5

Asia

5.1 Japan

During ancient times and in every part of the globe, mythology was an important human characteristic, creating beliefs, religions, and ultimately culture. In ancient Japan, the Sun god was female, in contrast to most cultures in which the main god had to be male. The goddess Amaterasu was thus the supreme ruler of the world. In one legend about Amaterasu, the goddess shut herself in a cave, and in doing so, brought darkness upon the world and in the heavens. Her disappearance caused a disaster and distress to all the other gods, who gathered and decided to perform a ritual to convince the goddess to leave the cave. Amaterasu, enticed by the ritual, emerged from the cave to shine light upon the Earth and in the heavens once again. Her light was essential in both realms. As the Sun symbol, she was the most revered and venerated personage in Japanese religion and mythology, and to this day, the symbol of the rising Sun represents Japan on the Japanese flag.

Not only the Sun, but also the stars played an important role in the everyday lives of ancient Japanese people, as indeed they did to scientists involved in astronomical studies. Being one of the most noticeable constellations in the sky, Orion was considered a particularly important group of stars. Astronomy was for the Japanese a symbol of knowledge and culture. They believed that the stars sent messages to humans, but the message was not seen as being for any particular individual. Rather it was viewed as informing the population as a whole, for example, indicating when to plant and when to harvest their crops. Practical information for everyday life!

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As in most ancient civilizations, the constellations were associated with mythology, but also with astronomy which was considered an important science. Archaeological excavations have unearthed an ancient tomb, called the Kitora tomb, near the village of Asukain, in which they found an elaborate astronomical chart. The tomb was built between the seventh and eighth centuries. Through this discovery, we know that the peoples of Japan had an advanced knowledge of astronomy at this time. The tomb comprises a small chamber only a meter high and a little more than two meters long, for the burial of a single person. The four walls of the chamber indicate the cardinal points. The north wall features the Black Divine Tortoise, the east wall the Azure Dragon, the south wall the Red Phoenix, and the west wall the White Tiger. The astronomical chart is on the ceiling of the tomb, which is decorated with a map of the night sky charting 68 constellations. The stars are depicted with gold leaf, while three circles painted in red clearly show the motions of the celestial bodies, and another circle represents the motion of the Sun. This is a great example of astronomy and also the artistic representation of figures. The murals are painted with great descriptive accuracy, so that the viewer can work out the meaning of the story they tell.

An important feature of Japanese art was an understanding of the natural world as a source of human spirituality and emotion. Painting was the preferred artistic expression, practised not only by professionals, but also by amateurs, influenced probably by Chinese culture. In fact, over the centuries, Japan has been subjected to many foreign invasions, and so has absorbed and assimilated elements from other cultures which have contributed to its aesthetic preferences. We can see this very feature of Japanese art in the murals of the Kitora tomb: the understanding of the natural world. The Kitora star chart is considered by archaeologists to be the oldest in the world.

5.2 Chinese Mythology, Astronomy, and Art

Chinese culture is one of the world's oldest, and considered by historians to be the dominant culture of East Asia. The Neolithic began in China in 7000 BC, with the appearance of the first agriculture, the construction of buildings, the manufacture of pottery, and ritual burial of the dead. Based on ancient texts and archaeological sites, the oldest dynasties, the Shang (ca. 1600–1046 BC) and Zhou (1600–221 BC), were located in the central, lower, and middle plains of the Yellow River. It was during these times that the ancient Chinese culture began to take shape, adopted later by the dynasties that followed.

Some historians affirm that the traditional traits of their ancient culture are still visible to this day.

During the Shang and Zhou dynasties the population was literate. In fact, we know their culture through their writings. They engaged in large scale building projects and kept records of these projects through a form of writing using pictograms. Culturally, they developed their religion, political philosophy, and artistic style.

Art in China differed from art in other ancient cultures in that artists were not professionals, but amateurs, usually nobles, members of the elite, and sometimes women, which was very unusual in those days. These artists were nevertheless scholars, intellectuals, and literate people, mainly men but including also a few women. They were probably students of Confucianism, which was one of the three major religions along with Taoism and Buddhism. Confucianism in particular was perhaps more of a philosophy than a religion. The role of these doctrines, besides being spiritual, was to influence government, science, and art through a philosophical approach to life. Apart from being scholars and intellectuals, Chinese artists were also keen observers of nature. Their style was minimalist, and somehow austere. Artistic skills were secondary; expressing the good character of the artist was more important.

Of course, there were also professional artists, employed by the imperial court and by rich patrons to decorate buildings and tombs. For the Chinese, the main art forms were calligraphy and paintings. They developed a notion of connoisseur of the arts, somehow a form of artistic snobbishness, which was not widespread at that time in history. But I dare say art snobs are actually a typical feature of our own times! In his "Record of the Classification of Old Painters" (unfortunately lost) Xie He, an art critic and historian of the sixth century AD, published six important points that should be observed in order to obtain a perfect work of art. These rules concerned: (1) vitality, (2) use of the brush, (3) depiction of form, (4) color, (5) spatial composition, and (6) copying of models. These were considered essential rules for becoming a good artist, and they were in fact quite rigid rules compared with our concept of art today. Even so, according to the ancient Chinese view of the arts, the most important thing for an artist was to transmit his or her feelings. This was more important than the craftsmanship of the work. And that idea very much reflects our own view of art today, but maybe without Xie He's rigid rules.

The arts occupied a very important place in Chinese culture. Besides calligraphy and painting, there was also sculpture. Monumental examples have been found in many places across the vast territories of China, but without doubt the best known are the life-size sculptures of the "Terracotta Army"

of Qin Shi Huang. This "army," included 7000 warriors, 600 horses, and a great many chariots, guards the emperor's tomb. Simply astonishing! There were also sculptures on a smaller scale, cast in bronze, representing animals and mythological creatures in three-dimensional form.

Chinese mythology is also a vast collection of religious traditions, legends, and folktales, transmitted either orally or in written form. As in many ancient cultures, the myths represent and express the people's image of themselves in their everyday lives, and also their beliefs. The myth of creation, for example, refers to a female cosmic deity called Doumu, which means "Mother of the Big Dipper," born when the Universe was created by Pangu. Doumu was the mother of the "Nine God-Kings" of the heavens, and it was believed that these were represented in the night sky by the seven stars in the constellation of the Big Dipper and two others not visible to the naked eye. This constellation was viewed as a chariot, and the goddess was also called "Lady Mother of the Chariot," and sometimes "Queen of Heaven," or "Mother of Heaven." In ancient China, mythology and cosmology were tightly intertwined, as the myth of Doumu demonstrates. Doumu was part of the mythology, she was the goddess, but the stars which form the Big Dipper and represented her sons were a clear reference to observation of the night sky.

Another myth about the Sun involves the archer Hou Yi. According to this legend, there were originally ten suns in the sky, which normally crossed the sky one by one. But one day, they all came out at once, causing people on Earth great suffering due to the terrible heat. Then Hou Yi appeared in the guise of hero and shot nine of the suns down, leaving only one in the sky, whereupon normal life was restored.

China was principally an agricultural country, but through archaeological studies, we know that there was a continuous development of astronomy. For purely practical reasons, being an agricultural society, the observation of celestial phenomena was essential in order to determine when to plant and harvest crops, as it was in most ancient cultures. But as time went by, the interest in astronomy became more scientifically oriented, and at the same time, it was understood that humans and their environment were closely connected with each other. In a philosophical sense, this connection between the environment and people was a response to their actions, thoughts, and emotions, similar to the philosophical position the ancient Chinese adopted toward the arts.

Astronomical study of the Sun was very important in China. The Chinese were among the first to record solar eclipses, having started in around 2000 BC. It was the astronomer Shi Shen in the fourth century BC who first understood what actually caused solar and lunar eclipses. In the first case, the

Moon passes between the Earth and the Sun and blocks out the Sun's light, and in the second case, the Moon passes through the shadow of the Earth and turns red or darkens. Astronomers had already recorded 1600 observations of solar and lunar eclipses by 750 BC. Shi Shen understood that moonlight was just light reflected to us from the Sun, just as the Ancient Greeks Parmenides and Aristotle had already realized. During the Song Dynasty (1031–1095 AD), the scientist Shen Kuo used the model for solar and lunar eclipses to prove that the celestial bodies were round and not flat, something that had also been understood in Ancient Greece by similar reasoning.

And it was during the Song Dynasty (960–1279) that many observatories were built. A number of star maps have been found carved on wood, painted on ceramics, and painted on the walls and ceilings of tombs. On one star map carved on wood during the Han dynasty and dated to 2000 years ago, we can see the Sun, the Moon, several comets, and the Milky Way. Another sky map painted on the ceiling of a tomb in Luoyang in the province of Henan shows over 300 stars, the planets, and the Milky Way. The unknown artist painted the stars in red, using different shapes to indicate the brightness and correctly indicating the relative positions of the stars in the sky. This mural, dated to the sixth century AD, shows that the artist had a good knowledge of science and art.

Archaeological excavations have discovered an ancient observatory in the province of Shaanxi, a structure about 2200 years old, dating to the Qin Dynasty. The site covers an area of 2 km^2, with 1424 round and square platforms corresponding to 332 stars and galaxies in the sky. An attempt to create heaven on Earth. Indeed, in ancient China, there was a social and traditional aspiration to connect the heavens with Earth.

Astronomers observed the sky simply with the naked eye, and yet still made important discoveries. Gan De discovered Ganymede, one of the natural satellites or moons of Jupiter, without a telescope. It would be more than 2000 years before Galileo succeeded in discovering Jupiter's satellite Ganymede. As attentive observers of the sky, the ancient Chinese astronomers recorded the appearance of Comet Halley more than 2600 years ago.

Interest in astronomy was always important in ancient China, and it is still alive and well today, although now with knowledge of modern astrophysics. China currently has one of the most active space programs in the world, although unfortunately there are few serious links with its Western counterpart, the USA. The space program of the People's Republic of China plans to launch satellites to explore the Moon, Mars, the Solar System, and deep space. On 29 November 2022, Shenzhou 15 was launched with three astronauts aboard, taking them to China's first space station Tiangong, which

means Heavenly Palace. It has been a successful mission, and China is now the third nation to have a permanent space station after the USA and Russia. Many scientific experiments are planned in the space station Tiangong, such as the launch of a new space telescope Xuntian which will map and catalog stars, an ancient Chinese tradition. But not only! It will also be looking out for supermassive black holes.

Recently, I had an interesting conversation about star catalogs with Luca Baldini, professor of experimental physics at the University of Pisa, Italy.

He pointed out that ESA's Gaia mission can be considered as a contemporary star catalog. Its mission is to map the distance, luminosity, temperature, and composition of the stars. Professor Baldini explains that Gaia will effectively create an extremely precise three-dimensional map of more than a thousand million stars in our galaxy and beyond. Just imagining millions of stars is an extraordinary idea, so it will be quite an impressive catalog! This mission will answer important questions about the origin and structure of the stars, including of course our own star, the Sun, and their evolution in our galaxy.

Professor Baldini also told me about an Earth-based mission that is mapping distant stars. The LSST telescope, managed by the SLAC National Accelerator Laboratory, is now called the Vera Rubin Observatory, in memory of the well-known American astronomer. This is an optical telescope. From its position on a mountaintop, it is observing the entire visible sky, capturing its changes over periods of time from seconds to years. With its sensitive camera, the Rubin Observatory will eventually produce images of a billion galaxies with greater accuracy than all previous instruments could ever have obtained.

Coming back to the Tiangong space station, there is also a plan to launch a mission to Mars and to build a Moon base with Russia. At the present time, with the war in Ukraine, the project could at best be indefinitely postponed.[1]

[1] The International Space Station was a peaceful collaboration between different nations with different ideologies, and thanks to science, it did work well for several decades. However, the war in Ukraine has changed everything, and up to now (2024), it does not look like the change is for the better. But that's just my personal opinion! On the other hand, three astronauts, one American woman and two Russian men, arrived aboard the International Space Station on a Soyuz spacecraft in September 2023. So, there is still a peaceful collaboration here despite the profound tensions between the two nations down here on Earth. They announced: "Here we get along just fine in contrast to the conflict on Earth. Symbol of peace and collaboration.".

5.3 India

I visited India when I was still an undergraduate student in art history. I traveled by land, when it was still possible to do so. From Italy, I went through Greece, Turkey, then Iran, where revolution was in the air! In the capital city of Tehran, young women could still wear miniskirts, but not for long. This was at the end of 1977. The Shah Pahlavi would soon be deposed and forced into exile in Europe. Immediately afterwards, he was replaced by the Ayatollah Khomeini, who came back from his own exile in Europe. What happened to Iran following the revolution is well known: a not very democratic government took control of the country, the regime of the ayatollahs, replacing the previous and also not so democratic government of the Shah. The effects of the Islamic revolution are still being felt today.

I then went through Afghanistan. In the capital city of Kabul, a few young women could be seen dressed in Western fashion at that time. In the rest of the country, women wore the veil known as the burka, which covered them entirely from head to toe. How could these poor women possibly see the outside world? In fact, they were not even part of the outside world; segregation was their destiny. As a traditional patriarchal and tribal society, Afghanistan has not been a good place for women for many centuries. To make the misery of the Afghan people even worse, a Russian invasion would soon be knocking at their door.

Next on my route was Pakistan. Misogyny there was, and probably still is, a painful reality. Muslim culture has existed for more than a millennium, and it is rich in beautiful art, poetry, and science, but that beauty has frequently been inaccessible to women. The same attitude has of course prevailed throughout Antiquity in many countries, but misogyny is still predominant in some, if not all, Muslim countries. Although I wouldn't wish to be overly controversial, this is without doubt an historical fact.

And finally, I arrived in India! My first impression was a rainbow of colors illuminating the countryside, the villages, and the cities. Of course, there was also unbelievable poverty, with many, many people simply living on the streets. There were thousands of people crowding the cities, along with a chaotic flow of cars, bicycles, and horse-drawn carriages, holy men wearing huge live snakes around their necks, and other men, holy or otherwise, semi-naked, covered in ash. A truly unreal scene! But compared with the restrictions I had witnessed in the countries I had just visited, it was a joy to see India. A few months later, it was not possible to go back home the same way I came. The whole area was on fire, and it still is. But not India.

Indian culture, including its religion, art, and science, is vast, and has been since the earliest times. Human activity goes back at least as far as the beginning of the Holocene period over 10 000 years ago. Civilization in the Indus valley dates back to 7000 BC. Archaeological excavations in the village of Balhathal in the province of Rajasthan have unearthed sites which clearly prove the antiquity of this civilization, but it could be even older. India is perhaps the nation with the most different religions and the greatest ethnic diversity, compared with other countries around the world, and it has always been this way since the beginning of its history. The main religions were Hinduism and Buddhism, but today there is also Islam, Sikhism, Christianity, Jainism, Zoroastrianism, Judaism, and several more. As in ancient times, religion occupies a central role in the lives of India's population (Fig. 5.1).

Astronomy has also been influenced by the religious and spiritual outlook of the world. The book "The Tao of Physics," written by physicist Fritjof Capra, perfectly translates the spiritual and religious connection to science of

Fig. 5.1 The Indian Sun god Surya. Pencil drawing on paper colored with gold acrylic paint

the ancient populations of India, which continues even today. According to Capra: "Physicists do not need mysticism, and mystics do not need physics, but humanity needs both." For him, there is a connection between quantum theory and the ideas of Hinduism, Buddhism, and Taoism, a connection between subatomic physics and the mystics.

Ancient Indian astronomy can be dated to the second millennium BC. References to astronomy can be found in the Vedas, extremely important sacred texts for Indian culture, which primarily include religion, but also art, science, and astronomy. This so-called Vedic astronomy focused mainly on studies of the Sun and Moon, and in particular their motions in relation to days, months, seasons, years, equinoxes, and solstices. To make astronomy comprehensible to the people, mythological gods were created, corresponding to the Sun, the Moon, Mercury, Venus, Mars, Jupiter, and Saturn, the seven "planets" that appear to move around the Earth. Besides these seven celestial bodies, there were another two, in fact two invisible demons, Rahu and Ketu, who sometimes made the Sun disappear. Once again, mythology was being used to explain the Solar System and eclipses to a largely illiterate population.

One of the best known astronomers of ancient India was Aryabhata. He was a mathematician and astronomer who made many discoveries relating to the motions of the Solar System. Very little is known about Aryabhata's personal life, but he was probably born in 476 AD in Ashmaka or Kusumapura, India. We know his inventions and discoveries mainly through his magnum opus "Aryabhatiya," which was probably already highly valued during his own lifetime. Unfortunately, the majority of his written works have been lost. He calculated the circumference of the Earth to a very good approximation, close to the measured value today, and predicted solar and lunar eclipses. Aryabhata realized that the stars appear to move because of the Earth's rotation about its own axis, and he may even have understood that the planets revolve on elliptical orbits around the Sun. So, he was in effect proposing a heliocentric model, ten centuries before Copernicus came to the same conclusion in fifteenth century Europe.

As I mentioned earlier, astronomy was explained through mythological stories and figurative art. In the Rigvedic period, Mercury was identified with the god Vishnu, who was a brother of Indra, sometimes identified as the Sun god. In later traditions, Vishnu became the solar deity, an important god among the crowded pantheon of Hindu divinities. One of the essential features characterizing Vishnu were the three strides he took to measure out the world: the first was to measure the Universe, the second was to measure what could be seen by humans, and the third was to measure what lay beyond mortals. Another interpretation of the three strides refers to the

course of the Sun in the Universe, in relation to the Heavens, the Earth, and the Netherworld.

In ancient India, there is no mythology or astronomy without the contribution of art. These things were indeed closely entangled. Subhash Kak, professor at the university of Oklahoma in the United States and scholar of Vedic culture, says that the best way to understand India is through art and cosmology, and he adds that art is not only an aesthetic expression of our sense of beauty, but reflects the cosmos and the divine.

Early artistic expression in India can be found in prehistoric cave paintings. The Bhimbetka rock paintings data back to the Paleolithic and Mesolithic and continue right up to the historic period. There are mostly painted scenes of animals and humans hunting them. This site is situated in the state of Madhya Pradesh in central India, and since 2003 it has been a UNESCO World Heritage Site. There are shelters in caves extending over 10 km, and archaeologists say that some of these shelters were probably inhabited for as long as 100 000 years, thus dating them back to the early Stone Age. The oldest cave paintings at Bhimbetka have been dated to 8000 BC.

During the Vedic period, the stars in the sky were represented as cosmic beings. This connection between stars and living beings, between the biological and the astronomical, and between microcosm and macrocosm constituted a prime belief in India, and to some extent it is still present today. Now, India is at the forefront of contemporary astrophysics and cosmology, and it has an advanced space program. The Indian Space Research Organization (ISRO) has launched its first astronomical mission, Aditya-L1, to study the Sun. The latter is no longer viewed as the god Vishnu! Modern Indian astrophysicists can now explain the real nature of our star.

The Aditya-L1 mission was launched on 2 September 2023 to observe the solar corona and the chromosphere, which is a thin layer between the photosphere and the corona, and to study the physics of the partially ionized plasma of coronal mass ejections, the coronal magnetic field, and flare exchanges. The mission will last for five years. But first the Indian mission must travel 1.5 million kilometers across space, a journey that will take some four months, stopping a long way from the Sun and in fact at a distance of 150 million km from the Earth at one of the so-called Lagrange points of the Sun–Earth system. These are a kind of "parking" position in space where objects have a tendency to remain where they are thanks to the equilibrium of gravitational forces. This is a way of reducing fuel consumption, but it also provides a good position from which to observe the exterior layers of the Sun with its specially designed scientific instruments (Fig. 5.2).

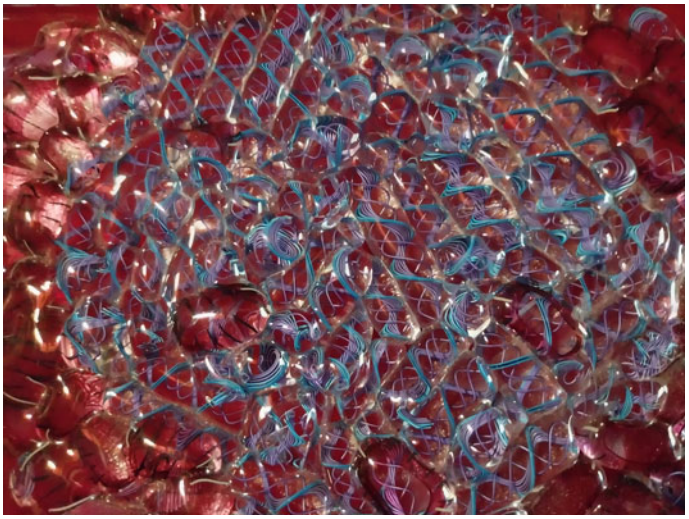

Fig. 5.2 The chromosphere, represented in blown glass. This is my interpretation of the thin layer called the chromosphere above the Sun's photosphere

As pointed out by Hugh Hudson, astrophysicist at Glasgow University, the corona can be seen only briefly during a total eclipse of the Sun. This mission will supply much more detailed information and hopefully clear up some of the mysteries surrounding the Sun's brilliant corona. Aditya-L1 will also study solar magnetic storms, the solar wind, and solar energetic particles. This is the first Indian mission dedicated to the study of the Sun.[2]

[2] Aditya comes from Sanskrit and is a synonym of the Hindu solar deity Surya.