

## KEPLER, SCIENCE AND PSEUDOSCIENCE. ASTRONOMY AND ASTROLOGY.

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### A BRIEF OVERVIEW OF KEPLER'S LIFE

Johannes Kepler is mostly known as a German astronomer and mathematician (27 December 1571 – 15 November 1630).



Kepler

He was born in the Free Imperial City of Weil der Stadt in Baden-Württemberg. His grandfather had served as Mayor of the city, but at the time of Johannes' birth, the family was already in decline. His father was a mercenary and is thought to have been killed in a battle in the Netherlands, when Johannes was 5 years old. His mother, an innkeeper's daughter, was interested in herbalism and, later on in her life, was accused of witchcraft. Born prematurely, Johannes was a sickly child, although he impressed travelers staying at his grandfather's inn with his mathematical abilities.

From a young age, Kepler showed great interest in celestial phenomena and objects. He observed the Great Comet of 1577 at the age of 5 and the lunar eclipse of 1580 at the age of 9.

Suffering from smallpox as a child left him with weak vision.

His first schooling was religious, as his family intended him to become a minister and, thus, sent him to a Protestant monastery. However, in 1588, he enrolled at the University of Tübingen, where he studied Theology, Philosophy, Mathematics and Astronomy. At this University he had the opportunity to become acquainted with the revolutionary ideas of Copernicus. He accepted the heliocentric system, which he supported both scientifically and theologically, presenting innovative theological views. While still a student, he gained a reputation as a brilliant mathematician and skilled astrologer.

When he was concluding his studies, Kepler was offered a teaching position at the Protestant School of Graz, in present-day Austria. At this school, he taught Mathematics, Astronomy and Astrology.

In April 1597, he married a young lady named Barbara Müller, who died in 1611, leaving Johannes with two orphan children, as well as a child from Barbara's previous marriage.

In 1598, the local ruler of the region, the young Archduke Ferdinand of Hapsburg, decided to ban Lutheranism. Kepler's school, along with all other Protestant institutions, was closed down. Kepler was given two choices: either to embrace Catholicism or to leave Graz. He wanted to return to Tübingen, but was not accepted because of his views on the heliocentric system and the way he used strange theological reasoning to support them.

In December 1599, the renowned Danish astronomer Tycho Brahe wrote to Kepler, inviting him to become his associate at his home outside Prague, where Brahe was employed as Imperial Mathematician of the Hapsburg Court. Kepler was under

pressure to leave Graz and so he accepted the invitation and met Brahe in the year 1600.



Brahe had made long-term observations and calculations of planetary positions, but was unable to formulate a theory about the motion of the planets. He was counting on the help of the brilliant Kepler.

However, their association was brief, as Brahe died on 24 October 1601.



After Brahe's death, Kepler was appointed Imperial Mathematician, a position he kept under three different emperors.

As Imperial Mathematician, he undertook the task of preparing the renowned "Rudolphine Tables".

Presented with the enormous volume of Brahe's observational data, Kepler worked for many years in order to formulate his laws. His theory on the solar system was completed in 1605 and published in 1609 in his book "*Astronomia Nova*", which includes his first and second laws.

In 1612, following the death of the Emperor and in order to avoid religious tension, he became a provincial mathematician in Linz.

In 1615, he married Susanna Reuttinger, with whom he had several children.

In 1619, he published "*Harmonices Mundi*", a multi-volume Astronomy book for students, which included, among other things, his third law.

In 1621, he published a seven-volume book titled "Epitome of Copernican Astronomy". This work made a significant contribution towards the acceptance of the heliocentric system in the following century.

In 1627, Kepler completed the Rudolphine Tables. This work accurately predicted future positions of the planets and rare astronomical events, such as the transit of Venus in 1631.

Kepler died of fever in Regensburg, Bavaria, on 15 November 1630. In 1632, his tomb was destroyed by the Swedish army during the armed conflicts of the Thirty Years' War.

## KEPLER'S VIEWS

### HIS RELATIONSHIP WITH RELIGION AND TRANSCENDENTALISM IN GENERAL

Kepler's philosophical views were rather an amalgam of platonic, Christian and modern scientific beliefs. He claimed that "Creation" operates as a single mathematical and deterministic entity.

Kepler was a Christian, on principle and, specifically, a Protestant. At the age of twenty, he wished to become a minister. Nevertheless, he had a peculiar perception of religion. The following view confirms this idiosyncrasy: Since Divinity is Triune, the Universe was created in its image. The Sun corresponds to the Father, the stellar sphere to the Son and intervening entities, including the planets, to the Holy Spirit.

Kepler supported the Copernican system with his own original theological claims, several of which upset theologians.

Many of Kepler's 20<sup>th</sup> century biographers state that he was involved with astrology only for the purposes of livelihood, thus insinuating that he did not really believe in it; however, 800 horoscopes and natal charts created by Kepler have survived.

Kepler had a unique view of both religion and astrology. He thought of himself as an "intermediate third", thus being positioned between critics and advocates of astrology. His views can be found in his works *Harmonice Mundi* and *De Fundamentis Astrologiae Certioribus* ("Concerning the More Certain Fundamentals of Astrology") (1601). His views against astrology were expressed during the final decade of his life.

All the above are clarified when examining some of his actual pursuits.

### CONNECTING THE STAR OF MATTHEW THE EVANGELIST WITH A CELESTIAL PHENOMENON

Kepler was perhaps the first to claim that the Star of Bethlehem was a celestial phenomenon. He reached this conclusion through a combination of mathematical calculations, astronomical observations, **as well as astrological conclusions**. Specifically, he assumed that this was a rare **planetary conjunction** in the constellation of Pisces in 7 BC, according to the calendar used at his time.

A planetary conjunction is the phenomenon of the closest approach, usually of two planets, as seen from their perspective on Earth.



Planetary conjunction



In 1601, before discovering his laws, Kepler had predicted a conjunction of planets Jupiter, Saturn and Mars in the constellation of Sagittarius, which would occur in November 1603 and would last for approximately two months.

Those interested in astronomy awaited the event to take place so as to check Kepler's predictions. Those interested in astrology also eagerly awaited the event for their own reasons, presented below:

According to astrology, when planets Jupiter, Saturn and Mars are close to each other, they form the so-called "planetary triangle of fire". This specific conjunction was of particular importance, because it would take place in the constellation of Sagittarius, one of the three constellations forming, along with Leo and Aries, the fiery triangle of constellations. According to Arabic astrology, when a planetary triangle of fire is formed, a comet appears. Therefore, if Kepler's predictions concerning the positions of the planets were verified, astrologers expected the appearance of a comet.

The planetary conjunction did, in fact, take place and the planets were then positioned so as to form a triangle, but, to the disappointment of astrologers, no comet appeared.

However, on 8 December 1604, a more remarkable and rare astronomical event took place. In the constellation of Ophiuchus, not too far from the planetary conjunction, a supernova known as SN 1604 occurred.

A supernova is a stellar explosion. When the mass of a star exceeds a certain limit during the final stage of its life, the star explodes and its brightness increases by hundreds of millions of times.

The verification of the predicted planetary conjunction, as well as the appearance of a supernova, excited Kepler's imagination, who, following the discovery of the laws of planetary motion, calculated that the three aforementioned planets had entered a conjunction in the constellation of Pisces in 7 BC and claimed that this phenomenon was the Star referred to by Matthew the Evangelist.

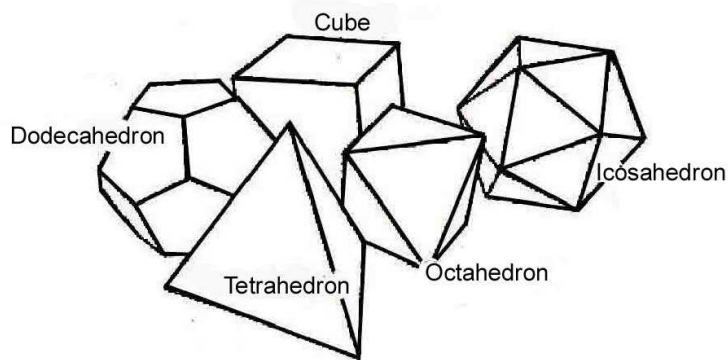
According to astrology, Saturn was the planetary patron of the Jews, Jupiter of kingship and good fortune and Mars of strength. The constellation of Pisces depicted Palestine on the firmament, i.e. the arch of the heavens. Therefore, Kepler claimed that, according to Astrology, an important Jewish king must have been born in Palestine in 7 BC.

*The astrological references above have absolutely no scientific validity. They are mentioned for historical reasons and so as to present the topic elaborated on in the most comprehensive way.*

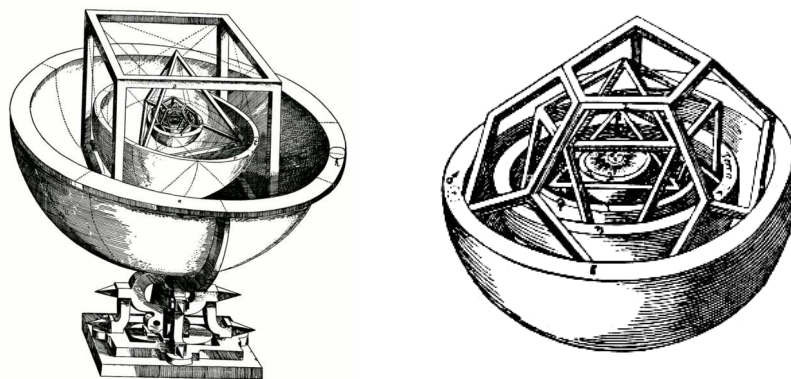
#### THE THEORY OF HIDDEN DIVINE HARMONY AND THE FORMULATION OF KEPLER'S LAWS

In 1596, Kepler authored a book titled "*Mysterium Cosmographicum*" ("The Cosmographic Mystery"), in which he attempted to reveal the mystery of the hidden harmony, which would, in turn, reveal the thoughts of God as Creator.

Kepler posited the question of why there were six planets (the number known to that date) and no other number. A firm believer in absolute divine harmony, he believed that this was due to the fact that there are only five regular polyhedrons. The inscribed and circumscribed sphere of each polyhedron includes the orbits of two successive planets. Therefore, as there are only five regular polyhedrons, only six planetary orbits may exist. In his view, these orbits should be the maximum circles of the six spheres that surround the five regular polyhedrons, if placed one inside the other.



Regular polyhedra



Keller's model of solar system (1600)

In other words, Kepler formulated a theory based on the medieval perception of the ordering of the world into "impure" and "pure" territories. In the pure territory, everything should be as perfect and harmonious as the perfect polygons.

The tenability of Kepler's reasoning had to be verified by accurate calculations of planetary positions, which should have taken place in the span of some decades.

At that time, the renowned Danish astronomer Tycho Brahe had kept a record of such calculations, which were the most accurate ones before the discovery of the telescope and their accuracy is impressive even to this day.

After Brahe's death, Kepler managed to gain access to his records. In a letter dated 1605, Kepler writes: "I confess that when Tycho died, I took advantage of the absence of his heirs and took the observations into my care or, perhaps, usurped them".

However, upon studying the records of Tycho Brahe, Kepler was greatly disappointed, as these did not prove that the orbits of the planets form perfect circles, and dedicated much time to ineffective efforts so as to harmonise Brahe's observations with circular planetary orbits.

Trapped by the metaphysical credence to the perfection and harmony of the sky, Kepler found it impossible to formulate laws on planetary motion.

Today, we accept that the laws of physics and chemistry apply unchanged in every part of the Universe. On the contrary, during the Middle Ages, the world was ordered according to a strict hierarchy: the Earth was at the centre and the world divided into the impure sub-lunar territory, where all living and non-living things were subject to decay, and into the territory beyond the moon, where entities were pure, immortal and perfect (perfect circles, perfect polygons, etc.).

Although Kepler accepted the heliocentric rather than the geocentric system, he believed in the perfection and harmony of celestial objects and phenomena beyond Earth.

He found it hard to abjure his metaphysical faith in such perfection and accept conic sections (which include ellipses) as planetary orbits.

**The laws of planetary motion were formulated when Kepler decided to try a mathematical standard (geometrical) other than that of perfectly circular orbits.**

He focused his efforts on the planet Mars, as Brahe had told him that the positions of this planet were harder to harmonise into a circular orbit. Kepler was foresighted and brilliant enough to apply his own geometrical analysis, which only required the ratio of the distance of planets from the Sun and not their precise distances, which were unknown.

#### KEPLER'S LAWS

**Law of elliptical orbits:** Planets orbit the Sun on an elliptical orbit, with the Sun at one of the two foci.

**Law of equal areas:** The radius of rotation (the line joining a planet to the centre of the sun) sweeps out equal areas during equal intervals of time.

**Law of periods:** The squares of the orbital periods of planets are directly proportional to the cubes of the semi-major axis of their orbits. The proportionality constant is the same for all planets.

PLANET	ORBITAL PERIOD (p)	p <sup>2</sup>	DISTANCE IN AU (d)	d <sup>3</sup>	p <sup>2</sup> /d <sup>3</sup>
Mercury	0.24	0.058	0.39	0.059	1.00
Venus	0.61	0.372	0.72	0.373	1.00
Earth	1.00	1.000	1.00	1.000	1.00
Mars	1.88	3.534	1.52	3.512	1.01
Jupiter	11.68	136.422	5.20	126.506	0.99
Saturn	29.50	870.250	9.54	868.251	1.00

#### THE IMPACT OF KEPLER'S LAWS ON ASTROLOGY

According to astrologists, the positions of the planets at various points of the zodiac cycle, their conjunctions and retrograde motions predict future events on Earth.

On the contrary, in astronomy, such phenomena are of no particular importance, as they are due to the relevant positions of the Earth and other planets during their orbit around the Sun.

Using these laws, astronomers could determine the position of planets in the sky both in the future and in the past; until then, they had only been able to make short-term calculations of planetary positions.

Using Kepler's laws, we can go back in time, so to speak, and examine if these views coincide with the same or, at the very least, similar events as those predicted by astrology. Thus, we can check astrological predictions and prove their insubstantiality.

**Therefore, Kepler's laws were the strongest scientific blow against astrology.**

*However, it is known that the first scientific blow against astrology had been made by Copernicus, who had removed the Earth from the centre of the world, essentially removing the planet from the focal point of presumed cosmic influences.*

*The first legal condemnation of astrology came from Colbert, a minister of the French King Louis XIV. In 1666, Colbert banned the teaching of astrology at French Universities by legal decree and many countries, subsequently, followed suit.*

**In formulating his Laws, Kepler did not intend to wound the prestige of astrology. On the contrary, he believed that the discovery of his laws would add prestige and scientific merit to astrology. Through his laws, Kepler hoped to be able to improve astrological predictions, which did not satisfy him.**

#### NEGATION OF BELIEFS DURING KEPLER'S LIFE

Kepler's Laws and Galileo's observations established the concept of the heliocentric system.

Elliptical orbits, as opposed to circular ones, vitiated the view of perfection of the Universe (as perceived at the time).

The supernovas that occurred in 1572 and 1604 were yet further proof that the Aristotelian “supralunar” world was not constant.

Astrology began to decline.

#### DEFINITION OF SCIENCE

For as long as Kepler was fixated on scientifically heretical views, he could not reach the scientific results he aspired to achieve. He did so when he began thinking freely.

By assessing and evaluating Kepler’s efforts and objectives, we can draw useful conclusions on the definition of science.

The following apply (or mostly apply) to natural sciences:

**Science is:**

*A set of observations, assumptions, theories, mathematical models, predictions and verifications that can describe and interpret part of the natural world and predict the occurrence and development of phenomena.*

*Science must meet the following conditions:*

- 1. It must allow for partial or whole refutability (and, by extension, be anthropogenic rather than divinely inspired).*
- 2. Theories must be verifiable.*
- 3. The same experimental procedures must lead to the same results.*

#### CLARIFICATIONS OF THE DEFINITION

Some may wonder why the word “**experiment**” is not included. Experiments are contained in observations and verifications. They may be used for better observation at a different scale or for the verification of theories. The “observations and verifications” include experiments in physics and chemistry, as well as astronomical observations.

**Prediction:** Every natural science makes predictions within its jurisdiction. Physics can predict the speed at which an object travels to reach the ground when released from a specific height. Chemistry can predict whether a chemical reaction will take place, the quantity of its products and the precise sequence in which a phenomenon occurs. Astronomy can predict eclipses.

**Refutability:** The power of science is mainly due to its refutability, which allows for the possibility of continuous improvement of scientific views.

#### A CONCISE HISTORY OF ASTROLOGY

##### **Birth and spread**

In 700 BC, the Babylonians introduced the zodiac cycle and identified their gods with the Sun, the Moon and the planets.

This innovation gave birth to astrology as we know it today - more or less - because the Babylonians believed that the positions of the planets in the sky and the qualities they ascribed to each corresponding god suitably supervised and affected humans.

On the contrary, during the same period, i.e. 700 BC in the territory of modern-day Hellas, the planets were not named after gods. Homer described planets according to their visual qualities, e.g. Stilbon (Στίλβων), Eosphorus (Εωσφόρος), Hesperus (Έσπερος), Pyroeis (Πυρόειος). It was later than the 4th century that the planets were named after corresponding Hellenic gods and these names continue to be used today (Ερμής Αφροδίτη Άρης Δίας and Κρόνος), known today as Mercury, Venus, Mars, Jupiter and Saturn, respectively).

Following the conquest of Babylon by Alexander the Great, astrology spread throughout the territory of Greece. In approximately 280 BC, the Babylonian Berossus founded a school of astrology on the island of Kos. During the same period, a similar school was founded in Alexandria by Manetho, a priest of Serapis.

During the Hellenistic era, certain innovations were introduced to astrology:

1. The main innovation was the introduction of the belief that the zodiac constellation ascending at the time of a person's birth, named the horoskopos ("hour-marker") for this reason, had a major impact on the life of that person. Until then, it had been believed that only the zodiac constellation through which the Sun passes on the day of one's birth played a major role.

2. The introduction of geometrical shapes to the zodiac cycle.

3. Greek astrologers Antipater and Achinapolus raised the question of whether the horoscope should refer to the moment of conception or the moment of birth, an issue that is still one of contention among astrologers.

Astrology gained many followers, but, as expected, also had many opponents from the sphere of intellect, since astrology came into conflict with most schools of philosophy. In 220 BC, the philosopher Carneades posed two questions which have still not been answered. He asked: Firstly, how is it possible that two twins, who have the same horoscope, could have different destinies and how can the son of a king and the son of a slave, both born at the same time on the same day, have different destinies? Secondly, why don't all the people killed in a battle have the same horoscope?

The Romans exiled astrologers. This measure might seem primitive and barbaric, but the Romans imposed a legislative system, which was pioneering for its time, that imposed control on various professionals and stipulated their punishment in case they deceived their clientele. The Roman state forced astrologers to submit certain predictions in writing and, after a certain period of time, they verified to what extent these occurred – and as these predictions could not be verified, astrologers were punished by exile. In fact, certain astrologers made sure they went into hiding on the day their predictions were to be checked. However, this fact convinced their naïve followers that astrologers were charlatans. Thus, astrology essentially became extinct in the ancient world.

In 640 AD, the Arabs conquered Alexandria and incorporated the astronomical and astrological knowledge of Hellenistic Egypt, as mainly recorded in written documents, into their culture. It was through the Arabs and via Spain that astrology spread throughout Europe approximately 1,000 years after being eradicated. Astrology came into its own during the Renaissance, when there was a trend for re-examining everything, without prejudice. Pope Leo X established a professorship of astrology at the Papal University and his example was followed by nearly all top educational foundations in the countries of Christian Europe.



### **Description of astrology as a pseudoscience**

The first general scientific condemnation of astrology came from Copernicus, who removed the Earth from the centre of the World and thus, essentially, removed the planet from the focal point of presumed cosmic influences.

The second and more substantial scientific condemnation of astrology came from Kepler, because using his laws, i.e. the laws of planetary motion, we can look back to the past and examine whether specific planetary positions coincide with the same or even similar events as those predicted by astrology. Thus, we can check astrological predictions and prove their insubstantiality.



The first legal condemnation of astrology came from Colbert, a minister of the French King Louis XIV, who issued a decree removing astrology from the activities of the French Academy and banning the teaching of astrology at French Universities. Thus, astrology was permanently rejected from the field of science.

### **Brief argumentation**

The theoretical basis of astrology can easily be proved to be unfounded, while its arguments can easily be checked and rejected by simple reasoning and, of course, by checking astrological predictions and using statistics.

Indicatively:

1. Stars and other celestial bodies of a constellation are not located at the same distance, only in the same area of the Sky, i.e. from the perspective seen from the Earth. A constellation is part of the “arch of the heavens”, i.e. part of an imaginary entity.

2. The Zodiac constellations through which the Sun passes on specific dates in our age do not coincide with the position of the Sun on the same date in antiquity, due to the precession of the Earth’s axis of rotation. Specifically, if someone was born on October 29, 1960, they would be characterized by astrologers as Scorpios, because on that date two thousand years ago, the Sun was in the constellation of Scorpio. However, on the same date in our age, i.e. since a few centuries ago, the Sun has been in Libra. This argument concerns the positions of the Sun.

3. However, in order to determine the positions of the planets in the zodiac cycle, astrologers take the observations of astronomers into consideration, i.e. they accept the positions of the planets as they are today and not as they were 2,000 to 2,500 years ago. After all, they cannot determine the positions of the planets on corresponding dates in antiquity.

4. In order to determine the horoscope, certain people take into consideration the contemporary positions of the Sun, while others pursue laughable calculations such as asking: “Is there another Libra in the family?”

5. The introduction of planets discovered by telescope (Uranus, Neptune, Pluto) into astrology is not in harmony with the principles of astrology, as the names given to these planets by the scientific community bear no relation to the qualities ascribed to them by astrologers. For example, astrologers ascribe qualities related with Hades to the planet Pluto, due to its name, despite the fact that such criteria were not taken into consideration when the scientific community named this planet.

6. The gravitational impact of even large planets such as Saturn, Uranus and Neptune on a newborn is obviously smaller than that of the largest object in the room where the birth takes place and clearly even smaller than that of the obstetrician (the power of gravity is inversely proportional to the square of distance).

7. Furthermore, the gravitational impact of Pluto, the mass of which is just two-thirds that of the moon and the distance of which from the Earth is enormous, is obviously smaller than that of the large satellites of the planets Jupiter and Saturn and most asteroids.

8. The discovery of Eris, a body larger than Pluto, as well as the “striking” of Pluto from the “club” of major planets by the International Astronomical Union, created confusion among astrologers, as seen in their numerous and conflicting publications and other references. On the contrary, for Astronomy, the characterization of Pluto as a “dwarf planet” is of no particular significance, since it is still governed by the same laws of celestial mechanics. This took place for reasons of better classification and more systematic study of the planets and bodies orbiting the Sun in general.

In conclusion, the logical proof presented above, which requires certain knowledge of astronomical concepts, is hardly necessary in order to prove that astrologers are charlatans. The verification of the actual occurrence of predictions and the use of statistics are catalytic factors to this end. Indicatively:

1. It is proven from the archives of Courts recording cases of divorce that individuals belonging to “compatible” astrological signs and individuals belonging to “incompatible” astrological signs get divorced at the same frequency rates.

2. Individuals killed during holiday weekends (the numbers of which are, sadly, high in our country), as well as their 1st degree relatives, are distributed throughout the spectrum of times and dates of birth and, thus, cannot be grouped under specific signs or horoscopes so as to justify any adverse influence.

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