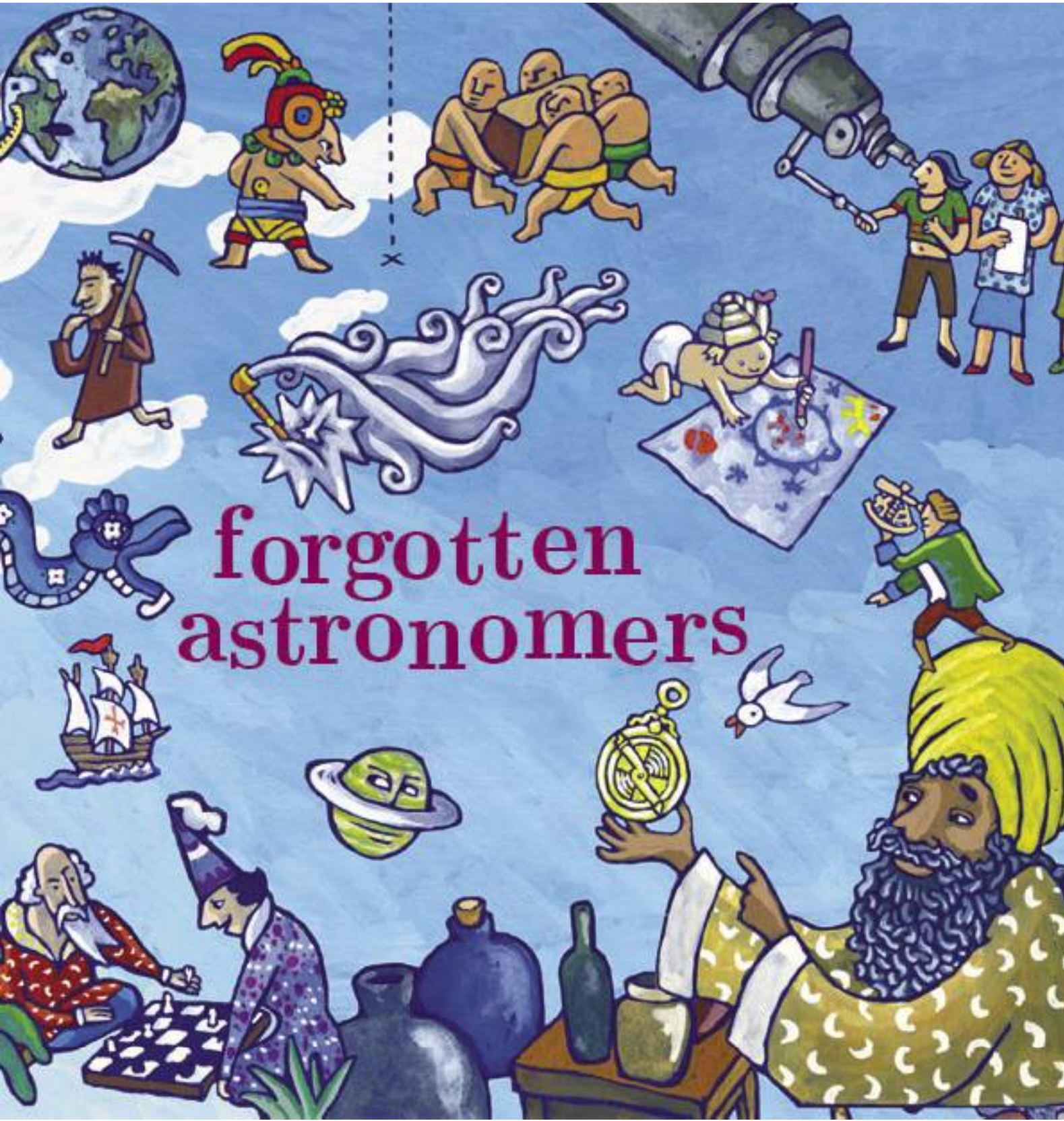
forgotten
astronomers

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forgotten astronomers

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The Spanish National Research Council (CSIC) is the largest public institution in Spain devoted to scientific research and technological development. It aims to encourage, develop and disseminate scientific and technological research in order to contribute to the advancement of knowledge and to the economic, social and cultural development. The CSIC is an institution which promotes science education and supports the work of UNAWE and EU-UNAWE programmes, which are especially designed for young people from all Spanish-speaking countries.

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EU-UNIVERSE AWARENESS

EU-UNAWE is an educational project of the European Union, based on the UNAWE programme. Both projects use the beauty and grandeur of the Universe to encourage young children, particularly those from underprivileged communities, to take an interest in science and technology and to foster their sense of global citizenship from an early age. UNAWE was founded in 2005. It is already active in 40 countries and comprises a global network of more than 500 astronomers, teachers and educators.

In three years, EU-UNAWE will implement Universe awareness-raising activities in six countries: Germany, Italy, Netherlands, Spain, United Kingdom and South Africa. The project includes the organization of teacher training workshops and the development of learning resources for children. In the long term, EU-UNAWE will help produce the next generation of engineers and scientists in Europe and encourage children from underprivileged areas to realize that they are part of a much larger global community.

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Children should be aware of the efforts made in the past by astronomers from the various cultures that define many of our countries today. This time we collected biographies of lesser-known astronomers while avoiding the most studied. It is not possible to gather in one book all the “forgotten astronomers”, but our effort is meant to illustrate some interesting cases. No doubt many others have been omitted, but this can be used as the starting point for similar publications.

We hope that the readers of this book will enjoy the adventures of our astronomers, that they will put themselves for a moment in their shoes and that they will use this opportunity to imagine their own contribution to the development of science and astronomy. Currently they can do that in school and perhaps in the future they can do a science degree. Research is always a challenge. Why not take it up!

Rosa M. Ros
Book Coordinator

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The history of 18 Rabbit

Maria Cristina Pineda Carías and Marcos Carías

From the year 695 to 738, the governor of the city of Copán was Uaxac Lahun Ubac Cauil, which means 18 Rabbit. He was the thirteenth King of a dynasty that contributed to the flourishing of Honduras, an important Mayan city.

18 Rabbit built Plaza del Sol, where the monuments, altars, and stands in the square indicate the position of the Sun at the solstices, at the equinoxes and when it reaches its zenith. The Mayans worshipped the Sun and followed its movements to keep track of the time. This allowed them to master the cycles of sowing and harvest, as well as the rains.

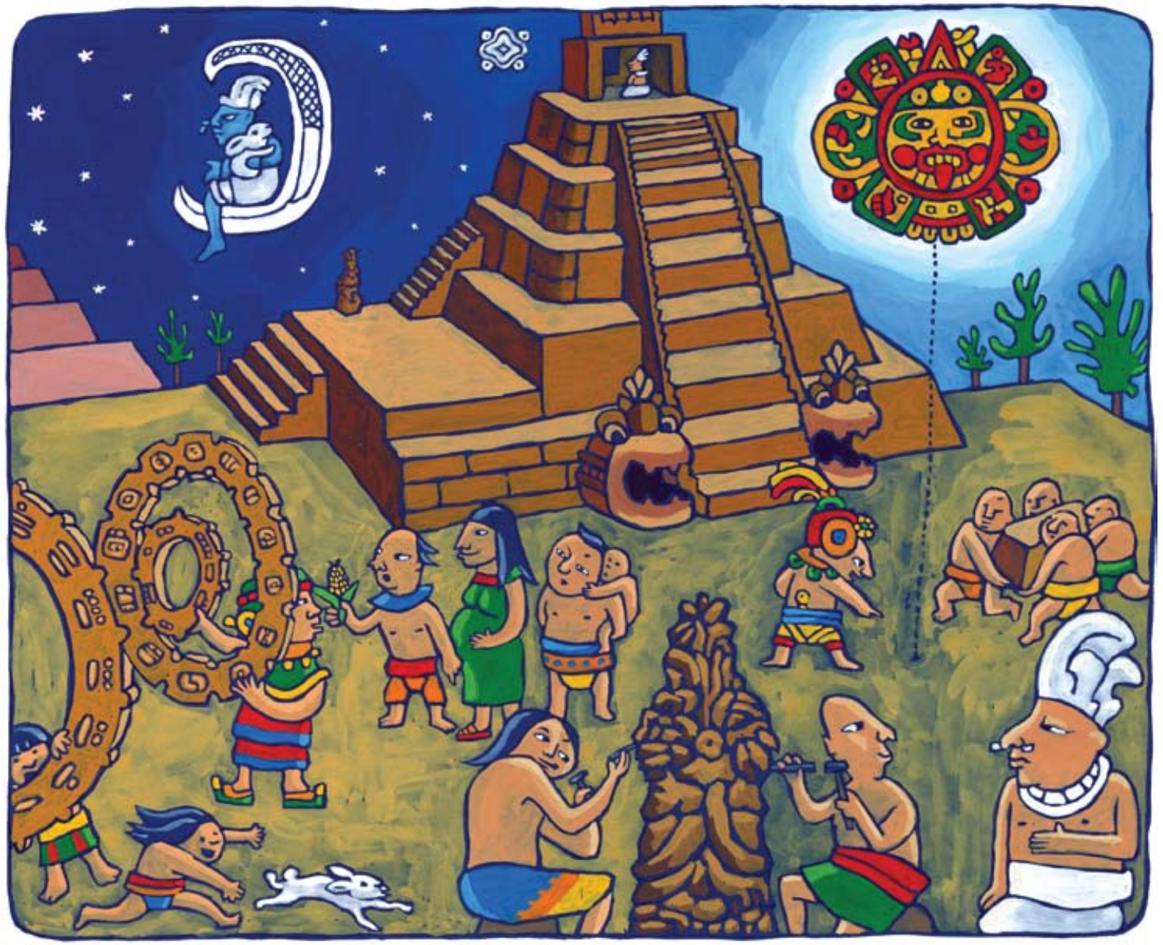
18 Rabbit loved astronomy and was also interested in architecture and sculpture. He is portrayed on several monuments: as a young man, watching the sunrise, and as an old man, watching the sunsets.

In Copán, he built a temple, a sort of sacred mountain, accessible through the open mouth of the Earth's monster. At the entrance, two carved characters supported the region of the sky with the clouds and the stars; they rested on sculpted skulls representing the underworld. It was in this temple that the governor meditated and performed sacrifices. Inside, towards the West side, there was a window from which he could observe the evening appearances of Venus.

Thanks to its quality and to the astronomical and mystical meaning of its monuments, the work of 18 Rabbit is considered one of the nicest legacies of humanity.

The surface of the Moon

The Maya saw the Moon as a rabbit; for that reason, some Kings were given this name. At first glance, it is easy to imagine this rabbit. Flipping through a map of the lunar surface, one can notice that the sea of Tranquility looks like its head and the seas of Fertility and Nectar, like its two ears. The body is made of the seas of Serenity, of the Steam and of the Rains and finally, the sea of the Crises stands for the cabbage that the rabbit is eating.



Gerbert, the golden head

Rosa M. Ros

Gerbert d'Orlhac was born in the mid-tenth century in Occitania (France) to a very humble family. He was a smart boy. In order that he could follow an ecclesiastical career, his father put him under the protection of the nobility.

At that time, the best place to study was close to the border with the Arabs. Gerbert went to Vic, Ripoll and Barcelona (Spain) to study the "quadrivium" (astronomy, music, geometry and arithmetic). When he became a Professor, he built astronomical models, such as armillary spheres, planispheres and other gadgets, which were meant to show to the students the movement of the stars. His outstanding scientific knowledge, very advanced for its time, and the ignorance of the people, is the source of various legends. They say that Gerbert knew everything thanks to a golden head given to him by the devil, and he could answer every question.

Some said he discovered a treasure thanks to a pact with the devil. In Rome there was a statue that pointed with a finger towards a hidden treasure and an inscription saying "try here". People tried hard, but nobody managed to locate the treasure. Gerbert, smart as he was, figured out how to interpret it. The clue was the shadow of the finger at midday. This is how he found the entrance to a Palace full of gold.

Yet despite the legends, Gerbert d'Orlhac, for his own merits, became Pope Sylvester II, the Pope of the new millennium, in a very dark time for science. He was among those who introduced the "zero" in Europe. Thanks to his efforts a new way of understanding science was dawning.

Because of his eagerness for learning, his talent in didactics and pedagogy, his intellectual rigour and his determination to overcome all sorts of difficulties, Gerbert served as a bridge between the Christian and the Islamic tradition.

The Ptolemaic and the Copernican systems

The Ptolemaic system assumes that the Earth is the centre of the Universe, with the Moon, the Sun and the planets revolving around it in a system of epicycles, that is, circles revolving around other circles centred on the Earth. In the 16th century, Nicolaus Copernicus proposed a new planetary system with the Sun as its centre, the planets revolving around it, and the Moon revolving around the Earth.

Fatima and the stars

Eulalia Pérez Sedeño

Fatima of Madrid was an astronomer, just like her father Maslama al - Mayriti. She could still remember how she first became interested in the stars.

–Mum, Mum, it is such a long time since I last saw Dad. Why is it that I almost never see him?
–It's that he is sleeping.
–And why does he sleep during the day? During the day, the Mums and Dads of the other children go to work.
Yes, they would work during the day and sleep at night. Some of them were selling food to eat or clothes to wear. Others worked in the fields, and some others were teaching children to read and write, and even to calculate. But Fatima's father... What sort of job was pushing him out every day at dusk?
–It is a very important job– said Fatima's Mum. –Thanks to him we know how to count the days, when there will be full moon and when we can celebrate Passover or Ramadan. We know when summer and winter begin.
Fatima was very intrigued, so she decided to find out what her father was doing for a living.

One day, after sunset, she decided to follow him through the dark and narrow lanes of Córdoba until she saw him entering a small tower. Fatima followed him, climbed the steep staircase and opened the door. What a surprise! Her father was holding in his hands some kind of tube and it was a gold colour. He would look upwards to the sky while gently touching this instrument. Fatima looked upwards too and had the feeling that the sky was coming towards her. Her eyes filled with tears. Thousands of sparkling dots were shining in the sky! Where was all this beauty coming from?

Her future became then clear. From that moment, she began to help her father. She worked with him on the astronomical tables of Al-Khwarizmi, on calendars, on studying the real positions of the Sun, of the Moon and of the planets and she also calculated parallaxes and eclipses.

Parallaxes

One of the main problems in astronomy is the calculation of distances. Parallax is one of the methods used for this purpose. In order to estimate the distance to an astronomical object, its position against the starry sky is observed twice. You can do a simple experiment to get the idea. Stretch your right arm with the index finger upwards. Cover your right eye with your left hand and look at the position of your finger against the wall. Then, without moving the finger, cover your left eye instead and you will see that the finger, which you have not moved, is in a different position with respect to the background. It is this apparent difference of position that astronomers use to calculate the distance to the finger, i.e. to the astronomical object, using the position angles and the distance between the two points of observation (in your case your two eyes).

Arzachel, builder of instruments

Antonio Claret dos Santos

Perhaps you've never heard about me. I was born almost one thousand years ago, around 1030, in Toledo, Spain, in a family of artisans. As a child, I learned the craft of making metal objects. However, what really attracted me were the stars.

It took me a long time to start writing and reading with ease. But I was like an owl: I would watch, pay attention to the teachers, ask questions like a parrot and be tenacious like an ant.

I dedicated my life to studying the movements of the stars. This research resulted in the Tables of Toledo, which allowed the calculation of the positions of the celestial bodies.

Yet what made me really tick was building astronomical instruments. In my time, an instrument widely used to study the stars was the astrolabe. It served to make calculations - a bit like a computer, nowadays. However, this instrument was not accurate enough if used in different places. After much thinking, I came up with a new one that corrected this shortcoming: the Saphaea. This one was universal and could be used in any city, a sort of GPS of the time.

It was hard work but it enormously simplified the handling of the instrument. What it did not simplify was my life, since I had to flee to Cordoba, where I spent the rest of my days.

The astrolabe

The planisphere is a star chart endowed with a spinning window that helps select the area of sky which is visible at a specific time in a specific place. An astrolabe also has a simplified star chart; the brightest stars correspond to the pointers of the spider (a cut-out metal circle with multiple vanes ending in a pointer representing the star). This instrument facilitated observations and trigonometric calculations for a given latitude. If used in a place located at a different latitude, the corresponding metal sheet had to be changed.

Alfonso X, the Wise

Antonio Claret dos Santos

Normally, a king is just a king. The case of Alfonso X, King of Castile and León, is different. He reigned in difficult times, but he also found time for astronomy because he loved it.

The scientific activities supervised by Alfonso X were meant to continue the work of Arzachel and of the Toledo School of Translators. Thanks to his initiative the Books of Astronomical Knowledge (a compilation of astronomical information) and the Alfonsine tables were produced. The importance of these tables was so great that they were used for over 400 years throughout the whole civilized world. The wise King was not working alone, but together with Muslim, Jewish and Christian astronomers.

He also edited books on law, religion, history and even chess. At that time it was common practice to write in Latin or Arabic, but it is worth noting that Alfonso X wrote part of his works in Romance, a sort of old Spanish.

The wise King died in 1284 in Seville without having solved the problem of succession caused by the premature death of his eldest son. Because of his dedication to astronomy he was unjustly accused of neglecting the political affairs. They say that he "so much looked at the sky that his crown fell off".

The Alfonsine tables

The Alfonsine tables are a set of astronomical data that made possible the computation of the positions of stars and planets. They also deal with eclipses, with the positions of the stars when crossing the Meridian and with calculating the date of religious celebrations. It took almost ten years to prepare them (1263-1272).

This work contains both his own and other astronomers' astronomical observations. To get an idea of the importance of the Tables, suffice it to say that they were reprinted thirteen times since 1453 and manually copied innumerable times. Only the Rudolphine tables, published by Kepler in 1627 and based on the observations of Tycho Brahe, surpassed them in accuracy.

Netzahualpilli's smoking star

Germán Puerta Restrepo

Netzahualpilli, King of Texcoco, was sitting and watching the stars. His attendants and the nobles knew that he was the most important astronomer of the time. They completely trusted his wisdom. In ancient Mexico, the most significant ceremony in the life of an astronomer was observing the transit of the Pleiades (*tzab*, the rattlesnake of the stars) at zenith. But that night the fire ceremony was overshadowed by the appearance of a *citlalimpopoca*, "the smoking star" (comet), a signal that was widely feared to be evil. Besides they knew that Moctezuma himself, Governor of Tenochtitlan, would come over in the morning to see the result. This is how the story goes.

It was almost midnight and *tzab*, the stars' rattlesnake, was approaching its zenith. Netzahualpilli, his astrologers and all the people were anxiously following the slow progress of *tzab* to see whether it would stop moving, thus fulfilling the old prophecy that predicted the end of time when the celestial rattlesnake would remain still in the middle of the sky.

But *tzab* went its way, the gods granted more time! And they say that on a sign of Netzahualpilli, the big pyre at the top of the Palace was lit up, so that all the people in the region could start the festivities. But at that time Netzahualpilli was not in the mood for celebrating because he still couldn't give an answer to Moctezuma.

Netzahualpilli knew that the 'Smoking star' was a mystery that had no explanation and that the Governor had already taken it as an evil sign. When he heard the echo of distant thunder coming from the sea, Netzahualpilli understood that, indeed, the *citlalimpopoca* was foreboding nothing good. This is how the story goes.

The comets

They are nothing more than dirty snowballs coming from the most distant area of the solar system in very elongated orbits. When they come close enough to the Sun, due to the increase in temperature, part of their components evaporate, displaying a bright tail. For centuries they have been interpreted as a symbol of bad omens without any scientific justification.

The Spanish landing in Mexico coincided with the passage of Halley's Comet.

The Magellanic Clouds

Alexandre Jose da Costa Ferreira

In the 16th century, there were still many who believed that the world ended somewhere, like a rim on a dish. But the astronomer Rui Faleiro convinced his friend and Navigator Ferdinand Magellan that he could reach the Indies travelling towards the West, just as imagined by Christopher Columbus.

They convinced Charles I, King of Spain, that they would circumnavigate the world sailing around South America. They left Seville on the 8th of September 1519 embarking on an adventure that would only end three years later, on the 6th of September 1522.

In the middle of the Atlantic Ocean, after crossing the equator, Magellan noticed two clouds in the night sky of the southern hemisphere and was surprised to see them revolving every night around the South Pole without getting dissolved in rain.

Magellan said to his chronicler Pigafetta: "Write about these clouds so that everyone knows that they exist".

They had to face many hardships during their journey. They were hit by massive storms. They almost died from cold while moving from the Atlantic Ocean to the Pacific. In the middle of the Pacific Ocean they ran out of food but they finally came to land.

When they reached the Moluccas Islands, Magellan realized that he was already in the Far East and that he reached his goal. It was possible to circumnavigate the Earth, just as predicted by Rui Falero, his astronomer!

Today, the memory of this journey is still alive in the sky of the southern hemisphere, where every night, in the same position, one can see two small clouds which were called the Magellanic Clouds.

Galaxies

The Magellanic Clouds are two irregular galaxies that belong to the Local Group of galaxies, just like the Milky Way, our galaxy. They are visible from the southern hemisphere on clear moonless nights. The bigger one is known as the Large Magellanic Cloud and the smaller as the Small Magellanic Cloud. They look like two small white spots near the Southern Cross constellation.

Most galaxies are spiral shaped, but the youngest ones have not yet gained structure and display irregular forms.

Joan Roget, the glass builder

Pere Closes

In 1610, a very special traveller reached Girona. His name was Girolamo Sirturo. He came from Northern Italy in search of an old man that many people had almost forgotten, the glass builder Joan Roget. Everyone was wondering what this Venetian adventurer might be looking for, since Joan was already very old and his sight was now poor. His brother's and his three sons' workshop was still open in Barcelona, but Joan had abandoned his own, which was already full of dust.

Joan Roget in Girona and his brother Pere Roget in Barcelona were able to carve crystals and manufacture glasses that they would sell to important people, when they were getting old and could no longer see well enough to read and to write. They also built long sight glasses. By looking through these long tubes distant things appeared much closer.

Girolamo Sirturo and his friend Galileo Galilei used an instrument which was similar to those built by Joan to observe the sky and discovered amazing things that one could have never imagined. Girolamo himself, before starting his journey, manufactured and tested one of these tubes that we now call telescopes.

Joan and Girolamo had many long conversations before the Venitian returned to Italy. Girolamo used to tell everyone who would listen to him, that Joan Roget's telescopes were the best that he had ever seen and that he regarded him as the inventor of this instrument. The good old man revealed to him some of his manufacturing's secrets, which turned out to be extremely useful.

Telescopes

The telescope was the first optical instrument used to observe the sky. Its invention is attributed to the Dutchman Hans Lipershey in 1608. This story is based on investigations by Simon Guilleuma on Joan Roget, Builder of "long sight glasses" and on the book published by Girolamo Sirtori in 1612. Galileo's friend claimed that he saw Joan Roget's telescopes on a trip to Girona (Spain) in 1610 and there are various wills of Catalan nobles which mentioned legacies of "long sight glasses", between 1593 and 1596.

However, Galileo was indisputably the first to direct this instrument to the sky and to publish what he saw, opening thus a new era for astronomy. Galileo observed mountains on the Moon, the phases of Venus, four satellites around Jupiter and the ring of Saturn, which he failed to interpret because of the poor quality of his telescope.

Jorge Juan, sailor and spy

Jaime Fabregat

Hi, I'm Jorge Juan. I'm speaking to you from the Pantheon of Illustrious Sailors. Mathematics – which is very relevant to a sailor – had been my passion until I died, in 1773. When I was 19, I took part in the expedition organized by the French "Académie des Sciences" in Paris, under Louis XV of France and Philip V of Spain, together with Antonio de Ulloa. We were both promoted to lieutenants in order to join the expedition. They wanted to measure the degree of a particular meridian in the Viceroyalty of Peru, and compare this measurement with that obtained in Lapland. Through the joint effort of several teams, we worked out that the Earth is not perfectly spherical and that it is flattened at the poles.

I was "the mathematician and the astronomer" - I would perform measurements, calculate longitudes and latitudes and design plans while Antonio was "the biologist". We spent a whopping nine years. There we lived in huts, climbed mountains and got to know the other cultures of the inhabitants of the area. Despite the problems that we had to overcome, we lived a great adventure. What memories! The observations helped us to determine scientifically the meridian that Pope Alexander VI drew as the Spanish - Portuguese dividing line in America.

But I also had other things to do: design ships, spy on behalf of the king and give my opinion as an expert when required to do so. I was greatly praised for all this.

I founded the Royal Astronomical Observatory in Madrid and Cadiz. As a member of the French Académie des Sciences and the Royal Society, I was in touch with eminent scientists from Paris, London and Berlin. Abroad, I was known as "The Wise Spaniard", a glory due to science!

The flat shape of the Earth

The Earth is not a perfect sphere. It looks more like an orange, somewhat flattened at the poles. It was the previously mentioned expedition that determined this flattening. The radius of the Earth in the equatorial zone is 6378 km, while in the polar area it is only 6357 km. This is also the case with other planets of the solar system, to a greater or lesser extent.

Subsequent reviews have shown that those of Jorge Juan were the most accurate of all the calculations made by the expedition which worked out that the shape of our planet is oblate, i.e. flattened at the poles.

The great adventure of Vicente Doz

Sergio López Borgoñoz and Marina López Rodríguez

We arrived at night. There were four of us: Vicente Doz, Salvador Medina, Jean Chappe D'Auteroche - a French astronomer- and I. We had made a long journey before reaching San José del Cabo, in the Baja California, and achieved an important mission in this remote and uncivilized place. At that time, few people in the world were aware of us, but our work was going to be very useful for future generations.

To our great surprise, we met there Joaquín Velázquez de León, a Mexican creole with a vast scientific knowledge, who was also performing measurements, and had already quite accurately determined its geographical position.

Over 50 years earlier, another astronomer, Edmond Halley, who discovered the comet that now bears his name, had devised a way to measure the distance from the Earth to the Sun. It consisted in measuring from distant places a very rare phenomenon, which only repeats many years later: the transit of Venus, that is, Venus passing in front of the Sun. That year, in 1769, it was going to happen. That is why we travelled so far.

The four of us successfully completed the observation, but shortly after, Medina and Chappe died from the yellow fever epidemic that struck the region.

As a survivor of the expedition, I went back with the data obtained at such a high price. These results, together with those of many other astronomers located in different parts of the world, allowed us to finally measure the distances between the planets of the solar system.

Dimensions of the Solar System

The Transit of Venus was crucial to determine the size of the Solar System. In the eighteenth century all the ratios between the distances of the different planets to the Sun were already known. It was not until the Transit of Venus of 1769 that the distance from the Earth to the Sun could be determined, hence all the other distances from different planets to the Sun were deduced.

Currently, the Earth-Sun distance is defined as the Astronomical Unit of distance (1 AU = 149.6 million km). The distances from the other planets to the Sun, using this unit, are as follows: Mercury 0.4 AU, Venus 0.7 AU, Mars, 1.5 AU, Jupiter 5.2 AU, Saturn 9.5 AU, Uranus 19.2 AU, and Neptune 30.1 AU.

A gift for the “Wise Caldas”

Antonio Bernal

His name was Francisco José de Caldas. He knew the stars by name, collected rocks, classified the plants of which he kept the leaves, and made pencil and watercolour drawings. He was the director of the first astronomical observatory in the Americas. They used to call him “The Wise Caldas”.

–Pachito, darling – his wife said one day to him, using this loving nickname - I’ve noticed you’ve been worried lately.

–That’s related to my work. I’m trying to calculate how far Quito is from Paris, but I don’t have the appropriate tool to do it.

–What sort of tool do you need?

–A clock!

It was 11 o´clock in Quito. If Caldas had known what time it was at that moment in Paris, he would have been able to calculate the distance from Quito – the capital of Ecuador - to the European city. But clocks were not common in America, because they had just been invented and only rich people owned them.

A few days later, Caldas ran to tell the news to his wife:

–The Baron is coming and he´s bringing me a gift! Now I will be able to determine the position of Quito.

–What Baron? – she asked.

–The Baron Alexander von Humboldt, who has the best instruments in Europe, including a clock.

–Do you think that he will give you his clock, when he doesn’t even know you?

–No! Manuelita, he’ll give me something way better.

–What’s that?

–It’s what he’s carrying on the clock, which is what I need for my calculations: the time in Paris!

The problem of the Longitude

To determine the position of a place on the Earth’s surface one has to know its latitude and longitude. The latitude is the angle, on the meridian, from the equator to that place and goes from 0 to 90° North or from 0 to 90° South. The longitude is the angle on the equator, from the Prime Greenwich meridian to the meridian of the place and goes from 0 to 12 hours East and from 0 to 12 hours West. The latitude is easy to calculate from the position of the sun or stars, but the longitude is more difficult to determine. There is a simple way to do that, which is to know the time difference with respect to the Prime meridian (Greenwich meridian). Until good mechanical clocks were built, it was extremely complicated to determine the longitude of a place.

Josep Comas i Sola, the hunter of small planets

Llorenç Puig

In 1868 a child was born in Barcelona. His name was Josep Comas i Sola. His parents were rich merchants. The small Josep liked to play, like all the other children, but what he liked most was to watch the stars at night. There were so many of them! And how beautiful they were! Were they inhabited by other living beings? By observing them with the naked eye he learned to distinguish the constellations, the movement of the stars, the phases of the moon ... And he would explain everything to his nanny, who could not figure out how such a young child knew so many things. Sensing his vocation, when he turned eleven, his parents bought him his first telescope. This made him very happy. With it, he could see the craters on the Moon and its valleys and mountains. Surely, he would have liked to travel to the Moon, like astronauts did years later.

When he was fifteen, something important happened: a meteorite fell in Tarragona. He studied this and published the results in his first scientific paper. After taking mathematics and astronomy at the University of Barcelona, he started working with much larger telescopes at the Fabra Observatory and made great discoveries. At his place, named "Villa Urania", he also installed one. Thanks to it, he discovered eleven asteroids and two comets, one of which bears his name. But perhaps his most important achievement is the discovery that Titan, a satellite of Saturn, has an atmosphere. It took nearly forty years until the great astronomer Kuiper confirmed this result.

Asteroids and Comets

Asteroids are rocky bodies that revolve around the Sun in the inner orbit of Neptune. They are larger than meteors and many of them are located in the asteroid belt that lies between the orbits of Mars and Jupiter. They can be defined as small planets.

Comets, unlike asteroids, are bodies composed of ice and rock that revolve around the Sun in highly elliptical orbits. The materials of the comet nucleus sublimate in the vicinity of the Sun, resulting in an "atmosphere" called the coma, made of gas and dust. When the comet approaches the Sun, the solar wind pushes this atmosphere and generates the tail that we see.

Paris Pismis, the teacher

Elsa Recillas Pismis

Since she was a child, Paris was noted for her prodigious memory. When her school received visitors, the teacher would read out a poem, which Paris did not know, and she would be able to reproduce it, without getting a single word wrong! That is how she started to develop this aspect of her intelligence.

She was the second of three siblings. Since she was neither the prettiest nor the male, she went unnoticed in her family and got accustomed to reading and to thinking. She loved mathematics and music, for example, which have many things in common. When she was old enough to go to university, her father flatly refused that she study among males. The family belonged to a Christian minority in Turkey, a country which was mostly Muslim, and at that time it was not customary that young females went to college. What did she do to convince the family? She cried and cried at least a few days a week, until her father got fed up and gave her permission to enroll at the Faculty of Mathematics in Istanbul.

After completing her studies, she did not take a break. She was granted a scholarship from the United States, where, years later, she would meet her future husband. They had a family and moved to Mexico, which became her adoptive country. As a Professor at the National Autonomous University of Mexico and at the Mexican observatories, she educated several generations of students who were to become famous astronomers and who dearly recalled her as the "Teacher." She discovered twenty open clusters and three globular clusters and investigated the structure of spiral galaxies.

Open clusters and globular clusters.

Clusters are groups of stars that are bound together by gravity. Open clusters are composed of stars from the same stellar cloud without structure or symmetry. They are young stars, massive and very hot, and their number can vary from a dozen to several thousand. Globular clusters are made up of millions of old cool stars with a roughly spherical distribution. These clusters are very massive and orbiting around the galaxy as a satellite.

The aim of UNAWE is that children from all countries may have a personal, enjoyable relationship with astronomy. EU-UNAWE is the European branch of this global project and involves Germany, Italy, the Netherlands, Spain, United Kingdom and South Africa. Through experiences and emotions related to stargazing children begin to understand that they are also part of the universe and they have a world in front of them ready to be explored.

EU-UNIVERSE AWARENESS

SEVENTH FRAMEWORK PROGRAMME

CSIC