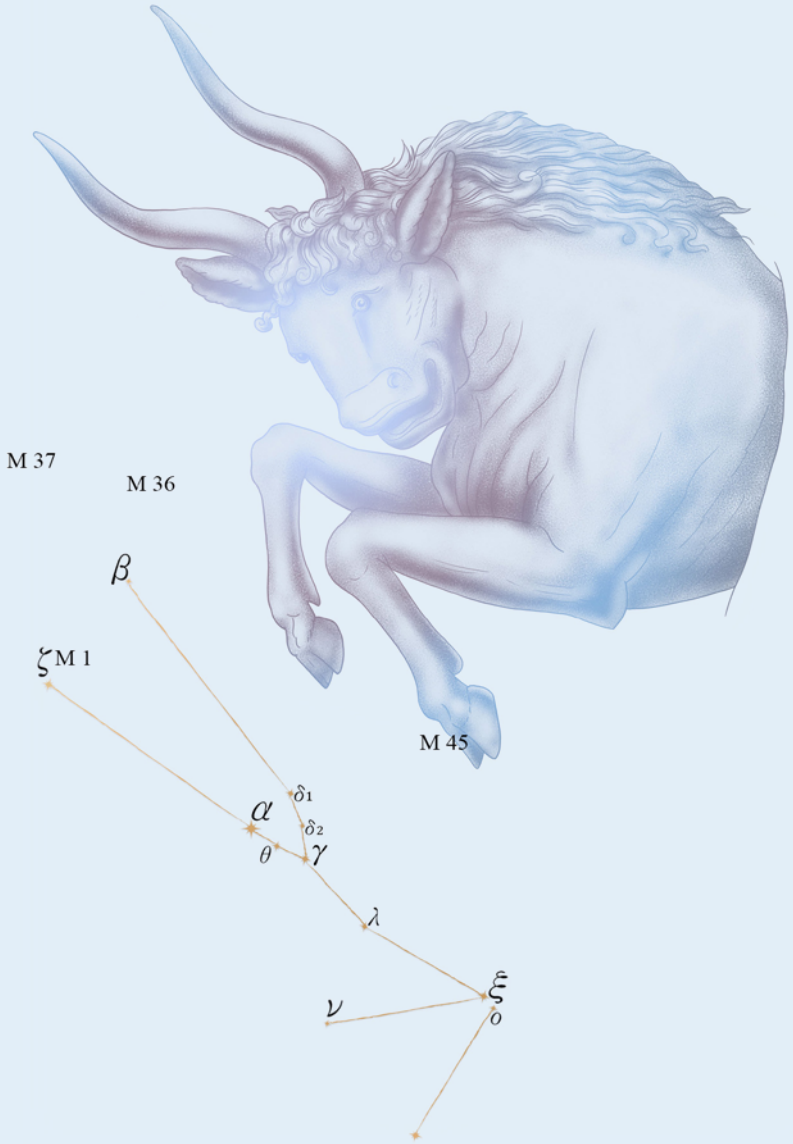
- **α Aries/Hamal** is the brightest star in Aries, and the 48th brightest star we can see in the night sky. This is an orange giant with an apparent stellar magnitude of 1.98 to 2.04. The star is approximately 2 times as massive as the Sun, and is located 66 light-years away from us. Ptolemy described α Arietis in his Almagest as lying outside the actual figure of the constellation. He regarded it as one of the informatae, unformed stars. Between 2000 and 100 B.C., Hamal was situated in the vernal equinox point marking the beginning of spring. The name Hamal name comes from the Arabic phrase ‹ras al-hamal›, which means ‹head of the ram›. Several well-known meteor showers are related to this constellation: May and Autumn Arietids, Delta Arietids, Epsilon Arietids, Daytime Arietids, and Aries-Triangulids.

- **β Aries/Sheratan.** A white star with an apparent stellar magnitude of 2.64, located 59.6 light-years away from the Earth. The name Sheratan comes from the Arabic phrase ‹ash-sharatan›, which means ‹the two signs›, it symbolizes the stellar duet of the vernal equinox: β Aries and γ Aries. It could have been a trio, if 2 millenniums ago the Arabs had taken into account the presence of Hamal in this particular constellation.

- **γ Aries/Mesarthim.** A triple-star system comprised of two white stars and a star with a magnitude of 9.6. The system is approximately 160 light-years away from the Earth. It used to be called the First Star of Aries, because there was time when it was the closest naked-eye star to the vernal equinox point. And Ptolemy defined it as the ‹more advanced one of the two stars on the horn›, while β Aries was at the rear. But times change, and stars change their places too.

The constellation of Aries can be seen in the Northern hemisphere in late winter and early spring. It can be observed at latitudes of 90 to −60 degrees.

The constellation of Aries is remarkable for its gamma star, or Mesarthim, which is one of the first ever double stars discovered with the aid of a telescope. Both these stars are more than twice as massive as our Sun, and about 50 times as bright.
(SpaceEngine)



TAURUS

02. Pioneer 10 is a NASA space probe launched in 1972. The craft crossed the orbit of Saturn in February 1976, the orbit of Uranus in July 1979, and the orbit of Neptune in June 1983. Perhaps in two million years the probe will approach the star Aldebaran.

This bull with a bulbous head is difficult to miss in the night sky, even in the middle of a megalopolis with its neon lights and smog. His high sharp horns and triangular muzzle are very clearly outlined by the stars. He is staring at Orion a bit quizzically, with the reddish Aldebaran twinkling in his right eye, his forelegs are bent as if he was getting ready for a jump but stopped not to startle the cloud of the Pleiades behind the scruff of his neck. That was approximately how John Flamsteed drew Taurus in his Atlas Coelestis in 1729. This picture can be easily recreated if you look at the starry sky, for example, in January.

Interestingly, only the bull's front part can be seen in the sky. The mythologists suggest an explanation related to the ocean: the hind legs and the croup are immersed in water and therefore not visible. And also, there is no room in the sky to show the whole bull because he is too big. This is the reason why there are the constellations of Aries and Cetus where the Bull's hind part should have been. So there is only a half of Taurus visible in the sky, the same as of Pegasus. But that's just one oddity, the other one is no less remarkable: Taurus travels backwards along the sky as if backing away from Orion.

The **zodiacal constellation of Taurus** is the 17th largest one in the sky. It lies in the first quadrant of the Northern hemisphere and covers an area of 797 square degrees. It is one of the 48 constellations catalogued by Greek astronomer Ptolemy in the 2nd century. Taurus can be observed at latitudes of +90° to −65°. It is surrounded with seven constellations: Aries to the west, Gemini to the east, Perseus

and Auriga to the north, Eridanus to the south, Orion to the southwest, and Cetus to the southwest. This is a really large constellation: astronomers reckon there are 216 to 500 naked-eye stars in it, as many as 17 stars with proper names, 2 Messier objects... So actually, there are things to explore and to compose legends about.

> The space is black because the rays of the stars cannot find a surface to reflect from. And the light drowns in the infinity. On the day when we spot a faint gleam deep inside the Universe we'll reach the end of the world, – Bernard Werber.

Among the legends related to the constellations, two are most popular. One of them is about Io, a mistress of Zeus, who the god turned into a heifer to hide her from his wife Hera. But the jealous Hera suspected infidelity and sent a guard, the hundred-eyed watchman Argus, to watch Io. Io escaped, she plunged into the sea and swam beyond the horizon where the sky merged with the ocean. That was how she ended up in the sky.

In the other legend, Taurus is an image of Zeus himself who assumed the form of a bull to abduct Europa, a daughter of the king of Tyre. To do that, he sneaked into the herd on the pasture next to the meadow where beautiful girls, Europa's friends, were larking about; he watched them and waited for an opportune moment. He was very good-looking in that role, with snow-white skin and polished, glistening horns; Europa noticed him and came closer to pat him. And he went down on his knees, as if suggesting that she could mount his back. By the way, in the star maps Taurus has been traditionally depicted with his front legs crossed, probably kneeling to lure Europa onto his back. And after Europa climbed his back the bull walked into the water and swam; the girl had no choice but to grad a tight hold of his horns. That was how they got to the island of Crete where Zeus restored his appearance of a god, seduced Europa, showered her with jewels and gave her a dog that would later become a constellation too, Canis Major. One of the descendants of Zeus and Europa was

Minos, the king of Crete, who erected the famous Knossos Palace where games with bulls were held.

There are some unique star clusters in the constellation of Taurus, which cannot be ignored.

The **Hyades** are the stars that make the bull's muzzle so bright and recognizable. This is a V- shaped group of stars, which was referred to as ‹star rain› by Ovid in *The Fasti*. And there is another mystery of nature lying behind this name: the rise of these stars at a certain time of the year was considered a portent of rainy weather to come. In the mythology, the Hyades were the daughters of Atlas and the Oceanid Aethra. Their elder brother was Hyas, a brave hunter who once got killed by a lioness. Weeping inconsolably, his sisters died of grief and were ascended to the sky for that. Ptolemy listed five Hyades in his star catalogue, but it was as early as in the 2nd century. Binoculars and small telescopes show much more stars in the cluster, astronomers speak of several hundreds of luminaries. The members of the Hyades move in space, and in 1908 American astronomer Lewis Boss (1846–1912) published his famous diagram showing their paths converging towards a point near Betelgeuse, the brightest star in Orion.

The Pleiades star cluster is also famously known as the Seven Sisters. (Picture of SpaceEngine)

The **Pleiades** is a Messier object, a star cluster that looks like a cloud of elves or a swarm of golden bees on the Bull's back. The Pleiades also have another name, the Seven Sisters. According to a Greek legend, they are daughters of the Titan Atlas and the Oceanid

Pleione, ascended to the sky by Zeus who thus saved them from being pursued by the amorous Orion. The origin of their name is associated with Pleione, the seven sisters' mother: ‹plein› means the sailing sport, ‹Pleione› is the queen of sails, and ‹the Pleiades› are sails, because in the ancient Greeks' times they used to be visible all night long during summer sea voyages. The Pleiades are approximately 440 light-years away from the Earth. And they are so original that the ancient Greeks believed the Pleiades to be a separate mini-constellation, and used them as a calendar marker.

This is the Crab Nebula – M1, or NGC 1952. M1 has a prominent pulsar in its center. The distance is 6500 light-years.

(NASA, ECO and Allison Loll/Jeff Hester)

The **Crab Nebula** is another Messier object. It is located next to the tip of the bull's right horn marked as ζ Tau, and is the result of one of the most well-known events in the history of astronomy: the star explosion observed from the Earth in 1054. The explosion was so bright that it could be seen in daylight during three weeks. Now we know that the event was a supernova, a violent death of a massive star, and the Crab Nebula is the remnants of the exploded star, which can now be observed only through telescopes.

There are a few stars in the constellation of Taurus, which have legends and lots of stories attached to them:

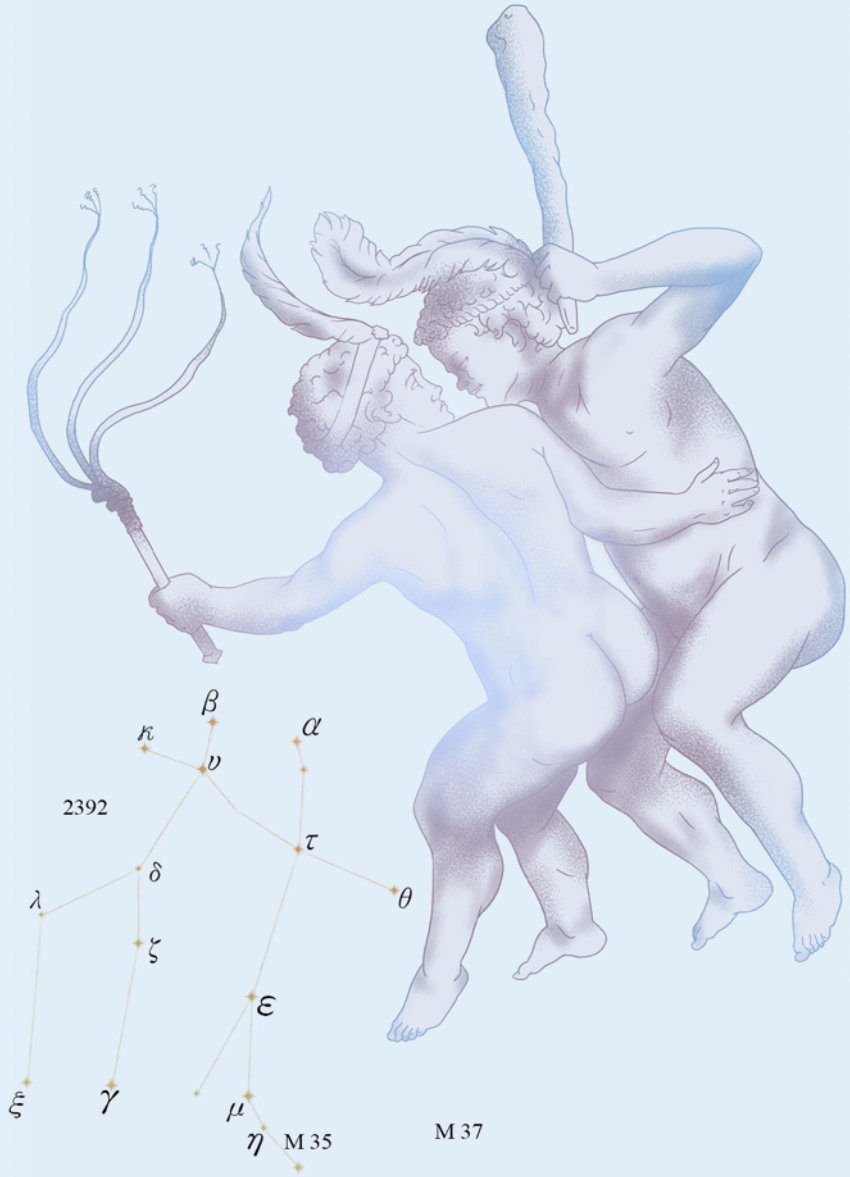
✶ **α Tau/Aldebaran.** Taurus's brightest star is its sparkling right eye, the 13th brightest star in the sky. This is an orange giant with an apparent magnitude of 0.75 to 0.95, the star's diameter is about 40 times as great as that of the Sun, and it is approximately 425 times as bright. The star lies 65.1 light-years away from the Earth. Its name derives from ‹al-dabaran›, Arabic for ‹the follower›. According to the 10th century Persian astronomer al-Sufi, the name was given to it because the star seems to follow the Pleiades across the sky. The Romans called this star Palilicium because it disappeared in twilight during the festival devoted to Pales, a Roman deity of shepherds, on April 21. But as for the ancient Greeks, strangely enough, they didn't give the star a proper name. Only Ptolemy referred to it as ‹the Torch› in his book on astrology Tetrabiblos.

✶ The distance between the Moon and the Earth may seem short, but all the other planets together could be placed between our planet and its satellite.

✶ **β Tau/Elnath** with an apparent magnitude of 1.68. It is a white-blue giant star lying around 131 light-years away from us. Elnath is 700 times as bright as the Sun. Its name comes from the Arabic phrase ‹an-nath›, which means ‹the butting›.

✶ **η Tau/Alcyone** is the third brightest star in Taurus and the brightest member of the Pleiades cluster. It has an apparent stellar magnitude of 2.87 and lies around 370 light-years from the Sun. In fact, this isn't even one star but a star system, a blue-white giant with an apparent magnitude of 2.87. Alcyone's radius is 10 times greater than that of the Sun and it is about 2400 times brighter.

The constellation of Taurus is best visible in December and January. The Sun appears in Taurus from May 13 to June 21.



GEMINI

03. The constellations which the celestial equator passes through are called equatorial ones. Some of their stars can be in the Northern and the Southern Hemispheres. There are only 15 of such constellations, and they are visible in both hemispheres throughout the year. These are Canis Minor, Cetus, Aquila, Monoceros, Sextans, Orion, Serpens, Hydra, and Eridanus, and the next six are of the zodiacal group: Aquarius, Pisces, Taurus, Leo, Virgo, and Ophiuchus.

On a frosty winter evening, when the air is clear and transparent, and the violet-colored atlas of the sky is studded with myriads of stars, they are the brightest ones: the figures of two brothers, half-hugging, telling their star tales to each other. Their inclined heads are so close, and their feet are touching the Milky Way, as if the brothers are on the road flying towards adventures. There is probably no other constellation in the sky where two bright stars would lie so close to each other – real Twins indeed!

Gemini is one of the 48 constellations, first catalogued by Greek astronomer Claudius Ptolemy in the 2nd century. It is the 30th largest constellation in the sky, and Pollux, the constellation's brightest star, is the giant star closest to us. The constellation covers an area of 514 square degrees and lies in the second quadrant of the Northern hemisphere. It can be seen at latitudes of +90° to −60°. That is, it is convenient to observe it from the Northern hemisphere in winter, and in summer Gemini is well visible in the Southern one too.

Gemini is surrounded with six constellations: Taurus to the west, Cancer to the east, Auriga and Lynx to the north, Monoceros and Canis Minor to the south.

This zodiacal constellation lies along the path the Sun travels across the sky during the year. The orange giant Pollux and the white giant Castor are its two brightest stars. Greeks referred to them together as the Dioskuroi (Dioscuri in Latin), which literally means ‹sons of Zeus›. But there is still debate among the mythologists on whether

they both were indeed sons of Zeus, due to the unusual circumstances of their birth. Their mother Leda, queen of Sparta, was indeed once visited by Zeus once in the form of a swan (the constellation of Cygnus was named after this disguise of his). That same night, Leda also lay with her husband, King Tyndareus. Both unions were fruitful, for Leda subsequently gave birth to four children: immortal Pollux and Helen (later to become the famous war-monger Helen of Troy) by Zeus, and mortal Castor and Clytemnestra by Tyndareus. Castor and Pollux grew up the closest of friends as they never quarreled or acted without consulting each other. They were said to look alike and even to dress alike as is often the case with twins.

Castor became a famed horseman and warrior who taught Heracles to fence and Pollux was second to none in fist-fighting. When Castor was killed in a battle Zeus gave Pollux immortality, but the latter refused and asked for permission to share this divine gift with his brother. Moved by the request, Zeus placed the brothers in the sky and allowed them to live in turns in the underground kingdom of Hades and on Olympus. This detail of the myth has to do with the fact that at certain times an attentive observer can spot Castor in the background of dawn, and Pollux of sunset on the same day. Interestingly, the appearance of St Elmo's fire, the glow of atmospheric electricity discharges on solitary tall objects, such as masts or steeples, was perceived in the past as a visit paid to the Twins by their sister Helen of Troy.

- **α Gem/Castor** is the second-brightest star in Gemini and the 44th brightest star in the sky. This is a double star with a combined apparent magnitude of 1.58. Astronomers believe that Castor is in fact a complex system of six stars bound together by gravity, although at first sight they seem to be one star. Although Castor has been given the Alpha Geminorum designation, it is almost one-half stellar magnitude fainter than Pollux which is Beta Geminorum.

Despite being considered twin stars, Castor and Pollux are unrelated because they lie at different distances from us, 51 and 34 light-years respectively.

- **β Gem/Pollux** is the brightest star in the constellation of Gemini, ranking 17th brightest among the celestial luminaries. It has an apparent magnitude of 1.14 and lies 33.78 light-years away from the Solar system. This is a mature orange giant star, with a mass twice as great as that of the Sun, and a radius nine times as great as the Sun's. In 2006 the astronomers confirmed that there was an extrasolar planet, Pollux b, revolving around the star, its mass is at least 2.3 times as great as that of Jupiter, and its period of revolution is equal to 590 days.

- **γ Gem/Alhena** is the third-brightest star with an apparent stellar magnitude of 1.91, visible to the naked eye. This is a white subgiant star located at a distance of roughly 109 light-years from the Earth. It is 123 times as bright as the Sun, with a mass 2.8 times as great

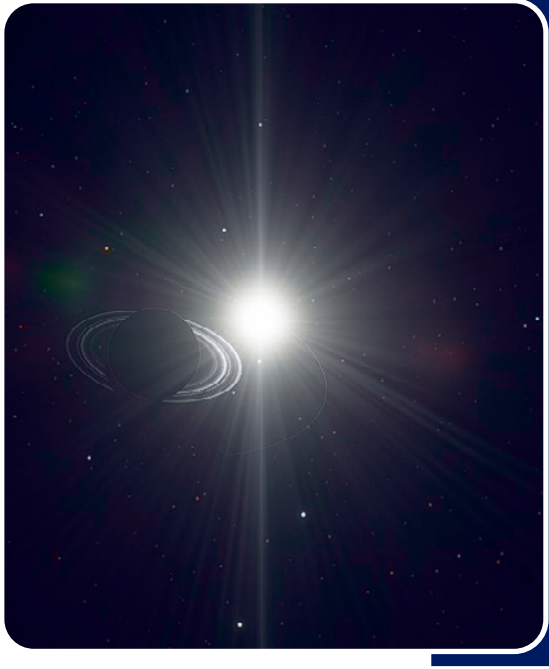
Messier 35 (M35) is a large open star cluster located in the constellation Gemini.

(малюнок SpaceEngine)

as that of the Sun, its radius is 3.3 times as great as the Sun's. The star's name comes from the Arabic word ‹Al-Han'ah› meaning ‹the brand on the camel's neck›. The star is sometimes also called Almeisan, which means ‹the shining one› in the Arabic culture.

There is also a Messier object in the constellation, Messier 35 (photo courtesy of SpaceEngine), this open star cluster occupies a region of the sky about the size of the full Moon. The cluster has an apparent magnitude of 5.30 and lies at a distance of around 2800 light-years from the Earth. Messier 35 was discovered almost at the same time by two scientists: Swiss astronomer Philippe Loys de Cheseaux in 1745, and then by English doctor and astronomer John Bevis in 1750.

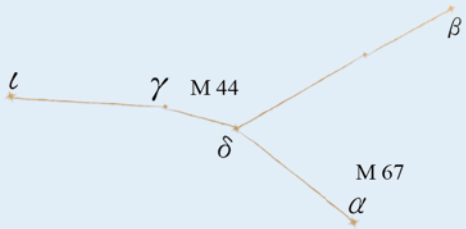
The constellation is best visible in the sky in December and January. And in latitudes to the north of the 62nd degree north latitude (for instance, in Reykjavik, the capital of Iceland), Castor and Pollux never go beyond the horizon.

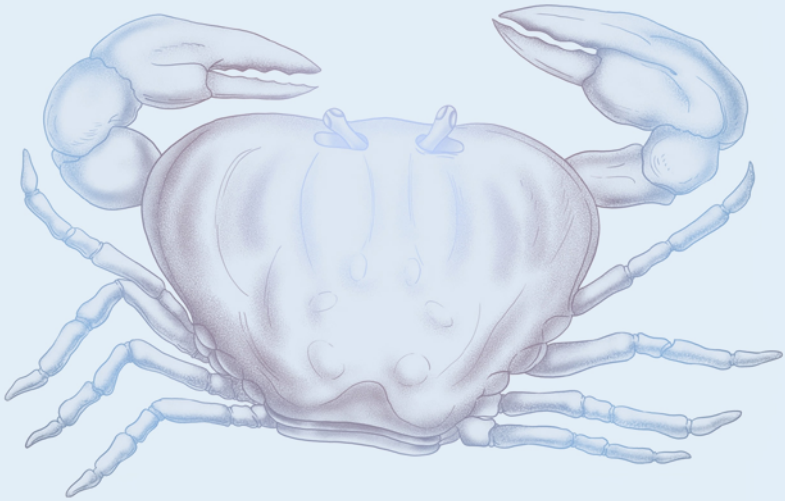


There is another interesting fact about the constellation of Gemini: it was thanks to its stars that astronomer Herschel was able to discover planet Uranus with the aid of a telescope in the 18th century.

Uranus has 28 satellites, as well as 13 rings.

(SpaceEngine)





CANCER

04. Clusters of stars of the Southern and Northern hemispheres can be seen if you are standing on the earth's equator, but not all at once. And as for the equatorial constellations, they can be observed almost from anywhere in the world.

It is pleasant to admire it in those moments when your heart desires full harmony. To find the bright head of one of the Twins, Pollux, in the March sky, and move your eyes to a rather dim constellation to the left. There are no presumptuous flares of mega-stars in it, and all the luminaries are calm and balanced as if they are under water which smoothes the contrasts. It is called Cancer in Latin, and the Crab in English; history is silent about when the constellation was named Cancer (‹the Crayfish›). However, it was first catalogued by Greek astronomer Claudius Ptolemy in the 2nd century as Cancer. It can be assumed that it all began in 1690 when Uranographia, a star atlas by Johannes Hevelius, was published. The Polish astronomer and telescope designer drew this constellation in the maps looking like a sea crawfish (or a lobster, if you will) — that is, not with a roundish body but with an oblong one, like a common river crayfish.

The constellation of **Cancer** is located in the Northern hemisphere. It is of an average size, covering an area of 506 square degrees and ranking 31st largest among the 88 constellations of the night sky. Cancer is visible at latitudes of 90 to −60 degrees. One of Zodiac's twelve constellations lies along the path the Sun travels in the sky during the year, and is indeed the faintest one among them. Cancer is bordered by Gemini to the west, Lynx to the north, Leo Minor to the

The first tablets with inscriptions about the sky come from the place where writing and the civilization itself had originated — from an oasis between two rivers in Mesopotamia. At different times this country was called Sumer or Babylonia. The names of many constellations bear relics of the Sumerian language and religious beliefs.

northeast, Leo to the east, Hydra to the south, and Canis Minor to the southwest.

The crayfish, or rather the crab, which the constellation has been named after, was a minor character in one of Heracles's labors. While Heracles was fighting against a many-headed monster named Hydra in a swamp near Lerna (the Lernaean Hydra is a prototype of one of the constellations too), the crab crawled onshore and, when it got under Heracles's heel, pinched his foot with all its might. Infuriated, Heracles crushed the crab and, according to one of the versions, kicked it into the sky out of spite. But another version goes that the crab was placed among the stars by Hera who hated Heracles, as a token of gratitude for its timely pinch. However, she placed the crab in the region of the sky where there are no bright stars, because however hard it had tried, the crab failed to accomplish its task and disable Heracles for a long time. Indeed, there are no stars brighter than magnitude 4 in the constellation of Cancer, and only six stars are brighter than 5.0.

But nonetheless, there are a number of astronomical concepts related to this constellation, which everybody has at least heard about. For instance, the Tropic of Cancer is the latitude of the Earth where the Sun appears above your head at midday on the summer solstice day, June 21. At the time of the ancient Greeks, the Sun was located among the stars of Cancer on that day, but because of the precession, or the Earth's wobble, the summer solstice point has moved from Cancer, through the neighboring Gemini, into Taurus. The northern Tropic of Cancer is one of the five important parallels marked on world maps, the northernmost latitude where the Sun can be in the zenith.

Interestingly, the order (ranking) of stars in this constellation is not formed as usual, by brightness.

- **α Cnc/Acubens** is only the fourth brightest star in the constellation. It is located in the Crab's southern pincer. Its apparent magnitude varies between 4.20 and 4.27. This is not even one star but a star

system that lies at a distance of roughly 174 light-years from us. Acubens is 23 times as bright as the Sun, located close to the ecliptic which is the Sun's annual path, and not always visible: sometimes it is hidden behind the Moon or other planets. The star's name is translated from Arabic as ‹the claw›, which is explainable as Acubens is located in the sharpest part of the pincer.

- **β Cnc/Altarf** is the brightest star in the constellation with an apparent magnitude of 3.5. This is a double star comprised of a K-type orange giant and a magnitude 14 companion located 29 arcseconds away. Beta Cancri lies approximately 290 light-years away from us. The star's name derives from the Arabic word ‹at-tarf›, which means ‹the eye›, or ‹at-tarfah›, meaning ‹the glance›.

- **γ Cnc/Asellus Borealis** is a white subgiant star lying about 158 light-years away from the Earth. The star's apparent magnitude is 4.66. Its name in Latin means ‹the northern donkey› or ‹the northern donkey's foal›. The star is located near the ecliptic too, and may be hidden.

The constellation doesn't only have the Northern Donkey. There is also δ Cancri, Asellus Australis (the Southern Donkey), and they have a legend of their own. Ancient Greek writer Eratosthenes wrote about a battle between gods and giants that had followed the overthrow of the titans. Gods Dionysus, Hephaestus, and some of his companions arrived on donkeyback to join the battle. The giants had never heard donkeys' bellowing before, and were put to flight by the noise, as they believed

NGC 2632/Beehive is an open star cluster. It can be observed with the naked eye; therefore it has been known from ancient times and popular with amateur astronomers. Beehive is one of the star clusters closest to the Earth, as it lies 580 light-years away from it. The cluster's stars have been found to have a few exoplanets.

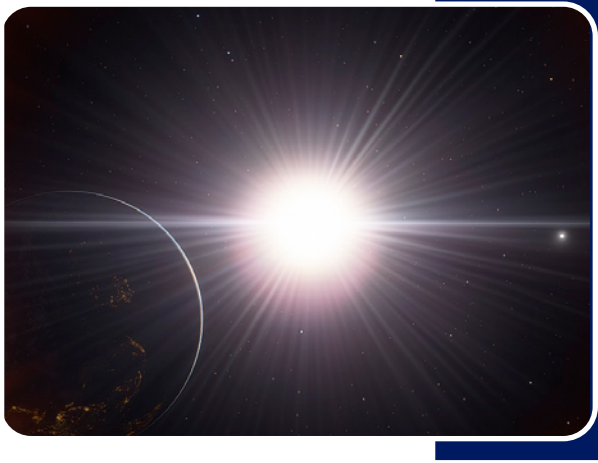
that there was some horrible monster about to be set at them. Dionysus placed the donkeys in the sky at each side of the nebula which the Greeks referred to as Fatne, ‹the crib›.

Messier 44, Hive cluster (Giuseppe Donatiello from Oria, Italy)

Ptolemy described Fatne in Almagest as ‹the nebulous mass in the breast of Cancer›, having no idea what it was in actual fact. Its true nature of a cluster of faint stars wasn't established until 1609 when Galileo first aimed his telescope at it. Astronomers now know this star cluster under the Latin name of Praesepe, which means ‹the beehive› or ‹the crib›, as the Latin word has two meanings. The nebula is also known as M44 by its number in Charles Messier's catalogue of nebulous objects.

One of Cancer's ‹brightest› representatives is M 67/NGC 2682, an open star cluster whose age is estimated to be 3.2–5.0 bln years. Its initial mass at the moment of formation was approximately 10 times as great. The whole cluster is rather large: the region of the sky it occupies is the size of the full Moon.

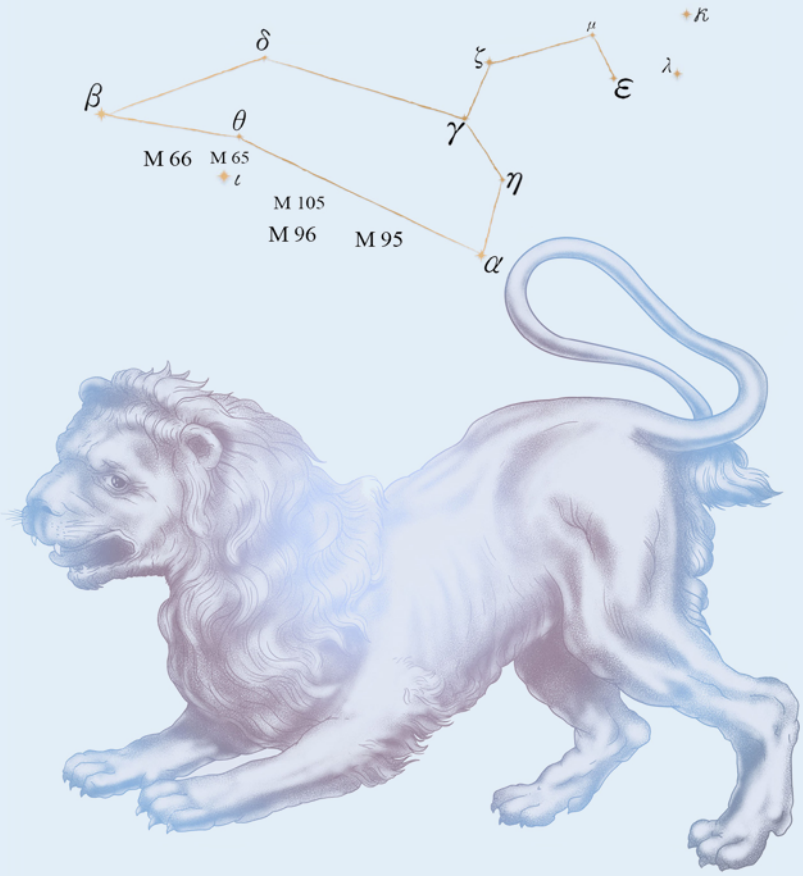
Zero Kelvin is defined as absolute zero: – 273.15°C.
273.15 K is equal to 0°C.



You can look at the Sun through a telescope twice in your life: the first time with your left eye, and the second with your right.

(SpaceEngine)

The constellation of Cancer is best observed in March, during its culmination. But keep in mind that it isn't easy to see it with the naked eye in an urban environment.



LEO

05. The set of observable constellations also varies depending on the time of the year: our planet revolves around the Sun and stays in different constellations for different numbers of days. In December it visits the constellation of Ophiuchus for a short while, which was ‹discarded› by the ancient astronomers to make it come out even (12 is a dozen in some number systems, for instance, in Great Britain).

The spring night sky looks mesmerizing. One can't take their eyes off it. The luminaries acquire chaster and clearer outlines, as if they are drawn up in a line in anticipation of the annual routine, and freeze, allowing us to feast our eyes on them to our heart's content. Here is the most popular asterism, the dipper of Ursa Major, which can be located by any schoolchild. Canes Venatici is just a short distance away, as well as Coma Berenices. And if you continue the line of the dipper's rear wall (near its long handle) downwards, towards the ecliptic, it will point at the brightest star of one of the largest constellations, Leo.

Astrologically, **Leo** is an aesthete and gourmet who is susceptible to flattery, and astronomically, it is one of the most beautiful and easy-to-perceive constellations. It's easy because it won't take you much time to identify the figure of a lion, and you needn't even use too much imagination. All you have to do is just find that most shiny star, Regulus, and connect the bright stars above it with imaginary lines. The celestial lion looks indeed very much like the king of beasts we all have remembered since childhood. He has just stopped in the Sun's path and slightly bent his front paws as if getting ready to jump. His head and chest form a well-known and instantly recognizable asterism: the sickle resembling the mirror reflection of a question mark. The dot at the bottom of that mark is Regulus, a bright white-blue star.

The constellation of Lion/Leo occupies an area of 947 square degrees, which makes it the 12th largest constellation in the night sky. Leo borders with nine constellations: Cancer, Coma Berenices,

Crater, Hydra, Leo Minor, Lynx, Sextans, Ursa Major, and Virgo. Leo is one of the zodiacal constellations, it can be observed at latitudes of 90 to -65 degrees.

This is one of the oldest constellations, one of the 48 first described by Greek astronomer Ptolemy in the 2nd century. The Persians called it Shir, and the Babylonians, the Great Lion. The ancient Egyptians worshipped the constellation as the place where the Sun had risen after the creation of the world. Its appearance in the night sky coincided with the summer solstice and the annual overflow of the Nile.

Both ancient Greek scientist Eratosthenus and Roman writer Gaius Julius Hyginus insisted that the lion had been placed in the sky because it was the king of beasts. But the mythologists believe it to be the Nemean lion killed by Heracles during the first of his 12 labors. Nemea was a town south of Corinth. The lion dwelled there in a cave, going out of it to hunt and to kidnap the local inhabitants. The people became fewer and fewer, but no bravehearts showed up. And there came Heracles. At first he tried to slay the lion using his bow, but the arrows bounced off the beast without causing any harm to its hide, which was no surprise as the lion was rumored to be no normal beast but the offspring of the dog Orthrus and the monster Typhon. Undaunted, Heracles grabbed his club and rushed after the beast who escaped into the cave. There he vanquished the lion and carried its carcass outside, and then cut off its skin which he then wore as a cloak, which made Heracles look even more formidable.

The myth is interesting indeed, but the reason for placing the defeated lion in the sky remains unclear: it has no heroic traits worthy of such honors. Maybe Eratosthenus is right after all, and the constellation was just named after the kingly beast venerated by all nations?

GRB 090423 is the most distant gamma-ray burst which lasted for 10 seconds. The burst took place only in 630 million years after the Big Bang, confirming that massive stars emerged and died in a very young Universe.

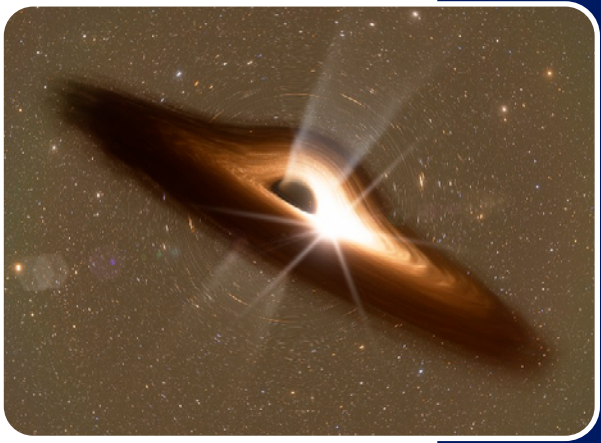
- **α Leo/Regulus** is the brightest star in the constellation and the 22nd brightest one in the sky, with an apparent magnitude of 1.36. In the ancient times it was believed to be the guardian of the skies. This is a multiple star system comprised of at least four stars. It is one and a half hundred times brighter than the Sun, and the high level of visibility can be also explained by its relative proximity to us: it lies only 77 light-years away. Regulus lies at the bottom of the sickle, the asterism representing the lion's heart. According to Ptolemy's description, Regulus means ‹the little king› in Latin, or ‹the prince›. Claudius Ptolemy in his Almagest referred to it as Basiliskos, or, in Latinized form, Basiliscus, which has the same meaning: ‹the royal heir›.

- **β Leo/Denebola** is the third brightest star in the constellation, it is located at the tip of the mighty stellar beast's tail and has a corresponding name that derives from the Arabic phrase ‹dhanab al-asad›, which means ‹the lion's tail›. Denebola, with a stellar magnitude of 2.14, is a blue-white subgiant located approximately 36 light-years away from the Earth.

- **γ Leo/Algieba** is the second brightest star, or rather star system, with an apparent magnitude of 1.98, lying around 130 light-years away from the Sun. If you look at it through a small telescope, you can see a pair of orange giants. Algieba's name comes from the Arabic word ‹al-jabhah›, meaning ‹the forehead›. It's quite an unexpected name because according to Ptolemy, the star is located in the lion's mane. But the matter is that the Arabs saw the stellar lion's figure as being of a much greater size than what the Greeks imagined, thus the discrepancy.

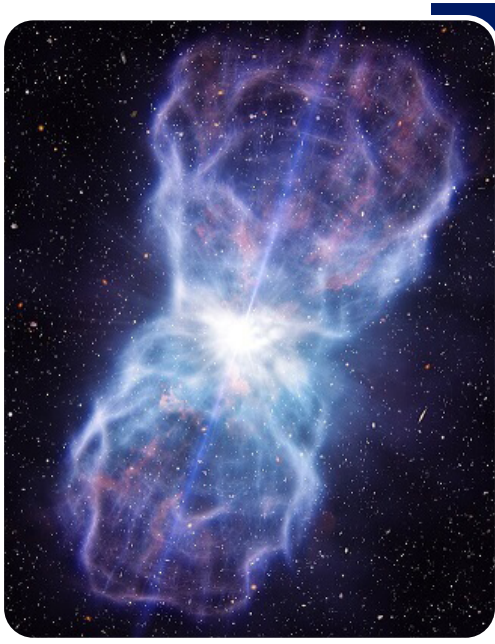
M66 is 35 mln light-years away from us.
The galaxy is 100 thousands light-years across.

(Hubble, NASA, ESA)



Picture of a black hole.

(SpaceEngine)



In this picture you can see the quasar SDSS J1106+1939.

A supermassive black hole sucks matter in and ejects it at a speed of 8,000 km/s. The quasar is more than two trillion times brighter than the Sun.

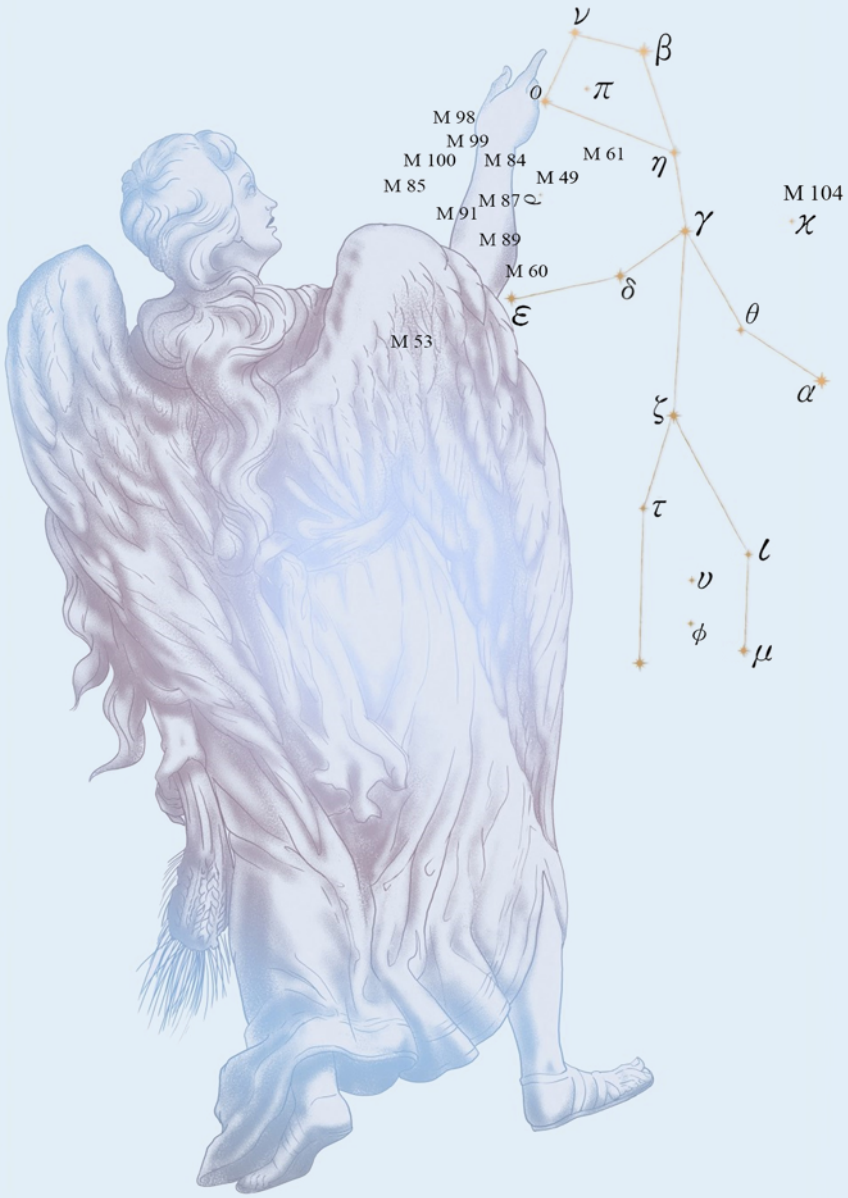
(Illustrations by Calada, ESO)

The constellation of Leo contains five Messier objects, which are all galaxies:

- M65 is an intermediate spiral galaxy with visible bands of dark dust;
- M66 is another intermediate spiral galaxy located about 95 thousand light-years away from the Earth;
- M95 is a barred spiral galaxy, with a visual magnitude of 11.4 and located at a distance of roughly 38 million light-years;
- M96 is another intermediate spiral galaxy, it has a visual magnitude of 10.1 and lies approximately 31 million light-years away;
- M105 – an elliptical galaxy, in the center of which there is a supermassive black hole.

Among the other remarkable deep-sky objects, it is worth mentioning the huge cloud of hydrogen and helium known as the Leo Ring.

The Sun, as a rule, stays in the constellation of Leo from August 10 to September 15, and the best time to observe the constellation of Leo in Europe is spring from March till May. Leo continues to be visible until July, but as the time approaches when the Sun will be in the house of Leo in late July and early August, the constellation begins to grow dimmer. It will begin to become brighter only in late September.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VIRGO

06. When looking into the clear night sky one can see up to 5 thousand stars, and the total number of naked-eye stars is up to 10,000. Some of them are visible only from the Northern hemisphere, and some only from the Southern one. There is no place on the Earth where all the constellations could be seen at once.

...Look into the midnight sky in early spring when the air is fresh and clean, and the murmur of March brooks or the quiet rustle of the first, still sticky leaves are barely audible in the night's silence. She is well visible in May as well as in the first half of summer, but then the air becomes viscous like honey and absorbs the brightness of her stars, subdues the shine. And so she hurries to go away, disappointed with the indifference and the other human vices she can see.

The Fair Maiden in shining garments and with show-white wings behind her shoulders is depicted in John Flamsteed's Atlas Coelestis (1729) with a palm branch in her right hand and an ear of grain woven from stars in her left hand.

Virgo is the second largest constellation in the sky, with only Hydra being larger, which lies in the third quadrant of the Southern hemisphere and covers an area of 1,294 square degrees. This is one of the 15 equatorial constellations and one of the 12 zodiacal ones. It was first catalogued by Greek astronomer Ptolemy in the 2nd century. The constellation can be observed at latitudes of +80° to −80°. Virgo borders with Boötes, Coma Berenices, Corvus, Crater, Hydra, Leo, and Libra.

The Greeks called this constellation Parthenos. This name was given to it by Ptolemy in Almagest. Virgo is most often associated with Dike, the goddess of justice, daughter of Zeus and Themis. But some mythologists believe the constellation's prototype to be Astraea, daughter of the divine master of the winds and the goddess of dawn Eos.

The myth about Dike is very eloquent. It is about the morals: about the reduction of the human race's moral standards. It was the favorite

tale of the Greek and Roman mythologists, and its subject seems to be still relevant today.

...Dike lived in the golden age of mankind, when Cronus was the ruler of Olympus. It was the time of peace and happiness and the season of perennial spring, when people didn't have to work hard to get their food and never grew old. There existed no sorrow, crime, or war. It was easy to do justice. But then Zeus overthrew Cronus, shortened springtime, and introduced the yearly cycle of seasons. The Silver age began: humans became quarrelsome and ceased to honor the gods. Dike felt very sad. She assembled the human race and gave them a stern warning: hard times were coming. She herself took refuge in the mountains, unwilling to watch the decline of morals. But she hoped in vain that the humans would come to their senses. In the Bronze Age, when the Earth was overflowing with violence and wars, Dike spread her wings and flew up to heaven where she sits to this day next to the constellation of Libra, which some people see as the scales of justice.

There are also other goddesses who can claim to be prototypes of Virgo. One of them is Persephone, daughter of Demeter. She was abducted by her uncle Hades, the god of the underworld and Zeus's brother. He took her into his chariot drawn by four black horses, and carried her off to his underworld kingdom. After searching the Earth in vain for her missing daughter, Demeter cursed the fields of Sicily, so that the crops failed. The Sun revealed the truth to her. Demeter was furious, and Zeus had a hard time too as he had to sort things out with his brother. But Persephone could not return anymore to the land of living. A compromise was reached: for half the year Persephone would live in the underworld with her husband, and for other half, above ground with her mother. This sounds like an allegory of the alternation of seasons, doesn't it?

Another version was suggested by ancient Greek scientist Eratosthenus and Roman writer Gaius Julius Hyginus. They associated the constellation of Virgo with Tyche, the goddess of fortune. However, Tyche is usually depicted holding the horn of plenty rather than an ear of grain.

There are 95 visible stars in Virgo, 17 of them have proper names.

- **α Vir/Spica** is the brightest star whose name means ‹the ear of grain› in Latin. The Greek name for this star, Stachys, has the same meaning. The Arabs referred to it as ‹al-sunbulah›, which means ‹the ear of grain› too. This is the 15th brightest star in the sky. Its apparent magnitude is equal to 1.04. This is a blue giant located approximately 260 light-years away from the Solar system and around 12,100 brighter than the Sun. By all appearances, Spica was the star that helped Greek astronomer and mathematician Hipparchus discover the precession of the equinoxes in 127 B.C. Nicolaus Copernicus who was the first to formulate a comprehensive heliocentric cosmology displacing the Earth from the center of the Universe, also made many observations of Spica when exploring the precession.

- **β Vir/Zavijava** lies just 35.65 light-years away from the Sun. Despite being designated as beta, it is only the fifth-brightest star in the constellation. The name Zavijava (also Zavijah, Zavyava or Zawijah) derives from the Arabic phrase that means ‹corner of the barking dog›. Sometimes it was also referred to as Alaraph. Ptolemy in his Almagest placed this star on the top of Virgo's left wing.

- **γ Vir/Porrima** has a visual magnitude of 2.74 and is located at a distance of roughly 38.1 light-years from the Earth. The star was named after a Roman goddess. According to Ovid in *The Fasti*, Porrima and Postverta were sisters and companions of the prophetess Carmenta. Porrima sang about the past events, and Postverta about what was yet to happen. This is one of the binary stars closest to us. Interestingly, in 1929 there was the maximum distance between the components of this binary luminary, and by 2007 it was so much diminished (by 1.2 times) that the double star became visible from the Earth as a single one.

Virgo possesses a great number of galaxies, known as the Virgo Cluster. This local cluster is comprised of more than 2,000 individual galaxies of all sorts of shapes and types. The cluster's center lies around 54 million light-years away from our Solar system. There are 11 Messier objects in Virgo, which are all galaxies.

The largest galaxy known to scientists is IC 1101. It is 2,000 times as massive as the Milky Way, and 60 times as great. If it had been in its place it would have absorbed all the four galaxies nearest to us. Large galaxies can devour their smaller neighbors, absorbing their stars and drawing them in. It is highly likely that it was the way IC 1101 reached such considerable size.

Virgo A/M87 is a large galaxy in the Virgo Cluster. This is a supergiant elliptical galaxy. The black hole in its center ejects a 5000 light-years long jet of subatomic matter.

The IC 1101 galaxy is the largest known galaxy.
(Hubble, NASA/ESA)

3C 273 is the brightest quasar in the Earth's starry sky.
(Hubble, NASA/ESA)

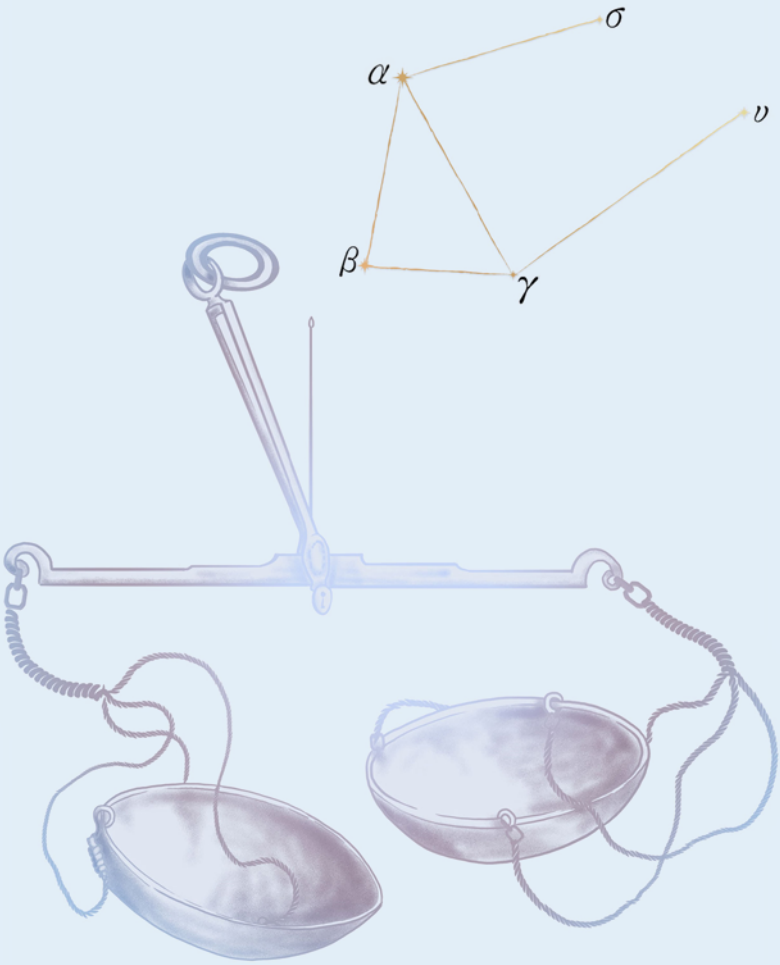
This is the first-ever photo of a black hole located in the very center of the M87 galaxy. Its mass is more than 6.5 bln times as great as that of the Sun.
(Event Horizon Telescope/European Southern Observatory)

3C 273 is the brightest quasar in the Earth's starry sky. The plasma temperature around the black hole is about 10 trillion °C. The distance to the Sun is approximately 2.44 billion light-years.

The M104 galaxy looks like a sombrero hat. This galaxy can be easily seen through amateur telescopes.
(Hubble, NASA/ESA)

And by the way, the autumn equinox point where the Sun crosses the celestial equator heading southward lies within Virgo. This happens on September 22 or 23. In the ancient times, the autumn equinox point was in Libra; therefore it is still called sometimes ‹the first point of Libra›. But due to the precession effect, the autumn equinox point crossed Libra's modern boundary and entered Virgo sometime in 730 B.C. It continues to move and will reach Leo 2439.

The best time to observe this constellation is March and April.



LIBRA

07. The farthest distance a human has ever traveled away from the Earth is 401,056 kilometers. It refers to the Apollo 13 crewed mission with three NASA astronauts on board in 1970.

To find peace of mind, it is sometimes enough to spend some time alone with the stars: the night's glittering velvet mesmerizes the observer, giving them amazingly beautiful illusions. You can let your imagination run free and, connecting the stars with lines, invent stellar tales in the sky: find out what the Great Bear has in its dipper, who the Herdsman is waving at, or what the Scorpion is reaching for with its pincers. The two balancing scales between the Scorpion's pincers and the young Virgin's left foot, which was how the constellation was depicted by the ancient artists, can symbolize harmony, the balance of good and evil, of light and darkness, of love and hate. Did you know that scales have by no means always been associated with Themis, justice, or even fairness?..

The constellation of **Libra** lies in the third quadrant of the Southern hemisphere, a short distance from the celestial equator. It can be observed at latitudes of 65 to −90 degrees. Libra is a zodiacal constellation as it lies in the Zodiac belt that forms an imaginary ring close to the Earth's orbit. The Sun passes through the sign of Libra from September 23 to October 23. During this time, the Sun could be said to be hiding in the house of Libra. And this is the only zodiacal constellation that symbolizes an inanimate object. As for Libra's size, it covers an area of 538 square degrees, ranking 29th among the 88 constellations of the night sky and being the 7th largest in the Zodiac. Libra is comprised of 83 stars, and surrounded with seven constellations: Serpens to the north, Virgo to the northwest, Hydra and Centaurus to the southwest, Lupus to the south, Scorpius to the east, and Ophiuchus to the northeast.

In the ancient Greek times, the region of the sky known to us as Libra was occupied with the neighboring Scorpius's pincers. The Greeks

referred to this region as Chelae, which literally means ‹the claws›, and this definition lives on in the names of Libra's individual stars. As it has turned out, Libra is now a slightly larger constellation than Scorpius, but it is much less conspicuous due to having no stars brighter than magnitude 3, and much less expressive.

The identification of this area with a balance was established in the 1st century B.C. among the Romans, although it's hard to say for sure who and when introduced it: the event has been lost in the mists of history. In his Almagest written around 150 B.C., Ptolemy continued to refer to this constellation as the Claws, preferring to follow the Greek tradition, even though it had already been supplanted by then. For example, Libra was shown as a pair of scales on the celestial globe held by the Farnese Atlas, a Roman statue carved around the same time when Almagest was written. Eight centuries after Ptolemy, the Arabs called this constellation both al-Zubanayn/the Claws and al-Mizan/the Balance, maintaining the dual identity.

For the Romans, Libra was their favorite constellation. They said that the Moon had been in Libra when Rome was founded. ‹Italy belongs to the Balance, her rightful sign. Beneath it Rome and her sovereignty of the world were founded,› the Roman writer Manilius said. He described Libra as ‹the sign in which the seasons are balanced, and the hours of night and day match each other›.

This is a hint that the Romans visualized Libra as a balance because the Sun lay within this constellation at the autumn equinox when day and night are equal. But what Manilius spoke about was the astrological sign and not the astronomical constellation: due to the precession, the autumn equinox point moved out of Libra in approximately 730 B.C., that is, in the Roman Empire times it was already in Virgo. By the way, in 2439 the autumn equinox point will move into Leo.

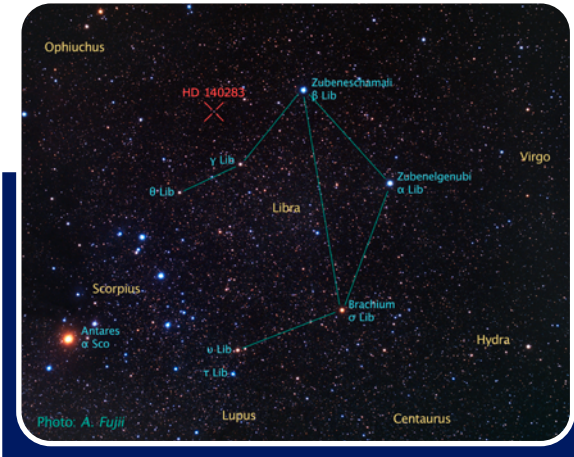
The constellation of Libra has only two stars brighter than magnitude 3.

- **α Librae/Zubenelgenubi** derives from the Arabic ‹al-zubana al-janubiyy›, which means ‹the southern claw›, this is a reminder of the constellation being identified by the Greeks with the scorpion's claws. It is a blue-white dwarf with a stellar magnitude of 2.61, located 185 light-years away from the Earth.

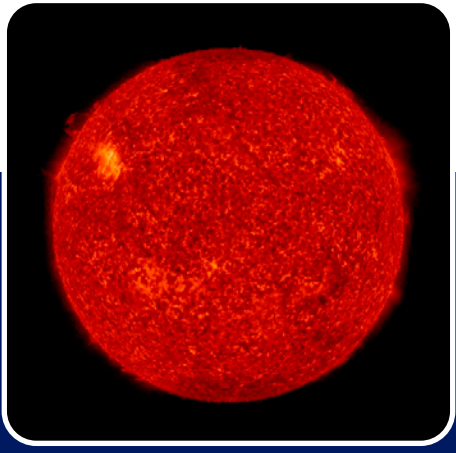
- **β Librae/Zubeneschamali** comes from the Arabic ‹al-zubana al-samaliyy›, ‹the northern claw›. This is a multiple star system of magnitude 2.75, located around 77 light-years away from us.

- **σ Librae/Brachium** is the third-brightest star with a stellar magnitude of 3.29. It is a red giant lying approximately 288 light-years away from the Earth.

The easiest way to locate Libra is to find its two brightest stars, Zubenelgenubi and Zubeneschamali, then draw an imaginary line between them and try to imagine that it is a balancing beam with one star at each end. The two other bright stars in Libra play the role of scale pans. If you have located a quadrangle of bright stars in the sky, this is Libra. It will be easier to find the constellation if you know that Virgo lies behind Libra and Scorpius is situated ahead of it. Both these constellations are brighter and more recognizable.



Libra stars
and the location of HD 140283.
(A. Fujii and Z. Levay (STScI))



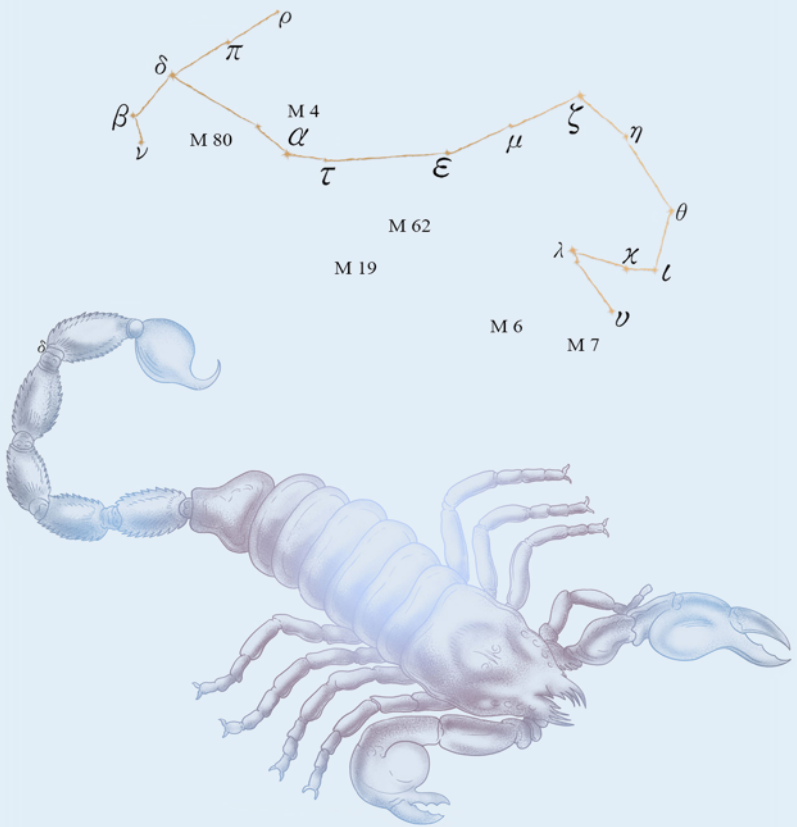
Methuselah (HD 140283) is a subgiant star.
(Picture: NASA, SDO, AIA)

The best time of year to observe the stars and deep-sky objects in Libra is from April to June.

Methuselah (HD 140283) is a subgiant star about 190 light-years away from the Earth. It had been born in a dwarf galaxy which was absorbed by the Milky Way some 12 bln years ago. It is the oldest star in the Sun's immediate environment, and the content of iron and oxygen in its photosphere is 250 and 50 times as low respectively as compared to the Sun.

Astronomers believe that hypothetically there can be habitable exoplanets in Libra. For several decades already, radio signals are sent out towards there in hopes that contact can be established.

Over the last 500 years, the Earth's mass has increased by one billion tons due to interstellar dust accumulation.
Every minute of the day, the Earth travels 19,300 kilometers.
The photo was taken from the Moon's orbit by Apollo 8 astronaut Bill Anders. (NASA)



SCORPIUS

08. Stars have different brightness, and this fact was noticed as early as by the ancient researchers. In the 2nd century B.C., ancient Greek scientist Hipparchus defined six stellar magnitudes based on the star's apparent brightness, the brightest star being of the first magnitude. In the 17th century A.D. it was proposed to distinguish the stars in one constellation according to their brightness, denoting them with Greek letters. The brightest one is alpha, then comes beta, and so on, in brightness descending order. This ranking has been used by astronomers up to the present day, although there are some constellations where this principle is not observed.

...Their twinkling, even in fog, is a signal of incredible force and energy, it can be heard by everybody: astronomers, lovers of star tales, and just random passers-by carried away by the sight of the night sky. This is something everybody needs: to spend even a few minutes alone with the stars to feel the amazing beauty and complexity of the Universe which we call home.

You will not have to look long for the constellation of **Scorpius** in the sky, so clearly drawn is its shape, and so bright are its stars. Its characteristic J-shape is sometimes called a fishhook, as the tail of a scorpion getting ready to attack resembles one indeed. It is not for nothing that Pacific islanders believe it to be the fishing rod of the Polynesian god Maui who, as the legend goes, used it to pull New Zealand from the ocean bottom. But some astronomers insist that Scorpius is S-shaped, which is not far from the truth either.

Scorpius lies in the third quadrant of the Southern hemisphere, to the south from the celestial equator. It is the 33rd largest constellation covering an area of 497 square degrees, which can be observed at latitudes of +40° to −90°. It is located between Libra to the west and Sagittarius to the east, bordering also with Norma, Ophiuchus, and Corona Australis.

‹There is a certain place where the scorpion with his tail and curving claws sprawls across two signs of the Zodiac,› Ovid wrote in his

Metamorphoses. He referred to the ancient Greek version of Scorpius, which was larger than the constellation we know today. At those times, the constellation was comprised of two parts: Scorpius – the body and the sting, and Chelae – the claws, or the pincers. In the 1st century B.C. the claws were turned into a new constellation, Libra.

In mythology, Scorpius is the scorpion that stung Orion the hunter to death, although there are different opinions as to the exact circumstances. Eratosthenes says in his description of Scorpius that Orion tried to abduct Artemis, goddess of the hunt, and that she sent the scorpion to sting him; ancient Greek poet Aratus and Roman writer and astronomer Gaius Julius Hyginus write about this as well. But Eratosthenes and Hyginus say the island of Crete was the place of Orion's death, and Aratus speaks of Chios.

Whatever the case, the moral is that Orion was punished for his arrogance. This seems to be one of the most ancient Greek myths, and its origin lies in the sky itself, because the two constellations, Scorpius and Orion, are located opposite each other. And when Scorpius rises in the east, Orion hurries to hide in the west. But the constellation is much older than even the ancient Greeks, there is written evidence that the Sumerians knew it as GIR-TAB, the Scorpion, more than 5000 years ago.

Scorpius is the modern astronomical name of the constellation, the ancient Greeks spelled it as Skorpios. This name is also used by Ptolemy in Almagest.

Interestingly, the full Moon can be observed in Scorpius in early summer when these venomous creatures liven up after winter hibernation and leave their burrows in search for prey. At this time, their stings are especially painful.

The Sun enters the constellation of Scorpius on November 23, and leaves it already on November 29 (passing this constellation in record time, in only one week) to enter Ophiuchus where it will stay for 20 days.

In this constellation, there are 13 stars visible to the naked eye.

- **α Scorpii/Antares.** In Greek, its name means ‹similar to Mars› because of its bright reddish-orange hue, like that of the planet Mars. Ptolemy in Almagest refers to it as ‹the middle one of the three bright stars in the body, Antares›. And it was one of the few stars he gave names to. This is a red supergiant with a visual magnitude of 0.96, a radius of about 883 times as great as that of the Sun, and approximately 10,000 times brighter than the Sun. The star's estimated age is about 12 million years.

- **λ Scorpii/Shaula.** It's the second brightest star with an apparent magnitude of 1.63. This is even not a star but a triple-star system, it lies roughly 700 light-years away from us.

- **γ Scorpii/Sargas.** This is the third-brightest star with a stellar magnitude of 1.85. It is a yellow giant star, which lies at a distance of 300 light-yeas away from our Solar system.

Star systems can be made up of a great number of stars gravitationally bound to one another. To date, Nu of Scorpius (Nu Scorpii) holds the record: this system is comprised of as many as 7 stars!

There are four Messier objects in Scorpius, they are star clusters. The most well-known of them are M6, the Butterfly Cluster, comprised of 80 stars and having the shape of a butterfly, and M7, the Ptolemy Cluster, which is also made up of about 80 stars. Ptolemy in Almagest listed three stars lying outside the constellation (the so-called ‹unformed stars›), describing the first one of them as the ‹hazy star behind the sting›. Most probably it was the large and bright open cluster known to us as M7, which is therefore called the Ptolemy Cluster.

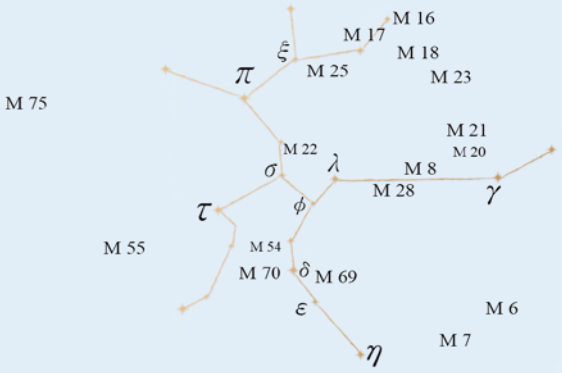
The hottest star is located in the Butterfly Cluster, NGC 6302. Its temperature is about 250,000 °C, and its brightness is gradually decreasing. The process of its transformation into a white dwarf is underway. This is one of the most complex structures among the known polar nebulas. The distance between the Earth an NGC 6302 is roughly 36,000 light-years. Until recently, it had been covered from the astronomers' sight with a cloud of dust, gas and ice, but the state-of-the-art Hubble telescope has made it possible to take unique photos of this celestial body.

(Hubble, NASA, ESA)

NGC 6357 is an emission nebula with an open cluster, which lies 8,000 light-years away from us. It also bears such names as Lobster, or War and Peace. The nebula contains a region of active star formation and many ‹newborn› stars of OB class. This is a photo of NGC 6357 taken with a wide-angle camera.
(Davide De Martin, ESA, Hubble)

The Dark Energy Camera has captured
this star-forming nebula.
(CTIO, NOIRLab, DOE, NSF, AURA)

The constellation of Scorpius is best observed in the Northern hemisphere if you look southwards in July and August. It remains visible in the Northern hemisphere till September, but as the time draws near when the Sun will be in the house of Scorpius, the constellation begins to grow dim. The best time of day to locate it is at night, at about 22.00. And bear in mind, if you look from below the equator Scorpius will seem turned upside down.



SAGITTARIUS

09. The Earth's position shifts by less than 1 degree per day relative to the Sun. A constellation, whatever it is, is fixed. The direction in which the stars allegedly move across the night sky is conditional upon the Earth's rotation around its axis. And the Pole Star appears not to move because it is located right on the Earth's axis of rotation.

When we stare into the midnight sky, even without a goal of identifying a constellation or locating a star but just admiring the luminaries' twinkling, our eyes cannot help getting caught by asterisms, the groups of stars forming familiar patterns: the dipper in the Great Bear, the ear of grain in the Virgin's hand, the Scorpion's curved sting resembling a fishhook. An asterism is always an easily recognizable part of a constellation that can serve as a hint to identify the constellation itself. Sometimes the asterisms are quite unexpected, and the celestial formation isn't a logical part of the main figure. Why does the Bear have a dipper? And Sagittarius, a teapot? But nevertheless, it is this teapot comprised of stellar triangles that makes it very easy to locate in the sky one of the largest constellations, Sagittarius.

The Australian Wolfe Creek Crater is a well-preserved impact crater. It was formed when an iron meteorite weighing about 5,000 tons fell down around 300,000 years ago. The crater is 880 m in diameter, and 60 m deep.

Sagittarius covers an area of 867 square degrees in the Southern Hemisphere of the sky. It is the 15th largest constellation, located between Scorpius and Ophiuchus to the west and Capricornus to the east. Adjacent to Sagittarius are Corona Australis, Microscopium, Serpens, and Telescopium.

In the ancient sky charts, Sagittarius is depicted as a centaur with a horse's croup and a human torso in a cloak. He has a bow in his hands, the bowstring is pulled back, and the sharp arrow is about to

pierce the neighboring Scorpius. Ancient Greek poet and astronomer Aratus referred to the Archer as Toxotes, and his bow as Toxon, as if they were separate constellations.

Sagittarius is a constellation of Sumerian origin, according to the Sumerians' beliefs it was the figure of their winged god of war and hunting. This figure was copied by the Greeks who removed the Sumerian bowman's wings in the process. For this reason, there exist no myths about Sagittarius as the Greek mythographers were confused as to its identity. Some doubted that it was a centaur at all, including Eratosthenes who gave the fact that centaurs did not use bows as one of the reasons. Instead, Eratosthenes described Sagittarius as a two-legged creature with a satyr's tail. According to him, that figure was Crotus, son of Eupheme, the nurse of the Muses, who were nine daughters of Zeus. The Roman mythographer Hyginus in his *Fabulae* added the information that Crotus's father was Pan, agreeing with Eratosthenes that the archer was a satyr, not a centaur.

One of the legends goes that Crotus invented archery and often went hunting on horseback. He dwelled on Mount Helicon among the Muses who enjoyed his company. They sang for him, and he applauded to them loudly. It was upon the Muses' request that Zeus placed him among the stars where he now demonstrates the art of archery. In the sky, he was given the hind legs of a horse, as he was a keen horseman. There is another reason for not referring to Sagittarius as a centaur: this niche is filled by the constellation of Centaur/Centaurus.

Ptolemy in Almagest described Sagittarius in a flowing cloak, ephaptis, attached to his shoulders. At the Archer's feet there is a wreath of stars, Corona Australis.

There are a number of bright stars in the constellation of Sagittarius, but they are ranked quite wrongly. For some inexplicable reason, Ptolemy in Almagest classified the stars which we know to be Alpha and

Beta Sagittarii as second-magnitude stars, while in fact they are only fourth-magnitude. Johann Bayer who lived too far north to see these stars with his own eyes accepted Ptolemy's assessment and referred to them as Alpha and Beta in his Uranometria atlas of 1603. In actual fact, Alpha Sagittarii is only the 15th brightest star in the constellation.

The Pistol Star, V4647 Sagittarii, radiates as much light into space in one minute as our Sun does in 3 years. And Eta Carinae in the constellation of Carina copes with this task in only 20 seconds.

- **α Sgr/Rukbat.** Its name comes from the Arabic for ‹the archer's knee›. Rukbat's apparent stellar magnitude is equal to only 3.96.

- **β Sgr/Arkab.** This is a double star with an apparent magnitude of 3.97, both stars are visible to the naked eye. The name comes from the Arabic for ‹the archer's Achilles tendon›.

- **γ Sgr/Alnasl.** Its name derives from the Arabic for ‹the point›, that is, the tip of the archer's arrow. The star's apparent magnitude is 2.98.

And the brightest stars in Sagittarius are quite different ones:

- **Kaus Australis** is a star with a visual magnitude of 1.85. This is a double star system located 143 light-years away from the Earth.

- **Nunki** is the second brightest star with a stellar magnitude of 2.05. This is a blue subgiant star located about 228 light-years away from us.

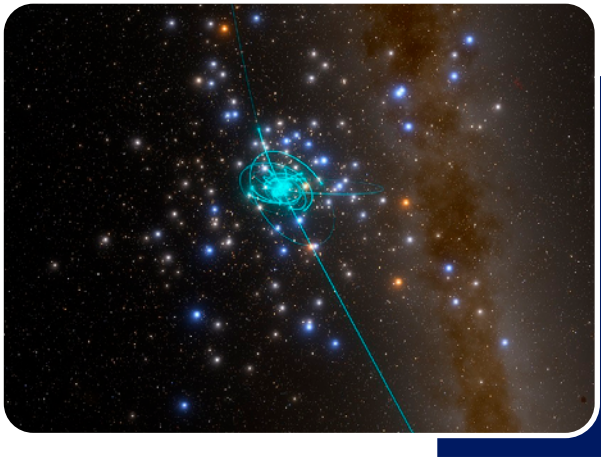
- **Ascella** is another double star system which lies roughly 90 light-years away from our Solar system. With a magnitude of 2.59, Ascella is the third-brightest star.

The Red Spider planetary nebula is one of the best known hot white dwarf stars. NGC 6537 was formed as a result of external gas shells being ejected from an ordinary star.

(European Southern Observatory)

In Sagittarius, there are seven stars brighter than magnitude 3, and three relatively nearly stars located within 10 parsecs (32.6 light-years) from the Earth. The nearest star is Ross 154 located at a distance of only 9.69 light-years away from us.

Interestingly, the process of discovering new stars in Sagittarius is still underway. In 2015, John Seach from Australia discovered yet another star in this constellation, Nova Sagittarii; in spring of 2021,



Sagittarius A* is a supermassive black hole in the center of the Milky Way. It is surrounded with a hot radio-emitting gas cloud of about 5.88 light-years in diameter.

(SpaceEngine)

Hideo Nishimura from Japan spotted ASASSN-21eh which was close to stellar magnitude 10, and in summer of 2022 a group of scientists headed by Florian Peissker from the University of Cologne, Germany, discovered a star which was named S4716 in immediate proximity to a black hole. However, researchers note that no luminaries can be formed so close to a black hole, which means that the star must have been somehow transferred to Sagittarius, and it has yet to be found out how it happened.

As for observing the constellation, the opportunities for ordinary lovers of astronomy are limited: in Europe, to the north of the Pyrenees, Sagittarius lies very low above the horizon and it is difficult to discern it, in the north of Scotland and in Scandinavia it isn't visible at all. The luckiest locations are the south of Brazil, South Africa and Central Australia (30° south): Sagittarius passes right above their heads.

Twenty-six thousand light-years away from us, there is the Sagittarius B2 gas-and-dust cloud. The scientists have discovered that it contains billions of liters of alcohol. Moreover, they have found ethyl formiate in the cloud, which is responsible for the characteristic taste of raspberries and smell of rum.

The constellation culminates in August, it is best observed 2–3 hours before midnight.