1st Bridges between Cultures

Equinoxes, light and culture

March 20th, 2021

YouTube channel NASE-Virtual

Editors: Rosa M. Ros & Beatriz García

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NASE BOXES ONLINE

International Day of Light

16 May

1st Bridges between Cultures

Equinoxes, light and culture

NASE

Instituto de Tecnologías en Deteccion y Astropartículas
Mendoza, Argentina

March 20th 2021

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Editors: Rosa M. Ros & Beatriz García

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Introduction

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Astronomy has been a paradigm of scientificity in the "West" for centuries. It has also been considered a fascinating discipline and, simultaneously, devoted to the study of issues far appart from worldly concerns and interests. This combination of factors has made it difficult to understand the historical and socially situated character of astronomical knowledge in particular, and scientific knowledge in general. Cultural astronomy is an interdisciplinary area, which aims precisely to understand the various types of knowledge and practices about the sky of human societies as part of their social and cultural life. That is to say, to think about them, no more and no less, than with the same perspective that we understand everything else that humans do.

Today some may have heard of certain branches of cultural astronomy, especially archaeoastronomy or ethnoastronomy. But they are often interpreted as the study of "ancient" or "exotic" astronomies as curiosities, prior to or deviant from the "true astronomy", a science which would have nothing to do with historical processes, politics, institutional dynamics, metaphors or social imaginaries. But this perspective is seriously biased. Everything we human beings think and do, we think and do as part of a fundamentally social species. In fact, we are social beings even before we are human beings. Our minds, the great human adaptive tool, have evolved not only to adapt to the physical and biological environment in which we live, but simultaneously for and in a social environment. We do not come from a pre-social "state of nature" followed by a "pact" that would have founded society. We have been constituting ourselves as humans collectively, forming a diversity of societies with complex links between them. That is why all our forms of knowledge are, from their foundations and structurally, socially and historically constituted. This does not make them arbitrary, but contingent, located in certain social, cultural and historical "coordinates", in the same way as they depend on the structure of our nervous system, on the fact that we have stereoscopic vision, or a certain average range of hearing capacity.

For all these reasons, astronomy education must be conceived in the context of cultural astronomy. Only an education that takes place within the framework of a conception of astronomy as a socio-cultural product will allow future generations to have a broader, more critical and deeper view of our knowledge about the sky. All astronomical education must be an intercultural education, that is, one that does not simply "tolerate" diversity, but one that appreciates and values in depth the different ways in which human beings experience the world. An education that helps to understand the logics, interests, circumstances and underlying questions that motivate each of the different ways in which humans have related to the sky. A way of approaching the diverse knowledge about the sky that realizes that the diversity of human worlds also implies relations of power and inequality.

From this perspective, an astronomy education will not only make the perspectives of Western academic astronomy truly accessible to everyone. It will also enable them to understand its interests, objectives, criteria of truth, motivations and institutional structures. This will allow them to critically appropriate it, to link it with their own forms of astronomical knowledge and to contribute from their own knowledge with new perspectives and possibilities. Simultaneously, it will make it possible for the other astronomies developed by the different human groups to be known by the rest of the people, on their own terms, not in a caricatured way.

In this sense, it is essential that initiatives such as this book published by NASE multiply. These are the first courageous steps to establish a deep socio-cultural dialogue within the framework of academic astronomy education. May the readers of these texts be stimulated to explore in depth the enormous wealth of possibilities of human experiences of the sky.

Experiments

Spain - Argentina

NASE Experiments between equinoxes: Herschel´s Experiment

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We live in an era of multiple possibilities in terms of technology available to access the knowledge, to educate ourselves and the others, to tell and show what each one does in their familiar and close environments, but it was not until humanity found itself face to face with those circumstances that no one thought to live or that turn us upside down or that show us how fragile human life is, until all of us desperately wanted to contact each other.

Not only because of an issue related to the isolation imposed by a pandemic, which we believed to be a thing of the past, but because being isolated is when it was clear the need to establish bridges that would allow us to reach those we were not going to physically find in a long time.

To communicate is to transfer and to receive, and the bridges that we proposed to work during 2021 were built thanks to the existing highways of new technologies, fiber optics, wireless communication, the internet and social networks. The isolation was only physical, it was not social and in that context the Network of Astronomy School Education proposed what we humans always propose when the destiny of our work is the people: to devise alternatives, move forward overcoming obstacles and, if necessary, creating new bonds.

Science became the protagonist of 2020 and 2021, because almost everything we did, what we were able to conserve and innovate with respect to education, dissemination and culture, was achieved thanks to it.

In 2021 we think that the International Day of Light (IDL-May16) and the achievements associated with the laser, will make possible to put those citizen science projects that each school, each family or community, could do in small groups, which would show the power of the discovery against the natural phenomenon, and we proposed to reproduce the fantastic experience of William Herschel who more that 200 years ago, using 4 thermometers and a prism, discovered that beyond the red color in the spectrum of solar light, there was a type of radiation that the eye could not detect, and which he named infrared.

Fig. 1 and 2: Engravings representing William and Carolina Hershcel doing their astronomical work. (Credit: Wikipedia)

In 1757, the Hershel family, a native of Germany, settled in England. William doubled his studies in music that led him to be the conductor of the Bath orchestra. In 1772 his sister Carolina, a great singer, also emigrated to the United Kingdom and it was there that the brothers began not only to be interested, but to work intensely in Astronomy, installing in the house a workshop where they polished mirrors, manufactured instruments of measurement and experimented with the science of the heavens and the natural sciences in general. Probably most people remember William for the discovery of the planet Uranus in 1781, which he baptized "George " after King George II of England and kept that name until 1850. He began. In 1789 the Hershel family completed the construction of the great telescope of 40 pis (for the length of the tube) and 1.2 meters in diameter, with which they produced astonishing discoveries. Around 1800 the Hershel family still had time to experiment with light and the nature of heat and in this way using a prism to display the electromagnetic spectrum, William, and surely also Carolina, had the idea of registering changes in temperature in different colors. They used as a method to compare these temperatures, three thermometers, located in different regions of the spectrum and finally one was located a little beyond red. A four thermometer served as a control to record the variation in ambient temperature. It was logical that the thermometers in different colors of the spectrum, would register temperatures slightly higher than those of the environment, but the surprising thing was that, beyond red, the temperature also increased. They had discovered the infrared!.

This is one of the experiments that still surprises and fascinates teachers and students today, so the invitation was global and the call included the preparation of the experiment, the acquisition of data, recording the temperature of the 4 thermometers in a table. Every minute, lasted 5 minutes, analyze the changes, control with the thermometer that registered the ambient temperature and, finally, verify the existence of infrared radiation and rescue this wonderful family, of astronomers and musicians.

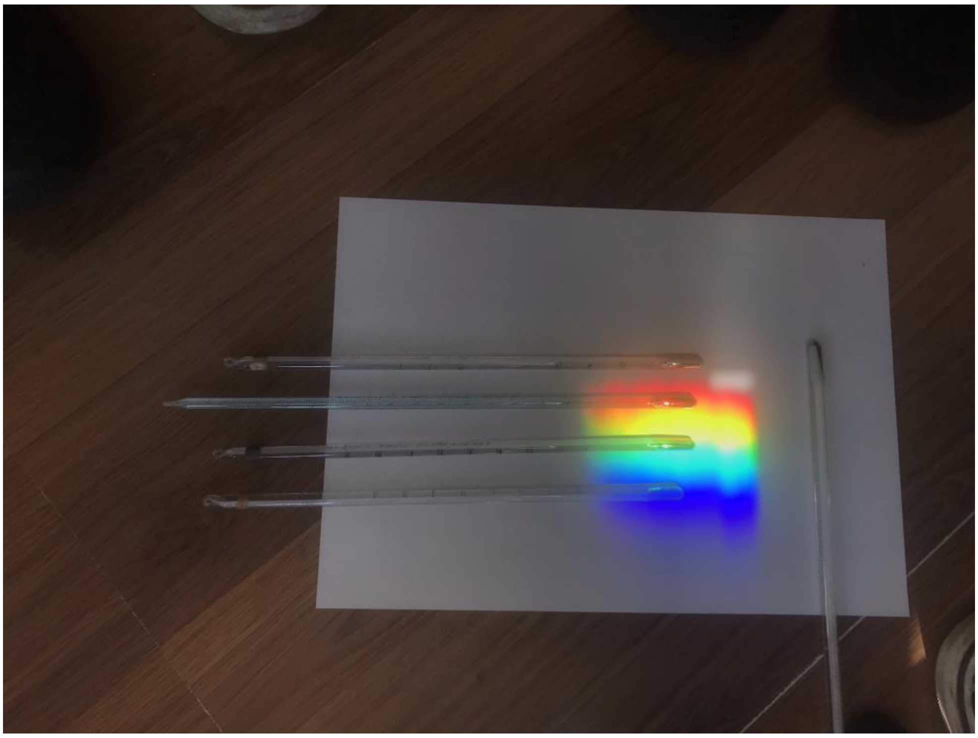

Fig. 3: Herschel's experiment (Credit: Corina Toma)

In order for the call to be more successful, in addition to remembering the international day of light, the organizers think that they will highlight special characteristics of planet Earth, such as the succession of the seasons and the fact that 2 days in the year the Sun rises by the east sets in the west and the days last the same as the nights, it was a way of appealing to what each one perceives in his place and at the same time throughout the planet. Hence the experiments should be carried out, between equinoxes.

The participants sent their records, data and representative images of the preparation of the experiments that converged towards a global event, which united xx countries from 5 continents.

Beyond the natural world, the astronomical manifestations, culture defines us; Therefore, in this particular year where we demonstrate our qualities, our resilience and adaptability, the debate around the historical meaning of various manifestations of diverse peoples of the planet,

This compilation of the presentations at the Bridges Between Cultures event not only gives us enormous joy but also gives us hope in the face of the challenges that we will undoubtedly have to live in the future and shows that science as part of culture, brings us closer together, unites us and reveals those invisible ties that, like bridges that join the banks of mighty rivers, allow us to feel close, part of a species and responsible for the legacy for the new scientific citizens.

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www.naseprogram.org

Austria

Caroline and William - the exclusive interview with the Herschel siblings

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The historic discovery of infrared radiation from the sun by the Herschel siblings in 1800 is used as a motivation for a scientific outreach project that involves several elements ranging from the arts over technology to astronomical science. For this paper a fictional recent interview with Caroline and William Herschel forms the dramaturgical framework.

What would Caroline and William Herschel think about the fantastic technological possibilities we have today to use infrared radiation in the daily life and scientific research? These are the questions that were posed in a fictional interview depicted below!

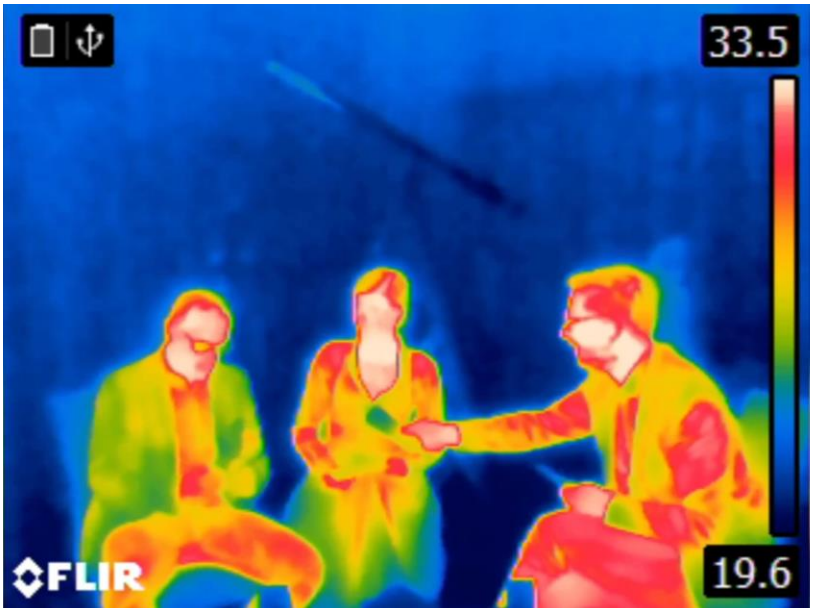

Fig. 1: The fictional interview of William and Caroline Herschel was filmed with a thermal infrared camera. The colours correspond to measured temperatures given on the right side scale in degrees Celsius. (Credit: F. Kerschbaum)

But let's look back: While studying solar heat and colours, William Herschel discovered infrared radiation by chance in already 1800 (Herschel, 1800 and other related papers in the same volume). It was the first invisible radiation that was not pure magic but was probed in a systematic way. Herschel was not working alone. Over most of his career his sister Caroline Herschel was a congenial partner. (Fara 2004, Hoskin 2005). While Caroline started as assistant but over the years developed her own projects and published independent papers on e.g. comets, stellar clusters, nebulae and double stars. From 1787 on she got paid for her work by the crown, in 1828 she received the Gold Medal from the RAS, of which she became honorary member in 1835. Her scientific contributions and her for at these days exceptional career and reputation make Caroline Herschel a fantastic role model for women in science and also underline the important role of team work.

These and other related historical aspects were covered in our outreach project by means of a theatre play, and explanatory materials at our web-site:
https://space.univie.ac.at/en/projects/rainbow/

Back to our fictional interview with Caroline and William that is also available via the above web-site: So what are the most fascinating new possibilities we have today? Caroline liked the ease we measure and image infrared light - especially with the camera we used in the interview. Compared to the cumbersome and complicated way to detect even strongest solar infrared radiation with thermometers these modern tools can be used in a very simple and straightforward way as shown in the picture below taken at a science fair.

Fig. 2: Caroline's modern successors use thermal infrared cameras for illustrating the so different world infrared "eyes" see - here at a science fair in Vienna. (Credit: F. Kerschbaum)

But such cameras are not only fantastic for illustrating the invisible infrared radiation but turn out quite useful in daily life, as William Herschel states. He was fascinated by applications like the search for lost persons in dark forests or the search for thermal leaks in facades of private homes using such handheld infrared cameras as shown in the following picture.

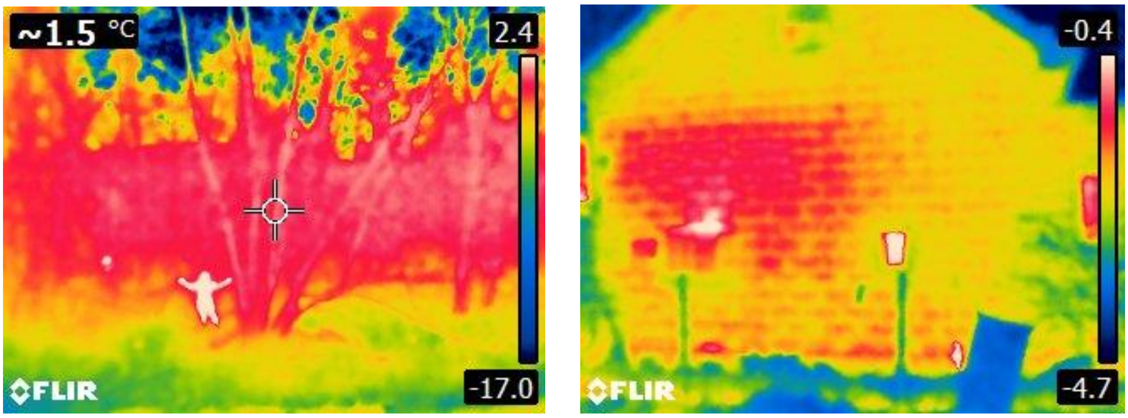

Fig. 3: By means of a thermal camera one can search for lost persons in dark forests (left) or check insulation of outside walls of private homes (right). (Credit: F. Kerschbaum)

After discussing the astronomical science now possible with infrared space telescopes the Herschel siblings were very moved when being informed that the biggest space telescope ever flown so far was named after them: the Herschel Space Telescope of the European Space Agency!

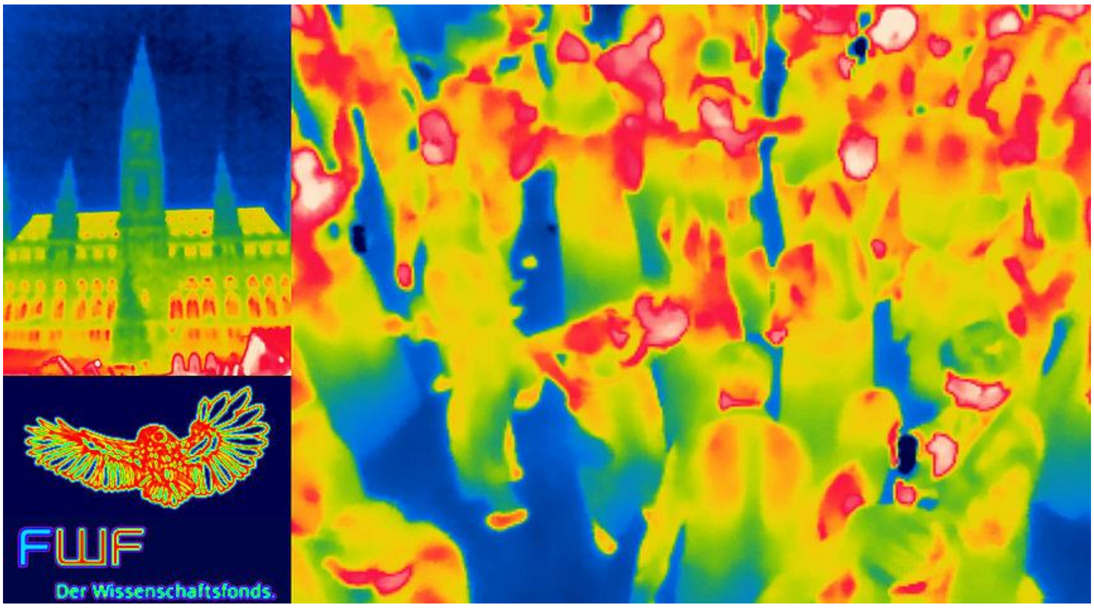

Fig. 4: Infrared image (Credit: F. Kerschbaum)

Towards the end of our interview the Herschels informed us that they will soon be leaving for the Vienna Science Ball where they support a contest for the “hottest” dancer and where their expertise on Infrared Radiation is needed.

Fortunately for this paper we were able to get a snapshot from the dancefloor (below) and may guess who will win the first prize in the contest!

Acknowledgements: The Austria Science Fund FWF supported the outreach project under project number WKP100. Shown below is the Infrared dancing contest for the hottest dancer in Vienna’s town hall.

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Senegal

Making Experiments in Senegal

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Framework

As part of the celebration of the International Year of Light we had the opportunity to participate in the project « Bridges between Cultures »initiated by the NASE group (1). We started a programme that lasted from March 2021 to September 2021, i.e. from the beginning of the equinox to the end of the equinox. Our topic was entitled "Making Experiments in Senegal".

Goal

Our objective was to carry out a project with secondary school pupils by reproducing the Herschel experiment (2) on the detection of infrared light beyond the visible part of the electromagnetic spectrum.

So we started the experiment with three students from the same neighborhood and school to set up the basics of the experiment, then another student from a higher level was integrated into the project two months later. The idea is to introduce the pupils to the scientific approach

Experimental method

In the first phase of the project, we had difficulties to find experimental material in Senegal, mainly the prism which is the basis of the Herschel experiment. After discussion with the NASE Project Manager, Rosa Maria Ros, about our constraints, we were able to make a homemade prism with the means at hand, which allowed us to start our experiments and to participate in the first online meeting with the different members of the Bridges between Cultures project in March 2021.

Together with the students we presented our prism and the spectrum of light obtained, and the students also showed their enthusiasm to be part of a STEM project for the first time.

As a result of this meeting we were promised dedicated prisms for the Herschel experiment by a member of NASE from the University of Vienna in Austria, and a few months later we received the complete equipment including prism and thermometers.

Fig. 1: First setup of the herschel's experiment with an artisanl prism in March 2021

Fig. 2: Herschel's experiment with dedicated prism in May 2021

Conclusion

It was a great adventure to promote science, to work with the students in this project and to introduce them to the world of research, to make an experimental set-up, to take measurements and to try to understand the meaning.

However, we were not able to obtain good results as expected but in the future with the equipment we have acquired and the experience we have gained we will be able to do better.

Acknowledgments

We are very grateful to the entire NASE team. We also thank Prof. Dr. Franz KERSCHBAUM of the University of Vienna for his material support.

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Iran

Iranian Students activities for astronomy school educations

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Mehr observatory which is located in Bushehr Province, in south of Iran has been presenting a lots of activities for teachers and students around the country for more than 15 years. After some years of activities they created a bigger network for education and teachers called “Iranian Teachers Astronomy Union” (ITAU). The most important part of their work is that all of these activities have been carried out by students themselves. In their activities students are not only some participants. They are leaders, they are instructors and they will be teachers. The result turn out to be incredible. They created an international network for all of the students regarding to the experiences that they had in 2020. “Students International Network for Astronomy” (SINA) is now a very big family with bigger plans.

Fig. 1: Some of students’ activities in Mehr observatory. Bushehr, Iran.

After 2019 with carrying out the first NASE course in Bushehr, Mehr observatory have done lots of NASE courses and also lots of NASE and other astronomical projects. Students are the main participants in every course and they are really active for the projects. Successfully, Iranian students have selected for the final events of NASE international projects since 2019.

The power of the sun Project:

The power of the sun was the NASE project for 2019. The idea was about to calculate the power that we receive or feel from the sun in the earth with simple materials such as light bulbs and oil. Mehr observatory prepared some workshops about this project and they did the project supported by teachers around the country and finally, more than 100 students have done this experiment. 4 students from Iran were selected to go for the final ceremony in Spain. Also two other students presented this experiment in the “bridge between culture” online event.

Fig2: Students are doing the experiment of solar power.

The parallel earth Project:

In 2020 because of the Covid-19 pandemic all of the activities changed to be online and in Iran Mehr observatory and ITAU tried to help teachers and students to connect with astronomy with this experiment and many online workshops helped. One of the biggest point about this experiment in Iran was including very young children to do this. It was a big success and they were selected to present in the online final event of the Parallel earth experiment.

Fig3: Young children are experiencing the parallel earth in front of the one of ancient palaces of their city.

The Herschel experiment Project:

This project was a very big success for them because they could support many students and teachers to do this. Many online workshop created and finally more than 200 students and teachers participated. Finally, 5 teachers from Iran and Mehr observatory were selected to join in the final event in Spain. They were also one of the teams who carried out this experiment for students of Atarfe city.

Fig4: Students are trying to find the infrared with termometers and a prism.

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www.naseprogram.org

Korea

Making Experiments in Korea

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We will introduce the study of the Sun's differential rotation by measuring the movement speed of sunspots by taking pictures. We are conducting an international joint research project with our school and the Queensland Academy for Science Mathematics and Technology (QASMT) school in Australia. Students not only exchange academically with each other but also share cultural differences by talking about school life and daily routines. Each school has 3 students and 1 teacher.

Observation of the sun was carried out with care, all you need is a lens or telescope, a filter that reduces the amount of sunlight, and a camera. In our school, a 5-inch refracting telescope, neutral density (ND) filter, and DSLR camera were used. It was observed every day for 26 days from March 8 to April 2, 2021, and data were obtained for 22 days excluding 4 days with bad weather. Sunspots were not seen every day but appeared on 11 days. The position of sunspots was verified by comparison with NASA SOHO data. We will calculate the latitude and longitude of each sunspot to determine the value of the sun's rotational velocity.

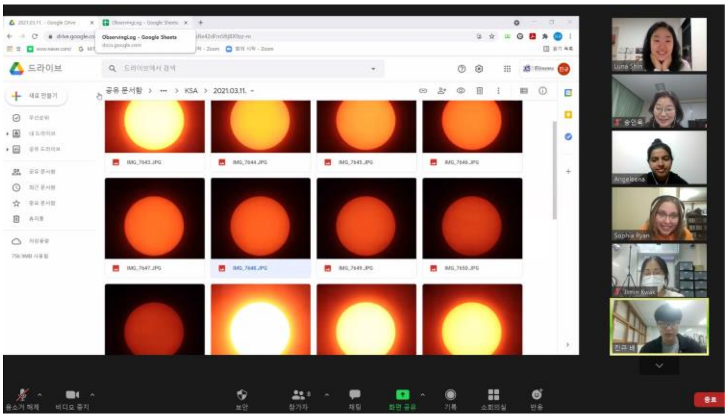

Fig. 1: We communicate through Zoom online

These years currently, there are not many sunspots and it is difficult to interpret. However, using data from when there were many sunspots in 2014, the solar rotational period can be determined by measuring the speed of differential rotation by latitude. After choosing two good photos, one places the OHP film with the mapping grid printed on it and rotates the mapping grid so that the same dark spots are on the same latitude. One can measure the distance from the line of longitude and latitude 0 degrees. One observes whether differential rotation occurs at each latitude through the difference in longitude.

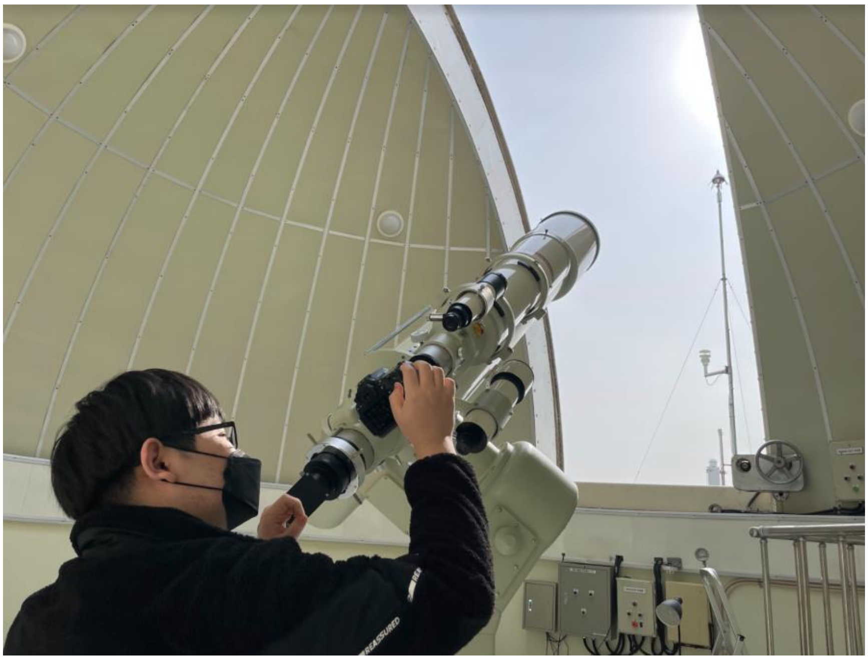

Fig. 2: Student observes the Sun

Rotational periods were measured of 27.11 days at the equator of the Sun, 27.11 days at 8 degrees latitude, 29.38 days at 12 degrees latitude, and 29.38 days at 18 degrees latitude. Known values are about 25 days at the equator, 27 days near 40 degrees' latitude, and 30 days near 70 degrees' latitude. Although there is a difference, the obtained values were meaningful for the differential rotation of the sun by latitude in terms of the student's experiment.

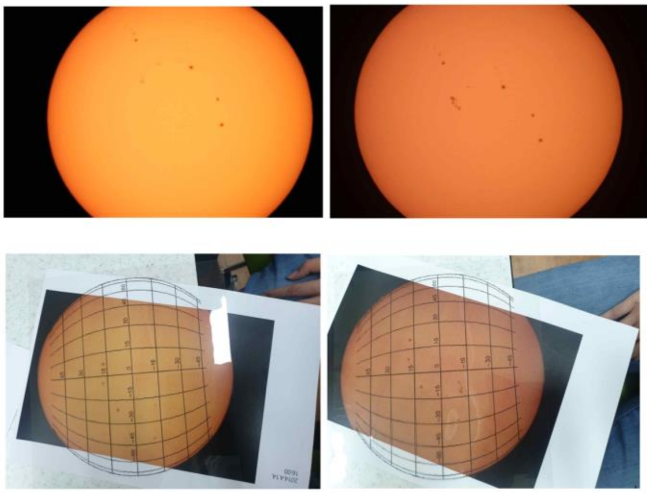

Fig. 3: Using Grid OHP to measure the location of sunspots

In the international joint research conducted this year, it was not possible to combine data of both sides due to weather and sunspot conditions. We were able to improve students' responsibility, cultural exchange, and self-awareness through joint projects such as introducing methods and making plans.

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Equinoxes

Spain Argentina

Spring and Easter traditions: comparing solar and lunar calendar

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Introduction

NASE is focused in teacher's education in astronomy. Astronomy is part of our live, Astronomy is present in our cities and the cultural Astronomy is important in the teacher's education. We want ot introduce an example of tradictions related astronomical concepts, in particular the relations ships between Equinnoxes and Easter and the traditions related to them: mainly Eggs.

Comparing solar and lunar calendars

In many countries of Christian tradition, the great festival that corresponds to the beginning of spring (in the northern hemisphere) and the beginning of autumn (in the southern hemisphere) is Easter. While the equinox usually corresponds to March 21, Easter Sunday is set as the first Sunday after the full moon after the March equinox, when the Sun passes through the Aries point. According to tradition, the first Good Friday corresponded to a full moon and since then Easter Sunday is determined in the manner mentioned above.

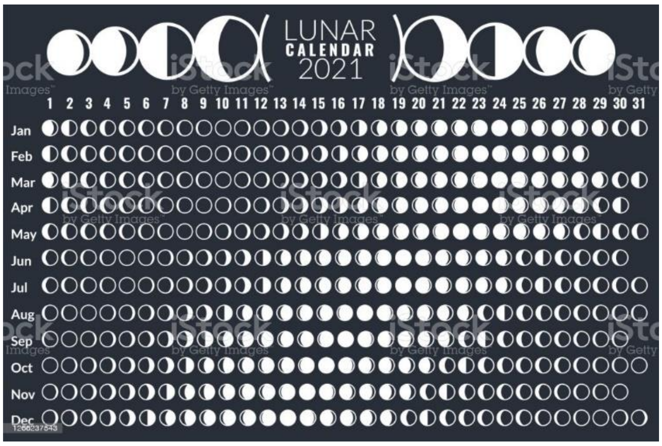

Fig. 1: Visualizing the lunar calendar of any year shows an evident periodicity between the lunar phases and the calendar. (Credit Wikipedia)

In the process to determine the date of Easter, although it has been known since ancient times, it is a not very simple process and is linked to studying the relationship between the movement of the Moon (when there is a full moon) and the movement of the Sun (when the March equinox takes place).

The golden number

In 432 BC At the Olympic Games, the astronomer Meton of Athens communicated to the Athenians a discovery known as the "Metonic cycle." Meton showed that 19-year cycles are precise so that the Moon's cycles can coincide with the solar cycles (with only a couple of hours of error) and consequently every 19 years the same distribution of moons is repeated within a given year. . Meton discovered that in a 19 solar year cycle there are almost exactly 235 lunar months (there is only 2 hours difference between the two cycles).

The range of a given year within the Metonic cycle is called the Golden Number, because given the importance of this discovery at the time, the Athenians engraved it with gold letters in the temple dedicated to Minerva. There are 19 golden numbers (from 1 to 19) and each year has its associated golden number.

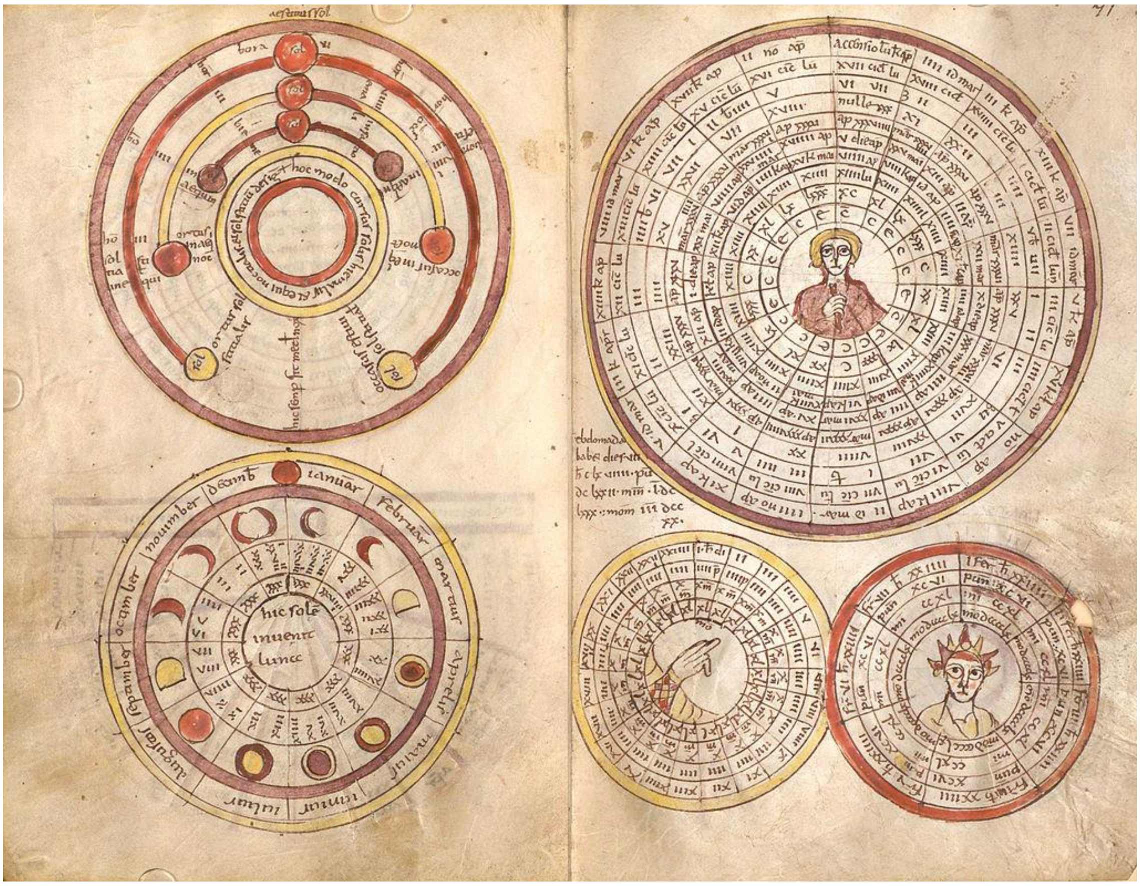

Fig. 2: Medieval illustrations for calculating the golden number (Credit Wikipedia).

The golden number of a considered year is calculated as follows, which is shown below with an example (for mathematicians it is a modulo 19 calculation).

We consider the year 2021 and divide it by 19, obtaining 2021/19 = 106,368, we truncate the remainder and multiply it by 19, so we have 106x19 = 2014 that subtracted from 2021 gives us 2021-2014 = 7 years. As we start counting from 1 and not from 0, we must add a unit: 7 + 1 = 8, which is the golden number of 2021. This means that the distribution of the phases of the Moon in 2021 is the same as the year 2002 and year 1983 etc ... All these years have a golden number 8. This procedure is valid for now until the error that it entails is not advanced in one day, but that will not happen for more than 300 years.

The Epacta and the Age of the Moon

To determine the Easter date of a specific year, the Epacta is considered, which is the number of days that the Moon has on January 1 of a given year, and allows calculating the phase in which the Moon is (that is, the age of the Moon) any day of the year.

To calculate the epact we will proceed with an example. For the year 2021 a golden number of 8 has been obtained, then (8-1) x11 = 77, which if it is greater than 30, then 30 is subtracted as many times as necessary to make it smaller: 77-30 = 47, again 47-30 = 17 which is the Epacta of 2021. The role that number 30 plays is due to the fact that the Moon needs almost 30 days for its translational movement.

Age of the Moon = Epacta + 1 unit per month since March + day of the month

For example the age of the Moon on November 19, 2021 =
Effect of 2021 is 17 + months from March to November are 8 + 19 days =
44 days you have to remove 30 as many times as necessary = 44-30 = 14 days
and this means that on November 19, 2021 there is a Full Moon! (The phases of the Moon are about 28 days, on the first day it is a New Moon (nothing is seen), on the 7/8 day it is a Crescent Moon (in the form of a D in the HN and a C in the HS), on the 14th day it is the Full Moon, on the 22/23 it is the Decreasing Moon (in the form of a C in the HN and a D in the HS) and again on the 28th it is the New Moon).

Calculation of the Easter date

To calculate the date of Easter the process is somewhat complicated. The first Christians used the Jewish calendar to establish Easter Sunday, the day of Christ's resurrection, since according to the Gospels Jesus died on the Friday before Jewish Passover (that night was a Full Moon according to various historians with a practical concept Since many Jews were heading to Jerusalem for the Passover celebration and the Full Moon made their way easier at night).

When Christianity became the religion of the Roman Empire (Milan edict of 313), for the Romans it was strange that the Jewish Passover was changing year after year since they used the Julian calendar which is solar, while the Jewish calendar was lunar and also did not want it to coincide with the Jewish Passover because they had to clearly differentiate themselves from this religion.

Fig. 3: Good Friday procession in Seville with the Full Moon in all its splendor.

In these circumstances, during the Council of Nicea in 325 (the first ecumenical council of Christianity) it was decided that Christian Easter would be celebrated on the first Sunday after the first Full Moon after the vernal equinox. And furthermore, in this council it was established that the spring equinox was March 21 and that by Full Moon, the astronomical Moon was not understood, but rather to avoid having to observe with the imprecision and precariousness of the time, the Full Moon Pascual was calculated from the golden number and the Epacta according to a very strict formulation and tables that have been reformulated since the 15th century. Currently a formula established by J.C. Friedrich Gauss (1777-1855) and Butcher's algorithm is also applied in the form of a computer program. The end result was that the Catholic Easter does not coincide with the Jewish Easter nor with the Orthodox Easter (the latter is governed by the Julian calendar and instead the Catholic Easter by the Gregorian calendar established in 1582 by Pope Gregory XIII).

Spring Traditions: Eggs

Spring traditions related to eggs are followed in many places on Earth.

Some are based on pagan traditions; The egg has always been considered a symbol of life and fertility and was attributed a very important role in spring celebrations. Others based on Christian traditions that are also related to spring and Easter.

In China, they began giving away red-dyed eggs during the spring equinox festivals as a symbol of friendship in 5000 BC. The color red, for the Chinese, means long life and happiness.

Throughout the different Egyptian dynasties, an egg was synonymous with fertility and rebirth. Spring is still celebrated in Egypt today with eggs decorated with phrases and wishes. It is celebrated on the Monday after Catholic Easter and during that day the eggs are boiled and then decorated.

Much later in the Persian empire, golden and delicately painted eggs were also exchanged at the beginning of spring, when the year begins for the Persian calendar.

The English term for Easter "Easter" according to an 8th century monk is related to the Teutonic goddess Estre, goddess of the rising light of day and of spring. She was related to fertility and was symbolized by eggs that give new life and by rabbits that represent prolific reproduction. The rabbit is first mentioned as a symbol of Easter in Germany in 1590.

In the 13th century, during Lent (40 days before the death of Christ) eggs could not be eaten. People kept the eggs with a layer of liquid wax that they later decorated and painted over the years and were given to family and friends on Easter Sunday. They were considered to represent the appearance of Jesus after his resurrection and were a gift for children. Each country has developed its tradition when it comes to decorating eggs.

Fig. 4: Decorated eggs from Romania

The peoples of Central Europe and Slavic countries prepare the eggs in baskets that they carry to bless on Holy Saturday and are eaten on Sunday. In Romania, on Easter Sunday, eggs collide with each other as if they were cups in a toast. In the Mediterranean area, eggs are placed in cakes or crowns and godparents give them to their godchildren.

Fig. 5: Mona de Pascua from the Mediterranean area (Valencia, Spain)

In Russia, on Orthodox Easter, the last two tsars gave away jewelery in the shape of an egg, baptized with the name of the jeweler Carl Fabergé, following the tradition of giving eggs.

Fig. 6: Eggs from the SAN Fabergé Museum. Petersburg

En Grecia tiene la costumbre de romper huevos sobre las demás personas para simbolizar la apertura del Santo Sepulcro, y en ocasiones tienen lugar "duelos" entre dos personas de manera que la persona cuyo huevo no se ha roto es la afortunada. Los huevos suelen ser decorados en color rojo para simbolizar la sangre de Cristo.

Actualmente se ha generalizado la costumbre de regalar huevos de chocolate por Pascua. En el siglo XIX aparecen en distintos países, pero fue el empresario Joseph Fry el que produjo los primeros huevos de Pascua de chocolate en Inglaterra en 1873 y posteriormente siguió elaborándolos Cadbury's. Con los años se han llegado a realizar conejos y todo tipo de animales de chocolate para hacer las delicias de los niños.

En otros países el huevo no se usa cocido, sino que solamente se utiliza la cascara para colorearla y colgar los huevos de pascua en árboles como se hace en Alemania. Esta tradición llego a los Estados Unidos en el siglo XVIII con los colonos procedentes de este país, los que también dieron a conocer el famoso conejito de Pascua

Fig. 7: Huevos de Pascua en los árboles

En Estados Unidos, el conejo de Pascua se dice que lleva una canasta llena de huevos de distintos colores y según la tradición el sábado de Pascua los esconde para que el domingo de resurrección por la mañana.

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Iran

Nowruz, the spring equinox

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The Persian Solar Hijri Calendar

Officially used in Iran and Afghanistan, the Solar Hijri calendar is one of the world's most accurate calendar systems. It is also known as Persian Calendar, Iranian Calendar, and SH Calendar. The Solar Hijri calendar is not to be confused with the Islamic Hijri calendar used in many Muslim countries and by Muslims around the world.

Why this Calendar is so important?

- Tied to the Equinox
- The Solar Hijri calendar is a solar calendar, meaning that its time reckoning is based on the Earth's movements around the Sun.
- Unlike the Gregorian calendar, which follows a set of predetermined rules to stay in sync with the solar year, the Solar Hijri calendar is based on astronomical observations. The year begins at midnight closest to the vernal equinox in Iran—specifically at the Iran standard time. The meridian at longitude 52.5° East, which runs about 250 miles (400 km) east of Tehran. The first day of the new year is called Nowruz, and it is celebrated around the world by Iranian people.

The historical buildings that Ancient Iranian used it for Astronomical activities. This masterpiece called (Chahartaq)

What is Chahartaq?

The Niasar Fire Temple (called Chahartaq) is a structure with a dome over a rock at the highest point of Niasar village, located 28 kilometers west of Kashan. The Fire Temple can be seen from quite a distance and has remained relatively intact since the time of Sassanid dynasty. But also this structure has a another usage, researchers found out that chahartaq can shows and help astronomers to notice equinox, but how? They guess by the angle of building and where they built.

Fig. 1: Niasar Chahartaq, Located in Niasar city, near Kashan

What is Nowruz and How we celebrate it?

Nowruz is two-week celebration that marks the beginning of the New Year in Iran's official Solar Hijri calendar. The celebration includes four public holidays from the first to the fourth day of Farvardin, the first month of the Iranian calendar, usually beginning on March 21. On the Eve of Nowruz, the fire festival Chaharshanbe-Suri is celebrated.

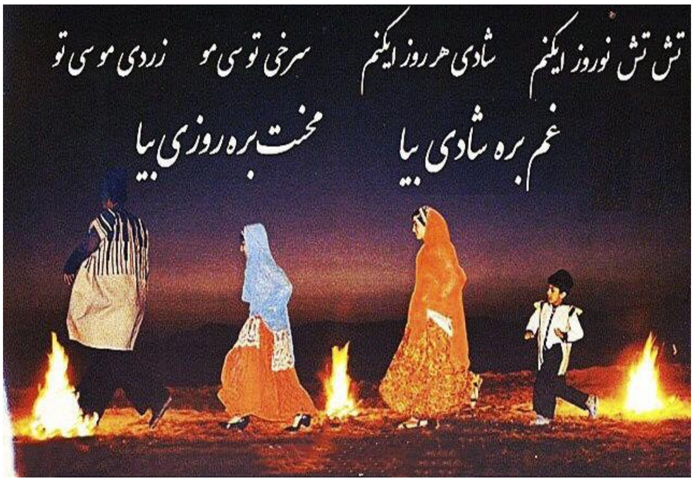

Fig. 2: Dancing and singing while jumping on fire is one of beautiful ceremonies on Chaharshanbe-Suri

Traditions for Persian New Year

Charshanbe-Suri, (lit. "Festive Wednesday") is a prelude to the New Year. In Iran, it is celebrated on the eve of the last Wednesday before Nowruz. It is usually celebrated in the evening by performing rituals such as jumping over bonfires and lighting off firecrackers and fireworks. Iranians sing the poetic line "my yellow is yours, your red is mine", which means my weakness to you and your strength to me. to the fire during the festival, asking the fire to take away ill-health and problems and replace them with warmth, health, and energy. Trail mix and berries are also served during the celebration. Haft-Seen also spelled as Haft-Sīn (Persian: هفت‌سین ,the seven seen's) is a tabletop (sofreh) arrangement of seven symbolic items traditionally displayed at Nowruz, the Persian new year. The haft-seen table includes seven items all starting with the letter Seen (letter s) (fa), (س) in the Persian alphabet.

The Haft-Seen table ítems

- Sabzeh – (سبزه)wheat, barley, mung bean or lentil sprouts growing in a dish - symbolizing rebirth
- Samanu – (سمنو) sweet pudding made from wheat germ – symbolizing affluence
- Senjed – (سنجد) dried oleaster Wild Olive fruit – symbolizing love
- Seer – (سیر) garlic – symbolizing the medicine and health
- Seeb – (سیب) apple – symbolizing beauty
- Somāq – (سماق) sumac fruit – symbolizing (the color of) sunrise
- Serkeh – (سرکه) vinegar – symbolizing old-age and patience

Fig. 3: Haft-seen table and its Items. Some of Items doesn’t start with letter (seen) but they are also exist on the table.

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Bulgaria
Bulgarian traditions and spring equinox

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Municipal Center for Extracurricular Activities, Dolna Mitropolia Municipality, Bulgaria participates in an online astronomical and cultural event "Bridge between Cultures" dedicated to the vernal equinox on March 20, 2021. The event is organized by The Network for Astronomy School Education, NASE.

Beliefs and ideas of the ancient Bulgarians related to the vernal equinox

As early as the VI-V millennium BC, the ancient farmers in Bulgaria had an astronomical calendar based on the four main points in the "life" of the Sun - the two equinoxes (spring and autumn) and the two solstices (December and June). This calendar is recorded with drawings and signs in the Sanctuary in the Magura Cave.

Fig. 1: Magura Cave

The spring holidays are centered around the vernal equinox. The customs and rituals performed in the spring should provide favorable weather for crops and a good harvest.

Baba Marta – 1 st March

This is the first spring holiday associated with the new Sun, the new reviving life. We exchange "Martenitsas" - twisted white and red thread threads that are tied on the hand or hung on the garment.

Fig. 2: Martenitsas

Lazarki

The young women, called "lazars", pick flowers for the wreaths that they will weave for Palm Sunday (the next day). The girls are dressed in traditional folk costumes. They go around the houses of the village, sing ritual Lazarus songs and bless for health, happiness and prosperity. The owner of the house gives them eggs, money, fruits and small gifts.

Fig. 3: Lazars from northern Bulgaria

Group for authentic folklore "Kalushari“

The folk custom "Kalush" was played during the Rusalii Week. The group is composed of an odd number of young people led by a leader - Vataf. The Kalush people drove away "evil forces and spirits" from sick people.

Fig. 4: "Kalushari“ from Baykal village, Dolna Mitropolia Municipality

The secret code of Bulgarian embroidery and astronomy

Elbetitsa - the most popular motif in Bulgarian embroidery. In essence, it is one of the most ancient images of solar calendars. The rays represent the 8 main holidays associated with the Sun - the spring and autumn equinoxes and the summer and winter solstices (with red color) and the four positions between them (with white color). It was also used by various peoples in antiquity - Scythian-Sarmatian, Iranian and Indo-Aryan.

Fig. 5: Elbetitsa Fig. 6: Tree of life - a cosmogonic principle Fig. 7:Spirals and vortices

Special thanks to:
Krasimira Boyanova, Secretary of Probuda-1925 Community Center, Baikal village, Dolna Mitropolia municipality.

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USA
Cultural Astronomy as Inspiration

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Cultural astronomy is fascinating and can be used to inspire students for astronomy and study in other STEM fields. This paper gives background information and then some captivating photographic examples.

Archaeoastronomy

Archaeoastronomy is part of cultural astronomy and is the study of astronomy as it was used by ancient cultures. Archaeoastronomical studies are interdisciplinary in that they include fields such as astronomy, archaeology, and anthropology. They often involve investigating possible astronomical orientations and their cultural associations.

Something known and used by many ancient cultures is that at most latitudes the positions of sunrise and sunset change daily throughout the year. The Sun moves along the horizon between the points for the June and December solstices and rises and sets in the same place on the same day every year.

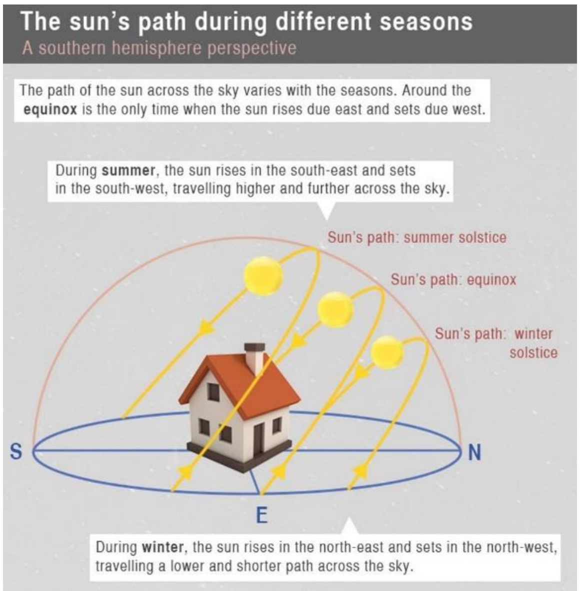
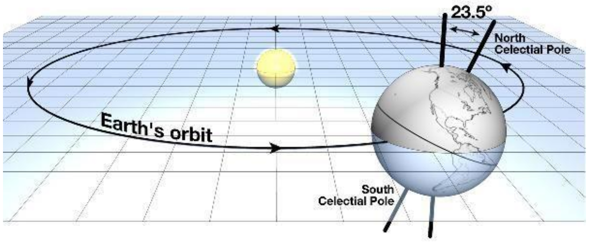


Fig. 1. The Sun's Path Across the Sky in the Southern Hemisphere. (Credit: Wikipedia)

Figure 1 shows the path of the Sun across the sky in the Southern Hemisphere where the summer solstice occurs in December and the winter solstice in June. The Sun travels higher and lower paths across the sky depending on the season and the points on the horizon where it rises and sets shift accordingly. The reason for this is that the axis of the Earth is tilted almost 23.5 degrees (Fig. 2). As the Earth revolves around the Sun the axis always points in the same direction (Fig. 3).



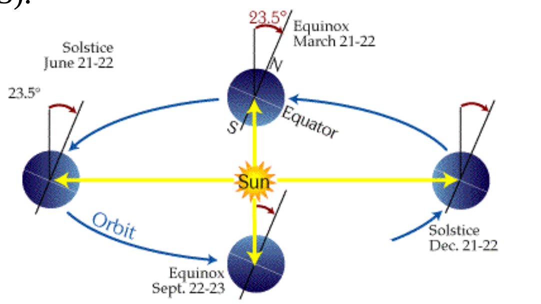


Fig. 2. Tilt of the Earth's Axis (Credit: Wikipedia). Fig. 3. Axis Always Points the Same Direction (Credit: Wikipedia)

This gives the Sun a different rising and setting position each day (Fig. 1). The axial tilt is also responsible for the Earth having changing seasons (Fig. 4).

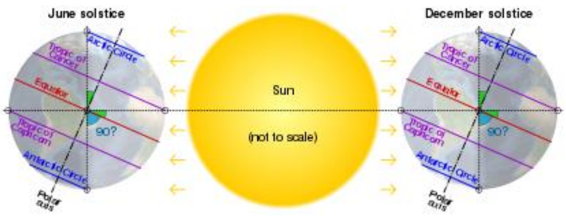


Fig. 4. Sun Directly Above Points on Earth (Credit: Wikipedia)

Astronomy of the Inca Empire

Astronomy was an integral part of Andean mythology and creation and was at the very heart of the Incas' religion and agriculture. Inca astronomy serves as just one of many great examples of astronomy in culture that can be used for educational inspiration.

The Incas proclaimed themselves to be the children of the Sun. They worshipped it and viewed their emperor as being the Sun's direct descendant, the son of the Sun. The emperor, Pachacuti, his son, and grandson in the 16th century built the largest empire ever known in the Americas, 4800 km from Chile to Columbia.

The Incas learned the cycles of solstices and equinoxes and used this knowledge as a key component of their annual crop management activities, as well as for determining dates for religious celebrations. Many waqas (shrines) were orientated to the June solstice sunrise, while others pointed to the Sun at December solstice. Light tubes or cave openings allowed altars to be illuminated at specific times while other orientations guided the eye to the horizon on significant solar dates. Pillars were set on hills to mark the passage of the Sun on the horizon as a calendar.

Dark 'constellations'

The Milky Way provided visual inspiration for several themes of Inca cosmology. The Incas recognized dark constellations, or the shapes of beings formed by dark areas of gas and dust that blocked light behind them in the visible band of the galaxy. The Incas saw great cosmological characters meant to guide them in their daily lives. The creatures in the Milky Way prominent at night in the Southern Hemisphere that were envisioned by the Incas are depicted in Figure 5.

Fig. 5. (1) Machacuay (serpent), (2) Hanp'atu (toad), (3) Yutu (tinamou – large bird), (4) Yacana (mother llama), (5)Unallamacha (baby llama), (6) Atoq (fox), (7) Michi runa (shepherd). (Credit: Wikipedia)

Kenko Grande

There are many fascinating examples of the Incas' use of the Sun for timekeeping and for light and shadow effects. The first is at Kenko Grande which lies above Cusco. It is a very large limestone outcropping with many carvings including two gnomons on its upper surface (Fig. 6). There an effect of light and shadow was designed for the June solstice sunrise and is called the "The Awakening of the Puma."

Fig. 6. Kenko Grande (Credit: S.R. Gullberg).

A crevasse is aligned to allow the light of the Sun at June solstice sunrise to pass through and illuminate the two gnomons and cast shadows (Fig. 7). Collectively this forms the face of the puma, one of the three sacred creatures of Inca cosmology, the other two being the condor and the serpent (Fig. 8)

Fig. 7. Crevasse to Admit Light at June Solstice Sunrise (Credit: S.R. Gullberg). Fig. 8. The Awakening of the Puma (Credit: S.R. Gullberg).

The cave within Kenko Grande includes an altar and on its far side is a set of three stairs. Approaching local noon when nearing the June solstice, sunlight progressively climbs the stairs and points to the altar (Figs. 9 and 10)

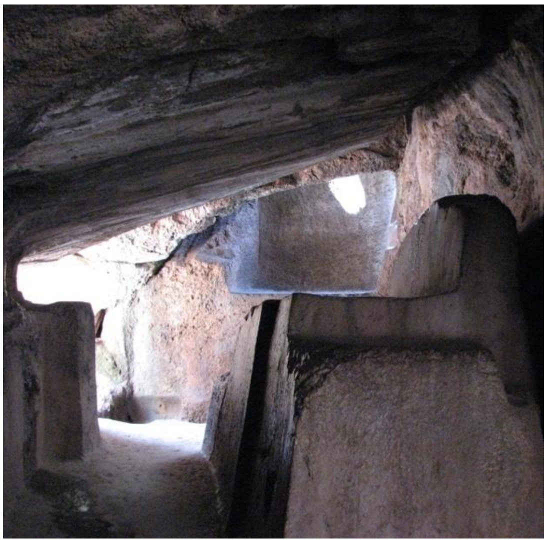


Fig. 9. Cave within Kenko Grande (Credit: S.R. Gullberg). Fig. 10. Sunlight Climbs these Stairs (Credit: S.R. Gullberg)

Lacco

Not far from Kenko Grande is another fascinating site called Lacco (Fig. 11). It is also a very large carved limestone outcropping and within it there are three caves of interest.
In the Southwest Cave there is a light tube aimed for a small altar and the photo shows the crescent Moon crossing the aligned path when looking outward through the light tube (Fig. 12).


Fig. 11. Lacco with Nevado Ausengate Beyond (Credit: S.R. Gullberg) Fig. 12. Crescent Moon in Field of View (Credit: S.R. Gullberg)

Lacco's Northeast Cave's opening is oriented for the June solstice sunrise at which time sunlight illuminates an altar and the cave's interior (Figs. 13 and 14). The sunrise position on the horizon changes each day as it approaches from the right, it stops as shown at the point of the June solstice, and then it proceeds back to the right again toward the horizon point of the December Solstice.

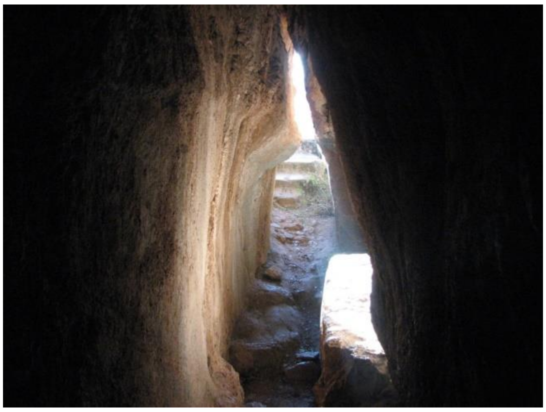



Fig. 13. June Solstice Sunrise (Credit: S.R. Gullberg). Fig. 14. Altar and Cave Illuminated (Credit: S.R. Gullberg)

Lacco's Southeast Cave has two chambers and the inner one includes a finely carved altar with a light tube that allows it to be illuminated at the time of the zenith Sun (Figs. 14 and 15). This occurs on and near the two days each year when the Sun, between the

Tropic of Cancer and the Tropic of Capricorn, is directly overhead. At the latitude of Cusco this happens on February 13th and October 30th.

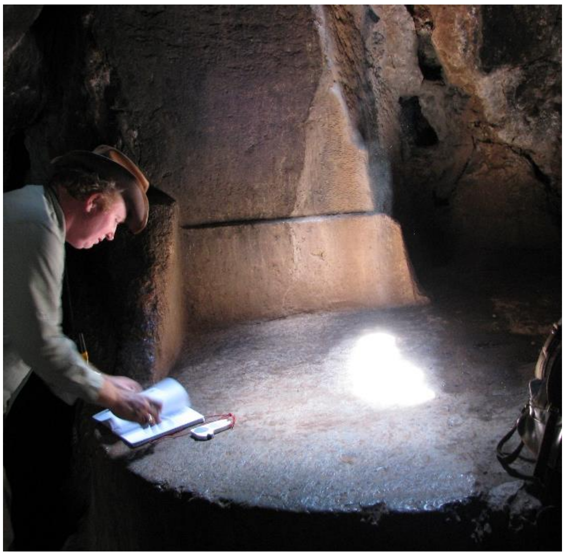


Fig. 14. Overhead Light-Tube (Credit: S.R. Gullberg). Fig. 15. Illuminated Altar (Credit: S.R. Gullberg)

Waqa 44

Waqa 44 is a smaller limestone outcropping with two carved circles showing the directions to look for the cardinal solstice and equinox horizon events. It lies near both Kenko Grande and Lacco (Fig. 16).

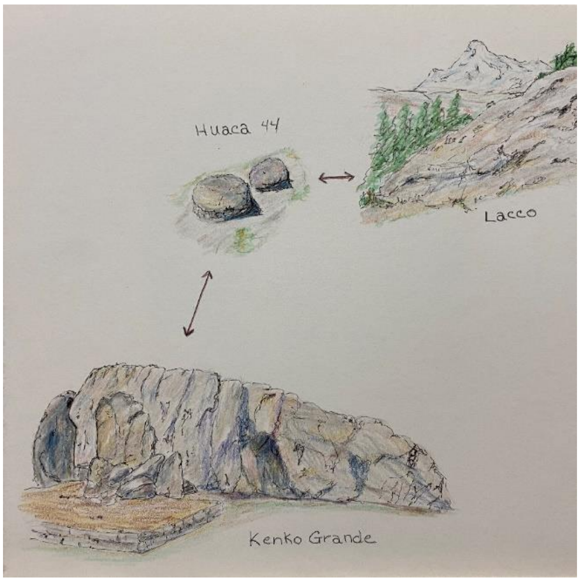


Fig. 16. Kenko Grande, Lacco, and Waqa 44. (Credit: J. Gullberg)

Lines are visualized between or across the large and the small circles and are oriented to indicate the direction to look for one of six primary solar horizon events. Figure 17 shows these lines and Figure 18 depicts the line between the two pointing to the June solstice sunrise.
JSSR – June Solstice Sun Rise, DSSS – December Solstice Sun Set, DSSR – December Solstice Sun Rise, JSSS – June Solstice Sun Set, ESR – Equinox Sun Rise, ESS – Equinox Sun Set.

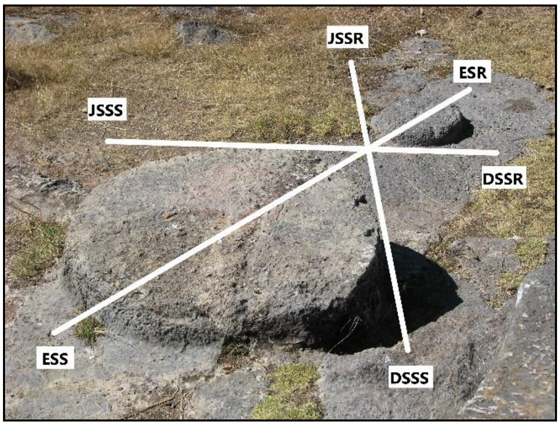


Fig. 17. Tangential Lines for Solar Horizon Events. (Credit: S.R. Gullberg). Fig. 18. Line Indicates June Solstice Sunrise. (Credit: S.R. Gullberg)

Q’espiwanka Pillars

Sixteen solar pillars are said to have once stood on the Cusco horizon but were destroyed by Spaniards following their conquest of the Incas. Beyond Cusco two survive, however, near the modern village of Urubamba and are situated high on the Cerro Saywa ridge. They have been found to mark the rising Sun at June solstice when viewed from a sacred boulder at the center of the palace of Huayna Capac, called Q’espiwanka. It has been said that these pillars validate Spanish chronicles describing the ones in Cusco that no longer exist.

Fig. 19. White Granite Boulder of Q’espiwanka (Credit: S.R. Gullberg).

The pillars are viewed from a white granite boulder at Q'espiwanka that is next to a modern chapel (Fig. 19). Figure 20 shows the two pillars on the Cerro Saywa Ridge and Figure 21 depicts the Sun rising over the right tower days before the solstice. It will continue to move further toward the left pillar by the solstice.

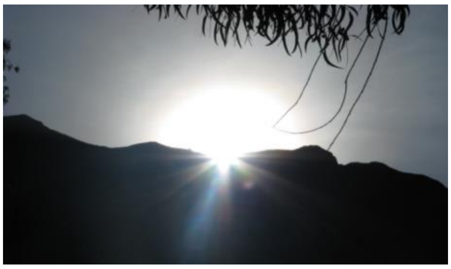


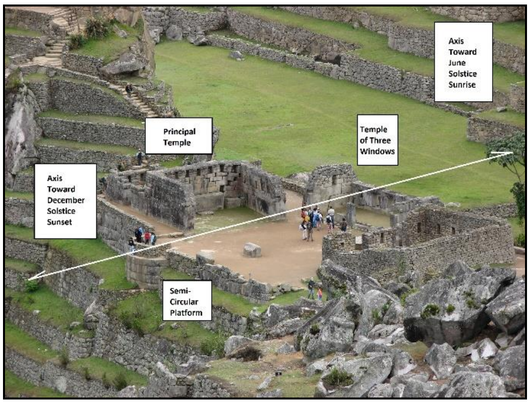
Fig. 20. The Two Solar Pillars on Cerro Saywa Ridge (Credit: S.R. Gullberg). Fig. 21. Sunrise Over the Right Pillar Days Before the June Solstice and will Continue toward the Left Pillar for the Solstice Sunrise. (Credit: S.R. Gullberg).

Machu Picchu

There is much to examine at Machu Picchu. It was never discovered by the Spaniards and thus remained largely undisturbed. The Sacred Plaza lies to the left and slightly above the llama in the photo (Fig. 22).

Fig. 22. Machu Picchu (Credit: S.R. Gullberg)

A striking example is that Machu Picchu's Sacred Plaza, the River Intihuatana deep in the gorge below, and the Sun Temple on the Llactapata Ridge all lie on the axis of the June solstice sunrise and the December solstice sunset. The image in Figure 23 is one of the Sacred Plaza and Figure 24 is one of the Sun rising over it at June solstice.



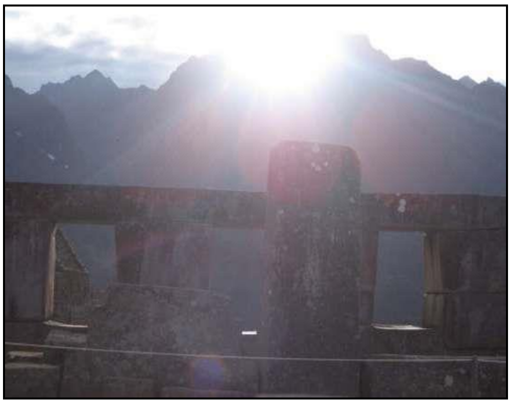


Fig. 23. The Sacred Plaza and Axis for June Solstice Sunrise and December Solstice Sunset. (Credit: S.R. Gullberg). Fig. 24. June Solstice Sunrise Over the Sacred Plaza. (Credit: S.R. Gullberg)

Figure 25 shows the Llactapata Ridge as viewed from the famous Intihuatana stone of Machu Picchu. There are more than 100 structures on the ridge totally engulfed by the dense vegetation of the cloud forest. The Sun Temple is kept clear.

Fig. 25. Llactapata Ridge as seen from Machu Picchu. (Credit: S.R. Gullberg)

Llactapata

The Sun Temple of Llactapata overlooks Machu Picchu and is oriented for June solstice sunrise (Fig. 26). The beginning of a ceremonial stone channel from the Sun Temple's main door is shown at the bottom of Figure 27.

Fig. 26. Llactapata Sun Temple (Credit: S.R. Gullberg). Fig. 27. Stone Channel Begins in Front of Door. (Credit: S.R. Gullberg)

Figure 28 looks out from that door and it can be see that the stone channel is oriented for Machu Picchu's Sacred Plaza and beyond to the June solstice sunrise. It is thought the Incas, who believed that flowing liquids could impart great energy, may have poured ceremonial fluids down this channel in an effort to reenergize the Sun and keep it from descending permanently below the horizon as it crossed the winter sky. The Incas did not want it to disappear forever and thus could have used fluids to ceremoniously impart the energy needed for it to climb in the sky again, and of course it did after the solstice. In the Southern Hemisphere the June solstice occurs in the winter when the Sun crosses the sky on its lowest path. June solstice sunrise is shown in Figure 29

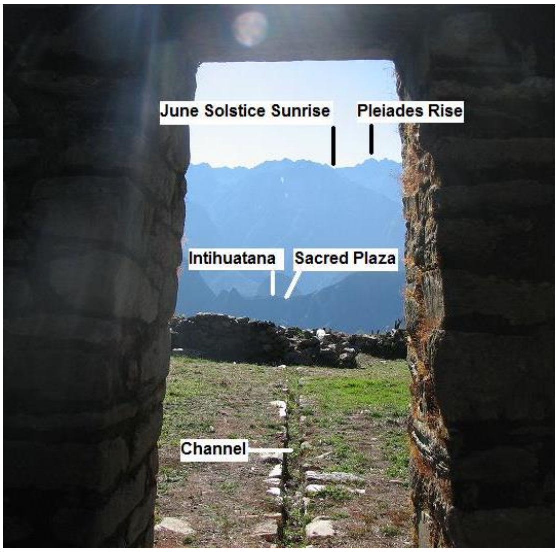


Fig. 28. Water Channel Aimed for Sacred Plaza and June Solstice Sunrise. (Credit: S.R. Gullberg). Fig. 29. June Solstice Sunrise at Llactapata. (Credit: S.R. Gullberg).

The River Intihuatana

The River Intihuatana lies deep in the gorge below Machu Picchu and Llactapata. As Figure 30 shows, it is a nicely carved stone and is the central feature of a ceremonial center lying near the Urubamba River. It also lies on the June solstice sunrise/December solstice sunset axis along with the Sacred Plaza and the Sun Temple. The three sites together form what is now thought to be a larger ceremonial complex (Fig. 31).

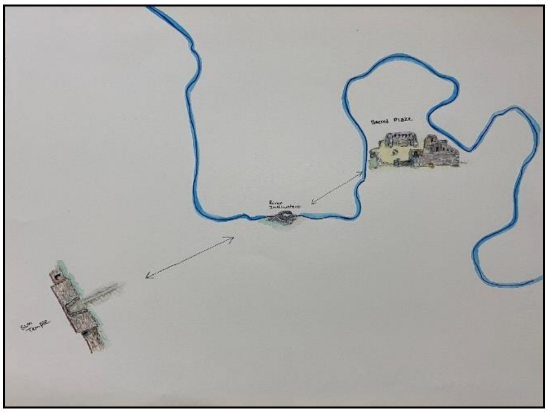


Fig. 30. River Intihuatana. (Credit: S.R. Gullberg). Fig. 31. The Llactapata Sun Temple, River Intihuatana, and Machu Picchu Sacred Plaza lie on the axis of the June solstice sunrise and December solstice sunset. (Credit: J. Gullberg)

Summary

Research shows that the Inca landscape most definitely was filled with examples of the astronomy used in their culture. Examples of light and shadow effects throughout the year, especially at times of the solstices, equinoxes, zenith suns, and anti-zenith suns, were found at many sites.

Regarding the primary solar horizon events, examples at the solstices were found to be most prominent. June solstice sunrise effects occurred most often, but December solstice sunrise orientations were a close second. Two of the Incas' primary annual festivals, Inti Raymi and Capac Raymi respectively, occurred at these two times of the year.

Cultural astronomy examples like the ones shown in this paper are fascinating and regularly captivate student interest. This can be used to help inspire them toward further study in astronomy and other sciences as well.

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Mexico
Mid-solstices or equinoxes?

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Introduction

The rise of modernism suppressed the traditional dates marking the opening and end of climatic seasons, giving way to the universal system of reckoning seasons from the equinoxes and solstices. Today, these concepts are so deeply rooted in our common knowledge that we almost automatically accept both terms as self-evident and fixed to the now recognized four seasons of the year. However, even if they appear universally understood and accepted today, they conveyed different cultural understandings and meanings even in the recent past. On numerous occasions archaeoastronomers and cultural astronomers have shown that sightlines were used when orienting prehistoric architectural structures in monuments. It seems that special care was taken in establishing their direction to some direction in the landscape or to some point on the skyline.

As extensive surveys in historical and comparative linguistics have long assessed, the names or terms for east and west usually relate to the rising and setting of the Sun (e.g., Buck 1971; Brown 1983). Those findings indirectly indicate that different peoples observed solar positions on the horizon to name cardinal directions. However, the Sun rises or sets on due east and west only twice a year - at equinoxes; its rising or setting positions vary between solstitial extremes. Thus, observing variations in the location of sunrise and sunset positions through the year and because the Sun moves fast at equinoxes and slowly at solstices, they would quickly identify solstices as extreme or turning points. On the other hand, the Sun spends more of its time at solstitial extremes, indicating the start of the reverse motion.

Both solstitial extremes keep annual periodicity, dividing the year into two halves. In addition, because solstice extremes are easily perceived and understood, they often constitute one on the frameworks of local worldviews or cosmologies, transformed into the four corners of the world. Thus the solstices may reflect either the idea of the four-directionality of space or the year's division into two halves (McCluskey 1993).

In contrast to the solstices, true equinoxes are not natural phenomena, and our astronomical definitions involve concepts that are not self-evident. Astronomical meanings of the equinox require concepts like the ecliptic, celestial equator, declination, vernal and autumnal points, and precise time measuring devices that originated in the ancient Near East, Greece, and Rome. As a product of a particular scholarly tradition, the term "equinox" raises immediate difficulties in that it may be regarded as belonging to a class of celestial phenomena identifiable from the same universal or objective perspective. Beyond western society, besides the modern astronomical meaning of the equinox, there still exist culturally varying definitions. Their identification is not an easy task. As Clive Ruggles rightly observes (1997), statistical interpretations of prehistoric orientations often drop alignments directed at sunrise on March 20, 21, 22, 23 into one bag, treating them as relating to the exact astronomically defined equinox. The absence of independent contextual data showing that the alignments were equinoctially motivated raises the suspicion that they were selected because they fit the equinox hypothesis. This tendency naturally deprives us of the opportunity to look for alternative interpretations. For example, in their comprehensive analysis of the origin of the adscription of the true vernal equinox to a canonical date of March 25, César González García and Juan Antonio Belmonte (2006) argued in favor of the use of the temporal equinox (see below) at the time of the Julian calendar reform in 46 BCE. In addition, intense archaeoastronomical investigations carried out on different continents show us that the equinox concept has not been as important and meaningful as it seems to be for our societies among many ancient and nonmodern peoples (Ruggles 1997, 2017).

Culturally defined equinoxes

Whether they are astronomical or cultural ways of defining an equinox, they all arise from the idea of determining the halfway or midpoint between the solstices (Ruggles 1997: S45-S47; González García and Belmonte 2006: 99) (see Figure 1).

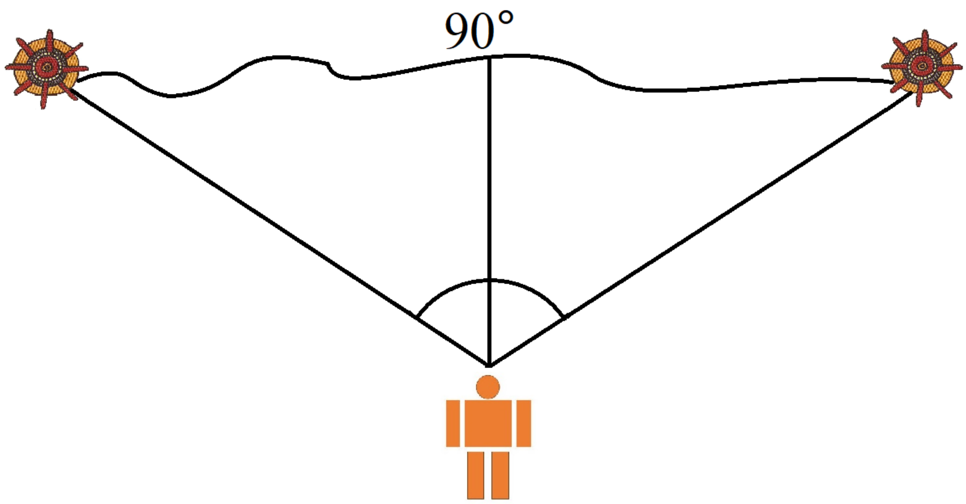

Fig. 1: Determining the halfways or midpoints between the solstices. The horizon altitude is not equal; the line in the middle shows the azimuth of 90°. Sunrise at the equinox, with a declination of 0°, can only occur when the altitudes of the horizon of winter and summer solstices and equinoxes are equal. Due to the varied horizon elevation, the true equinox sunrise occurs to the left of the azimuth of 90°. Also, the date of halfway between solstitial dates marks the sunrise position left of the azimuth of 90°.

At first glimpse, the idea of finding a midpoint between solstitial extremes is simple: observations of the rising or setting positions of the sun on the horizon are easy and entirely accurate. All observations should be made from the same fixed observation point; the spatial midpoint is naturally ascertained by bisecting the space between both solstitial markers. This method provides a relatively precise equinox date if the horizon altitudes are the same for solstices and equinoxes. However, as simple as possible, this method can yield troubles, mainly because it depends on the horizon altitudes (for more details, consult Ruggles 1997). The precision with which spatial mid-points are determined entirely depends on the configurations of a local landscape.

Another method divides the number of days that separates the solstices into two near-equal parts, 182/183 days each. This method produces the dates with declinations at around +0.5°. Supposing that the solstitial dates are correct, this method assigns the days of March 22-23 (instead of March 20-21) and September 20-21 (instead of September 22-23) to the equinoxes. This method is independent of local landscapes.
It is also possible to use gnomons (or the like devices). Its functionality differs with the geographical location. For example, in the tropics, it is helpful to find the days of zenithal passages of the Sun. In high latitude areas, its ability to produce long shadow casts provides precise directions of the solstices and midpoints between them.

Still, another method of finding the midpoint between the solstices is using a schematic or fixed 364-day calendar. Though it seems to be a coarse approximation of the tropical year, it divides seasons into four parts of 91 days each. This system places the solstitial and equinoctial dates at equidistant intervals. Pivoted upon one of the solstices, this system misses the dates of a true astronomical equinox by one or two days.

The best way to name equinox would be to use emic terms derived from indigenous or ancient traditions rather than Western terms. Since we usually lack them, especially for prehistoric peoples, it would be better to adopt the name of a mid-solstice day (cf. González García and Belmonte 2006: 99). However, as long as the origin of those culturally defined equinoxes is not fully known, any attempt to arbitrarily define it will be subject to risk.

Equinox at Chichén Itzá

Perhaps one of the best-known ancient monuments associated with the vernal equinox is the Temple of Kukulkan at Chichén Itzá, in the Mexican state of Yucatan. As a UNESCO World Heritage Site, Chichén Itzá is one of the most popular destinations, partially because it is near the seaside resort Cancun and other popular tourist destinations located on the Riviera Maya. Though regularly visited 365 days a year, the site observes the increasing number of visitors around the vernal equinox. Each March 21, they come to witness the image of the Descending Feathered Serpent, projected in the form of light triangles on the staircase balustrade annexed to the northern side of the pyramid (Carlson 1999).

During the equinox sunset, when the Sun illuminates the Pyramid of Kukulkan, it casts seven triangles of light and shadow that seem to descend along its northeast stairway to the great, stone-made ophidian head at the foot of balustrade. Thus, both the head and triangles of light together, when bathed with solar light, appear to create a body of a giant descending Kukulkan Serpent. The impression it causes to each visitor demands comments on whether this effect was intended or occurred accidentally (figure 2).

Fig. 2: The Descending “Serpent of Light and Shadow” phenomenon, projected onto the balustrade of the northern stairway of the Pyramid of Kukulkan at Chichén Itzá. Photo: S. Iwaniszewski, March 15, 2020.

The Pyramid of Kukulkan, built between 900 and 1000 CE, has long been interpreted as an architectural model of Maya cosmology. It is a typical radial pyramid consisting of nine terraces or bodies, referring to nine celestial levels. Moreover, it has four stairways on four sides of the pyramid, each containing 91 steps, as first noted by sixteenth century Spanish bishop and chronicler Diego de Landa (1978). This may reflect the idea of the computational or the 364-day year known from the almanacs from the Mayan codices and computations displayed on some monuments.

As the light-and-shadow effect at Chichén Itzá is visible a few weeks before and after the vernal equinox (Šprajc and Sánchez Nava 2018), it is difficult to assert that the true equinox (the days of March 20 or 21) was the date initially intended by the builders.

This unique light-and-shadow phenomenon captures the imagination of thousands of visitors, reviving the old idea of the Maya mystique (Webster 20006): a peaceful Maya society led by priest-rulers who developed astronomy and mathematics. Although almost two million tourists visit the site each year, they know little about the ancient Maya. So, while watching the event, they fill gaps in their knowledge with modern expectations and beliefs. In this case, impressed by the event, they may feel they are witnessing something profound and vital to the ancient Maya. Furthermore, as the hierophany produces a tangible contact with the supposed forgotten Maya knowledge, the visitors associate what we know about the Maya ancient astronomy with the date of the vernal equinox. This way, thousands of visitors may reinforce their impression that the Maya knew how to determine the spring equinox date precisely

Equinox at Cuicuilco

As previously noted, due to the uneven motion of the Sun, the temporal midpoint between the solstices misses the true equinox by one or two days. Such is the case for astronomical alignments of the Cuicuilco round pyramid. Cuicuilco once was an important cultural center in the southern Basin of Mexico, but today it is virtually lost within the cityscape of modern Mexico City. The 23-meters high round pyramid was designed and built during the latter half of the 1st millennium BCE. Two ramps and monumental staircases annexed to the structure's body on its east and west sides enabled access to the top of the pyramid. Both staircases display rough east and west directions. As observed from the top of the pyramid, the rising Sun aligns with Cerro Papayo, a prominent feature on the eastern horizon (Figure 3). Thus, the days when the Sun rises over the summit of Cerro Papayo today occur on March 22-23 and September 21-22 (Šprajc 2001: 163-173). Both dates are equidistant between the two solstices (from winter to summer). Likewise, using a schematic, 364-day calendar, it is also possible to count 91 days from the winter solstice day to arrive at March 23.

Fig. 3: Sunrise over the Mount Papayo, from the top of the round pyramid at Cuicuilco. (Credit: S. Iwaniszewski, March 23, 1997)

Cultural appropriation of equinox

The true or astronomical equinox is undoubtedly a modern phenomenon. It may sound a little bit ironic that modern pilgrims today visit archaeological sites to witness and recover ancestral wisdom molded in the guise of contemporary astronomy. However, as John Carlson (1999) noticed, March 21 causally became the date of pilgrimages to Chichen Itza. Long before the spring equinox was perceived as a Chichen Itza celestial hierophany, March 21 became the birthday anniversary of Mexico's nineteenth-century President Benito Juárez (Carlson 1999). As a result, March 21 was marked as a Mexican national holiday day for a long time, with numerous institutions, schools and businesses closed. In the 1980s, slowly, March 21 got a reputation as a particular date on which non-indigenous people, New Agers included, started to visit archaeological sites. They went on a short, one-day pilgrimage to ancient sites to perform healing practices (a blend of traditional and New Age medicines) and charge with energy (spring equinox as a moment proper to receive life-giving power from the rays of the Sun). Today, on March 21, the sites are also visited by the Mexicannes (Mexicanidad, Mexicayotl), countercultural identity groups seeking to restore Mexican (=Aztec) identification from national heritage and indigenous traditions (Figure 3). Paradoxically, today Cuicuilco is visited on March 21 to celebrate the western science equinox, while on March 23, it still displays native, mid-solstice alignments.

Concluding remarks

Although people see the same sky, their perceptions and conceptualizations of what they perceive are culture-dependent. As a cultural product, celestial lore is at the same time closely integrated with a particular society. The study of indigenous, non-Western astronomies may offer us important insights into cultural diversity and different ways of perceiving the skies. Since the topic of equinoctial or mid-solstitial days brings together scholars, indigenous specialists, and the general public, it welcomes the variety of understandings of the sky past and present, West and non-West.

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