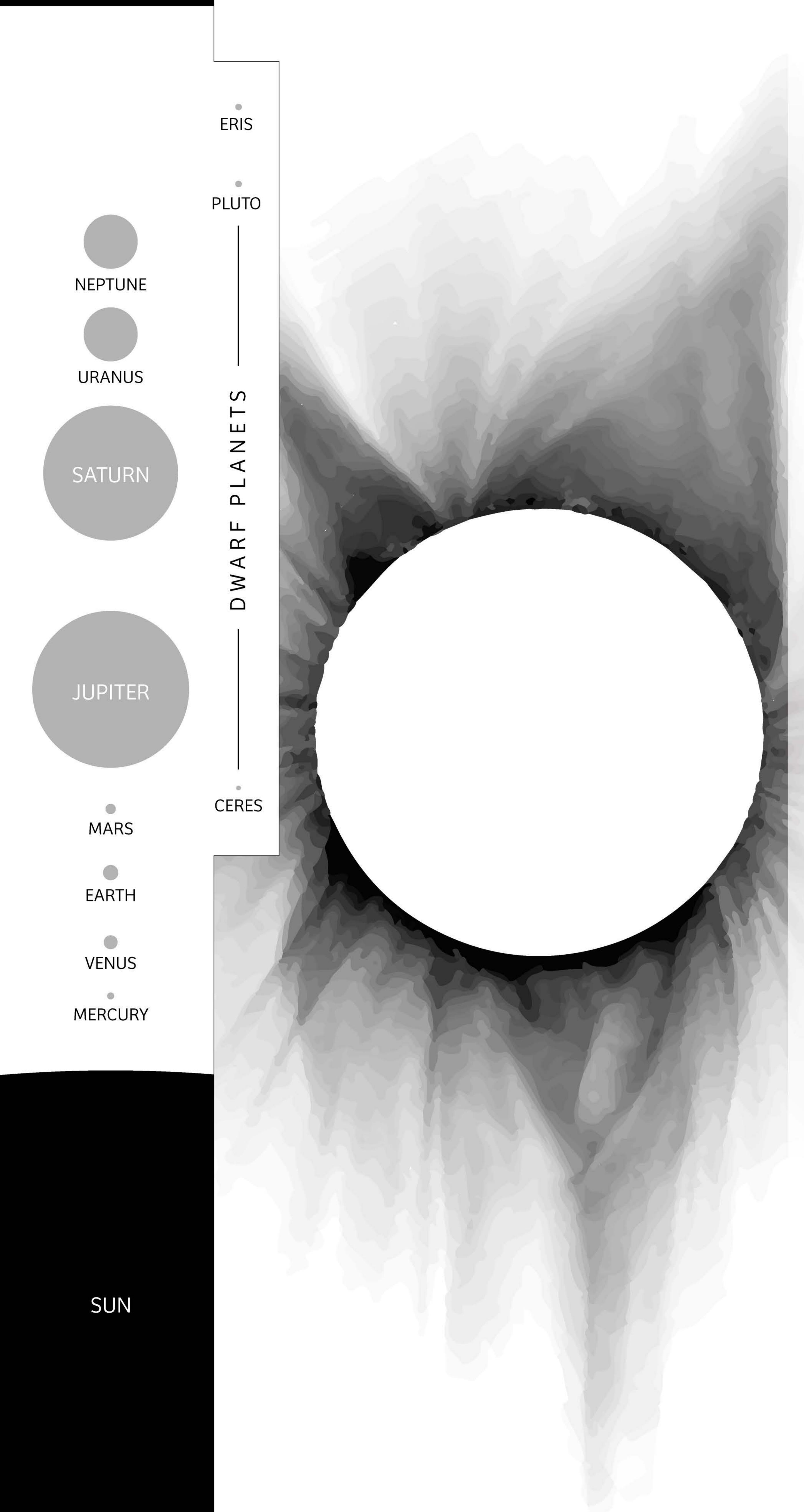


SUN: CENTRE OF THE SOLAR SYSTEM - THE SOURCE OF ALL LIFE ON EARTH



The Sun is an average middle-aged star. It is the central star in our solar system, and through gravity brings together its family of 8 planets, an (as yet) unknown number of dwarf planets, more than a 150 moons, and hundreds of thousands of asteroids and comets.

The Sun's enormous energy comes from the fusion of hydrogen to helium atoms in its core. The tiny amount of excess mass in each reaction leads to 4 million tonnes of mass being converted to energy (E=mc2) every second. When the Sun's hydrogen runs out, in about 5 billion years time, the Sun will swell to become a red giant star engulfing the inner solar system.

The Sun's visible surface, the photosphere, is continually churning and active. Dark sunspots, typically lasting a few days, grow and fade in numbers varying on an 11-year cycle. The daily motion of sunspots across the disk shows that the Sun rotates faster at the equator than at higher latitudes.

By chance, the Sun and Moon are the same apparent size in the sky. From time to tie the Moon crosses the face of the Sun producing a solar eclipse. At these times the thin pink solar 'chromosphere' becomes visible.

SUN STATISTICS

Distance from Earth: 150 million km (1 AU*)

Mass: 2 x 10³⁰ kg (3.3 x 10⁵ Earth's)

Light travel time to Earth: 8.3 minutes

Diameter: 1.4 million km

Temperature of the core: 15 million K

Surface temperature: 5,800 K Luminosity: 3.8 x 10³⁰ watts

Age: 4.6 billion years

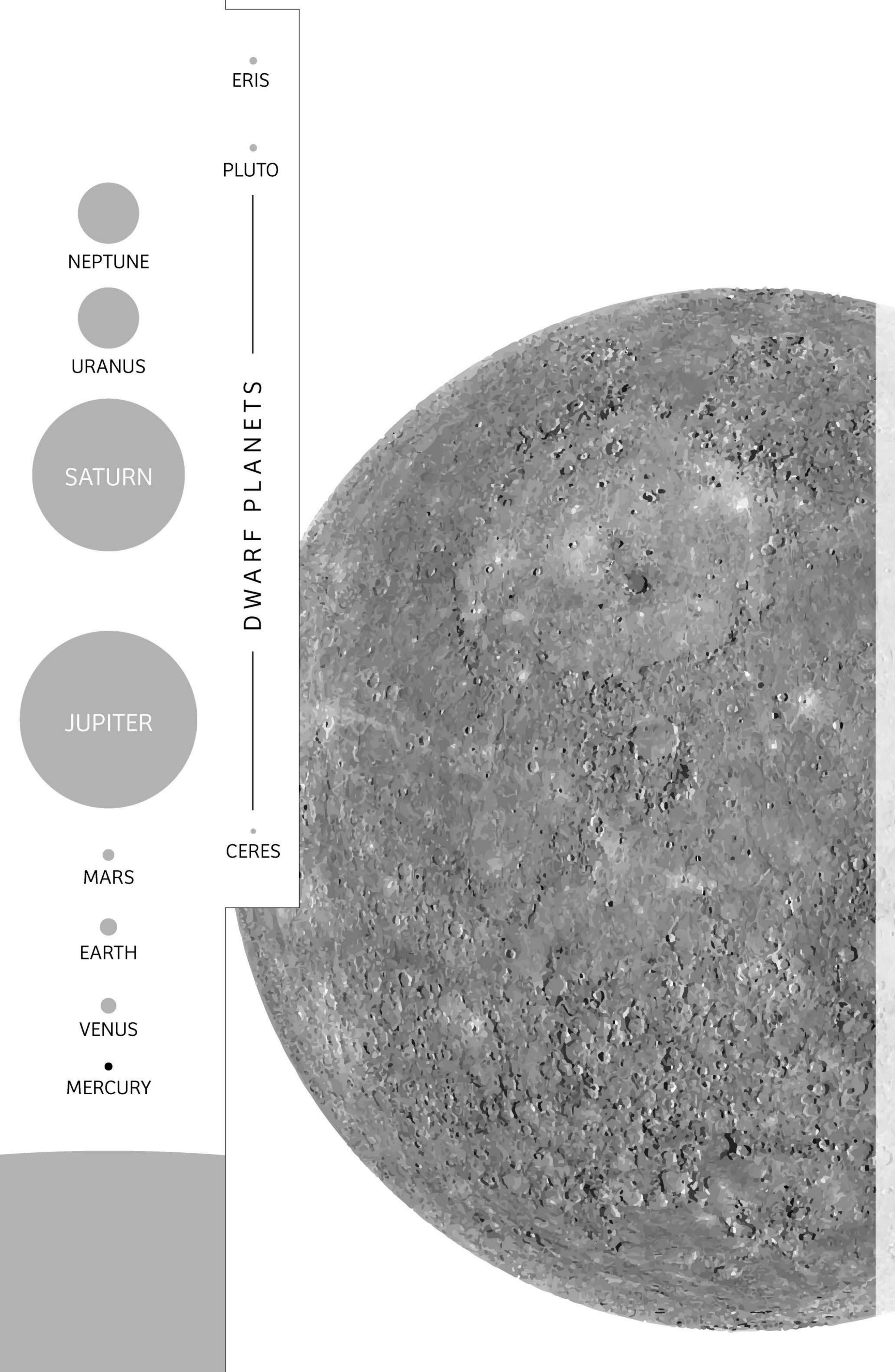
Mean rotation period: 25.4 days Composition: 70% hydrogen, 28% helium, 2% heavy elements

FASCINATING FACT: The mass of the Sun is about 2 trillion, trillion, trillion tons, and that is 750 times larger than all the planets put together.

^{*} One Astronomical Unit (AU) = mean distance of the Earth from the Sun.



MERCURY: THE CLOSEST PLANET TO THE SUN: A ROCKY (TERRESTRIAL) PLANET



FASCINATING FACT: Mercury is smaller than the moons Ganymede (Jupiter) and Titan (Saturn) and is only 40% larger than Earth's Moon.

Mercury is the closest planet to the Sun and orbits the Sun speedily in just 88 days. It rotates very slowly, once every 59 days or only 3 times during 2 orbits around the Sun. To an observer on the surface, a sunrise occurs only once every 176 Earth days. This produces the most extreme variation in temperature on all the planets, from about 90 K on the dark side to 700 K on the sunlit side.

It is also the smallest planet in the solar system - smaller than the largest moons of Jupiter and Saturn. Its surface is heavily cratered and it has no moons. Mercury has a very thin atmosphere, consisting of atoms blasted off its surface by the solar wind. Because Mercury is so hot and has little gravity, these atoms quickly escape into space. Mercury is thought to be made of heavy metals, and is one of the densest planets, second only to Earth. Even though it is closer to the Sun than Venus, it is not the hottest planet. Venus, being covered in thick cloud, can hold onto heat much better and reaches higher temperatures than Mercury.

The correct prediction of Mercury's motion was an important confirmation of Einstein's General Theory of Relativity. Because of its proximity to the Sun, it is difficult to send probes to study Mercury. Mariner 10 in 1974 and MESSENGER in 2004 both visited Mercury.

MERCURY STATISTICS

Diameter: 4,878 km (0.382 x Earth)

Mass: 0.06 x Earth

Mean distance from the Sun: 0.39 AU*

(85 million km)

Orbital period (sidereal**): 88.0 Earth days

Rotational period: 58.6 Earth days

Moons: 0

Inclination of equator to orbit: 0 degrees

(thus no seasons)

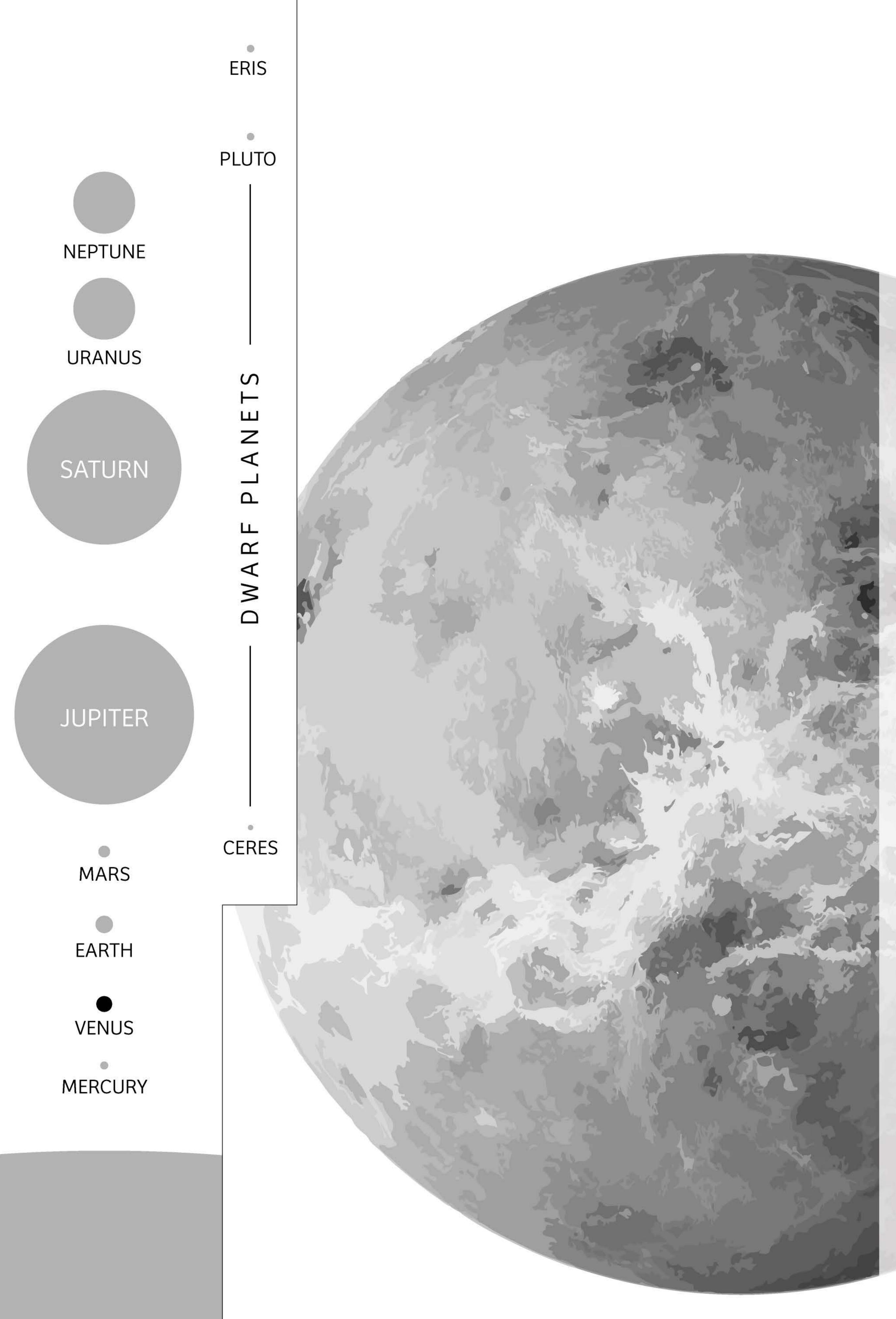
Composition: 70% iron, 30% silicates and a little nickel

* One Astronomical Unit (AU) = mean distance of the Earth from the Sun.

** Sidereal time is time kept with respect to distant stars.



VENUS: THE SECOND PLANET FROM THE SUN: A ROCKY (TERRESTRIAL) PLANET



Venus is similar to the Earth in size and mass, but has a very thick atmosphere mainly of carbon dioxide and nitrogen which conceals the surface from view. The image on the left is from a real-colour image of Venus taken by Mariner 10 an American robotic space probe launched by NASA on November 3, 1973, to fly by the planets Mercury and Venus. The surface is obscured by thick sulphur dioxide clouds. Drops of sulphuric acid are found in the clouds, and the atmospheric pressure at the planet's surface is 90 times that on Earth. The greenhouse effect makes Venus the hottest planet with an average surface temperature of about 465 C (740 K). Underneath the cloud the planet's surface shows extinct volcanoes, craters, plains and mountain ranges.

Venus is unusual in that it rotates in the opposite direction it orbital motion: to an observer on the surface, the Sun rises in the west and sets in the east.

Occasionally the planet passes across the face of the Sun when viewed from Earth, known as a transit of Venus. Observations of transits were first attempted in 1761 and 1769 to establish the distance to Venus and the scale of the solar system. Recent transits occurred in June 2004 and 2012.

VENUS STATISTICS

Diameter: 12,104 km (0.949 x Earth)

Mass: 0.82 x Earth

Mean distance from the Sun: 0.72 AU*

(108 million km)

Orbital period (sidereal**): 224.7 Earth days

Rotational period: 243 Earth days

Moons: 0

Inclination of equator to orbit: 177 degrees Composition: Iron core, molten mantle, crust

FASCINATING FACT: Venus rotates in the opposite direction to its orbital motion: the Sun rises in the west and the Venusian day lasts 116¾ Earth days.

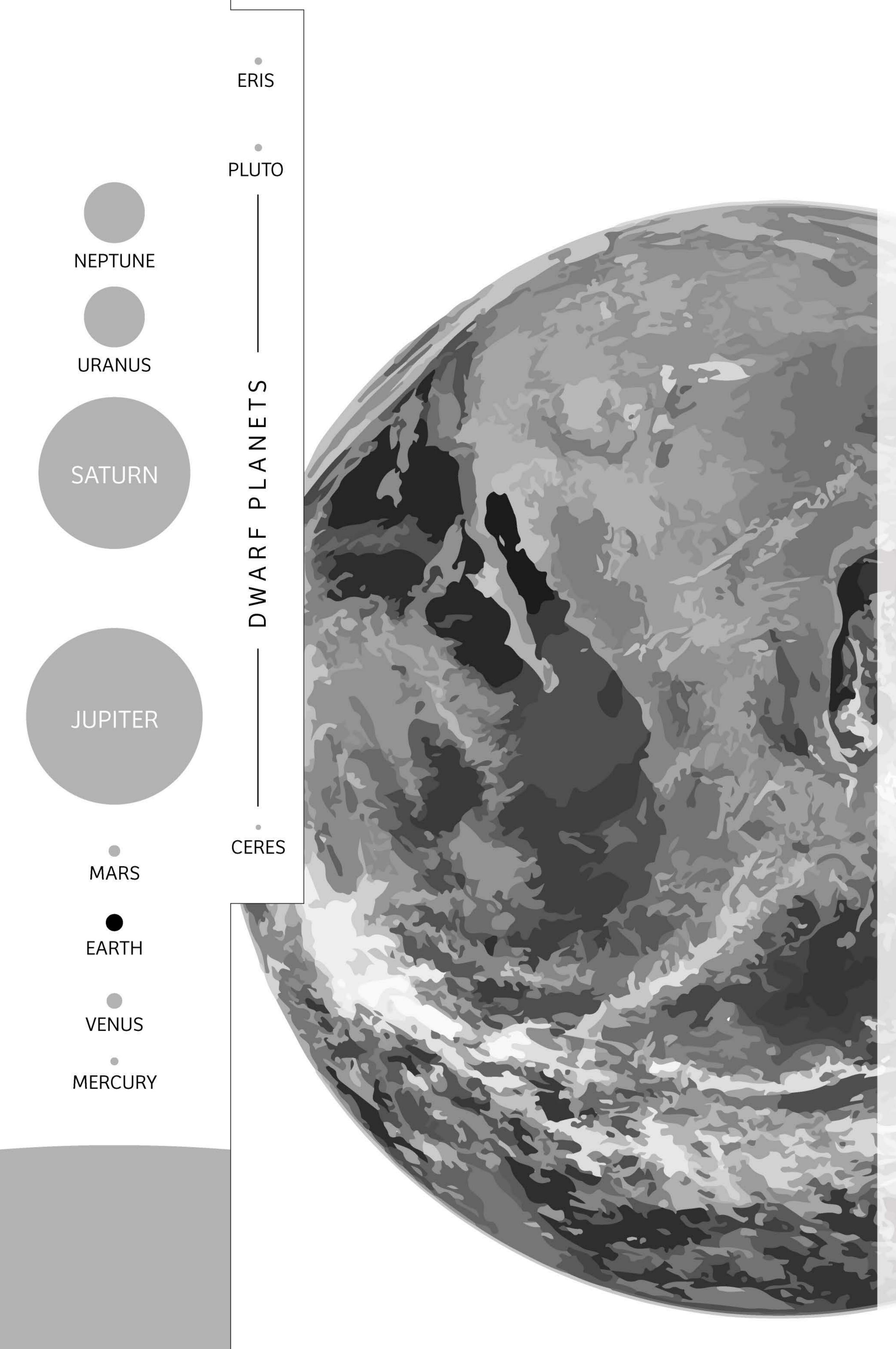
SUN

^{*} One Astronomical Unit (AU) = mean distance of the Earth from the Sun.

^{**} Sidereal time is time kept with respect to distant stars.



EARTH: THE THIRD PLANET FROM THE SUN: A ROCKY (TERRESTRIAL) PLANET



The Earth is the largest of the inner, rocky planets. It is the only planet with conditions suitable for liquid water on the surface, and the only one currently known to harbour living organisms of any kind. Earth's atmosphere is mainly nitrogen and oxygen, with small amounts of argon, carbon dioxide and water vapour. The atmosphere warms the planet by trapping and reflecting sunlight, whilst shielding life from harmful high energy solar radiation.

Earth has one natural satellite, the Moon, whose diameter is a little more than a quarter that of the Earth. It revolves around the Earth every 27.32 days, and always keeps the same face towards us. The lunar month is about 2 days longer than this, owing to the motion of the Earth-Moon system around the Sun.

Unlike the other terrestrial planets, the Earth's crust is divided into a dozen or so solid plates, 10-16 km thick, that float independently on top of the hot mantle below. Earthquakes and volcanoes result from the movement of these 'tectonic plates' as they pull apart or crash into each other.

EARTH STATISTICS

Diameter: 12,756 km Mass: 6 x 10²⁴ kg

Mean distance from the Sun: 1.00 AU*

(150 million km)

Orbital period (sidereal**): 365.26 days Rotational period: 23 hrs 56 mins

Moons: 1

Inclination of equator to orbit: 23.4 degrees Composition: 34.6% iron, 29.5% oxygen and 15.2% silicon

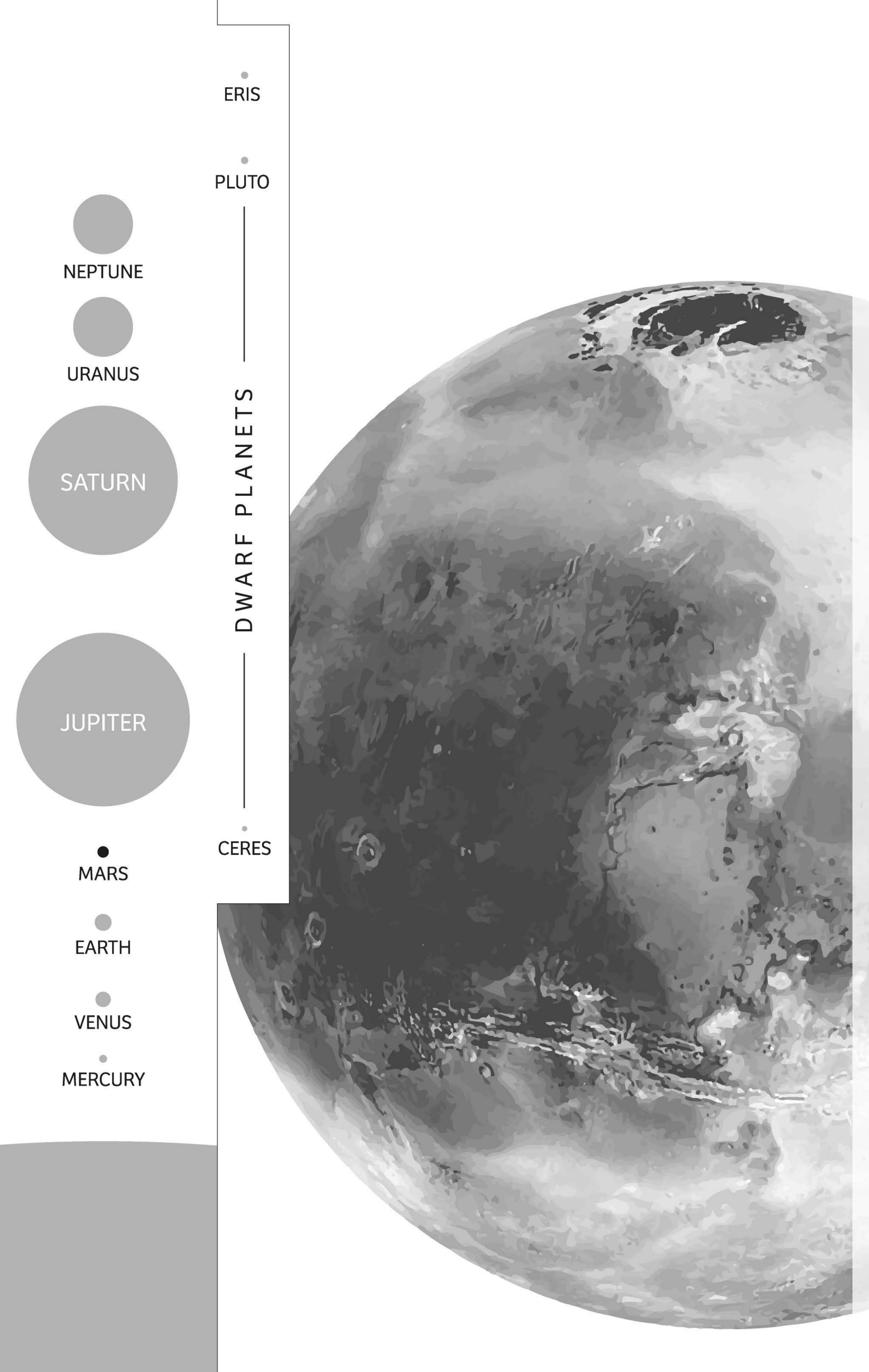
FASCINATING FACT: The temperature of Earth's core (7500 K) is hotter than the surface of the Sun (5800 K).

^{*} One Astronomical Unit (AU) = mean distance of the Earth from the Sun.

^{**} Sidereal time is time kept with respect to distant stars.



MARS: THE FOURTH PLANET FROM THE SUN: A ROCKY (TERRESTRIAL) PLANET



Mars is often called the red planet, its colour caused by iron oxide dust on the surfaces. It has a very thin atmosphere mostly of carbon dioxide, and polar caps composed of both carbon dioxide and water ice. Geological features and recent robotic exploration suggest the past existence of water on the sufrace of the planet. An extinct volcano call Olympus Mons, is at 25 km high the solar system's largest mountain. the Valles Marineris canyon (across the centre of the image) is over 4000 km long and up to 7 km deep.

Mars has two small moons, Phobos (diameter 22 km) and Deimos (13 km). Both are thought to be captured asteroids. Phobos, in a close orbit, will eventually crash into the planet or break up to form a ring.

Between Mars and Jupiteer lies the Asteroid Belt, where several hundred thousand small rocky objects exist, twenty-six of which are known to be over 200 km in diameter.

MARS STATISTICS

Distance from Earth: 6,795 (0.533 x Earth)

Mass: 0.11 x Earth

Mean distance from the Sun: 1.52 AU*

(228 million km)

Orbital period (sidereal**): 687 days Rotational period: 24 hrs 37 mins

Moons: 2

Inclination of equator to orbit: 25.2 degrees Composition: 50% iron rich core, molten

rocky mantle & thin crust

FASCINATING FACT: Mars' Olympus Mons is the solar system's highest mountain, 25 km high and 550 km across.

^{*} One Astronomical Unit (AU) = mean distance of the Earth from the Sun.

^{**} Sidereal time is time kept with respect to distant stars.



JUPITER: THE FIFTH PLANET FROM THE SUN: A GAS GIANT



Jupiter is the largest planet in the solar system and one of the four 'gas giants' - planets which do not have solid surfaces. Its thick atmosphere is composed of hydrogen and helium together with small quantities of methane and ammonia. It surrounds a rocky core about five times the mass of Earth.

The banded patterns are created by strong winds stirring the clouds in the atmosphere. The Great Red Spot is a storm big enough to swallow two Earths, and is thought to have lasted for over a million years.

Like all gas giants, Jupiter is surrounded by a large number of moons. The four principal moons (Io, Europa, Ganymede and Callisto) were discovered by Galileo in 1610 soon after the invention of the telescope. Their discovery was a major factor in the acceptance of Copernicus' sun-centred theory of the solar system. The shadow of Europa can be seen on the lower left side of this image.

JUPITER STATISTICS

Diameter: 143,000 km (11.2 x Earth)

Mass: 318 x Earth

Mean distance from Sun: 5.20 AU* (778 million km)

Orbital period (sidereal**): 11.86 Earth years

Rotational period: 9 hrs 55 mins

Moons: 62 or more

Rings: yes (radius 100,000-210,000 km)
Inclination of equator to orbit: 3 degrees
Composition: 75% hydrogen, 25% helium,
traces of water, methane and ammonia

SUN

FASCINATING FACT: Jupiter has rings! The faint rings around Jupiter were the third set of rings discovered in the solar system, after Saturn (of course) and Uranus.

^{*} One Astronomical Unit (AU) = mean distance of the Earth from the Sun.

^{**} Sidereal time is time kept with respect to distant stars.



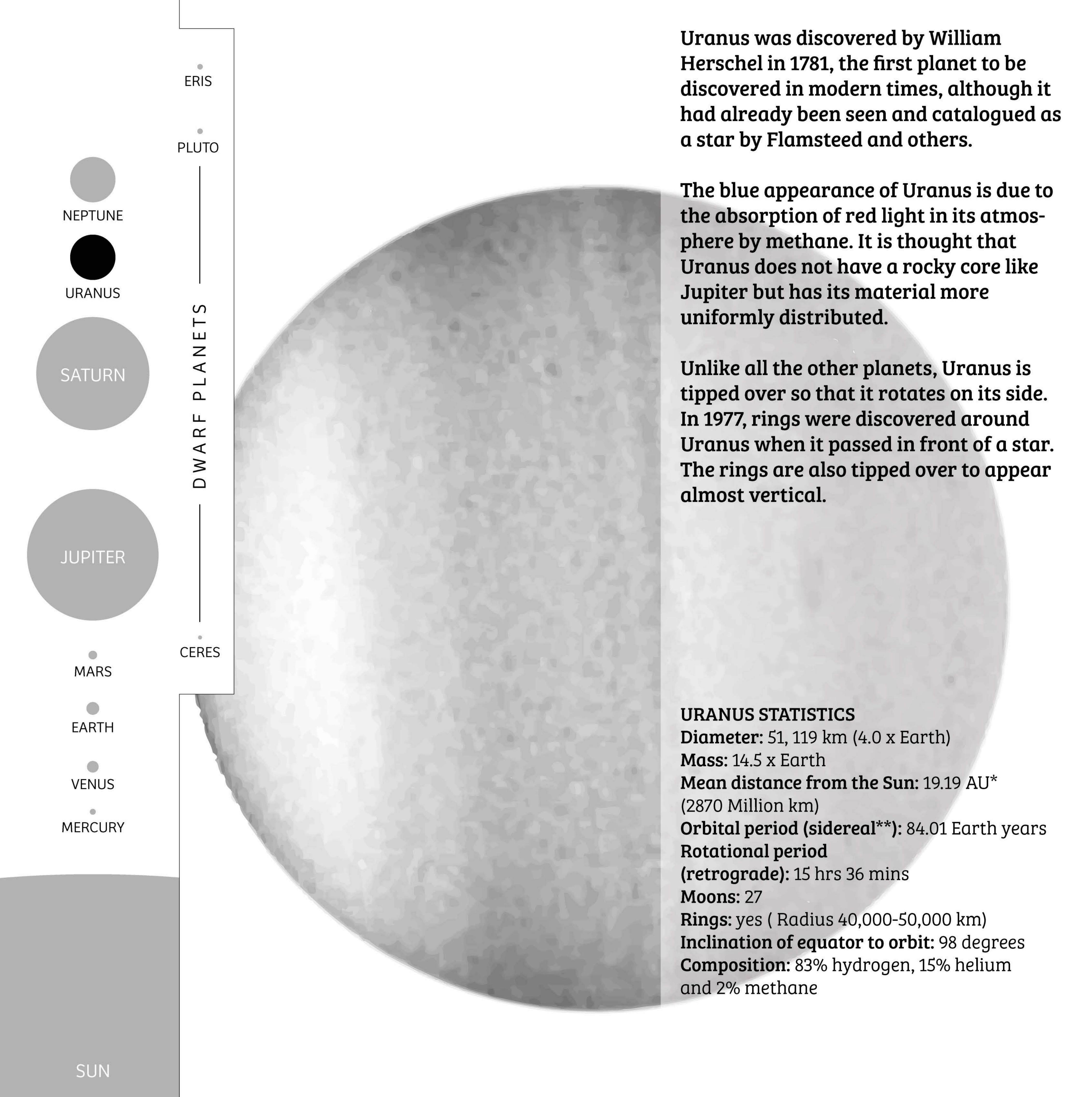
SATURN: THE SIXTH PLANET FROM THE SUN: A GAS GIANT



FASCINATING FACT: Saturn's rings extend to 8 times the planet's radius but are only about 1 km thick.



URANUS: THE SEVENTH PLANET FROM THE SUN: A GAS GIANT



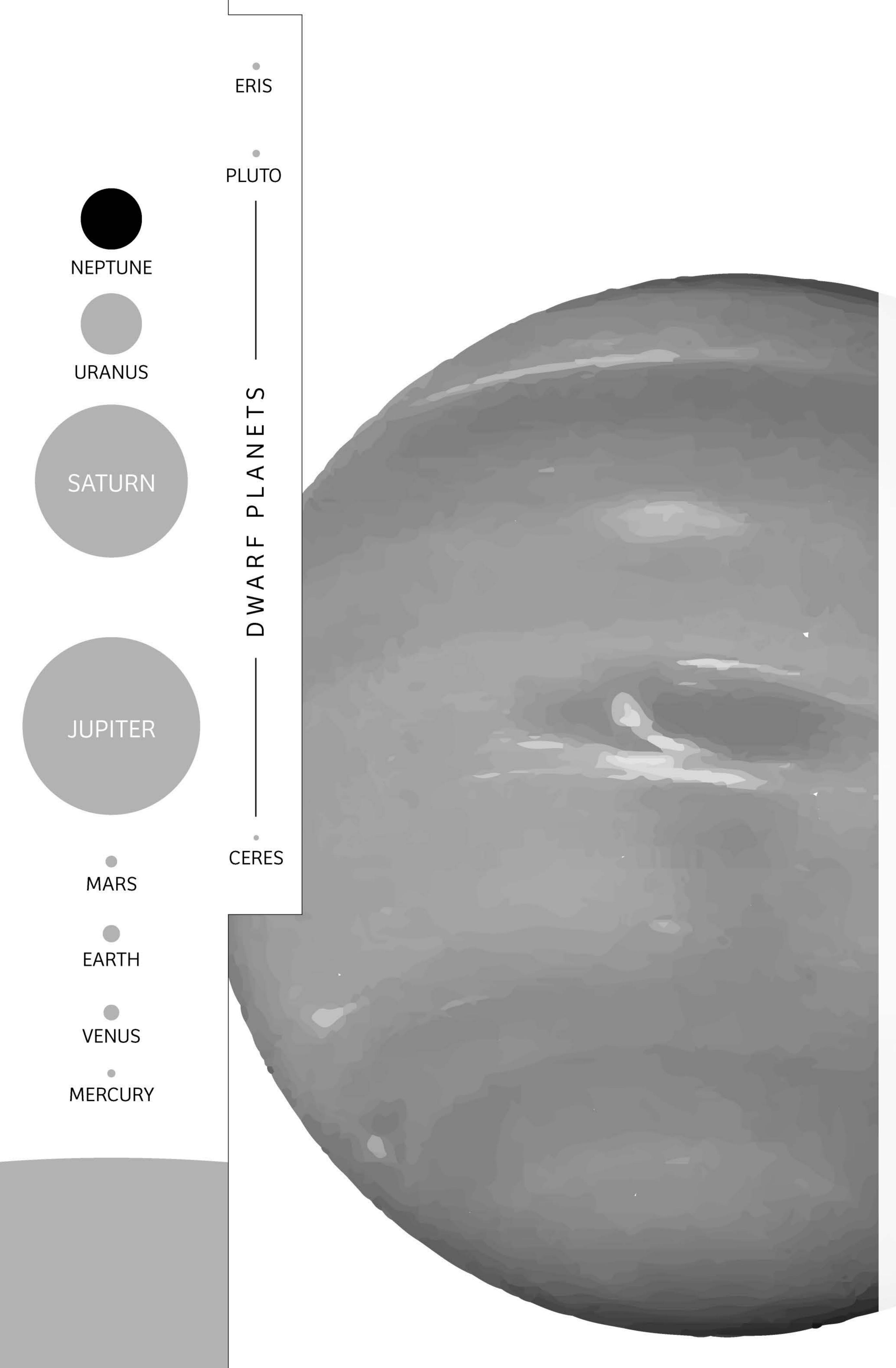
^{*} One Astronomical Unit (AU) = mean distance of the Earth from the Sun.

FASCINATING FACT: Uranus is tipped over so that it rotates around an axis that is almost parallel to the ecliptic (the plane of its orbit around the Sun). Its unusual rotation may be the result of a collision early in its life.

^{**} Sidereal time is time kept with respect to distant stars.



NEPTUNE: THE EIGHTH PLANET FROM THE SUN: A GAS GIANT



Neptune was discovered by Galle and d'Arrest in 1846 near the positions predicted by mathematicians John Couch Adams, of Cambridge, and Urbain LeVerrier after observations of Uranus showed that its motion apparently didn't obey Newton's laws of gravity. Amazingly, Neptune was first observed by Galileo in 1612, who recorded it as a star that had moved, but did not identify it as a planet.

Neptune's atmosphere is predominately hydrogen and helium with a mixture of methane, water and ammonia. The cloud tops show patterned belts similar to those of Jupiter and Saturn, but much fainter. Winds on Neptune have been measured at 2,000 km/hr making them the fastest in the solar system.

NEPTUNE STATISTICS

Diameter: 50,538 km (4.0 x Earth)

Mass: 17.2 x Earth

Mean distance from the Sun: 30.07 AU*

(4,500 million km)

Orbital period (sidereal**): 164.79 Earth years

Rotational period

(retrograde): 18 hrs 26 mins

Moons: 13

Rings: yes (Radius 40,000-60,000 km)
Inclination of equator to orbit: 28 degrees
Composition: Rock and ices, 15% hydrogen

and a little helium

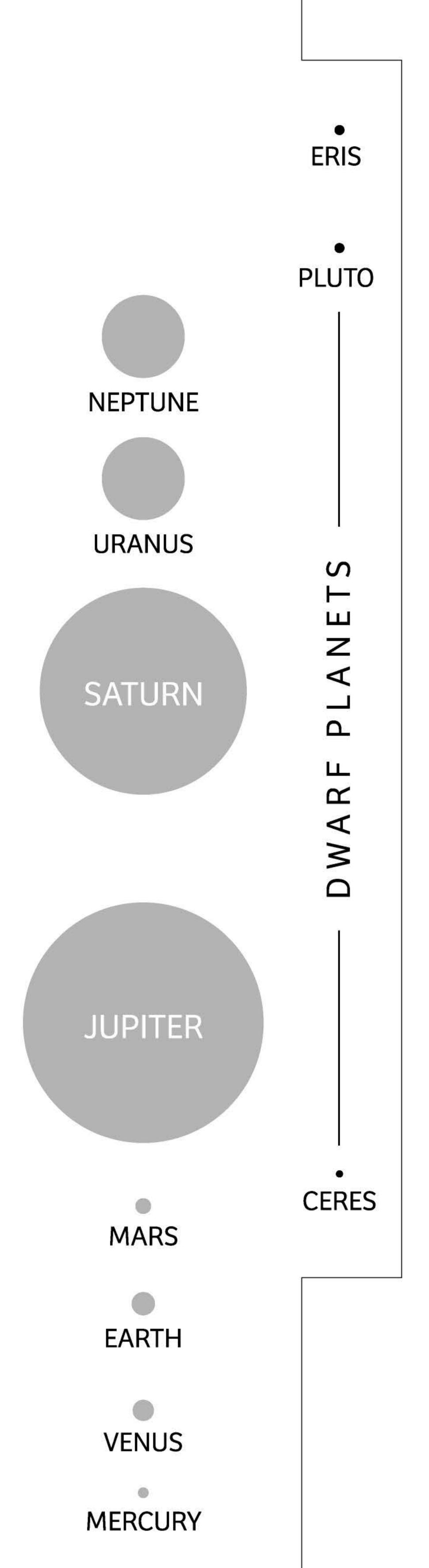
FASCINATING FACT: Neptune has a storm known as the Great Dark Spot (in the centre of the image) which is about as big as Earth.

^{*} One Astronomical Unit (AU) = mean distance of the Earth from the Sun.

^{**} Sidereal time is time kept with respect to distant stars.



THE DWARF PLANETS: PLUTO, CERES & ERIS



Dwarf planets are a new category of solar system body, defined by the International Astronomical Union in 2006 after the discovery of Eris. There are currently 5 recognised dwarf planets: Ceres, Pluto, Eris, Makemake and Haumea, and there are thought to be many more beyond the orbit of Neptune. Ceres was the first to be officially discovered, on January 1, 1801 by Giuseppe Piazzi. It was named after the Roman goddess of the harvest, of growing plants, and of motherly love.

Pluto was discovered in 1930 by Clyde Tombaugh, and was originally classified as a planet. It is made of rock and ice, and its moon Charon was discovered in 1978. They are only 20,000 km apart, and orbit each other every 6.39 Earth days.

Eris is the largest dwarf planet in the solar system and is the largest object found in orbit around the Sun since the discovery of Neptune and its moon Triton in 1846. It has a diameter between 2,400 and 3,000 kilometres (1,490 to 1,860 miles) and is 27% more massive than Pluto.

PLUTO STATISTICS

Diameter: 2,344 km (0.183 x Earth)

Mass: 1.3 x 10²² kg

Mean distance from the Sun: 39.5 AU*

(5.9 billion km)

CERES STATISTICS

Diameter: 980 x 910 km (0.076 x Earth)

Mass: $9.43 \times 10^{20} \text{ kg}$

Mean distance from the Sun: 2.77 AU*

(414 million km)

ERIS STATISTICS

Diameter: 2,600 km (0.203 x Earth)

Mass: 1.67 x 10²² kg

Mean distance from the Sun: 97 AU*

(14,5 billion km)

SUN

^{*} One Astronomical Unit (AU) = mean distance of the Earth from the Sun.

^{**} Sidereal time is time kept with respect to distant stars.