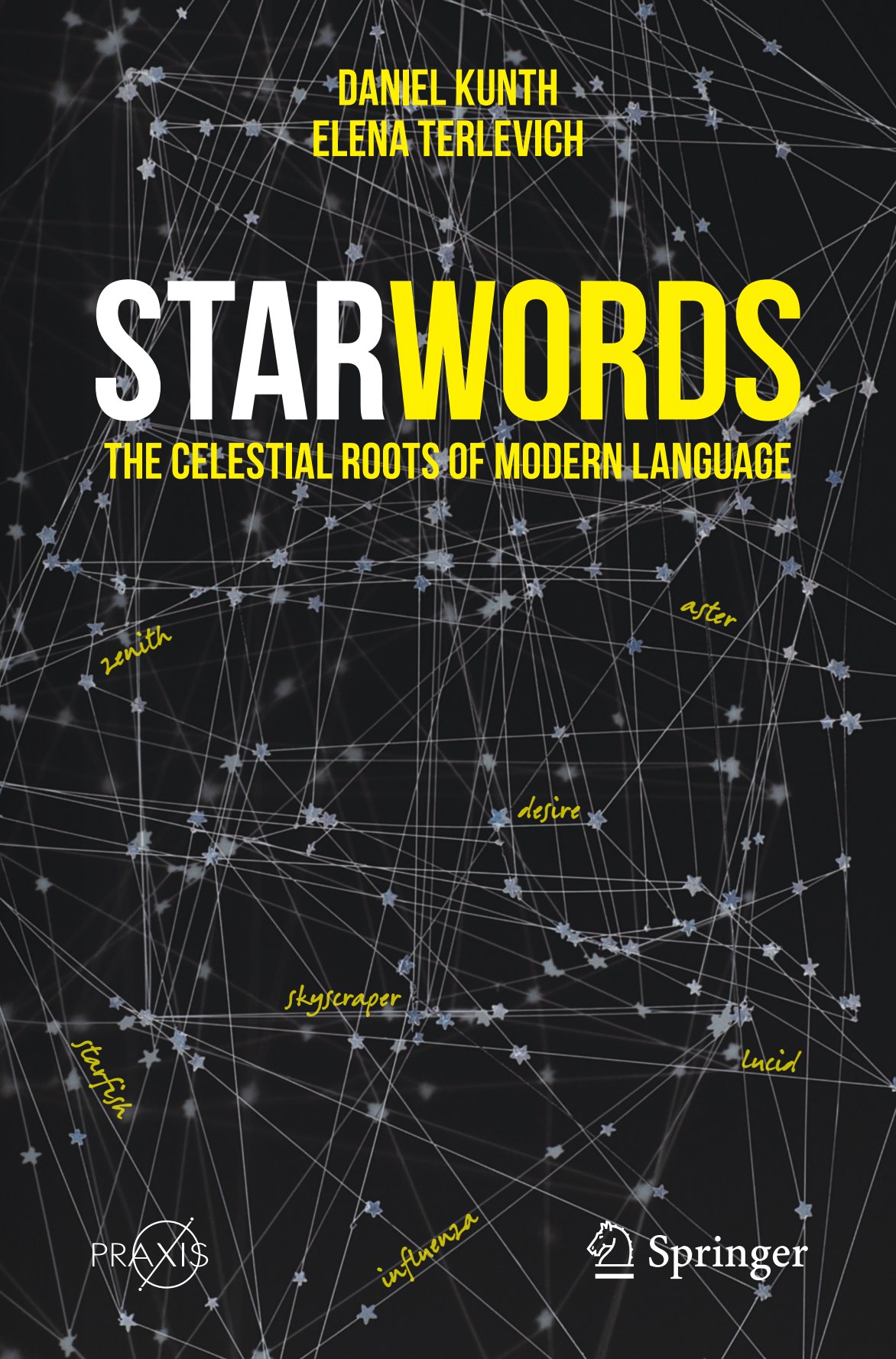
DANIEL KUNTH
ELENA TERLEVICH

STARWORDS

THE CELESTIAL ROOTS OF MODERN LANGUAGE



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Daniel Kunth • Elena Terlevich

StarWords

The Celestial Roots of Modern Language

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Foreword

Sky words are a kind of response to the myth of the Tower of Babel: God, annoyed by humanity's pride, which set out to build a tower whose height should be a challenge to deity, obliges men to speak mutually incomprehensible languages, so that they no longer understand each other and are no longer able to pursue this gigantic project. The words of the sky, on the other hand, come from all the civilisations that have scrutinised the firmament that surrounds us. In this celestial glossary, we will find words of Greek or Latin origin and precise references to the ancient mythology so well described in Ovid's Metamorphoses. The Arab world brings many words to astronomers: nadir, zenith, Betelgeuse, Aldebaran…, which we will of course find in this text. But the story does not end there: the sailors who accompanied Magellan on his voyage to the southern hemisphere named new constellations visible in the southern sky. This is how the constellations of the Painter, the Coachman and the Fly, came to be known. The word supernova, which designates an explosive star, comes from the title of Tycho Brahe's book, who observed such an event in 1572. Closer to home, the acronyms "quasar" and "pulsar" were coined, the former in 1960 and the latter in 1967. The colourful naming of the "Big Bang" was introduced by Fred Hoyle, a strong opponent of the model, as he intended to mock the new theory in the early 1950s on the BBC. In short, sky words come from many different languages and have been shaped at different times since antiquity.

In fact, as the book shows very well, we are not content to simply use the different words of the sky, we play with them, we make them rhyme, we even go as far as making puns. Celestial lexicographers are often facetious: a black hole is not a hole and it is obviously not black. The Big Bang is neither big nor

bang. In spite of, or because of these subliminal jokes, we identify ourselves quite easily in this composite and timeless glossary.

There is a long tradition, illustrated by people as diverse as Boris Vian, Raymond Queneau, Georges Perec, the members of the French Oulipo movement, Raymond Devos, Michel Audiard, Serge Gainsbourg and even Bobby Lapointe, who play with words as much as they use them. But not only them, Oulipo has reached the Anglo-Saxon philosophy and culture as exemplified by various authors from Swift and Sterne, from Lewis Carroll and Edward Lear and even James Bond to Ludwig Wittgenstein and Joe Brainard. Daniel Kunth and Elena Terlevich have followed this prestigious lineage and make the words of heaven available to all those who not only want to understand them but also to laugh or smile at them. Humour is not confined to our narrow Earth. It sets the vast sky ablaze.

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France

Jean Audouze

Preface

A Japanese haiku says: "I saw a wild flower. When I knew its name, I found it more beautiful". The same could be said of the stars. It is the whole relationship of words to things that is inscribed in this oriental wisdom.

We learn about words in many ways, through our encounters, our conversations, our readings. They are part of us. They pass through our mouths and our pens. They accumulate in our brains. People die, civilisations disappear, but words, like light weightless clouds, continuously circulate and change. They pass down from one generation to the next, witnesses of the time in which they were born, sometimes preserved by subtle historical references, others vaguely keeping the initial elusive relic of their original meaning.

The words of astronomy, because of the breadth and universality of their subject matter, are particularly rich in this respect. The presence of the stars in the sky is perceived by all humans (especially before the light pollution due to urban lighting). It has accompanied the birth and evolution of our languages.

It is no wonder that the words that describe the sky are found in a considerable number of everyday expressions, on all continents as well as in the mythologies and holy stories of all traditional cultures. This book offers us the fine pleasure of presenting and discovering a number of unexpected references and correspondences in the fertile ground of words that we pronounce without often knowing what their origin evokes. Thanks to this work, we will no longer use them in the same way.

Hubert Reeves (1932–2023)

Introduction

The sky always appears as a naked and singular beauty. The same crowd of diverse and contradictory desires have crossed ages and cultures. For hundreds of thousands of years, we have contemplated the firmament, perplexed or in awe.

Desires to fly are compelling. Infinity makes people dream, arouses sometimes fear, sometimes respect, invites us to travel and to explore endlessly without limit.

The sky remains silent. It delivers only scarce messages, always coded. Only the astral scintillations remain accessible to our eyes. Yet humans have not resisted for long the temptation to read the sky, not as in a book but as in a mirror, only to discover our own expectations.

What about today? We have questioned and even explained the heavens through a double antagonistic narrative: religious tales are prompt to tell us how the biblical events will lead to man's redemption, while scientific narratives give the Universe a beginning and a development in which our history has gradually emerged in the course of slow evolution.

As our fellow astronomers, we have set ourselves the goal of understanding how this world has become so complex over time. On the other hand, we were careful not to decide on the primary causes: where did this concentrated cosmos which we call the Big Bang comes from? Up to now, no one can say with certainty … Simply, it was not, and now it is!

Freedom undoubtedly comes from this shadowy part. The great mystery of this shattering birth remains a chance offered to the dreams of mankind: each poet, artist or philosopher is free to believe in a different hypothesis of the origin of the world, or to invent their own. Science standing tells us "I do not

know what preceded the beginning, but I do not despair of understanding it", and adds "I know only a little of what followed and what will be tomorrow".

In any case, it is not surprising that our postures, our dreams and our gestures retain the mark of these renewed contacts with the sky. We have thus forged the words that build the myths of our origins, explain our fantasies or simply serve to exchange our impressions.

We often wonder how *sky,* or *ciel* or *himmel* and expressions prior to these have made sense and became firmly associated with the observed object. How *cosmos* or *nebula* were connected to the corresponding thought.

In all fields of knowledge, science and technology, words are given to us but few of us are concerned about their history. In reality, they have a life of their own. We find them in dictionary entries, betraying their origins, putting on make-up, deserting, procreating or founding new families.

Everyone agrees that there is a resemblance between *aster*, *astronomer*, *astrologer*, *astronaut* and place them in the same family, but should we attach *disaster* to them? What is the relationship between *cosmonaut*, *cosmopolitan* and *cosmetic*? *Sidereal* and *iron* and steel? Whoever hears about *helium* forgets that this element was first discovered in the spectrum of the Sun (Helios). Who remembers that *quintessence* was first the fifth essence, a perfectly rigid vibrating substance, impregnating the void of the Cosmos as well as material bodies? From the celestial origin of these words, we have manipulated or relegated them to a use farther from that for which they were intended.

It also happens that the sky inherits our foibles and fantasies: the mirror works both ways. Did Venus or Mars name our mythological heroes before finding a home in the planets that bear their names, or vice versa? And is *venereal* a heavenly word or an earthly evil?

In 1991, D. Kunth (DK) was lucky enough to be invited by the French actress Jeanne Moreau to appear on an edition of *Mon zénith à moi* on the French TV channel Canal + where she was the guest star. DK's score was simple, but oh so intimidating: He was requested to explain, live of course, the astronomical meaning of the word *zenith*, its place in culture and perhaps its hidden meanings. One cannot know if, in her eyes, the task was fulfilled. But DK remembers himself babbling in front of her, how he had discovered, not without surprise, in a simple dictionary, the amazing phonetic shift that, from Arabic to French, forged the word we use today (see next chapter). Zenith was one of the starting points of his research on sky words and of this book.

Later, he learned, fortuitously, the origin of *canicule*, *desire* and *malotru*, a priori unrelated to the sky and could not help but tracking down celestial words of daily use. It is the fruit of this collection that we submit today,

convinced that this harvest is not over. We use these heavenly words without realising it.

Astronomy has acquired very powerful observation tools and forged new concepts. New terms have emerged that give meaning to the activities of those who observe and study the sky. A vocabulary of the trade jargon allows astronomers to understand each other and to exchange complicated concepts that are not crystal clear to non-specialists. We do not consider them in this book, but have not resisted using, if only to demystify them, certain words that have infiltrated themselves into everyday language, such as, among others, *black hole* and *Big Bang*. We have also chosen to avoid the jargon that relates to atmospheric phenomena, with their bundles of clouds, tornadoes, thunder, lightning, accompanying air light and wind. We are here in the realm of the in-between, between earth and cosmos, which acts for us astronomers as a screen above which we never cease to elevate our eyes!

Instead of a shopping list of words related to the sky, where we would find *cosmos* and luminous *sunflowers* next to *starfish*, *alfalfa*, *parasol*, *clouds*, *asterisks* (and, in some way, *Asterix*!), *horoscopes*, *almanacs*, *orbits* and *September*, we preferred a dizzying walk leading from the immediate sky to the most distant and… most "conceptualised" cosmos, only to return to our closest environment, that of the Solar System. Sun, Moon and planets, which we are not only able to see, but which punctuate our days and years. So it is quite naturally with the calendar that we end this journey.

The choices we have made certainly do not exhaust the subject. They also obey our personal inclinations and are not devoid of subjectivity.

Technical definitions are given inside tables and boxes and the reader can easily skip them if they wish. At the end of most sections, quotes from well-known personalities as well as popular expressions were added.

A glossary designed to serve as a quick reference to the words scattered throughout the text and a short note on the astronomers and scientists cited in the book is given at the end. All of the sky words described in the text, most proper nouns and some popular expressions, are also exemplified in it. Some words are absent from the story – because their affiliation to the sky is too obvious – or do not, in our opinion, lend themselves to any particular anecdote. Some are simply relegated to the end of the book in the glossary.

Daniel Kunth

Acknowledgements

This work was written in bits and pieces. It took many years of gestation, punctuated by long discussions with J. L. Guillon, linguist. About 10 years ago, we had elaborated some chronicles which were published in several issues of the review *Alliage* at the request of Roselyne Chaumont and Jean Marc Levy-Leblond. One will recognise the spirit and the letter in certain pages. Then, there was the chance of readings, many small words pinned or left in DK's mailbox by informed friends, so that it was necessary one day to recompose, to put in form and to rework the sources. This book owes a lot to DK's wife, Muriel Fournigault, who added meaning to this work.

We would also like to thank Jean Audouze and Hubert Reeves for their attentive readings. We are particularly indebted to the artists and graphic designers who kindly gave the permission to reproduce their artwork.

For the English version of this book, we are grateful for input from the linguist Arin Bayraktaroglu and from Alejandro, Hayley, Ana and Roberto Terlevich.

This work can still evolve, as unexpected words or new expressions can certainly enrich it. The use of a digital database could bring surprises. Some of you readers may cherish words that have not yet found their way into this book. If so, please let us know. We will be happy to include them in a future edition.

Contents

The original version of the book has been revised. A correction to this book can be found at https://doi.org/10.1007/978-3-031-49024-8_11

Sky

Asia, celesta, celestial, Celestine, cerulean, East, farm, firmament, kamikaze, Levant, meteors, nadir, orient, pole of attraction, rainbow, setting, shelter, skyscraper, West, zenith

"The sky is falling in" is the popular idiom that indicates that someone is being overly dramatic about some event. We can say that ultimately, it is found also under our feet, since the Earth is round.

Its plural form is used, for example, in the magnificent changing skies of popular songs. The word sky takes on different images, expressing in turn the vault of heaven (low, stormy or serene sky), the ceiling or the absence of it (open-air mine or concert) or the divine (Heavens help me!). "Open sky" is the name of the progressive celtic rock album by Iona, from the 2000s. As for "Heavens, my husband!", this remains one of the conventional twists of comedy plays.

Geophysicists and astronomers share the sky for different reasons. Geophysicists are interested in studying the Earth, and some of them are concerned with the precious atmosphere that surrounds it. We astrophysicists define the sky more broadly. For us, it becomes a pure optical illusion since the sky is only the projection of the great cosmic space. The sky of the former sometimes disturbs that of the latter which, in order to observe, we search for the best possible high sites on Earth, free of clouds and light pollution. If we all observe meteors, we do not give them the same meaning. Geophysicists relate them to atmospheric phenomena caused by the vicissitudes of the weather. They describe lightning, waterspouts and even some winds as airborne meteors. Astronomers refer to *meteors* as the fires in the sky that pass

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through the atmosphere when a solid body from outer space burns up through friction. The term is often synonymous with *shooting star* (see p. 27) and it has entered everyday language as that which passes or dazzles in a lively though fleeting way: meteoric rise, expression disputed by the journalist Guy Keleny in his celebrated column "Errors and Omissions", in the British newspaper *The Independent*: meteors fall through the atmosphere; they don't rise.

Until the 18th century, some meteors were considered as simple meteorological phenomena; this was the case for comets and meteorites. Today, we know that they do come from a more remote space.

Heaven and Bliss

The etymological origin *caelum* of the word sky remains mysterious, and its descendants are scattered in words as diverse as celestial, which qualified Imperial China, rainbow and *skyscraper* or *cerulean*, which means "deep sky-blue colour".

The rainbow has always fascinated people, and there are many fables in which it plays a role. The French and the Spanish forget the rainy origin and prefer to name it "arc in the sky" or "arc of Iris". In Ireland, a cauldron of gold is said to be located at the very spot where the rainbow meets the ground. It is difficult to grab it, because not only the Irish *leprechaun* jealously guards his treasure, but the rainbow is a luminous phenomenon that moves with the spectator, who never reaches its ends. We know that the horizon moves together with us, so does the rainbow.

In Greek mythology, it is the path between heaven and earth created by Iris, the messenger of the gods. The poets saw in it the trace of Iris' feet when she came down from Olympus to carry a message. Its semantic origin can be found in the Spanish term *arco iris*. In the Judeo-Christian symbolism, it appears after the Flood and marks God's covenant with mankind: no more floods… on the strict condition that you behave and respect the commandments! The joy that followed persists in the saying that "after the rain, nice weather".

More rarely, this ribbon of light has been perceived as a premonition of danger: it becomes the devil's bow or the wolf's tail. In Australia, it was linked to the snake responsible for diseases, and the smallpox brought by the first European adventurers was named "the scale of the great snake". During Renaissance, the idea that one could change sex by passing under a rainbow was common, while sailors feared that their ship would be sucked under at one end.

Nowadays, it remains positively associated with several flags, including the European pacifist flag (seven colours with purple on top) and the gay and lesbian flag (six colours with red on top) created in 1978 in the United States by the American graphic designer and political activist Gilbert Baker.

But finally, where does it come from? For us scientists, the rainbow results from the dispersion of the light of the Sun by raindrops, more or less round. The rainbow is a beautiful alliance of chromatic tones and purity of line. The violet colour is in the centre followed by yellow, green and red towards the outer edge. For the attentive eye and depending on the conditions, a second arc unfolds, wider and encompassing the first. Its brilliance is attenuated but what is even more astonishing, its colours are in the reverse order of the main arc: red on the concave and violet on the convex sides.

Isaac Newton's explanation for the two interlocking arcs and their inverted colours is amazingly simple in retrospect. Luckily, understanding this phenomenon did not take away its natural poetry.

Depending on the culture, we agree on seeing between three and nine colours, which depictions remain intimately marked by ideological inclinations or symbolic representations. In the West, Isaac Newton, who was not only a physicist but also a theologian and alchemist, fixed this number at seven: red, orange, yellow, green, blue, indigo and violet. Note that the term indigo was introduced by Isaac Newton because the plant comes from India from which the tincture is extracted. Why seven? Robert Boyle, Fellow of the Royal Society, describes seeing five colours (in the spectrum he produced with a prism) in his book *Experiments and Considerations Touching Colours, (1670): Red, Yellow, Green, Blew, and Purple*.

Perhaps Newton's theological culture imposed this numerology on him? It is likely that his belief in a universal harmony of nature suggested to Newton a spectrum of seven colours by strict homology with the musical scale, the days of the week or the number of planets known at the time.

Heaven calls for bliss. Thus, the *celesta*, that tiny piano of only four octaves that operates timbres (not strings), and that Béla Bartok uses in his work music for strings, percussion and celesta. It is also one of the registers of the organ, celestial voice (*Voix Céleste*, in French), which produces angelic, soft and veiled sounds.

There are also first names. Saint Celestial (what a combination!) who would have been bishop of Metz at the beginning of the 3rd century. He is honoured on October 14. Céleste, cousin and wife in the cartoon of Babar the elephant, reigns with him over Célesteville, and the couple, created in 1931, continues to enchant young readers today. Célestine is enjoying a resurgence in the name popularity since the beginning of this century. She owed her fame to La

Celestina, a Spanish tragi-comedy published in 1482 by Fernando de Rojas, in which Celestina is a scandalous matchmaker driven by a disproportional taste for money. The word also appears in the beautiful celestine or celestita crystal clusters or geodes.

Leaden Sky

But in fact, where does this sky come from and what is it made of? In ancient times, people thought of an immense solid vault on which stars were simply placed. It was also imagined as being pierced with tiny holes beyond which the great fire of creation smouldered. Depending on the culture, the sky has been viewed as a dome, a canopy, a blister, an inverted cup, a parasol or an umbrella turning around its handle. The Nordic people conceive it as a gigantic tent with the North Star as its only pole! The American artist James Turrell has built the monumental installation "The celestial vault" in The Hague (Netherlands), for people to get in and imagine the shape of the sky.

In the Middle Ages, the stars of the Christian world clung to an ultimate pure and transparent celestial sphere, while the planets, the Sun and the Moon were fixed on lower, concentric crystal spheres. The sphere of the stars, the firmament, separated us from God. It comes just after Saturn's sphere, the seventh, which is already very far away. Hence, the expression "to be in seventh heaven" represents the highest degree of elevation. Nowadays, the expression is synonymous with extreme enjoyment. Note that the number seven has a particular importance in many religions. It is the number of days needed by God to create the world (six in fact, because the seventh was for resting). We are all familiar with the seven-branched candelabrum, the seven sacraments, the seven heads of the beast of the Apocalypse and the seven deadly sins (the latter most famously depicted in Table of the Seven Deadly Sins, by Hiëronymus Bosch, 1505–1510, that can be admired in the Prado Museum, Madrid).

The Oyster and the Firmament

The *firmament*, although more poetic, is also more solid. It comes from the Latin *firmamentum*, the support, the backing. Perhaps, it was necessary to invent this firmness to prevent the celestial vault, set with stars, from falling on our heads as the Gauls feared. It protects us like the truss, the main part of

the framework that supports the roof of the house. Firmament, a reassuring cover that, braving fear, humankind has finally lifted in order to make a pact with an open and dizzying infinity. The sky then became the invitation to travel that science fiction has staged a thousand times.

Before leaving the firmament, we cannot resist the pleasure of savouring the alliance between the sky and a familiar mollusc, on the free verse by the French poet Francis Ponge in *Le Parti pris des choses* (The taken voice of things, 1942):

> Inside we find a whole world, to drink and eat: under a firmament (strictly speaking) of mother-of-pearl, the skies above sink on the skies below, to no longer form only a pond, a viscous and greenish sachet, which flows and ebbs at the smell and at the sight, fringed with a blackish lace on the edges.

We reach the firmament by simply following the path of the zenith, a point located vertically above our heads. It is specific to each of us. Its Arabic origin, *semt*, makes it clear that it is the "sacred path to heaven". *Semt* became *senit* when the monks of the Middle Ages substituted an n and an i for the m, in the course of their tedious handwriting and quillwork. Thank you again Jeanne Moreau for sending us along this starry track.

Is zenith just astronomical? The zenith, used as a metaphor, symbolically indicates the culmination of a life or career and, consequently, the beginning of the decline. We use it in connection with politicians and all those who occupy the stage front. By accreditation of the French Ministry of Culture, the zenith now refers to those vast establishments which organise public events and music hall shows. The stars of the music hall shine there in the firmament during their ephemeral passage to the pantheon of artists. At the opposite end of the spectrum and below our feet is the nadir.

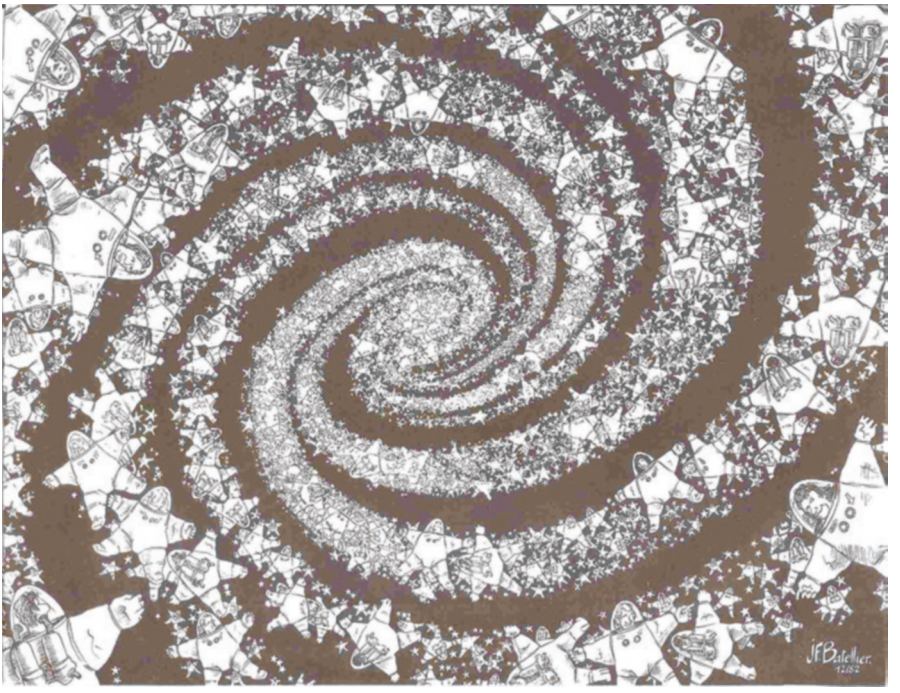
> North to South
> Zenith Nadir
> And the loud cries of the East
> The Ocean swells in the West
> The Tower to the Wheel
> Addresses
> Apollinaire, "Tour", Calligrammes.

and Montesquieu (who was elected a Fellow of the Royal Society) wrote in his irreverent Persian Letters: "The zenith of your mind does not reach the nadir of that of the least of the imams."

Should We Fear the Sky?

At the end of the Second World War, kamikazes appeared from the sky and spread terror. *Kami* in Japanese is the supreme, superior entity, a deity, while *kaze* is the wind that blows. The whole thing provokes a typhoon supposed to mark the superiority of the divine over the human… we know what happened to it. To protect oneself from such a threat, one had to run to the shelters. More recently, the news familiarise us daily with drones, unmanned aircraft, controlled remotely. These machines are not intended for martyrs but open up a new and terrifying way to ensure domination on Earth by controlling the sky.

Abri (in French) comes from the Latin *apricare* and meant exactly the opposite of what it means today. Originally in French and in Spanish, for instance, a shelter was an "open place" intended for "exposure" to the Sun to protect from the cold. It is now a place that protects from rain or even danger and where one can take refuge.

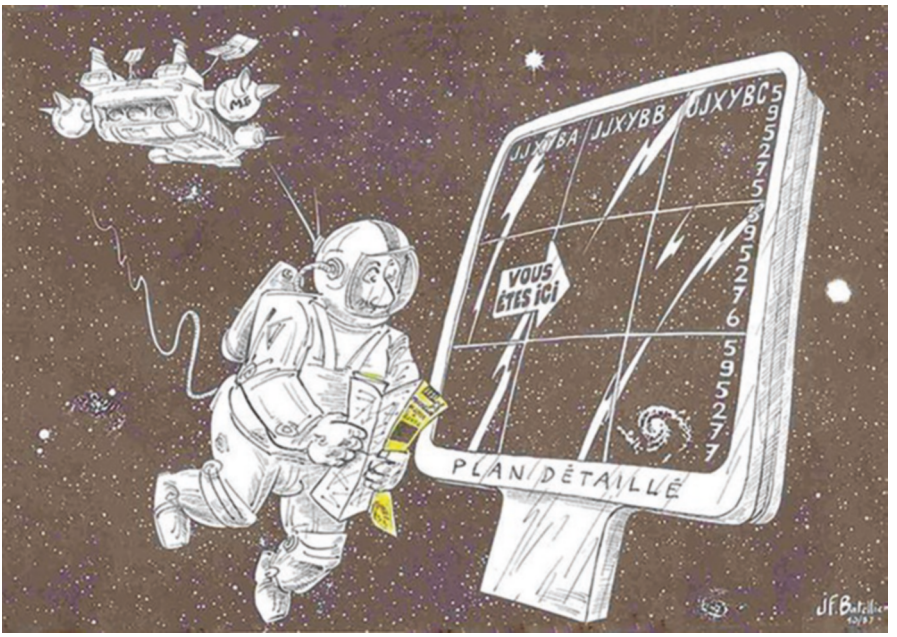


Human galaxy! **Mankind has always questioned his place in the Universe. Jean-François Batellier, artist**

The Sky at Our Feet

The sky is so omnipresent that we take it for granted, just like the air we breathe. The skies over our cities, contaminated by light pollution, contribute to this disaffection. This is not our case. This sky, shared with everyone, is as dear to us astronomers, as the more distant one that we scan from the observatories of Chile, Spain, Australia and Hawaii, or with the Hubble and James Webb Space Telescopes. Often in the evening, when we get home, we raise our heads and look for the Moon, the presence of Jupiter or the setting of Venus shortly after the Sun.

The constellations guide us: one can find our way back in a large foreign city just by following them. Many people, while fascinated by a sky they cannot see, ignore the one that is offered to them every night. They are interested in black holes, quasars and the Big Bang, but remain disoriented when the night surprises them outside the city, as if they were in terra incognita.



You are here! **Courtesy of Jean-François Batellier, artist**

A star does not say its name, nor where it comes from or where it goes.

The sky is above us and the Earth under our feet. But under our feet is the sky again, because the Earth is round and the inhabitants of the antipodes conceive us upside down too. We all know that there is always someone beyond the horizon.

Up and down are relative concepts; this is why farmers, travellers and sailors, for whom it is necessary to find their bearings, owe much to the stars and their apparent movements.

Humans got into the habit of orienting themselves (from the Latin *oriri*, to rise, especially in relation to a star) by the rising of the Sun and other stars, and then of making landmarks (especially on a map) coincide with the cardinal points. As opposed to the Orient, the Occident designates the cardinal point where the Sun disappears (the word derives from *ob* and *cadere*: object that falls to the ground, the star that sets). Since ancient times, the setting point has been the region of the Earth where the Sun sets, as opposed to the rising point. This meaning is found in German in "Morgenland", the land of the morning, and "Abendland", the land of the evening.

As early as the 13th century, Occident designated the entire known western portion of the Earth and was spelt with a capital letter. Europa is the one who, in Greek tradition, has big eyes and had been kidnapped by Zeus to be transported to Crete. According to another interpretation, Europe derives from an older Semitic root ereb (evening and Occident) and is opposed to country of the Levant. Thus, Europe would have gone to find itself in the West! Asia, which the Greeks located to the east of the Aegean islands, present-day Turkey, designated the rising of the Sun (from the Semitic root *ushos*).

The North and South of our planet can be found, thanks to the rotation of the stars around these fixed points. Men also had recourse to a strange stone discovered in China, a black stone, the magnet stone, which had the curious power of attracting iron, and the ability to transmit this power. Any bar magnet naturally orients itself in the north-south direction along the lines of the earth's magnetic field, and this property is used in the manufacture of compasses. The Earth's poles became the pole of attraction for magnets and electromagnets, and even, by a more audacious metaphor, the pole of attraction, in other words, the highlight of a successful festivity.

The sky is above but also below since we inhabit the Earth which is a sphere. Courtesy of Gerard Paris-Clavel, graphic designer

Sayings

Move heaven and earth: use all means
As true as the Earth turns: undeniable statement
To come back, to fall back to Earth: to lose one's illusions
Keep your feet on the ground: be realistic
Heaven, praise be to God!: expresses great satisfaction
Open air: without a roof
To be in seventh heaven: to be at the height of happiness
If it pleases God in Heaven: rely on your luck

Between heaven and earth: a certain height in the air
Having a cloudless sky: a worries-free future
To fall from the sky: to arrive by chance, unexpectedly
For heaven's sake: supplication
Pie in the sky: false hopes

Quotes

In space, no one can hear you scream: tagline from the movie Alien
Making the sky the best place on Earth: Air France advertising slogan
Red sky in the morning, shepherds warning: the coming day's weather cold and unpleasant
Space, the final frontier: a catchphrase from Star Trek
There is always somebody behind the horizon: Daniel Kunth
Memory marks the horizon of our consciousness: Amos Bronson Alcott

Light

alfalfa daytime God elucubrate illuminated leukaemia leukocytes lucerne Lucia lucid Lucifer lumen

"And there was light!", the writer Jon Meacham calls his Abraham Lincoln Prize winning biography. Reversing the action: "It is not the day that comes; it is the night that withdraws" writes Erri de Luca in *Three Horses*.

But the world begins with light, and the Sun is its source. Light is the connecting thread that links us to the sky, to the stars and ultimately to our deep origins.

What Is Light (Scientific Description)?

Light is a so-called electromagnetic wave that travels at 300,000 km/s in vacuum. A star like the Sun is a ball of hot gas that emits light into space. In contrast, the Earth and the Moon are opaque and only reflect the light from the Sun. The light travels through space and reaches the Earth after a more or less long journey: 1 second from the Moon, 8 minutes from the Sun, 4 years from Proxima Centauri the nearest star, tens of years from the neighbouring stars and billions of years from the most distant galaxies. When we look at the sky, the image our retina receives is actually a "false snapshot" because the light from each star was emitted in the past and arrives with a delay that depends on their distance from the Earth. The phrase "being light years away" expresses the idea of being far from the realities of this world.

D. Kunth, E. Terlevich, *StarWords*, Springer Praxis Books,
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The speed of light: **Light travels in a vacuum at a speed of 300,000 km/s. It can therefore travel the equivalent of seven times around the Earth in one second. This speed is an absolute limit. No matter, nor radiation can exceed it. Courtesy of Gérard Paris Clavel, graphic designer**

If the world springs from light, isn't it quite natural to find it in the arcane of language? The English language has made heavy use of a very old Indo-European root: *leuk*, which designates the act of "shining", not involving the idea of divinity. The Greek branch parts from the adjective *leukos*, with the derived meaning of "white", which is found in leucocytes (white blood cells) and in all the words containing leuc- such as leucorrhoea, leucoma or leukaemia, that disease which allows white blood cells to proliferate out of control.

Happily reminiscent of lazy summer vacations, Port Leucate, a charming little Mediterranean port, takes its name from the surrounding whiteness of the salt of the Corbières' countryside.

When Day Becomes God

Dei is the luminous sky, implying the idea of divinity. Dei will be used to name God, who comes from Heaven and with him, light, lightning and thunder, as opposed to humans on Earth. This very old Indo-European name goes back nearly 7000 years, to the fifth millennium BC, somewhere near the Danube. It is found in Latin, Celtic, Baltic and Sanskrit. The Germanic language has innovated, in English god, in German Gott. But in this case, the opposition between the earthly human and the celestial god, both heaven and divinity, dates from this period.

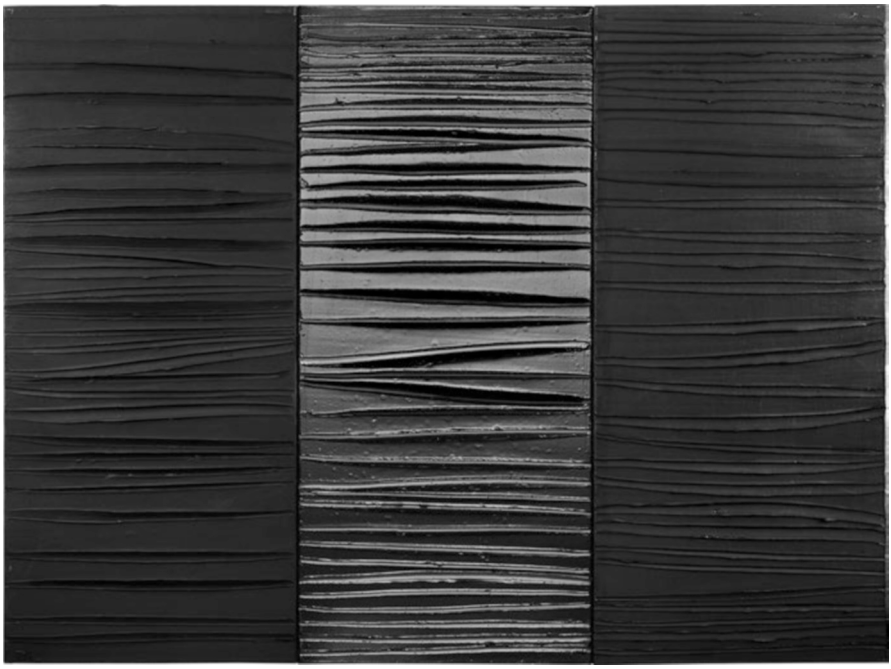
In Greek, the Indo-European root became *dios* in the sense of shining and in Latin in the form Deus, god. The French word derives from this. On the other hand, this root, still the same, was used to designate both the light of the Sun and the duration of a day: dies became di in Old French, to remain only in the last syllable of the names of the days of the week, while from dies the Latins forged *diurnum* (which occurs during the day), which became diurnal in English, and its opposite nocturnal. The first meaning of diurnal, which is very astronomical, is "that which is accomplished in 24 hours". Then, as opposed to nocturnal, it was restricted to mean "during the day". Curiously enough, diurnum was pronounced *djorn*, which, as a result of phonetic alterations, became *jorn*, then *jor*, then *jur* and finally *jour* in French. This root has been kept in English, for example, in journal and journey.

In the current uses of the word day, the French language has retained the two original meanings, light and duration. Light in "it's daytime" or "the day is breaking" and duration in "the longest day", "the days are getting longer" or "until the end of my days" which means "until I die".

God, day and diurnal thus come from a single and very ancient root decanting in beautiful progeny!

> Writing for the theater, you find yourself living nocturnal life.
> Irving Shaw

A Luminous Family Story



Intrication Light and darkness: **Pierre Soulages (1919–2022)**. Painting **181 × 243** cm, **25/02/2009**. Acrylic on canvas. triptych, three juxtaposed elements (**181 × 181** cm). Musée des Beaux-Arts de Lyon. Copyright: Archives Soulages – photo Vincent Cunillère

The root *leuk* has evolved into very different Latin forms, though similar in meaning: *lux*, *lumen*, *lustrum* and *luna*. But beware: linguistics requires a rigour that has nothing to envy to the so-called "exact" sciences! For in the descendants of leuk, we do not find luxury, lust, nor luxuriant, not even lustrum (the 5-year period), but we do have skylight, the opening on the roof of the house, which however reminds light, the small opening in the barrel of a gun or that of an organ pipe.

Lux begets glow, glow-worm, as one would expect. More unexpected, lucid, lucidity, elucidate, reluctant. Who will include elucubration, the act of "working by the light of the lamp to the point of developing obscure and convoluted ideas"?

Are Lucia or Lucette wiser because they are luminous? Who would think of Lucifer, the bearer of light, a fallen angel with a glorious past who became the prince of darkness and whom the Romans mistakenly associated with the morning star Venus?

Lux, popularised by the brand of soap, survives in lucerne, another world for alfalfa, first to designate the glow-worm, then this forage grass whose seeds are shiny.

French slang has taken over the word *luisant* or *luisard* to designate the Sun, as the French writer Boris Vian reminds us in his own sharp style: *Magnotez-vous sinon le luisard va tourner* (Hurry up otherwise the luminary will turn around).

The *lumen* family is prolific, with light of course, but also "to light up", the "alight" in the sense of descending from, or to set fire to. The Illuminati is a name given to several groups, both real and fictitious, but was originally a secret sect founded in Bavaria, Germany, following the path of the Lumières in France. Nowadays, Illuminati are depicted as controlling world events, lurking in the shadows and manipulating the strings and levers of power. Luminaries are discreet, luminescent objects that are draped in mystery. How pale the glow of a match seems compared to that of a star, and yet what a presence the poet grasps:

Three matches, one by one lit in the night
The first to see your whole face
The second to see your eyes
The last one to see your mouth
and the whole darkness to remind me of it all
by hugging you.
Jacques Prévert, Paroles (1945)

Illuminated and illuminations transport us to the Middle Ages and fill us with wonder. Illuminated is essential for a Christmas tree, but much less reassuring for a scientist or a mystical visionary or mystifier! If lucidity designates, figuratively speaking, one who is sharp in a certain field, it is opposed to one who is not a luminary when their intellectual capacities are questioned. The Enlightenment – along with its philosophy – expresses what the philosopher René Descartes considered a departure from the theological or supernatural point of view in order to remain within the secular point of view. Everyone sees "noon at their door" French people say where English one prefers "looks at their door" when it comes to lighting, whether one is secular or not. It all depends on the colour of the crystal through which one is looking.

The *lustrum* family, via modern Italian, has given lustrous, lustre, lustring or lustrine, illustrate and illustrious accompanied by its emphatic

illustrissime. We read: the line-up of star guests added lustre to the festival. Lustre enlightens us, but *lustrum* marks the passing years with no connection to the *lustrum* family:

> Think not that delight and understanding dwell just across the Karthian hills, or in any spot thou canst find in a day's, or a year's, or a *lustrum's* journey.
> H. P. Lovecraft, The complete collection

Another fine example, in linguistics, of deceptive kinship.

Finally, the last family, *luna*, is remarkable. Few words but a multitude of uses where our natural satellite plays the leading role. But we will come back to this further on in the book.

Our cities, seen from the sky, are so brightly lit that they draw a precise map of human activity on the Earth. Unfortunately, the more these artificial lights proliferate, the less our eyes are able to perceive the stars. Light mesmerises us, as the Indian Nobel laureate poet Rabindranath Tagore writes:

> Light, my light, the world-filling light,
> the eye-kissing light,
> heart-sweetening light!
> Ah, the light dances, my darling, at the center of my life;
> the light strikes, my darling, the chords of my love;
> the sky opens, the wind runs wild, laughter passes over the Earth. …

Moonless observing nights in Chile come back as moments of pure exaltation. Nights of great purity without the slightest hint of wind, not even the caress of a light breath. One is amazed to be able to touch the celestial vault with one's finger. An exuberance of stars like we rarely see elsewhere. Fixed, without the slightest twinkle, anchored in the firmament in an impeccable state of attention.

Sayings

A night owl: someone who lives at night
Sad as a nightcap: very sad, boring
Staying up all night: not sleeping all night
At night, at nightfall: in the night
At dusk: at twilight
At a late hour of the night: very late at night
Any time of day or night: 24 hours a day

Lady of the night: night blooming jasmine, evening primrose, prostitute
It's day or night: trying to find out
At night all cats are grey: without light, everything looks colourless
The queen of the night: moon
Since the dawn of time: from time immemorial
White night: night with no sleep

Quotes

Martin Luther King: "Darkness does not drive out darkness, only light can do that".
Galileo: Wine is sunlight trapped in water.
Koan Zen: I turn off the light where does it go?
Seen on a sundial: The light is the shadow of God (unexpected sentence!).
Leonardo da Vinci: Never the Sun sees shadow.
Anonymous: "Light travels faster than sound. That's why some people look brilliant until they start talking".
From Goethe (Treaty of light): Colours are actions of light.
From Charlie Chaplin (book : My life): Stars among stars give little light and no more heat.
Anonymous: We have loved the stars too much to be afraid of the night.
Georgian saying: You can't blame the Sun for not lighting up at night.
Arab proverb: What good is sunlight if you have your eyes closed?
Francis Blanche (french humourist): The proof the moon is inhabited is that there is light.

Stars

Antarctic arctic aster Asterix astrocyte astronef astronomical astrophyllite canicule edelweiss pentacrine Sirius starfish star-lore tramontana

The star is the most familiar and undoubtedly the most transcendental astronomical object. The word comes from the Latin *stella* and designates any visible star that twinkles, including planets and comets. The Old English word steorra or stearra stems from Proto-Germanic *sterro* from Proto-Indo-European *ster*, root shared by Latin *stella* and Greek *aster*. The Latin word itself stems from an Indo-European root *stel* meaning "that is strewn with stars".

On a clear night, a suggestive oxymoron, a few minutes are enough in darkness to perceive the sky as a ceiling on which sprinkling stars, planets of the Solar System, the Moon and the Sun nonchalantly move.

Twinkle, twinkle little star

Snufkin was deeply impressed.

"Stars!" he exclaimed. "Then I must come with you. Stars are my favourite things. I always lie and look at them before I go to sleep, and wonder who is on them and how one could get there. The sky looks so friendly with all those little eyes twinkling in it.

wrote the Finnish children's author Tove Jansson, in Comet in Moominland.

The original version of the chapter has been revised. A correction to this chapter can be found at https://doi.org/10.1007/978-3-031-49024-8_11

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A Thousand Stars and You and You

One remembers the pleasure of reading to children the beautifully illustrated book by Anna Milbourne and Serena Riglietti *How Big is a Million?* with the amazing poster of a starry night to answer finally the little penguin's quest.

And then, we can only ponder on our place in this vast Universe. People sometimes confuse star and planet, so the star known as "the Shepherd" is actually the planet Venus. This is not surprising, because at first glance, the stars all look the same. Only their positions differ, so thinks the layman. It is interesting to point out that they are coloured. In the northern winter, the Orion constellation offers to the naked eye a remarkable example of contrasting colours, pale blue, vivid white or orange tones.

Stars seem to be undoubtedly fixed on the celestial vault from which no feeling of depth emerges. Yet, the Greeks, in order to account for the colossal dimensions of the Universe, asserted that 7 days were necessary for a free falling anvil to reach its limits.

It was not until 1838 that the distance to the first star (outside the Solar System) was measured by the German astronomer Friedrich W. Bessel.

We now know that stars are found at diverse and large distances, staggered in depth, and that the brightest stars are not necessarily the closest, nor the faintest the farthest away.

Stars have been counted through the centuries. Counting them, imagine that!

To reach this point, some reluctance had to be overcome. In the 17th century, the expression "counting the stars" was synonymous with an impractical endeavour. After all, stars inspired an almost cultish admiration and studying them as actual objects wouldn't seem somewhat disrespectful?

On the other hand, some people didn't care, like the gastronome A. Brillat-Savarin who wrote in his Physiology of Taste: "The discovery of a new dish does more for the human race than the discovery of a star". If he is to be believed, when astronomers and gourmets compete over the search for infinity, the boundless gustatory range offers far more heavenly sensations.

There are many superstitions related to stars: this collective knowledge is called star-lore (inspired by folklore). When you look at a starry night in a dark, isolated place, the fascination our ancestors felt for them is easy to understand.

In a book entitled *Le folklore de France: le ciel, la nuit et les esprits de l'air* (French Folklore: the sky, the night and the air spirits), Paul Sébillot reported

in 1904 that superstitions relating to the stars remained very much alive in rural France as is the case everywhere in the world.

Our parents have told us that pointing is bad (referring to pointing at people). This might have been originated in an old folk's superstition, that pointing at a star could bring bad things, even death to you and your family. This legend comes from the belief that stars are gods, looking down to Earth from heaven. Pointing at a star (therefore at a god) could provoke its ire. In the Vosges and the Vendée, Sébillot related: "whoever gazed at the stars had to refrain from counting them, because if you bechance unfortunately counted your own you were at risk of dropping dead on the spot". In Marseilles, pointing at the stars was a recipe for warts. Worse still, in Belgium, near the small town of Leuze, when a star appeared to fall on a house or in a garden, it was said that a member of the family would soon die.

On How to Become a Pope

The superstition that to every person belongs a specific star is widespread. However, only 3000 are visible to the naked eye in each hemisphere, so we are likely to remain anonymous.

Counting stars had been considered deadly, but of course, knowing that there are at least 200 billion stars in the Galaxy, you would be dying before you could count all of them. However, if you were an unmarried person looking for love, you could count seven stars on seven consecutive nights. The first person to shake hands with you on the eighth night was the one you were going to marry.

Shooting stars (though actually no stars at all, but tiny meteorites burning by friction in the atmosphere as they fall to the ground) were believed to represent the soul of new babies coming to life on Earth, and if you happen to see one, make a wish and it will be granted. They will bring good luck if you see them to your right, and misfortune if to your left!

Stars have also been linked to weather. Poor harvest is predicted if the evening star is low in the sky, and draught is heralded by the appearance of Sirius.

A very old tale predicts rain when, even if the sky is clear, the tenuous Beehive cluster in Cancer is not distinguished.

Seafarers follow also star-related superstitions: the direction that a shooting star follows can predict the direction of the prevailing winds.

The North Star has served since ancient times like a beacon and a navigating tool. Sailors sometimes tattoo the North Star on their skin to carry the good luck with them.

Twinkle, twinkle little star, while amusing for children, is not a good indication for astronomers who want to observe them… it heralds turbulence in the atmosphere that made their observations difficult.

When a halo is seen surrounding the Moon, how many stars you can count inside it will indicate when, or for how long, the rain will fall.

It took an iconoclast like Arthur Rimbaud to dare to say:

> I piss towards the brown skies, very high and very far away:
> with the assent of the great heliotropes

Stars, as P. Sébillot reported, are frequently related to love. A young woman from Liege in Belgium, when she was courted, relied upon the first star she saw which represents a good or bad omen, depending on whether it is bright or dull.

The belief most representative of our high ambitions comes from Upper Brittany. It was said that whoever could see a star between nine and ten o'clock in the morning would get married within the year! To become Pope, you had to catch sight of a star at noon; to be a Cardinal, seeing it at eleven in the morning would suffice. The authors of this book have experienced that it is possible to follow the Star of the Shepherd (Venus) with the naked eye until at least eleven o'clock. Unfortunately, the Shepherd's Star is not a star and the writers of this book must confess that we have neither church nor religion!

How to Choose Well a Star Name?

Farmers of primitive societies felt the need of naming stars very early on, as did travellers and sailors to whom a "good star" never stopped showing the way. Today still, stars are used to locate and guide orbital stations and the most sophisticated artificial satellites. Knowledge and tradition coexist in these observatories, where grains of celestial dust are still called shooting stars. Lexical archaism and a thirst for knowledge characterise the passion for heavenly items.

We owe many star names to the Arabs. Who hasn't heard of Aldebaran, the white Deneb, Vega or the orange Betelgeuse, if only through science fiction heroes, a car brand (the Facel Vega or the Shooting Star from Renault) or an advertising slogan?

Some retain the mythological names given to them by the Greeks, such as Sirius, Arcturus or Procyon, which were meant to represent their deities; others, such as Castor and Pollux, Capella or Regulus were simply Latinised.

Many children dream of projecting their name to a distant star, the eternal repository of their brief passage on Earth. Professional astronomers discovering stars are frequently being asked by their children to name some star for them. Adults sometimes share this fantasy to the extent that some unscrupulous agencies offer a star to anyone who so wishes. These agencies provide an official certificate of "ownership" which of course has no legal value whatsoever. One of them, the International Star Registry, was founded in 1979 in Canada. For the appreciable amount of more than a hundred euros, you can choose a star and give it any name you like, why not your own? The certificate specifies the name chosen, the exact position, the colour and the brightness of the coveted star. Needless to say, the sky is a gift that keeps on giving for these agencies which draw huge benefits.

Every day, new stars are recorded. The world's telescopes, which are becoming more and more powerful, are tirelessly discovering billions of them, and the invention of new techniques is pushing back daily the known limits of the Universe. In a little over a century, we have gone from 3000 stars and planets visible to the naked eye to billions of records, most of which are stored and saved as electronic images.

So where might we find the heroines, princes, princesses and mythological beings to designate these stars that have appeared out of nowhere? Very prosaically, astronomers now agree to respect a cosmic civil protocol worthy of the Social Security System. There is no longer any question of a mute tribute to a beautiful woman or an ostentatious tribute to a possible patron. From now on, a star wisely takes its place in a stellar catalogue among millions of other stars. It is found by means of its position in the sky, which is determined by time and angle coordinates. The star named S1237+0456.2 passes through the zenith at 12:37 p.m. on September 21 at the northern latitude of 4 degrees, 56 minutes and 12 seconds.

Stellar catalogues become digital celestial directories, treated by modern computers as lists of numbers that are added and subtracted for the needs of precision-hungry telescopes and for greater efficiency.

Inspirational Stars

The celestial nature of the stars naturally predisposes them to become symbols of the spirit and inspiration that materialise our hitherto unspoken desires. The fact that we cannot reach them is a limit that teases our imagination. The Portuguese poet Florbela Espanca painfully regrets and questions: "Who gave us eyes to see the stars without giving us arms to reach them?

***Pentacrines* fossils found near Château - Chalon (Jura, France). Daniel Kunth's private collection (gift by Bernard Moninot, artist)**

They accompany celestial explorers and those who sleep under the starry sky. The most daring astronauts dream that their spaceships might one day, who knows, violate space-time to reach Proxima of the Centaur, our close neighbour star at some four light-years of distance from Earth.

Outstanding celebrities may be invited as guest stars, but fame is fickle and even superstars can fall when they lose their aura or influence.

Stars, the star system, the star dancer and the stars of generals or those of hotels and restaurants attest to the value we place on these elusive lights.

Their shape, strongly crested or geometrically simplified, inspires the most diverse nomenclatures: aster (little meadow flowers), the edelweiss (Dianthus?), silver star of the glaciers, without forgetting the astrance (astrancia or masterwort): a small perennial and aromatic herb with white or pink star-shaped flowers which one finds in the mountain pastures and the Pyrenees. It is said to be slightly poisonous; yet that did not prevent the Parisian restaurant that bears its name from obtaining a "three star" rating (perfectly edible) in the Michelin guide.

The Michelin guide! One of the oldest and most famous gastronomic guides in the world. Every year, it awards its renowned stars to the best restaurateurs. The guide is so influential that the awarding of a star significantly

increases clientele, but also implies too many obligations for its holder. It is curious that the so-called star is actually a rosette that has no similarity whatsoever with the official star used to classify hotels. Apparent retrograde motions are sometimes witnessed in the trajectory of planets. These apparent movements take place in the sky in the opposite direction of the normal movement of the planets… Stars pay no heed to these unlike the restorers who dread retrogression especially since they are widely reported in the media.

A stroll in vineyards of the Jura can lead you to the village of l'Étoile, discovered on a rocky outcrop overlooking the Seille valley. This village produces one of the tastiest AOC (PDO) of the Jura, as far as white wines are concerned. This wine, made from the Savagnin grape variety, is characterised by its particular finesse and elegance. But where does the village get its name from? A winegrower answered that question by offering to us a few white star-shaped pentacrines which he frequently finds when cultivating his vines. Pentacrine are small five-pointed starfish fossils. Black specimens are also found in the Saint Vincent hill in Digne-les-Bains village. The "Digne" star was a very fashionable piece of jewellery in Haute-Provence until the beginning of the 20th century: it was a modest piece though with a black pentacrine set into it, very often made of silver, occasionally of gold.

Tracks, 2022: **galaxies and stars on a flower. Direct carbon print on paper. Courtesy of Caroline Corbasson, artist**

If you wish to walk the heavens, head for Okinawa, Japan. On the beaches of Hatoma, Iriomote or Taketomi islands, microscopic star-shaped shells of dead marine single-celled organisms known as Foraminifera mix with the sand. Thus, as the name suggests, the beach Hoshizuna-no-Hama (from *hoshi* meaning star, *suna*, sand and *hama*, beach), on Iriomote island, is covered by "star sand".

Hotels for the rich at most have five stars. **Philippe Geluck (Reproduced with the kind permission of the author)**

Let's add astrocytes, star-shaped cells that swarm in the brain where they help to feed our neurones, and therefore to think, and astrophyllite a type of translucent mineral whose crystals develop innumerable small stars. We pity the starfish, which has five to eight branches, but never sees the sky.

Stars come in all shapes, designs, numbers and significance as they spangle heraldry and flags around the world. The United States, with 50 stars representing its 50 states, is the country with the most stars on its national flag.

Five-pointed stars are symbols of faith in many belief systems. For instance, the five-pointed yellow star is, together with the crescent moon, a well-known pictogram for Muslims where each branch represents one of the pillars of Islam. We used to find its little red sister on the flag of the USSR.

Likewise, pentagrams have been used since ancient times as magical symbols in association with the occult. In pagan witchcraft, they can both protect against evil and attract sinister forces in their reverse form which overturns the proper order of things.

One more vertex and … it becomes the Star of David, symbol of Judaism, whose points represent the six days of the week, the seventh day, the Sabbath, being indicated at the centre. According to another interpretation, the dots at the star ends and the six intersection points of the triangles embody the 12 tribes of Israel. It inspired another, more sinister interpretation, the yellow star, imposed on Jews to wear as a distinctive sign after 1939 by Nazi Germany.

George Szirtes, the Hungarian/British poet wrote in the poem "Ross: Yellow Star":

> The eye is drawn to that single yellow star
> that no wise man will follow.
> The hunched men in caps, the grimacing woman
> her eyes screwed up, cheeks hollow.

In a more frivolous register, Asterix the Gaul is without doubt the most popular hero in Franco-Belgian comics. As his creator, the scriptwriter René Goscinny intended Asterix had to be as noticeable as a simple punctuation mark. This is why his name is based on the word "asterisk", the little star that indicates a reference mark in a text. Since the "-ix" ending evokes that of Vercingetorix, "Asterix" could also be translated as "King of the stars", from the Latin *aster* (star) and the Celtic *rix* (king).

Astro boy in the Japanese manga by Osamu Tezuka and Star-Lord in the Guardians of the Galaxy American comic books are yet other examples of prominent characters bearing star-inspired names.

Shooting Stars

Shooting stars are intruders. A great number of them rain on Earth every year between August 10 and 15. They are sometimes referred to as tears of Saint Lawrence by Catholics since the meteor shower follows the celebration of this

saint on August 10. Around midnight, shooting stars fall in a shower, crossing the night like flaming arrows and disappearing immediately. If these golden showers, named Perseids, seem to come from the Perseus constellation it is only an illusion. In reality, at this moment, the Earth crosses its path not with stars, but with a multitude of debris (scientists call them meteoroids), left by the comet Swift-Tuttle (see p. 89). They penetrate the upper atmosphere at speeds of more than 200 times that of a rifle bullet and vanish, leaving behind them a long, glowing fiery trail. They are barely larger than a pinhead and we could hold a few hundred in our hands. Their existence contrasts with the very idea we have of a star or its definition in astronomy (don't we speak of astronomical prices to designate exorbitant and disproportionate costs?)

We once thought that their fall foretold the death of someone or that a grieving soul reminded the living of its passing. In the region of Maine, one had to pray for the gates of heaven to open to the soul of the deceased. In the Norman Bocage, it was whispered that the soul of a child would rise to heaven. But certain Amerindian tribes saw in these stripes nothing more than star excrement!

Making a wish when the luminous trace is visible must be done in silence, while revealing it destroys the hope of such wish becoming true. This very ancient belief, still very much alive today, is practised by both those who believe in it and those who do not.

Rain of shooting stars. **Courtesy of Jean-Pierre Desclozeaux, artist**

Beacon Stars

By sailing north, sailors reach the Arctic, a vast continental and maritime region located in the northern part of the globe and that extends beyond the Arctic Circle, the Big Dipper just above. Arctic is precisely forged from the Greek *arktos*, "bear". It belongs probably to the jargon of navigators and reminds us that we sail in the direction of the Great Bear constellation to reach the Arctic, a region diametrically opposed to Antarctica, the southern territory of the planet. The star that shines with a bright orange glow not far from there is Arcturus, literally the guardian of the Dipper.

Even though it translates as Grande Ourse in French, most people look for the "big saucepan" in the sky. To English and Irish folks, it becomes the Plough, and a wagon in many other parts of the world. For instance, the Romans saw a wagon pulled by oxen in these stars. The meaning is kept in the word septentrional made from the Latin words *triones* (ox) and *septem* (seven) which designates a northern region. In Shakespeare's play Henri VI, Part III, the Duke of York refutes Queen Mary's saying: "Thou are as opposite to every good… as the South to the Septentrion".

Sailors are always in search for the right wind. The compass rose or rose of the winds reflects their importance, even when they are not of divine origin. In France, Spain and Italy, the tramontana is the wind that blows from "behind the mountain"; hence, it also designates the Polar Star which rises due North and at the top of the peaks as seen by the Mediterranean people. Sailors go to the Bear when they sail against the wind. *J'ai perdu la tramontane* (I have lost the tramontana) sings G. Brassens (the French singer and poet) when he has lost his lover Margot: he abandons all reference points and easily loses his north.

The North Star, or Polaris, nestled in the Little Dipper, despite its modest luminosity, has been and still is the faithful landmark of navigators and nomads, poets and writers.

Unlike other stars in the sky, it remains in the same location every night from dusk to dawn. The Navajo people call it *Nahookos Biko'* which means "Central Fire". The North Star is the cosmic centre of the Navajo night sky and represents the central hearth and fireplace in traditional dwellings (hogan). It connects the male and female constellations which revolve around it: Ursa Major (*Nahookos bika'ii*), the great father, and Cassiopeia (*Nahookos ba'aadii*), the great mother.

Shakespeare's Caesar compares himself to Polaris:

But I am constant as the northern star,
of whose true fix'd and resting quality
there is no fellow in the firmament.

The short story "Polaris" (H.P. Lovecraft, 1920) introduces a narrator who dreams of a city of marble lying on a plateau between two peaks, with the "malign presence" of Polaris ever watching in the night sky.

From Canine Warmth to Gentle Cuddles

Further south Sirius culminates, bluish and resplendent, the fetish star of the Dogon people in Mali. It can be seen on beautiful winter evenings, keeping its distance from the world, which is probably why Hubert Beuve-Méry, former director of the newspaper *Le Monde*, adopted this pseudonym to sign his editorials.

Sirius was close to the rising Sun during the northern summer over 2000 years ago, earning it the nickname Seiros, "the burning one". Watching for the morning rise of the brilliant Sirius allowed the Egyptians to mark their year. A year structured by the river Nile since all Egyptian life beat to its rhythm. This rising of Sirius occurred in the middle of the flood season and the heat of summer. Sirius, the "little bitch", is also the one who, in Greek mythology, follows the hunter Orion. The wizard Sirius Black, in the Harry Potter saga, also bears this name for his ability to transform into a dog.

The Romans kept the suggestion of heat and the image of the dog to forge the word *canicule* (from *canis*, dog) which designates excessive summer temperatures. We find traces of this dog in the English expression *dog days*, and the Russian *kaniculy*, holidays.

In light of its brightness, it comes as no surprise that Sirius was chosen by the British rock band the Alan Parsons Project for the first track of their album Eye in the Sky. It has now become the most emblematic instrumental music of sporting events in North America, especially during Chicago Bulls games.

What can you do on a hot day? Cuddle? Cuddle comes from the Norman word and was used in the Middle Ages to name animals that rested in the shade during high heat. Everyone will have noticed that shady spots are also conducive to lovemaking. The word has strongly evolved, until it became in the 1970s, by gentle euphemism, the act of hugging someone you love.

What Is a Star (Scientific Description)?

Astronomers define a star as a huge mass of gas in equilibrium, which radiates into space the energy produced in its core by nuclear fusion reactions. This definition refers to the mature star. The term also covers the many transformations in which it begins to form, stabilises and then gradually dies out: the birth, life and death of stars can be described.

Stars are born in very dense molecular clouds. These unstable clouds contract and fragment to give birth to a generation of new stars. The contraction of a gas cloud is not as simple as we once thought. As the gestating star collapses, a gaseous disc forms, while jets of material are vertically ejected along its axis of rotation. The most powerful jets can be up to a light year long. Stars finally reach equilibrium under the effect of two opposing mechanisms – contraction under gravity forces and ejection of an excess of matter – which, subtly compensated, determines their new identity.

Their evolution depends above all on their mass. It is accompanied by strong thermal and dynamical instabilities until the ultimate stage where some form an iron core, while the most massive ones explode, leaving behind as remnant a pulsar or a black hole.

Pulsars, hyper-condensed, hard of hard, with a radius of a few kilometres, emit very powerful and very brief radio waves, of a regularity of watchmaking, regularity which tries to reach, but falls short by far, the watches marketed under this name. Black holes are the hyperdense remains of the most massive stars. Nothing can escape their strong attraction, not even light.

In addition to pulsars and black holes, the filaments of gas expelled at high speed into space disperse carbon, oxygen and iron cores that stars have produced in their core. Our Earth and our bodies are made of this debris from explosions. About ten stars are born and die each year in our Galaxy, the Milky Way.

Ciel no 20, Cygnus nebula. **1979. Oil and metal with bullet impacts 214 × 151 cm. Free interpretation of the artist showing the Cygnus nebula, a remnant of a stellar explosion. Jacques Monory (1924–2018), © 2023, ProLitteris, Zurich**

***Man comes down from above*. We know today that almost all matter is created by stars. The Earth and our bodies are made of the debris from their explosions. However important each one perceives themselves to be, we are nothing more than a pinch of that stardust. Courtesy of Gérard Paris-Clavel, graphic designer**

Sayings

To be born under a lucky star: to be very fortunate, extremely lucky
To aim for the stars: to set high goals, to aspire to greatness
To have stars in one's eyes: to be hopeful, albeit a little naive; overly idealistic
Star-crossed lovers: a pair of lovers whose relationship is doomed to fail due to outside forces
Written in the stars: it is fated or predestined to happen
To make someone see stars: to strike somebody very hard on the head
To thank one's lucky stars: to be very grateful for good fortune
Swinging On A Star: Bing Crosby song
When you wish upon a star: to make a wish when you see a falling star
Shoot for the stars: to try the best you can
Starry eyed: with great expectations, not necessarily justified
Stellar performance: the best possible performance, usually in sports or the arts
Like a shooting star: Popular song by Paradise
A Star Is Born: original (1937) film directed by W.A. Wellman and several remakes
Shining like a star: title of popular songs

Quotes

William Shakespeare: It is the stars, the stars up there that govern our existence.
Anatole France: What is admirable is not that the field of stars is so vast, but it is that man has measured it.
Harry Anderson: Any fool knows you can't touch the stars, but that doesn't stop the wise from trying.
Leonardo da Vinci: He who orients himself on the star does not look back.
Paul Eluard: A dream without stars is a forgotten dream.
Chinese citation: Ignorance is the night of the mind, and this night has neither moon nor stars.
Oscar Wilde (Lady Windermere's fan): We're all in the gutter, but some of us are looking at the stars.
Dalaï Lama: No one was born under a bad star, only people who can't read the sky.
Carl Sagan: The cosmos is within us. We are made of star-stuff. We are a way for the universe to know itself.
Paul A.M. Dirac: Pick a flower on Earth and you move the farthest star.
Dejan Stojanovic *(The Sign and Its Children)*: Every star was once darker than the night, before it awoke.

Constellations

Boreal, constellation, ecliptic, Pléiades, septentrional, zodiac

It takes careful and repeated observation to realise that on the firmament, stars maintain their positions in relation to each other. By mentally linking the stars to their close neighbours, we construct geometrical patterns which help us to remember the appearance of a particular region of the sky. This is how constellations came into being. Borrowed from the Latin *constellatio*, which refers to "the relative positions of the stars", the word constellation became by metonymy a group of stars forming a figure.

The assembling of stars into constellations is obviously purely arbitrary. Each civilisation, each tribe, builds the group, names it and animates it following its fantasy. The agricultural Sumerian civilisations identified the first constellations of the zodiac and we owe them Sagittarius and Aries.

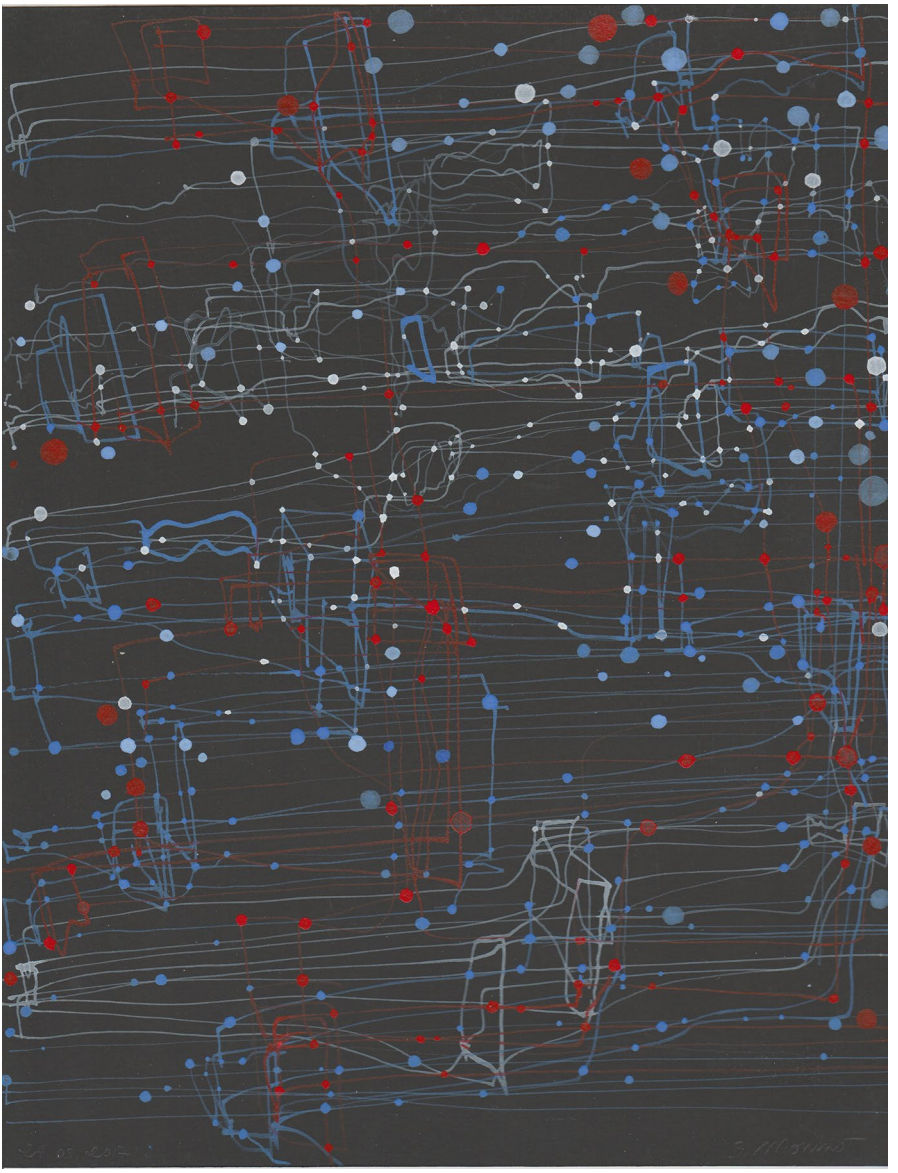
These stellar alignments, fruit of chance and imagination sometimes evoke an overbearing image. For instance, the case of those stars whose distribution suggests the presence of a bull's head, its eye indicated by a reddish star. The Arabs have precisely named it Aldebaran and the constellation is that of the Bull. Other peoples have seen the profile of a lion, or the sinuous line of a snake.

Since the discovery of the immensity of the cosmos and the true distances that separate stars from each other, we can infer with certainty that constellations are pure optical illusions. Today, they are only used to conveniently locate the position of a star and for romantic and literary purposes.

Most of them rise in the east and set in the west, like the Sun and Moon. This results in an apparent movement of the sky, called diurnal motion, which drives both the stars and the Sun and creates the alternating days and nights.

The Road to the Sun

The Sun partakes of the diurnal movement like the stars and constellations, although unlike them, it does not remain fixed on the celestial sphere. In 1 year, it appears to travel a large circle called the ecliptic.



***Cadastre*. Imaginary representation of star paths in the Milky Way. Courtesy of Bernard Moninot, artist**

The zodiac extends on either side of the ecliptic. This area of the celestial vault, 18 degrees wide, constitutes the celestial highway from which the Sun, the Moon and the planets never escape. The word appeared after the 13th century.

Zodiakos means "the wheel of animals" in Greek, the Greek root *zôon* meaning both animal and living being. One may recall Costa-Gavras' 1969 film Z, the Greek initial for life: it was the letter that opponents of the regime wrote on the walls to protest against the assassination of the Member of Parliament, the film's hero, played by the actor Yves Montand. But it is certain that zoology, a discipline created in the middle of the 18th century, has inflected the derivatives of zoo to animal. To the zoo we go to see animals!

Like any highway, the zodiac requires markers: towards the end of the 6th century BC, the Greeks divided this belt into 12 equal signs, within which they believed to see in the starry night the drawing of *zoidon* (small animals).

The names of these 12 rectangular boxes, or signs, are derived from the constellations in front of which the Sun passes during the year. This choice may be surprising, for their real number is 13 and because their extent is uneven. But the 12 lunations in the solar year are at the origin of the 12 months; hence, it was tempting to associate each sign with a single month (and a group of three with a season).

Through this zodiac (also called "road of the Sun" by the Romans), the Sun accomplished its annual route on a chariot harnessed to four horses. The first sign was Aries, where the Sun entered at the spring equinox. The ram was represented leaping through a ring symbolising the circle of the equator. But of the 12 signs of the zodiac, only seven are animals. Four others represent human beings and the fifth, Libra, is inanimate.

The points of intersection of the ecliptic and the terrestrial equator move slowly due to the circular motion of the Earth's axis in a cycle of 25,765 years, called precession. They make a complete turn of the zodiac and jump from one sign to another every 2147 years. Thus, this shift has played a very bad trick on astrologers: the spring equinox nowadays occurs while the Sun crosses the constellation of Pisces and is no longer in Aries! Similarly, the northern summer solstice occurred 5000 years ago in the constellation of Leo, the astrological house of the Sun, and then in Cancer, and today, the phenomenon occurs in the sign of Gemini – in June.

The origin of the constellations' name is not clearly established. There are still many speculations about them. When Cancer, for example, marked the sign of summer, it was stated that the crab which walks backwards evokes the Sun which reverses its course (and the days which start to shorten), while conversely the sign of Capricorn in winter marked the resumption of the ascending course of the same Sun. Goats also like to climb! The Aquarius zone, from January 20 to February 21, was given the name *hydrokhoeus*, literally "water pourer" to describe the rainiest period of the year in Greece.

If we look closely at this symbolism, we see that it speaks more about man than about the heavens. The symbols correspond to types of human personalities, psychological tendencies and social behaviours that everyone can relate to (Table 1).

Our galaxy in motion. **This large luminous scarf that crosses our sky is our Galaxy (Voie Lactée in French). This is a large disc made up of billions of stars rotating around itself. The Sun is in our Galaxy. Courtesy of Gérard Paris-Clavel graphic designer.**

Notorious Constellations

The surveying activity of the Sumerians was extended in the Northern Hemisphere by the Chaldeans, Babylonians, Egyptians and Arabs. After Alexander the Great's conquests, the Greeks in turn colonised the firmament with heroes of their own mythology, such as Hercules, Andromeda, Orion and Pegasus.

Table 1 Summary of the zodiacal signs in both hemispheres

	Animal:	*Human:*	*Other:*
Northern Hemisphere	*Taurus* *Aries* *Cancer* *Lion*	*Gemini* *Virgo*	
Southern Hemisphere	*Scorpio* *Capricorn* *Pisces*	*Sagittarius*	*Libra* *Aquarius*

There are only a few constellations whose shape is evocative of their name. With the exception of the Dragon, Scorpio or Orion the hunter followed by his dog Sirius, who would recognise a bear or the generous forms of the whale in the constellations that bear these names?

However, some stellar groupings are so characteristic that they have been adopted independently by tribes or civilisations that have never met. For example, the Pleiades, a tiny group of seven closely packed stars near the constellation Taurus, appear in many cultures and religions and even possibly in a few Neolithic caves such as Lascault in France. In Latin America, the observation of the heliacal rising (i.e. occurring at the same time as the rising of the Sun) of the Pleiades was used to foresee what would be the annual precipitation, as at the end of June, farmers would scan their particular arrangement in order to predict when and how much precipitation would fall during the rainy season a few months later. The Arabs, on the other hand, have since time immemorial associated them with the dry season and hot weather.

They represented seven sisters for the Greeks as well as for the Australian aborigines, so far away from each other. The Romanians and Chinese independently recognised a hen and her six young.

The original literary Pleïade were a group of seven Hellenistic tragic poets active in Alexandria in the reign of Ptolemy II (285–246 BC). The bulk of their work was lost in the destruction of the Great Library of Alexandria in 642 AD: only those of Lycophron survived.

Eighteen hundred years passed before the title was again adopted by a group of poets. In the mid-16th century, a group of French poets founded *La Pléiade*, with the aim of breaking away from a moribund medieval poetic tradition and enriching their native French language with a literature equal to those of the classical world and the Italian Renaissance. It included Ronsard, Du Bellay, Baïf, Belleau, Jodelle, Pontus de Tyard and Pelletier du Mans (replaced at his death by Dorat). Du Bellay's *Défense et illustration de la langue Française* (Defence and illustration of the French language, 1549) became the manifesto of the group. By extension, *pleiade* designates an important

collection of objects. The *Bibliothèque de la Pléiade* (by Gallimard Éditions) is one of the major collections of French publishing.

***Ciel no 2, Nebula in the Milky Way,* 1978. Oil 150 × 150 cm. Free interpretation of the artist showing a complex of gas, stars and dust in the Milky Way. Jacques Monory (1924–2018), © 2023, ProLitteris, Zurich.**

The Big Dipper was recorded by the peoples of Asia, North America, China and the Mediterranean regions. It was named and renamed in the collective memory long before it was inscribed on the sky charts. With its seven characteristic stars, the Big Dipper becomes the Seven Wise Men, the Seven Little Indians, the Big Dipper, the Great Chariot, the Plough, the Dipper and its young. In some parts of Brittany, the Great Bear is a shipwrecked vessel pulled by sea horses.

The Romans called it septentriones, "the seven plough oxen", and by extension the word septentrion meant the north wind and the lands to the north. Septentrional is today in competition with Nordic. Its synonym

boreal, which appeared in our language at the end of the 15th century, is borrowed from the Low Latin borealis, "of the north", in reference to Boreas, a deity associated with the north wind. Aurora borealis designates the Northern Lights.

The sky was and will remain a motive for power and rivalry. In this context, isn't naming already to claim possession? In England, the Great Bear first symbolised the chariot of King Arthur, while elsewhere it was that of the Emperor Charlemagne. In Gascony, it is said that after the death of King David, God took his remains and placed his chariot where we see it today.

In China, a legend describes how the seven gods of the Great Bear one day wanted to taste the pleasures of earthly life. They went down to the house of a man condemned to death and were welcomed by his young wives who offered them wine and refined pleasures. The court astronomer, noticing a great void in the sky, ran to inform the Emperor that the seven stars had disappeared from the firmament. Distraught at the idea that the end of the world was close, the Emperor ordered a general amnesty, and the wrongly accused man was pardoned.

We will not leave China without mentioning the love story of a weaving goddess (the star Vega) and a simple cowherd (the star Altaïr). These two stars are seen projected on either side of the Milky Way and shine overhead on summer evenings. The legend says that the goddess, overcome with love, married the mortal youngster and gave him two children. Her father found her and, furious, made her return among the gods. To prevent the cowherd incarnated as a star from finding his wife, a goddess using her hairpin engraved in the sky a large impassable river, the Milky Way. Vega must stay eternally on the same side of the celestial river and work non-stop on her loom, while Altaïr watches her from afar, taking care of their two children (actually, the two neighbouring stars Beta and Gamma Aquilae). Faced with the tears of the inconsolable princess, the despair of the herdsman and the cries of the motherless children, the gods granted them to meet once a year. On the seventh day of the seventh month, the day of their rendezvous, all the magpies of the world fly up to the sky to form a bridge over the star Deneb in the constellation of the Swan, which spans the Milky Way; this allows them to cross for this single encounter.

In China, every newly married or single woman makes an offering of fruit, flowers, tea and rice powder to these two stars.

A Very Crowded Sky

In the 15th–16th centuries, astronomers and navigators began to travel the southern seas and added new constellations to the sky. Their names evoke the technical advancements of the time and introduced a break in the animal and mythological tradition of the Ancients. We owe the navigator Amerigo Vespucci naming the constellation of the Triangle and the sublime Southern Cross, already recognised by the Portuguese navigator Magellan.

In the 18th century, the French astronomer Nicolas-Louis de Lacaille explored the sky of the Southern Hemisphere. He drew and named the outlines of 14 new constellations to fill in the existing gaps. They include the engraver's chisel, the compass, the reticulum, the telescope (why not!), the sternum or the vacuum pump whose invention by Robert Boyle was the subject of very serious controversy with Thomas Hobbes over the so-called "vital" force.

But when the exploration of the globe was completed, there was great confusion in the sky! New contradicting constellations were added to the old ones, the borders of some overlapping those of others, the celestial maps of one contradicting those of another. This is how a Fly came to "land" in the constellation of the Triangle in 1624, only to be transformed into a fleur-de-lys under the reign of Louis XIV. The flower and the insect have now deserted this corner of the firmament; the Fly has flown to other latitudes where Dutch astronomers had placed it in a very precarious position within reach of the tongue of the Chameleon and close to the legs of the Bird of Paradise.

In 1928, the International Astronomical Union (IAU) finally fixed the mapping of the constellations by adopting a rigorous coordinate system. Their names were Latinised and they divide the entire celestial sphere into 88 distinct regions without overlap. Among the ones left out are Antinous, faithful companion of the Roman emperor Hadrian; the Honours of Frederick II of Prussia, friend and protector of Voltaire; the Hot Air Balloon proposed by Lalande and adopted by the astronomer Bode as a tribute to the Montgolfier brothers; the Volta Battery, an electric generator; a bust of Christopher Columbus; Felix the cat (Lalande's favourite animal); a Typographic Machine; a Wall Quadrant; a Reindeer; the Hand of Justice; and a Sundial (in the sky, what an idea!)). There was also the Rooster, not in reference to the valiant fighters of Gaul but to the one that crowed twice after the triple denial of Saint Peter.

By metaphor, constellation in the Middle Ages meant a group of remarkable people (e.g. the group of poets of the Pleiades already mentioned) or any set of objects linked together. *Consteller* (in the sense of spangle) will appear much later, in poetic language.

Astral Influences

Almanac, ascendancy, consider, descendant, desire, disaster, ephemeris, flabbergast, horoscope, influence, influenza, mischief

Astrology was born out of the belief that the fires of the heavens act upon our destinies. Later, when the Sun replaced the Earth as the centre of the world, astronomy took a different path from astrology. As a result of this inversion, Venus, the Shepherd's Star, became a planet, and the Sun became a star.

Good and Bad Influences

The Chaldeans called the planets interpreters (of destiny of course), while the Greeks and Romans called the astrologers Chaldei. Nowadays, you only have to open any popular magazine to find a more or less detailed horoscope. Millions of people still believe in astrology, and one is always amazed by the cohabitation of the two skies, that of the astronomer and that of the astrologer, across cultures and eras. Sometimes one finds that the same person can adhere to certain aspects of astrology while staying curious about the advances of contemporary astronomy. Since the physical sciences understand the infinitely large and the infinitely small – one allowing to better know the other – one could even propose a quantum astrology! Nothing could be simpler than to build horoscopes accounting for the presence of virtual stars or small black holes in the process of evaporating which would introduce a fair dose of free will into the prediction of our destiny… while guaranteeing *ad aeternum* and for a good cause the funding of scientific research! No one has taken this seriously yet!

Astral influences are exercised, according to "serious" astrologers in connection with the position of the stars in the sky. The noun influence stems from the medieval Latin *influentia*, "action of the stars on the destiny of people", which itself comes from the Latin *influere* "to flow", suggesting the idea of material or wave coming from the stars. This is why astrologers have used and abused the word to express the harmful or fortunate actions of the

stars. The first time (in the 18th century) that one dared to speak of the influence of one man on another, one voluntarily used a provocative image which has since become commonplace and is no longer perceived today as a bold metaphor.

The stars, astrologers tell us, have a decisive impact on our mental and physical balance. "This obscure light that falls from the stars" declares Rodrigue in Corneille's Le Cid.

Shakespeare used symbolic notions of astrology and alchemy in his plays: Juliet was born in Lammas Eve (Leo); Romeo was linked with Sirio (the Prince), the second Sun. The metal associated both with royalty and with Leo is gold; hence, the parents of both, after the tragedy, promised to build gold statues to commemorate them.

The astrological doctors, dear to Molière, invoked them to maintain body and mind in harmony with the cosmic order. Generally speaking, a star or a planet badly situated in one's horoscope was supposed to affect individuals to the point of altering their health or even life. Among other disorders, one could contract the flu (still called "flu" in England) and for the Italians, "influenza", a historical reference to this astrological belief.

We always say: to each their own, someone was born under a good or bad star… and indeed, until the French poet La Fontaine, *malotru* referred to a poor devil born under a bad star (from the popular Latin male *astrucus*, which became *malastru* and then by an atypical phonetic evolution, *malotru*). It entered French in the 12th century via the Provençal idiom. Many people are indeed called Astruc in the south of France. *Malotru* designated an unfortunate, puny person, physically disadvantaged. Later on, in the eyes of Voltaire's contemporaries, *malotru* was used to designate the morally and socially disgraced, the one who did not know how to behave in good society. An ill-bred person, in other words! This is the meaning it retains today.

Our Birth Star

Astrologers, before anything else, draw up the scene inscribed on our heads at the time of our birth. The word horoscope is taken from the Latin *horoscopus*, which means "astral conjunctions at the time of birth". But the Latin word itself came from the Greek *horoscopos* composed of *hora*, *hour* and *skopein*, "to examine". It is indeed a question of examining the astral influences on an individual to predict their destiny.

Believe or not is the question? Paulo Vincente answer to it with a spice of humour: Like all Aquarius, I don't believe in horoscopes.

In the composition of Greek- and Latin-derived words, -scope is normally perceived as the element meaning "to see" or "to look" and corresponds, in most cases, to "examine with the eyes". Magnetoscope, telescope, microscope, periscope, etc. are examples of this. Quite simply, one looks at the small, the distant, with the help of a magnetic recording, etc. In this context, the stethoscope is intriguing. What can the doctor see when she puts this elegant lyre-shaped bi-auricular (normally worn as a scarf on the white coat, as a direct symbol of inquisitorial powers) into their ears? See nothing but examine, yes, with the ears. The doctor Laënnec, who knew Greek well, invented the device and coined the word in 1819 from *sthêtos*, "chest", and *skopein*, "to examine". This can be seen as another example of a term (*skope*) that appeared for a narrowly astrological use and whose semantic value has expanded over centuries.

The horoscope makes use of ephemerides. Borrowed in the 17th century from the Greek *ephêmeris biblos*, "daily journal", through the intermediary of Latin, it refers to astronomical tables giving the position of the stars for each day of the year. It was in the 18th century when it took on the meaning of a diary by extension, and then in the 20th century that of a calendar from which a small sheet was detached daily. This goes back to the original meaning of the word in Greek: *epi*, "during", and *hêmera*, "day".

The Good Fortune of Almanacs

Another form of diary has made a fortune: the almanac. With its first syllable al (as in alchemy and algebra), the word suggests its Arabic origin. The almanac registers the "memory of the moon", in other words the calendar of the lunar phases.

The word, in the late 14th century, designates "book of permanent tables of astronomical data", attested in Anglo-Latin from the mid-13th century, via Old French *almanach* or directly from Medieval Latin *almanachus*, a word of uncertain origin and the subject of much speculation. The Latin word is often said to be ultimately from Arabic somehow, but an exact phonological and semantic fit is wanting. It is usually connected to a supposed Spanish-Arabic *al-manakh* "calendar, almanac", which is possibly ultimately from Late Greek *almenichiakon* "calendar", which itself is said to be of Coptic origin. According to the Oxford English Dictionary (OED), a detailed case can be made "that

the word almanac was pseudo-Arabic and was generated within the circle of astronomers in Paris in the mid-13th century".

One-year versions, showing correspondence of days of the week and month, ecclesiastical calendars, etc., date from the 16th century; "astrological and weather predictions appear in the 16th–17th century; the 'useful statistics' are a modern feature".

The French adopted it at the beginning of the 15th century, a great period when both astrology and astronomy were developing in Europe. If the almanac is first a calendar, it also becomes the divination of the future in the 17th century.

Rabelais wrote almanacs to sell them for an extra income. His patients were unaware of his famous books (Pantagruel, etc.) but knew rather well of his almanacs sold by pedlars, and often questioned him, confusing him with a fortune teller. As a free spirit, he knew how to make fun of astrological predictions, but he readily admitted that his almanacs sold much better than his books.

In the 19th century, more than a million of them were distributed in the French countryside. Nowadays, the word refers to a popular, outdated but still available directory, *Almanach Vermot*, which has become a famous collection of puns.

In England, the production of almanacs had made astrology accessible to all of Elizabethan society, not solely royalty. The status of astrology is reflected in Shakespeare's plays: in King Lear, Kent searches in the stars the explanation for the difference between his daughters:

> It is the stars,
> The stars above govern our conditions
> Else one mate and make no beget.
> (Act four, Scene Three)

Shakespeare's plays reflect the status of astrology in Elizabethan society on all levels, i.e. politically, intellectually and religiously. Astrology was used in so many different ways, to predict individual's future, in medicine and science. Through his characters, Shakespeare shows the varying attitudes towards astrology, from superstition, belief, ridicule or mystery.

The Sun Is a Star, the Earth a Disaster

The zodiac sign that rises in the East at the moment of birth of an individual is the ascendant. It has a particular astrological significance for the existence

of a person, even more important than the solar sign (the one where the Sun appears at the moment of birth).

The term ascendant materialised in French in the 14th century and its use was generalised only in the 17th century. The French poet Malherbe uses it in a figurative sense but still very close to the astrological sense: "What star of ire and envy, when you were born, marked your ascendant?"

Ascendant had the same evolution as influence. The expression "to have ascendancy" extends to people. Ascendancy exercised as dominance is not necessarily perceived as positive. If negative, it can lead to disaster. This word was borrowed in the 17th century from the Italian *disastrato*, formed from the Greek prefix dis (or dys), meaning "bad", followed by the Latin word *aster*. A disaster was originally a disastrous star, as was the case for a long time with comets (see the Solar System's chapter), and finally designated the catastrophe that it brought before being extended to the idea of calamity, whatever its origin.

The word is part of the following opposition: the star announces a favourable fortune, while disaster, an irremediable catastrophe. It is necessary to tell the (presumably true) story of the teacher who, during a lesson on the prefix de-, was dismayed to hear a pupil suggesting to the inspector: "The Sun is a star and the Earth is a disaster". She saw the pupil's proposal as nothing more than an unfortunate child's word. The student had played with the syntax and applying the lesson on the prefix de-, unwittingly revealed a semantic symmetry of poignant relevance.

The poet Paul Verlaine uses these two words to create a very rich rhyme:

> The wise men of old, who were as good as these,
> Believe, and this is a point that is still unclear,
> To read in heaven the happiness as well as the disasters,
> And that each soul was linked to one of the stars.
> (Much has been made of this, without thinking that often
> The laughter is both ridiculous and disappointing,
> This explanation of the nocturnal mystery).
> But those who are born under the sign SATURN,
> Fauve planet, dear to necromancers,
> Have among all, according to the ancient grimoires,
> A lot of unhappiness and a lot of bile.
>
> Paul Verlaine, Poèmes Saturniens.

Fateful Actions

In Latin, *sidus* (*sideris*) means "constellation" as opposed to *stella*, "isolated star". *Stella* (star in English, hence stellar) has kept the same meaning as in Latin. This is not the case for the *sidus*' descendants. From the Latin period onwards, this word took on a very broad meaning and designated the sky as a whole. The corresponding adjective, *sideralis,* means "which concerns the stars". It is from this adjective that sidereal was coined in 1520, and it is also used in scholarly language: *sidereal year* (1762), *sidereal revolution* (1805), *sidereal day* (1835) and *sidereal time.*

As for the French word *sidéré* (dumbfound, stunned!), it comes from the Latin *sideratus* which undergoes the disastrous action of the stars, struck by insolation. Although it had the meaning of "influenced by the stars" until the 18th century, it was recovered at the end of the 19th century with the meaning of "stunned, literally abashed", which is still used today. *Desideratum* instead means nowadays "something that is needed or desired".

The horoscope will tell that a planet which exerts its influence on the health or life of a person is staggering. Sideration (1549), from the Latin *sideratio*, underlines the negative influence of the stars, more particularly the Sun; then in medical Latin necrosis, gangrene; and finally, as a term of astrology still in use, the sudden stellar influence on a person. Since the 18th century, in medicine, it still designates the annihilation of vital forces under the effect of a strong emotional shock or lightning. It is undoubtedly this meaning that was able to revive the term *sidéré* in French, at the end of the 19th century.

> The lower order is a mirror of the superior order, the forms of the earth correspond to the forms of the sky; the spots on the skin are a map of the incorruptible constellations; Judas mirror Jesus in a way.
>
> J. L. Borges Fictions

To consider (from the Latin *considerare: cum-sideris*) at first meant "to look at the stars" in naval language before it became generalised and acquired the meaning of looking attentively, reflecting, as done when much importance is given to what is observed.

On the other hand, siderurgy has nothing to do with sidereal. It is an acquired derivative of the Greek *sidêros*, "iron", and ergon, "work", on the manner of metallurgy, surgery, etc. It was thought that a link could be established following the idea that iron was first discovered by humans in meteorites. In fact, it is only a derivative formed from the Greek *sidêros* and not from

the Latin *sidus*, an appearance as misleading as that which makes us believe that the Sun revolves around the Earth! We see how a formal resemblance is not enough to establish a common origin, a kinship.

And yet… who would think of attaching words like *consider* and as we shall see *desire*, to stun?

Desire of the Stars

Desire, indeed, seems to be far from the stars, both in form and in meaning. Contrary to consider, it now means ceasing to contemplate the star (the prefix de is privative). From there we can only notice an absence, a strong regret that seizes us and leaves us wanting…

From the Latin *desiderare*, similar in structure to *considerare*, it was pronounced *desiderare*, as if there were two s. In its form, the word underwent a phonetic shortening. The double appearance of the syllable *de* was too much, so it was simplified to desire. And, since *-sire* does not exist, the s was pronounced as a z, as it should be between two vowels. This is not the case with words like disengage while disarm lets the z hiss and preserves in our memory the existence of armer. Desiderate has kept all its Latin letters… but is only used in administrative jargon.

Desire is certainly the most beautiful gift from heaven to our vital impulses! Conscious tendency towards a known or imagined object? Desire comes from the stars, and we astronomers feel that distance is a form of confiscation; hence, we find a way of warding off the fear of not mastering those phenomena that fascinate us from afar.

In any case, it is difficult to decide whether it is the desire or the object of desire that is primary. One could argue that it is the desire that creates its object.

Astronomers in the desire to see become image builders and deliver their point of view, a representation of the sky and space.

Finally, is it indeed from absence that desire is born? Psychoanalysts note that the desire for life is constantly in struggle against the death drive (to desire in Latin is also called *cupio,* (from *kuep*, "to boil"). This feeling, sometimes subtle and sometimes bubbling, reveals in man the angel or the animal.

André Maurois wrote: "The miracle of human love is that on a very simple instinct, desire, it builds the most complex and delicate edifices of feeling". T. E. Lawrence preferred the anticipation of the antechamber: "When a thing was within my reach, I no longer wanted it, my joy was in the desire". And

J.K. Rawling, the creator of Harry Potter, punctuated: I've been writing since I was six. It is a compulsion, so I can't really say where the desire came from; I've always had it. My breakthrough with the first book came through persistence, because a lot of publishers turned it down!

Friedrich Nietzsche concludes in a more cynical tone:

> We come to love our desire and no longer the object of our desire.

Cosmos

astronaut Big Bang black hole cosmogony cosmonaut cosmopolitan diffuse background galaxy macrocosm microcosm Milky Way nebula quasar quintessence taikonaut

Beautiful as a Star

The expression "The Universe" defines as a whole everything that exists. The word is composed of the Latin *uni-* ("one") and *versum* ("to turn"). It enjoys the ennobling qualities attributed to it by the Greek philosophers Plato and Pythagoras. Immanuel Kant himself marvelled:

> Newton, first among us, saw order and regularity united with great simplicity, where others before him found disorder and ill-arranged multiplicity; and ever since then comets run their course describing geometrical orbits.

Cosmos originates in the Greek word *kosmos*, which expresses the idea of order, harmony and beauty. Hence, the botanical term *Cosmos bipinnatus* (Mexican aster) for dazzling flowering plants with evenly placed petals used to adorn vases and gardens. The word gave way to a long series of creative compounds such as microcosm, macrocosm, cosmodrome, cosmonaut, cosmographer, cosmology, cosmogony, cosmobiology and cosmogenesis.

Ironically, women and men who travel in space (or the cosmos) are called differently depending on their country of origin. Cosmonauts is a Russian designation, derived from the Greek *cosmos* and *naute*, "navigator". The word astronaut, from the Greek *astron*, "star", is used in the United Kingdom, United States and Canada, while taikonauts, from the Chinese *tàikong*, "space", again, has appeared in China.

The original version of the chapter has been revised. A correction to this chapter can be found at https://doi.org/10.1007/978-3-031-49024-8_11

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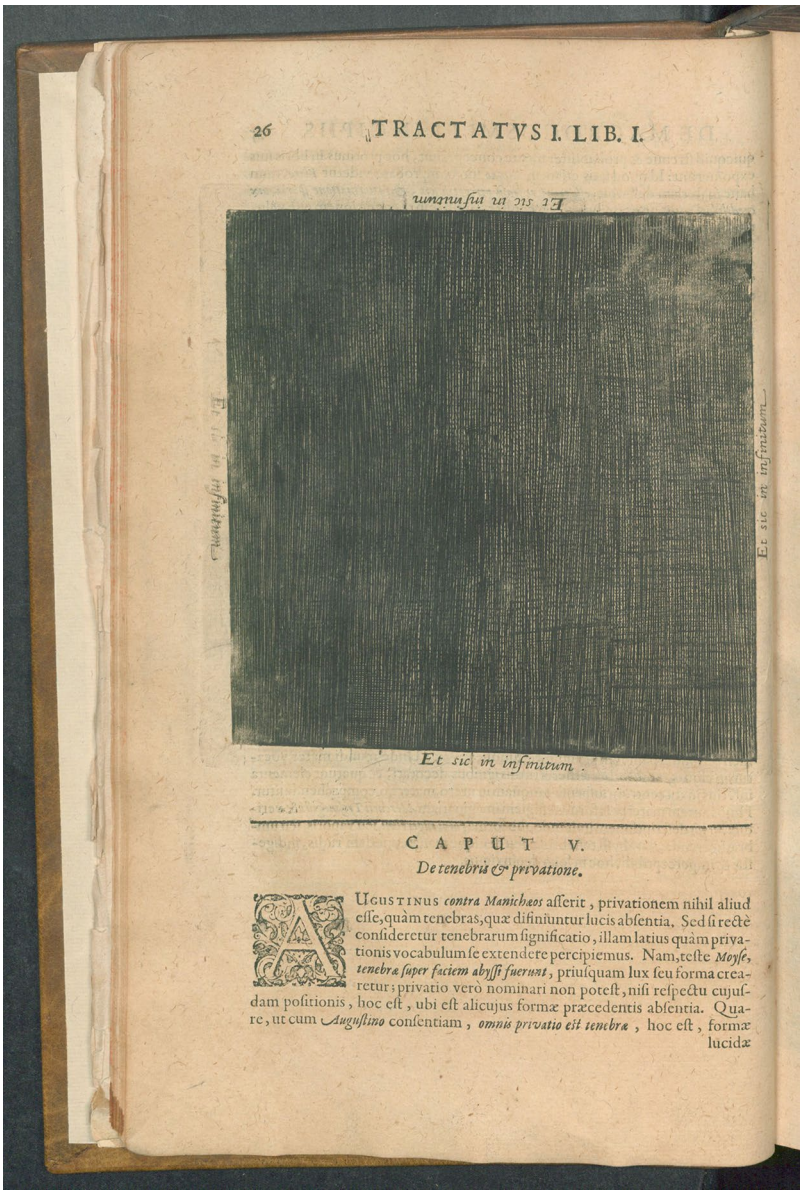
Each of us carries our own universe, unique, small, beautiful and discreet enough to demand respect, and big enough to claim its countless facets. Our narcissism borrows the same qualifiers as it does. "To be as beautiful as a star" springs from our lips when a beauty from elsewhere appears! Curiously, the Great Universe is much smaller than the original, since it is a simple paper of fine pulp, of modest dimensions, used in stationery for lithography.



***Black Square*. This document is from Robert Fludd (1574–1637), an English Paracelsian with both mathematician, physician, and occult interests. His black square is a representation of "the before Fiat lux" surrounded by the mention Et Sic in Infinitum. Courtesy from Welcome collection (London)**

Cosmos, as mentioned above, is also on the ground a botanical term for those beautiful and vibrant flowers that we can find in our gardens. The Italian novelist Erri De Luca, in *The Day Before Happiness* (2010), uses these analogies borrowed from botany:

> When we studied it in school, the universe was a table set for guests with telescopes. In fact, it stretched to the naked eye and looked like a mimosa in March, with its flowering clusters, overloaded with nebulous dots, thrown haphazardly into the foliage, crowded to the point of hiding the trunk.

Cosmopolitan, borrowed from the Greek *kosmopolitês*, designates the citizen of the world and, after having been denigrated by Nazi and Soviet anti-Semitic propaganda, is now claimed with pride. The adjective cosmic is derived from the Greek *kosmikos*, which refers to the Universe in the astronomical sense, but in literature, it qualifies what is outside the strictly earthly norms.

> It was just a colour out of space – a frightful messenger from unformed realms of infinity beyond all Nature as we know it; from realms whose mere existence stuns the brain and numbs us with the black extra-cosmic gulfs it throws open before our frenzied eyes.
>
> H.P. Lovecraft, The Colour Out of Space

Cosmos is associated with *cosmically* (in harmony with the Universe) and even cosmicity (with cosmic dimensions), all terms that are not often used. Thus, Gaston Bachelard, in *The Poetics of Space*, says: "I have a great dream of cosmicity. Who would not feel cosmically comforted by imagining taking a bath in the shell of the great clam?"

Derived from *kosmos* in the ornamental sense, the world cosmetic defines products which are visually appealing or in relation to the act of beautifying, such as those used to pamper one's hair and skin. Computer scientists help astronomers to clean up their images from afar using so-called cosmetic processes. Return to sender perhaps, but above all a way to prepare for contemplating the perfection of the world.

The Fifth Element

Aristotle defines the quintessence as the fifth essence, a vibrating but perfectly rigid substance that permeates both the cosmic void and material bodies. In classical and medieval philosophy, the world was thought to be made of four distinct elements: air, water, fire and earth. This fifth element resurfaced under the name of aether with Descartes, who imagined a subtle matter allowing all forms of interaction. Aether was thought to be an extraordinary, strange substance that permeated the celestial sphere and was purer than any of the four terrestrial elements.

Quintessence and these elements are mentioned in John Milton's Paradise Lost by the archangel Uriel in his description of the Creation to Satan:

> Swift to their several quarters hasted then
> The cumbrous elements—Earth, Flood, Air, Fire;
> And this ethereal quintessence of Heaven
> Flew upward, spirited with various forms,
> That rolled orbicular, and turned to stars.
> John Milton, Paradise Lost

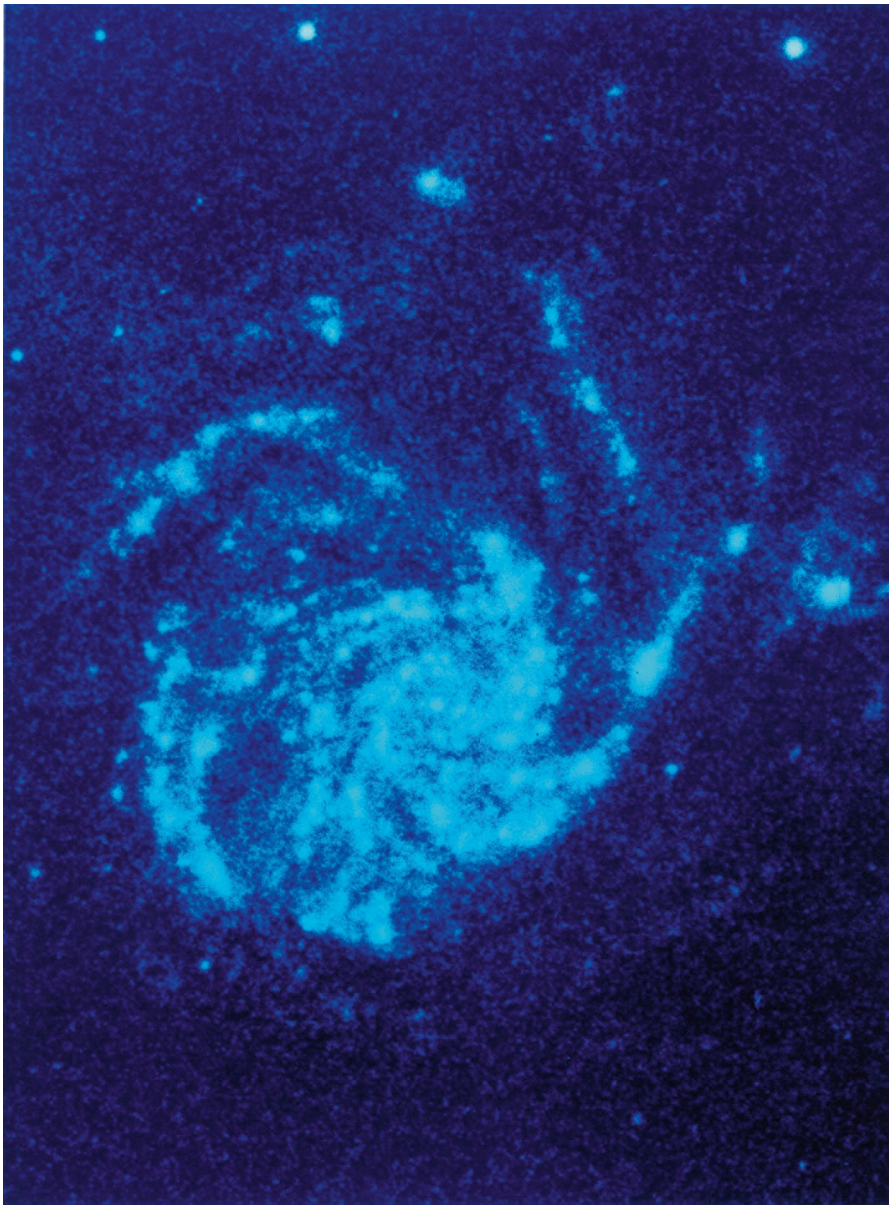
In turn, Huygens, Newton and Maxwell assigned it an obscure role as a go-between, an anonymous transmitter, at once transparent, empty and necessary, mobile and immobile, immaterial matter subjecting physicists to the most audacious hypotheses.

Unrelated to the one that film-lovers showcased by Luc Besson, this fifth element became in the 19th century the vibratory ether in which light is supposed to propagate. After the negative experiments performed by the physicist Albert Michelson to measure the speed of the Earth relative to the ether, we know that it simply does not exist. This negative result led to a new formulation of physics at the dawn of the 20th century with Albert Einstein's theory of relativity. Since then, two theories – those of the infinitely small and the infinitely large (quantum mechanics and general relativity) – place ether at the centre of their debates without reaching a common definition. The theory of the great everything, if it comes into being, proposes to achieve this. Nevertheless, quintessence remains in our imagination as the state of absolute excess. The ether or ethers? Are we entering the Baudelairean universe?

Cosmic Clouds

The cosmos is so vast that the most distant stars were and still are difficult to discern individually. To such an extent that when astronomers discovered diffuse, blurred patches of light in the sky, they named them nebulae – from the Greek *nephos*, "cloud", literally "looking like a cloud" as if to mark out a limit to their understanding. For Charles Messier, a French astronomer of the 18th century and eminent comet hunter, these blurry clouds made it more difficult to find his favourite hairy stars. He decided to compile a catalogue of diffuse-looking objects intended for comet researchers to avoid any confusion with these dim and rather strange gleams. His contemporary, the English astronomer William Herschel, was convinced that some nebulae were formed by vast star systems. In reality, this jumble includes large shells of gas expelled by ageing stars, clouds of gas and dust illuminated by star clusters, stars that were not distinguishable individually by any instrument of the time and finally the huge distant galaxies which pave the universe.

Understanding faraway galaxies remains one of the challenges of contemporary astronomy. Thanks to them, we experienced the most exciting moments of our life as astronomers, when we saw the outlines of these distant objects appear on the black screen of our clear nights. We knew that this light, emitted more than 10 billion years ago, had travelled an indescribable number of kilometres to end up popping up on the screen of our telescopes detectors enabling us to picture the Universe. Nothing less.



***Heat 2021*, A galaxy in blue light. Silk-screen printing on telescope mirror, steelView. Courtesy of Caroline Corbasson, artist**

Blank 2016, Cluster of galaxies. **Courtesy of Caroline Corbasson, artist**

Drawn 2018, **Two interactive galaxies. Charcoal drawing on paper. Four panels. Courtesy of Caroline Corbasson, artist.**

A Haze of Eternity

But perhaps the strangest nebula for an ordinary mortal is the Milky Way, a long ribbon of pale light, a figure of eternity. On a clear night, a watchful eye can perceive it stretching across the sky, interrupted sporadically by large dark areas.

> [...] sitting in a rump on the galaxy, I rode through the light years, caracoling on the planetary and stellar orbits as if on the saddle of a horse with hooves throwing sparks...
>
> Italo Calvino, *Cosmicomics*

A 17th-century haiku by Japanese poet Basho captures in just a few words the sparkling beauty of the Milky Way stretching out across the sky, a serene metaphorical river of stars rising above the storms of human life:

A stormy sea
Stretches out over Sado Island
Heavenly River.

In Japan, the Tanabata Festival, also known as the Star Festival, celebrates the reunion of the deities Orihime and Hikoboshi, represented by the stars Vega and Altair. According to the legend described in the "Constellations" chapter, the Milky Way separates these two lovers who are only allowed to meet once a year.

For the ancient Greeks, the Milky Way was the trail of milk spouting from the breasts of Hera. She once woke up and surprised Heracles breastfeeding on her bosom in order to achieve eternity. Furious, she angrily pushed him away but it was too late and the Milky Way was already illuminating the darkness of the sky.

For the Volga Tatars as well as for the Lapps, it is the path of the wild geese that migrate from the Arctic to the warm countries. It is said that Charlemagne gained eternal life by obeying Saint James, who pointed out the heavenly path to him. In the 17th century, it guided pilgrims on the route to Santiago de Compostela. It is not at all proven, as we have often heard, that the term *compostelle* is the transcription of the Spanish *campo de estrellas*, "field of stars", which would have indicated the presence of the apostle James' body. But more simply the word results of *compostum* and *compostela* which mean cemetery. For some Muslims, it remains the pilgrimage route to Mecca. Throughout the Christian world, it marks the route of souls to purgatory.

A broad and ample road, whose dust is gold,
And pavement stars—as stars to thee appear
Soon in the galaxy, that Milky Way
Which nightly as a circling zone thou seest
Powder'd with stars.

John Milton, Paradise Lost

The Milky Way, that great scarf splashed across the sky, is actually our Galaxy. It is a large rotating disc made up of 150 billion stars. We Earthlings are lodged within it, nearly 30,000 light years from its centre, which is located in the direction of the constellation of Sagittarius. It is precisely because we

see this disc from the edge that stars appear to be packed together. This is a pure optical illusion, a pure illusion of congestion. When in 1609 Galileo pointed his telescope at the Milky Way, he realised the depth of the Universe and exclaimed:

> The galaxy is, indeed, nothing but a cluster of innumerable stars scattered in little heaps, a considerable number of stars, many of which show themselves to be large and distinct; but the multitude of small stars remains completely indistinguishable.

Science fiction invites fabulous journeys through time and among the stars, but seldom beyond the Milky Way. Douglas Adams, born in Cambridge in 1952, author, producer and actor, is famous for his science fiction works. In his novel *The Hitchhiker's Guide to the Galaxy,* Arthur Accroc finds himself embarked on a journey through the most bizarre places in our Galaxy.

Billions of Galaxies

The word galaxy is derived from the Latin *galaxias*, itself from the Greek *galacto,* "milk", and carries the idea of a milky trail visible at night in the firmament. *Galaxia* is often used figuratively to convey the existence of a vast ensemble.

The Canadian scholar McLuhan observed that we are living in periods of history corresponding to the print civilisation and the audiovisual civilisation, respectively. McLuhan defines two structures of communication. One is the "Gutenberg Galaxy" and the other, the "Marconi Galaxy". Currently, we should add to them the social networks.

***Perpetum Mobile 2012*, Expanding Universe with spinning tops in our local world. Courtesy of Bernard Moninot, artist.**

More commercially, the term galaxy was chosen by a family car manufacturer and by a network of supermarkets, while *galak* designates a milk chocolate relatively white and much appreciated by children.

On a more sporting note, Galácticos refers to the few super stars of the Real Madrid football club who are recruited each year and are among the highest paid in the world, hence the expression, depending on the context has either a negative or a positive connotation.

Not far from the constellation of Cassiopeia, on a moonless night, everyone can see with the naked eye a whitish, diffuse, slightly elliptical patch of light: this is the Andromeda Galaxy, sister to the Milky Way.

It was only when the actual distance to more distant stars were measured last century that we realised that our Galaxy is just one of many.

Our Galaxy and Andromeda represent only a tiny fragment of an observable Universe composed of hundreds of billions of galaxies of all shapes and sizes. The brightest and the nearest were discovered two centuries ago by the English astronomer William Herschel who along with Thomas Wright and Immanuel Kant argued that they were island universes. It was not until the work of the Americans Heber Curtis, Harlow Shapley and most decisively, Edwin Hubble that – after one of the most heated debates in astronomy – it was shown that they were indeed outside the Milky Way, i.e. millions or even billions of light years from Earth. One should add that all these advances were possible, thanks to the American astronomer Henrietta Leavitt's revolutionary discoveries on distance determination.

What is a galaxy after all? A galaxy contains vast amounts of stars, dust and gas. It is a world that is structured by gravitation. Galaxies can contain hundreds of billions of stars. They are not uniformly distributed in space. Gathered in clusters of a few dozen to a few thousand members, they form filaments separated by gigantic cosmic voids.

Many of them would contain a super massive black hole; let's not be afraid of superlatives since we are talking about a dark world whose mass exceeds that of billions of Suns combined.

The black hole, which is not black and is actually the opposite of a hole, is a compact body, but so compact and so dense that its gravity does not allow light to escape, while light would be able to pass through a hole.

Black holes, big or small (originally postulated by John Michell as a "dark star" at the end of the 18th century), always arouse great interest among the public. We experience this after every lecture during the inevitable question about the nature of these strange occluded objects (we say "occluded" because they are closed in on themselves; the scientist Laplace was the first to use this term for black holes). They have largely inspired science fiction literature, cinema and music. Their strange nature prompted the French humourist François Cavanna to write that "however big a black hole may be, there is always something around"!

Paradoxically, black holes give rise to the most luminous phenomena in the Universe, known as quasars. These celestial objects, which have long been mistaken for stars (quasar stands for quasi-stellar astronomical radiosource) as they appear as such on photographic plates, are extremely compact, distant

and located at the very heart of galaxies. Their luminosity is breathtaking; it can reach thousands of times that of the Milky Way, even though they are hardly bigger than the Solar System: imagine Paris' light concentrated in a thimble!

Some astronomers dedicated many years of their careers to track down these rare and distant objects at a time when the Big Bang hypothesis was widely questioned. These "stars" became a fine example of the passionate debates that regularly affect the scientific community when nature poses one of those questions that shake our convictions.

Big Bang and Its Sibling

Suddenly, the Universe was big. The American astronomer Edwin Hubble and the Belgian Georges Lemaître, in the late 1920s, independently, reached the conviction that galaxies were moving away, fleeing from each other at speeds sometimes close to the speed of light. This discovery was the first step towards the Big Bang theory, which was neither "Big" nor "Bang" (see box). Shortly after the Big Bang, the first atomic nuclei appeared from strange elementary particles called *quarks*, named by their discoverer Murray Gell-Mann, in honour of James Joyce, who coined the word in *Finnegans Wake* ("Three Quarks for Muster Mark!"). These quarks constitute neutrons and protons. A few minutes later, the still sterile Universe includes nuclei of hydrogen, helium and others, but nothing to imagine life anywhere. The Universe, during the expansion, has continued to structure itself.

***Red shift (2004)*, Bernard Moninot' artistic representation of the universe with galaxies (spinning tops) reddened by the expansion. And so to infinity is written on the edge, as is on the Black Square by R. Fludd (see page 52) . Courtesy of Bernard Moninot.**

Ciel n0 16. **The centre of our Galaxy. 1979. The centre of the Milky Way is located by a box. In this location lies the black hole that has been recently discovered. Oil 250 × 400 cm, Collection MAC VAL Musée d'art contemporain du Val de Marne. Jacques Monory (1924–2018), © 2023, ProLitteris, Zurich.**

Invisible to understand: **A black hole is a region of space that contains mass so dense that even light does not have sufficient speed to escape. If the Sun could fit inside Mont Blanc, it would become a black hole, invisible to the eye. Courtesy of Gérard Paris-Clavel, graphic designer**

When first posed, this theory was far from being unanimously accepted.

Sir Fred Hoyle has always defended the idea that the Universe did not originate from this hypothetical explosion, but that on the contrary, it permanently maintained the same state through a process of continuous creation of matter. The very idea of a hot, explosive origin seemed so incongruous to him, and reminiscent of the Fiat Lux of the Bible that in the 1950s, he came to denigrate it in a series of BBC radio programmes. In derision, he coined the term Big Bang which ironically has survived him. The astronomy popularising magazine *Sky & Telescope* promoted a contest in the 1990s for renaming the theory, only to reach the conclusion that Big Bang was still the most popular one.

Was there anything before the Big Bang? The question of origins has always plagued humanity.

It situates us in a strange journey. It is as if we go to see a film but arrive after it has started and have to leave the cinema before the end, and without that vital information, try to reconstruct the whole argument.

Before the creation of the world, Jewish religion refers to an indescribable chaos which they call *tohu obohun* (which designates the vague, the void, in Hebrew). The meaning of *tohu bohu* shifted in the 19th century to the contemporary meaning of a great disorder where there is confused noise and a great tumult.

Astronomers refuse to evoke a beginning. They modestly prefer to stop at the wall of ignorance located a tiny fraction before time zero, tiny but not zero. This wall is located where our current knowledge prohibits any form of description of the cosmos. In any case, many researches are carried out in order to explain this "before" or to bypass it. One of the paths now being explored considers our Universe as singular, but not unique. It is only one of the "multiverses" that emerged from nothingness. One among an infinity of other parallel worlds. In this context, the very idea of a beginning no longer makes sense.

Big Bang has many siblings: The Big Bang Theory (the American TV series of tumultuous adventures in the world of "geeks"); Big Bang is a progressive music magazine, Big Bang communication promotes the services of an agency, etc.

We heard this expression in the mouth of the French politician Michel Rocard on February 17, 1993, in Montlouis-sur-Loire, when after the failure of the Left Party in the legislative elections, he replaced Laurent Fabius as head of the Socialist Party. He then called for a "political Big Bang" occurring on the Left Parties where centrists, ecologists and socialists would be

allied, but this never came to being. In his mind, the word meant the birth of a new world!

Closer to home, Jean-Pierre Bourgeois, a neurobiologist at the Pasteur Institute, did not hesitate to write in the scientific magazine *Science et Avenir* that a 2-year-old child is experiencing a genuine volcanic eruption under his skull, when "hundreds of millions of synapses are produced every second", and adds "his brain is in the middle of a synaptic Big Bang".

Our celestial and linguistic journey has taken us to the very beginnings of the Universe... at the very moment when it is just starting to take shape and when nothing we know today yet existed. Beyond the cosmic voids and galactic filaments, our physical theories come up against the indecipherable. This far into time and space we reach the limits of our knowledge. It is time to catch our breath, to return under more familiar skies and to explore our celestial niche where the Sun star reigns, surrounded by its subjects, the planets.

Quotes

F. Nietzsche: Every individual collaborates with the whole cosmos.

Steven Hawking: To limit our attention to earthly matters would be to limit the human mind.

Fred Hoyle: The space is not remote at all. It's only an hour drive if your car can go straight.

George Santayana (Spanish-American philosopher and essayist)**:** The Universe, as far as we can observe it, is a marvellous and immense engine; its extent, its order, its beauty, its cruelty, make it equally impressive.

George Gamow, *The Creation of the Universe:* It took less than an hour to make the atoms, a few hundred million years to make the stars and planets, but five billion years to make man!

Deborah Dultzin, *Fronteras del Universo*: It is exciting to realise that, like us, the stars, the galaxies and the universe itself are dynamic and changing, and evolve at their own pace and in their own way, and that the human mind is capable, from its limited space and during his short course, to ask and extract from the universe a handful of its most intimate secrets.

The Big Bang, The Night Sky and the Diffuse Background (Scientific Description)

The sky, the Earth, a thousand and one things were born from existence and existence was born from nothingness. Lao Tzu.

The Universe was born from a very hot, very dense and deeply unstable event: the Big Bang. The literal translation of "Big Bang" is incorrect, since it was not a tremendous explosion that marked the first beginnings of the Universe but the expansion of space. More precisely, this event occurred about 13.8 billion years ago. At that time, the Universe was nothing but pure, highly condensed energy. From this condensed cosmos, matter and light began to occupy more and more space, and this expansion has never stopped since.

To this day, we still find ourselves in a Universe that continues to expand like a gigantic bubble with no conceivable centre or edge. With the naked eye, we can only see a tiny piece of infinity and are unable to perceive this expansion. We astronomers seek to verify this indirectly day after day with our telescopes.

These quarks make up neutrons and protons. A few minutes later, the still barren Universe includes hydrogen nuclei, helium and a couple more elements, not enough to imagine life anywhere.

We need to wait for the first stars to appear, for them to produce the rest of the more complex chemical elements that we know today and are made of!

As the Universe expanded, it continued to structure itself. Today, with the Hubble Space Telescope, one can see thousands of galaxies in any corner of the sky glimpsed through the eye of a needle held out at arm's length. It took about a billion years for the first stars and galaxies to appear, although it is not yet clear in what order. At least one of them – the Sun, which was born about 4.6 billion years ago – gave rise to life.

The Big Bang produces a fossil image of this first event that reaches us today in the form of radio waves. This invisible light is a precious relic, the ultimate witness to the very early moments of the Universe. Cosmologists like to refer to it as the diffuse background, which should not be confused with the "aura" of the mystics, nor with the background music of supermarkets, a cultural parasite designed to stimulate consumers.

However dark it may seem to us, the sky radiates this famous cosmic microwave background in the submillimetre radio wave range, emitted from all directions in the Universe.

But where does the darkness of the night sky come from? It took several centuries to understand why the sky is not as bright as the Sun at night. The German astronomer Heinrich Olbers, together with the Englishman Edmond Halley and the Swiss Jean-Philippe Loys de Chéseaux, was the first to ponder. In an immobile and infinite Universe, no matter in which direction we look, our gaze should intercept the surface of a star of at least the same brightness as the Sun. The American writer Edgar Allan Poe with a dazzling intuition brought a first solution in his short story Eureka: the stars of the Universe did not always exist, and the light of the most distant ones did not reach us yet. Today, Olbers' paradox is fully resolved in modern cosmological theories of the Big Bang which postulate that the Universe is expanding and has a finite age.

Sun

dawn dusk eclipse equinox evening green-ray helianthus heliotrope helium morning noon solstice sunflower sunlight

The Sphinx poses a second riddle to Oedipus:
"What are the two sisters, one of whom begets the other, and the second in turn begets the first?"
"Day and night" answers Oedipus.
The dejected Sphinx throws himself into an abyss and rids Thebes of his presence.
Oedipus King, Sophocles

The word Sun is derived from the classical Latin *sol* and is defined, like the Sun King, without any other external reference but itself.

It was during the night that the Sun was born. As Leonardo da Vinci pointed out: the Sun never sees the shadow. The Sun burns, warms, rises and disappears while remaining equal to itself, so it reassures. Who would nowadays question the Sun's early morning rise?

Omnipotent, venerable, an object of respect tinged with fear. At the beginning of the Neolithic period, 8000 years before our era, it was already represented in the form of a large wheel. It is puzzling that this condensed image of the solar disc preceded the invention of the wheel by more than 5000 years! More concisely, the solar symbol commonly used by astronomers is a simple circle with a dot at its centre.

Many cosmogonies place the Sun in the pantheon of the gods. One of the oldest megalithic buildings, a place of solar worship, is Stonehenge in England. It is a double circle of carved stones, built more than 5000 years ago aiming

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to locate the position of the Sun and celebrate religious rites at the time of the equinox.

By shedding human blood, the Aztecs, like the Mayas, were offering human sacrifices for the Sun God (Itzamná), with the belief that they were allowing the Sun to continue its course and the earth to be fertile.

The Sumerians personified the Sun through the gods Utu and Shamash, and the Egyptians placed the Sun god Ra at the centre of their celebrations. Akhenaton, the controversial pharaoh, reduced the power of the priests during his reign, while he established the cult of Aton, the solar disc.

In ancient Rome, the deity Sol was the object of a cult introduced at the same time as that of the Moon by the Sabine kings. His Greek counterpart is Helios, much more insignificant than the Ra of ancient Egypt. He is the brother of Aurora (Eos) and the Moon (Selene).

The Sun, male or female? *Der Mond* masculine and *die Sonne* feminine in German. It differs throughout human history. It probably reflects the eternal conflict between man and woman who alone has the power to give birth.

But is it that simple? In all Celtic languages, the word Sun is feminine and Moon, masculine. The faces of their deities are embodied in the Celtic legend of Tristan and Isolde. Isolde, the woman, forces the man to love her. This violent passion leads him to lose his honour and his life. We find here the recurrent theme of the sovereignty of the Celtic woman who, in love, asserts herself at least in equal measure as the man.

Sunrise in Ivry-sur-Seine **(France). Courtesy of Gérard Paris-Clavel, graphic designer**

In Japan too, the Sun in the guise of Amaterasu o-mi-kami represents "the great deity who lights up the sky". It was she who gave birth to the long imperial lineage that continues today.

One, Two, Three…Billions of Suns

But the Sun is first and foremost a star similar to multitude of others. This we have only known with certainty for two centuries. It is the only star close enough to the Earth to be studied in detail.

The word "Sun" is associated with all that this star inspires in terms of strength, light, grandeur and openness. It is used to evoke a "great man", "public life", "the day" and other equally revealing expressions. However, as pointed out by an Indian proverb: No one is perfect here; the Sun itself has its spots.

Madame Soleil, a French astrologer (born Germaine Soleil, we're not making this up!), made a name for herself on September 14, 1970, when she created a daily show on the French radio Europe 1, answering live to questions that listeners had posed about their future. Her name is inseparable from her popularity, which was such that President Georges Pompidou said at a press conference, in response to a journalist: "I am not Madame Soleil!".

We get *sunburnt,* we keep *our goods in the Sun,* which, moreover, can *melt like snow in the Sun,* and when we do not have our place in the Sun, we have the right to be indignant, like Diogenes, *Get out of my Sun since it shines for everyone!*

Helios, the Greek counterpart, gave its name to helium, a rare gas, which was discovered independently in 1868 by astronomers Jules Janssen and Joseph N. Lockyer in the spectrum of our beloved star. This Greek version of the Sun is to be found in heliotropism or heliotherapy, and many places or resorts were named after heliopolis. Heliopolis designates an area in Seville, a major city of ancient Egypt, as well as a tourist resort at the Isle du Levant in France.

Helliantin, technically called methyl orange (MO) or III5 orange, is a coloured indicator of PH, used in chemistry to mark the presence of an acidic medium (it turns pink to red) or a basic medium (it turns yellow to orange). It is used for acid-base measurements. The term dates from the 19th century and derives from *Helianthus*, a large plant with yellow flowers.

Green Sun is not only a cinematic shock, a cult science fiction film, released in 1973 by Richard Fleischer that foresee what could happen on our planet if natural sources are depleted! Green Sun is at the origin of the presence of life

on Earth under the implacable gaze of our fiery star. When it is not "blazing" (i.e. scorching), its heat which is essential for life and chlorophyll synthesis conditions most plants. Some follow the course of the Sun as courtiers would do when the sovereign passes by. Thus do sunflowers of the *Helianthus* family (to which the knobbly Jerusalem artichokes belong!). The marigold (or calendula) is a modest flower whose name comes from modern Latin *calendae*, perhaps because it flowers all year round.

It is seen opening its dew-drenched petals as the Sun rises, and then closing them as it sets, thus playing light effects throughout the day.

We never become tired of the changing light effects between the atmosphere and the Sun's rays! They develop after a storm when a rainbow appears, which made Victor Hugo write: "Life is like a rainbow, you need rain and sunshine to see the colours …".

This is without counting the aurora australis or borealis, other poetic manifestations of the relationship between the Sun and the Earth. Aurora was the name given by the Romans to the goddess of dawn. Polar auroras occur near the two magnetic poles of the Earth, the borealis auroras in the north and the australis auroras in the south. They are among nature's most beautiful spectacles, occurring when the solar wind – a stream of energetic particles ejected from the Sun's upper atmosphere – collides with the molecules of the Earth's atmosphere and burst into light.

For the most patient among us, the setting Sun reserves the famous *green ray* (the title of a 1986 film by Éric Rohmer) which is only visible under exceptional atmospheric conditions. We observed it more than once, just at dusk, before starting our observations. In the Andes Mountains, in Chile, at the very moment when the Sun plunges and disappears into the distance, an emerald-coloured pearl freezes, suspended for a moment above the glowing disc.

We protect our eyes from the blinding glare of the Sun by means of sunglasses. It is also found in sunlight, which designates a projector that is essential for filming.

Sayings

Heat wave: scorching
Nothing new under the Sun: nothing new on Earth
A place in the Sun: a profitable situation
To have property in the Sun: to own land
Melt away like snow in the Sun: very quickly
To be in the morning of one's life: in one's youth

Being a morning person: getting up early
One of these four mornings: one day, maybe
Early morning: at an early hour
From morning to evening: all day
Being in the evening of one's life: at the end of life
Evening wear: formal
The big night: an exceptional evening, like the night of the first sexual encounter, or … that of the triumph of the Revolution
The Sun never sets on the British Empire
The Land of the Rising Sun: Japan
The House of the Rising Sun: 1964 recording by The Animals group
To Rise with the Sun: to get out of bed early in the morning
Sun Belt: the southern states in the United States that are known for warm sunny weather
One's Moment in the Sun: to enjoy a brief period when one has become successful, famous, popular, etc.
As if the Sun Shines Out of His Backside: used to describe a person who is arrogant. A person that thinks they are better or more important than others
To Make Hay While the Sun Shines: to take advantage of a good situation that probably won't last very long
Where the Sun Don't Shine: one's butt
Indian proverb: No one is perfect here; the Sun itself has its spots.

Quotes

Natalie Clifford Barney: The Sun, the gold of the poor.
Salim Jabran (refugee): The Sun crosses the borders without the soldiers shooting at it.

Moon

albedo crescent half moon honeymoon lunar lunation lunula moonlight moonshot satellite selenite selenium old moons waning

The Moon is the only natural Earth satellite. Its Latin root name comes from *luna,* "the bright one" which derives from *leuk,* "light". It is also the name of a Roman goddess. In the luna family, the Indo-Germanic word Moon rules. Along with the Sun, it is one of the two great luminaries, although its brilliance is not its own, but only a reflection.

Anyone Home?

The Greek equivalent of Luna is the goddess Selene, a beautiful woman with a sparkling white face, sister of Helios (the Sun).

The Selenites are the inhabitants of the Moon whose presumed existence has been postulated on several opportunities throughout the ages. They are already mentioned by Lucian of Samosata (120–185 A.D.) in what is considered the first science fiction book: *The True Story*. We find them thereafter in several legends, literary works (Cyrano de Bergerac, H.G. Wells) and cinematographic works (Georges Méliès).

The Moon was staged by William Shakespeare in A Midsummer Night's Dream where one of the characters is called Moonlight. The poet Lautréamont wondered: "What must this assemblage of strange and mute beings be, are they inhabitants of the Moon?" The philosopher and writer Fontenelle, on the other hand, did not doubt it and began to dream that "one day there could be trade between the Earth and the Moon".

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Selenite is also a crystal form of the mineral gypsum. The name comes from the Greek and means Moon stone. The largest monumental selenite crystals (more than 11 m long) have been found in the Naica Mine cave in Mexico.

The Greek root also defines selenium, an element discovered by chemists in the 19th century in the residual matter from the preparation of sulphuric acid. At the same time, tellurium was being extracted from gold mines in Transylvania. The resemblance between these two elements, which are always found together, struck people. That is why their names derive from the Earth and the Moon and are inseparably linked.

The Man in the Moon

***Sailing with the moon*. Gift to Daniel Kunth by Jean-Pierre Desclozeaux, artist**

Old European traditions told how man was banished to the Moon as punishment for having committed a crime. They depict either the man caught gathering sticks on the Sabbath (Jewish folklore) or a woodcutter caught working on a Sabbath in Germanic cultures. This was described by the eclectic scholar Sabine Baring-Gould author of *The Book of Were-Wolves* (1865), one of the most frequently cited studies of lycanthropy, where a young man is transformed into a wolf during full Moon. The Roman legend claims that he is a sheep thief. In Dante's "Inferno" and also in "Paradise", the medieval tradition that it is Cain's face that we see in the Moon is referred to.

Paul Sébillot's book, *Le folklore de France*, evokes numerous superstitions linked to the man in the Moon, as described in what follows:

In the past, it was said that the Moon is glued to the sky and has mountains and valleys. Some people imagined that the Moon's hidden face was a huge mouth, sucking up all the blood shed on Earth. We can imagine the anxiety that would have resulted from this.

The dark spots on the Moon also suggested guilt-inducing representations. Mostly, they represent a person transported there to atone for their faults. Exposed for everyone to see, it serves as an example to those who might be tempted to commit similar misdeeds. In the Perche region of France, this moral lesson is presented in the form of a man who carries a bundle of sticks, the first thief to appear on Earth, whom God punished by placing him in the moon. The characters were sent to expiate a religious fault (disobedience of Sunday rest, lack of charity, blasphemy, etc.; there were many reasons).

The Moon was a witnessing head that stared at the guilty ones. The latter, imagining its eyes riveted on them, were afraid. "Making a hole in the Moon" also referred to the act of running away without paying one's debts or to go out of business.

In the Bourbon region in France, mothers used to scold their unruly children while they were reluctantly washing themselves and point out the Moon as the "dirty little child who didn't want to wash up" and who as a penance, would end up "up there". So beware, little one!

It is said that the fishermen of Lunel city, in the south of France, used to fish for eels during the darkest nights to make almost miraculous catches. But in general, they laughed at the misfortunes of these unlucky simpletons who only just tried to catch the reflection of the moon in a river.

Climbing to the moon by piling up barrels, or taking the moon with one's teeth, remains an unsuccessful attempt that can be found as shorthand in popular expressions such as "asking for the moon" or "promising the moon".

In India, Ganesh is a deity represented with a man's body of red colour, four arms and an elephant head with a single tusk. A legend tells that one

night, Ganesh fell from his vehicle, the rat, and broke a tusk. The Moon burst out laughing and Ganesh angrily threw the broken tusk at her. Since that day, during the processions in honour of Ganesh, one must avoid looking at the Moon.

There is a Haida myth (from the peoples of the Northwestern coast of Canada and Alaska) that interprets the figure on the Moon as a boy unwillingly gathering sticks. He ridicules the Moon and, as a punishment, he is taken and trapped there forever.

A softer version of the man in the Moon appears in the old *Bagford Ballads*, sung in the Court of Holywells, stored in the British Museum: "The man in the Moon drinks claret":

Our man in the Moon drinks clarret,
With powder-beef, turneps and carret,
If he doth so, why should not you
Drink until the sky looks blew?

Also, in the old nursery rhyme:

The man in the Moon came tumbling down
and asked his way to Norwich;
He went by the south and burnt his mouth
with supping cold pease porridge.

Lunar Wisdom

In popular animist cults, the Moon played a prominent role. It was invoked either in prayers or adjurations, a remnant of more ancient times when it was a divine and powerful entity.

While the Sun reassures, the obscure threatens. A world without the Moon is a world inhabited by dark forces. The night world is under the empire of witchcraft, the undead and the werewolves!

The Moon too was endowed with disturbing powers, more particularly over women: it was understood that the Moon governed their menstrual periods. Determining fertility, it could also influence the sex of the child to be born, or its mental constitution. In the famous song Hijo de la Luna (Son of the Moon) by Meccano (a Spanish pop rock group), a Romany woman begs the Moon to give her a husband. The Moon asks for their first child in payment, and as a result, the woman gives birth to an albino. The furious

husband kills his wife, believing that she had been unfaithful. In the end, the Moon adopts the child and wanes to a crescent shape to cradle the baby.

Woe betides anyone who disrespected the Moon. In Lower Brittany, a girl or a young woman should never turn to the Moon to urinate, especially if it was horned (i.e. in its first quarters), under penalty of giving birth to a "son of the Moon", literally a lunatic. The lunatics and the lunars referred to persons who are mentally ill or dangerous, not easy to deal with.

Paul Sébillot reports that in the vicinity of Morlaix city in France, the woman who went out to urinate and uncovered herself under Moonlight ran the immense risk of conceiving under its influence, giving birth to a monstrous being!

Last but no less threatening, those who were born when the Moon "hangs", i.e. when it seems to be suspended at the tip of a cloud (always in its first quarter), were considered to be born under a bad influence and destined to die by hanging.

Nowadays, many people still think that women give birth preferentially on a full moon night. In first place come the *Midwive's Tale* that blindly credits the influence of the Moon (one of us had to argue against it with the staff of the maternity clinic, even up to checking that no statistics of the place allowed to support this conclusion). A study carried out in the 1970s by the INSERM (National Institute of Health and Medical Research, created in France in 1964), based on millions of births, did not support the conclusion that the Moon induces labour.

The Moon was also blamed of exerting its power on inanimate objects. Gnawing stones, burning thatched roofs, making glasses iridescent and fading the colours of fabrics! Curiously, this last belief has now found an explanation that exonerates the Moon: exposed linen cools faster on cloudless nights (when the Moon is clearly visible) and condenses the dew. Now dew contains hydrogen peroxide which can oxidise the organic dyes in the linen. This substance is produced during daytime by the Sun's ultraviolet radiation in suspended water.

In the same vein, the Moon is believed to be the mistress of vegetation and everything that grows. One can still find on the Internet the address of hairdressers who offer appointments during the full Moon. In many countries, farmers are convinced that the Moon has a significant effect on plants, which as mostly made of water would be subject to its influence, just like our seas and oceans. They sow at the new Moon, which guarantees a good synchronisation between the growth of the seed and that of the lunar disc. Some gardeners still scrupulously respect the phases of the Moon when picking,

transplanting, working the soil and harvesting. On the other hand, they fear the red moon, which is accused of burning young shoots in April! "Red moon frost from the plant burns the shoot" according to the popular saying. They have observed that frosts occur on clear nights when the moon is in the sky. What popular belief presents as a cause-and-effect relationship can be explained without recourse to magic but by the greenhouse effect, as two manifestations of the same cause. When the sky is overcast, the Moon does not show, and the cloud cover slows down the cooling of the ground, whereas the opposite happens when the sky is clear!

The Moon of our ancestors remained a celestial body that it was better left unnamed... for fear of becoming the victim of a Moon stroke. In France, the popular adjective *mal luné* means someone who is in a bad mood and is still used today as is *lunatic*.

To have the Moon in your head, a quarter Moon or a quarter, meant to be a little crazy. More positive, the expression to be in the Moon applies to poets and sweet dreamers lost in their thoughts and the honeymoon tastes sweet but alas lasts only a short time. And if you are in love, you are moonstruck and unable to think clearly, mentally deranged and lost in romance.

The South American folk song *Troubadour toad* advises the lovestruck creature: "don't you know that the Moon is cool as it gave its blood to the stars?"

The Moon's influence on our mood, feelings and relationships has given rise to many common idioms. When a person is over the Moon, their joy has literally reached unattainable heights and they are extremely pleased. Likewise, the extreme distance between the Earth and the Moon has led to the common phrase "I love you to the Moon and back" used to emphasise strong affection for another person.

However, things take a turn for the worse when you promise the Moon and make an extravagant commitment that you are unlikely to keep, or moon about, which means both to waste time aimlessly and to become depressed or melancholic over someone or something you desire intensely.

Nowadays, to Moon somebody when you are discontent is considered quite rude, but to cast beyond the Moon is always a good recommendation to students.

To be over the Moon is always a nice feeling. Those who need to have a second job under the cover of night have become known as people who moonlight.

The Moon Timepiece

The Moon was used as a timepiece from very early on. Its shape changes with the days and provides a concrete time reference which speaks to our senses. It was the origin of the first lunar calendars which are still used in some countries. Our language has preserved the lunation, the old moons, many moons ago to attest an elapsed time, and of course the first day of the week in the whole Christian world: *lunedi* in Italian, Monday in English and *Lundi* in French. We'll come back to this. To have one's moons originates from the tenacious idea that the lunar cycle regulates women's menstruation.

Forms and Forces

The shape of the Moon is more prominent than that of the Sun because we have always been able to contemplate its roundness without risk to the eyes. It inspires terms as diverse as half-moon, or the lunula, the small crescent shapes at the base of our nails.

Common sense and popular humour have modelled the roundness of this celestial body to many aspects of daily life. In slang, the moon refers to our buttocks as well as to a one-franc coin.

The delicious croissant that we enjoy for breakfast was originally a pastry made by the Viennese to celebrate the end of the second siege of their city by Ottoman troops in 1683. What could be more pleasant than savouring the victory by biting into the emblem of the vanquished? Wikipedia attributes the invention of the crescent to a Viennese café owner named Kolschitsky who, having recovered bags of coffee left by the Turks, had the idea of serving it with a crescent-shaped pastry as a symbol of the occupiers' departure. It was Marie-Antoinette of Austria, originally from Vienna, who officially introduced and popularised it in France from 1770 onwards.

The English word crescent is borrowed from the Old French word croissant, which in turn finds its origins in the Latin word *crēscēns*, present active participle of *crēscō*, meaning "to arise, thrive".

This present participle of the verb "to grow" also designates the time that elapses between the new and full Moon, whereas afterwards it is referred to as waning. From the 13th century, it no longer designates a period of lunation but the visible shape of the Moon. In the Northern Hemisphere, a vertical bar is added to the visible crescent of the Moon to form a p when it is first quarter, or a d when it is last quarter and the Moon is waning. But on our plate, no

matter how we put it, upright, upside down or on its side, we never risk eating a waning croissant!!

This last remark undoubtedly adds to the nonsensical ideas that the Moon inspires in us: "To d*iscover the Moon*" is the height of naivety, bordering on silliness. To say that someone is like the Moon, or even as stupid as the Moon, underlines the fact that they have neither invented *lukewarm water* nor they are rocket scientists… and *promising the Moon* only engages those who listen. *Moonshine* originally referred to illegally made liquor (made under the cover of night).

Refractive Material

Lunette has designated as early as 1280 an optical instrument with circular glass. Galileo's lunette remains famous as he pointed it to the sky for the first time. In the 17th century, lunettes became glasses and later on the rear window of a car.

A lunette (from French "little moon") is a half-moon-shaped architectural space, variously filled with sculpture, painted, some times glazed, filled with recessed masonry, or void. A lunette may also be segmental, and the arch may be an arc taken from an oval. A lunette window is commonly called a half-moon window, or fanlight when bars separating its panes fan out radially.

Reflecting Material

Venus owes its brightness to the thick atmosphere that covers its surface and whose clouds reflect the light of the Sun. Its *albedo* is significant. This word used in astronomy and physics (1886) is derived from the Latin *albus*, "white", here referring to the fraction of the incoming light that is scattered by a non-luminous body. It is commonly applied to celestial objects.

The Moon reflects back into space only 12% of the Sun's light. The surface of our satellite is very dark: the ground is covered with regolith, a fine meteoric dust similar to powdered coal. If we painted the Moon even black, we could improve the reflection of its surface; a smoother coat would be more dazzling. Its albedo would increase and our moonlights more luminous would make:

The birds in the trees dream
And the water jets sob with ecstasy

The great slender water jets among the marbles
P. Verlaine, Clair de lune.

Galileo, when he first gazed at the Moon through his telescope was shocked. Amazed, he discovered that the Moon was not, as had been thought, a smooth crystal-polished ball, but rather was mountainous and much more rugged than the Earth. The line that separates light and dark rather than showing a perfect curve has irregularities and zigzags. The shadows grow and shrink as they do on Earth when the Sun rises into the sky. Galileo deduced that there are mountains 7000 metres high and deep valleys on the Moon. He also found an explanation for the long-observed phenomenon of "ashen light", the pale glow that covers the Moon when the illuminated part is a thin crescent, just before or after the New Moon. Galileo explained that this is "Earthlight" reflected by the Moon. This reciprocity reinforces his belief that celestial phenomena are not fundamentally different from terrestrial phenomena.

Attractive Material

The Moon "falls" as the apple falls under the irresistible attraction of the Earth. It is very likely that the apple was for Newton the eureka of his theory of universal gravitation. His thought was so dazzling and synthetic that his law unites phenomena as apparently disparate as the fall of bodies on Earth, the tides, the flattening of the Earth's poles and the movements of the Moon and the planets. Gravitation is the product of a double influence. The scientific Latin *gravitatio* already introduces the notion of gravity, but it is the English *gravitation* that was imposed when Newton's writings were translated into French.

In French, as we well know, being serious quickly becomes heavy. Is it serious, doctor? This story of heaviness can be a harbinger of good news: when a young woman learns she is gravid, it is because she is pregnant.

Satellite for Life

Why the Moon is a satellite (and generally all the heavenly bodies orbiting another) while the satellites of the planets of the Solar System are called moons in the Anglo-Saxon world is another interesting story. The word *satellite*, borrowed from classical Latin, was first used to designate a bodyguard, an armed soldier, devoted to his master and not always recommendable! In the 18th

century, the word gained its honourable reputation from astronomy by becoming the body that depends on another (*De quatuor Jovis satellitibus erronibus* as written by Kepler, i.e. "Of the four satellite planets of Jupiter"). Thus, Io and Europa are satellites of Jupiter and the Moon is the satellite of the Earth. This term can now enter everyday vocabulary with its head held high.

It is however most often applied to a secondary element in relation to a main element (satellite vein, satellite building, a person depending on another, etc.).

The Moon is believed to have had a beneficial effect on our planet. It is thought to have stabilised its trajectory around the Sun which in turn favoured the emergence of life.

After the Second World War, the countries of Eastern Europe were referred to as satellite states, closer to the old Latin meaning of "servant". These countries were said to remain in the orbit of the USSR, dependent on it.

Sayings

To have the Moon in mind: to be a little crazy
To be on the Moon: to be a sweet dreamer
Discovering the Moon: being very naive
To be as stupid as the moon: to be very stupid
Promising the Moon: making seductive and untenable promises
Moon Kick: in swimming, a reverse dive with a backward turn
For many moons: for a very long time
Honeymoon: the first happy time of a marriage, a period of good understanding between two parties, two countries
Falling from the Moon: surprised by an unexpected event
Old moons: outdated ideas
Picking up the Moon or taking the Moon with your teeth: achieving the impossible
Once in a blue Moon: very seldom

Quotes

Francis Blanche (French humourist): The proof that the moon is inhabited is that there is light.
Chinese proverb: The multitude of stars supports the moon.
Foulfoudé's proverb (idiom spoken by the Peuls and other tribes in Africa): They show you the moon and you look at the finger.

Eclipses

commotion eclipse eclipsing ecliptic hullabaloo

The Sun and the Moon share the firmament. One at night, the other during the day. The full Moon marks the moment when, as the Moon rises in the East, the Sun takes advantage of it to disappear. Their rendezvous are difficult, as the French singer Charles Trenet sang so well:

The Sun has an appointment with the Moon
But the Moon is not there and the Sun is waiting
Down here often, each to his own
Everyone must do the same
The Moon is here, the Moon is here
The Moon is there, but the Sun does not see it.

A game of hide-and-seek where, sometimes, the Earth has a say. When it comes between the two "spouses", its shadow covers the Moon and eclipses it. Conversely, the Moon can come between the Sun and the Earth. In this case, there is an eclipse of the Sun. By a happy coincidence seen from the Earth, the Sun and Moon have exactly the same apparent diameter, which allows solar eclipses to be sometimes total and magnificent!

This phenomenon, carefully observed by the Ancients who were anxious to predict its recurrence, is at the origin of the word ecliptic: the region in the sky where eclipses occur.

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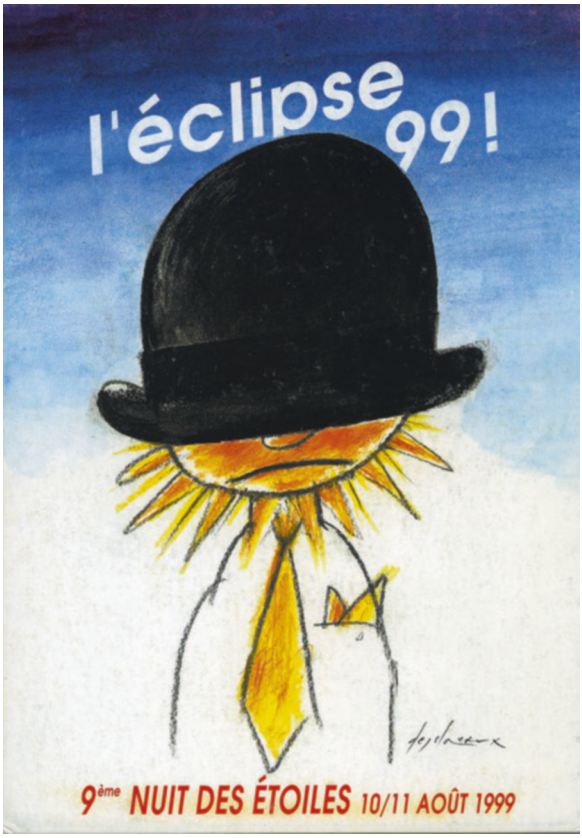
Today, the term eclipse is used to describe the disappearance of a person and in medicine to describe disorders that disappear and return for more or less long periods (visual or mental eclipse). It is used to describe the temporary decline in prestige or popularity of a politician or artist. When it is prolonged, we speak of a fall, decadence, disfavour… while waiting for the return, or even the "comeback" before the farewell to the public.

Our ancestors were very early attracted by the regularity of celestial phenomena: the alternating of days and nights, the diurnal and repetitive movement of the stars, the permanence of the constellations and the periodicity of the seasons. But against this rather reassuring background, men saw the occurrence of worrying elements, kinds of cosmic disorder when extraordinary, exceptional and sometimes spectacular phenomena appeared such as eclipses, comets, meteors or shooting stars. These disorders precisely because they were not announced and were generally badly received, seemed terribly disturbing, even fatal.

When Tintin and Captain Haddock are taken prisoners by the Incas in the Temple of the Sun, they are rescued, thanks to the occurrence of a solar eclipse. The adventure, real this time, happened in Jamaica on February 29, 1504, to Christopher Columbus, who was struggling with hostile natives. He took advantage of a providential lunar eclipse that he knew was imminent. He announced the phenomenon to the Indians. At first, they laughed. But the prediction turned out to be true. The original inhabitants, terrorised by the phenomenon, agreed to aid Columbus and his crew.



***Jean-Pierre Desclozeaux's poster*. The solar eclipse 1999 in France.**

The Aztecs saw in eclipses the mouth of a threatening monster, ready to devour them, while the Chinese imagined it, not without fear, swallowing the two celestial bodies. Everywhere the eclipses of the Moon and the Sun were the occasion for uproar and hullabaloo in order to sanction misalliances that could endanger the natural order of things. They were thought as presaging wars, epidemics, furious hurricanes or the famine that was once so common in our latitudes.

Even if explained, eclipses were not welcome in Shakespeare time:

> These late eclipses in the Sun and moon
> portend no good to us. Though the wisdom of
> nature can reason it thus and thus, yet nature finds
> itself scourged by the sequent effects.
> —Gloucester in King Lear

Quotes

Paulo Vincente: String: partially eclipses the moon.
Seneca: When the Sun eclipses, we see its greatness.

Comets

Blue Comet, comet, comet game, comet tail, Ford Comet, shooting the comet

Comets come from the farthest reaches of the Solar System, and after a brief burst, they return to the outskirts, but not without burning their wings from coming so close to the Sun.

The word comet appeared in French in 1140 (adopted in England by 1200) borrowed from the Latin *cometes,* itself coming from the Greek *komêtês*, hairy. According to Theophrastus, a disciple of Aristotle, the name "hairy star" came from Egypt, while in Japan and China, they were simply called "brush stars" or "bush stars" depending on the size of their tails!

The Hale-Bopp Comet appeared, clearly visible in our sky, in early 1997. We were confident on the appointment and stood waiting to see it disappearing behind the horizon, the wind of its course painting its long hair. People even in urban areas were fortunate to see it in spite of the city lights. For DK, it appeared after turning the corner in the Butte-aux-Cailles street in Paris, adorning the sky with a raging comma. So many images, so many illusions… she wasn't heading towards the horizon contrary to what one would expect because her hair does not indicate the direction of the race, like a horse's mane or the features of a racing car in a comic strip, but it develops simply opposite to the Sun. Her hair was actually pointing away from the Sun.

D. Kunth, E. Terlevich, *StarWords*, Springer Praxis Books,
https://doi.org/10.1007/978-3-031-49024-8_8

Comets (Scientific Description)

Comets are visible to the naked eye and quite spectacular. A nebulous object, often with a huge luminous tail, can be seen moving from one night to the next relative to the stars. Their appearance is either periodic (Halley's Comet returns every 76 years, Encke's Comet every 3.3 years) or unexpected (Comet Hyakutake in 1996).

Comets are the wanderers of the Solar System. They consist of a hard nucleus a few kilometres in diameter made of ice that traps rocks, dust and gas. A large Mont Blanc in size, and in the past believed to be a "cosmic sorbet" in structure. This has been challenged by the most recent encounter with it in 1987. Although everyone expected the core to be shiny, it was found to be one of the darkest objects found in space which was unexpected since water remains the dominant component! The reason is that molecular absorbing material like soot is ultimately mixed with the iced water in large amounts. As usual, new questions arise as knowledge accumulates.

These cores are found at the farthest reaches of the Solar System, trillions of kilometres from the Sun. They form the Oort reservoir (named after the Dutch astronomer who described it) and are estimated to number in the billions if not trillions. At this distance, these nuclei are weakly bound to the Sun and easily disturbed by nearby stars. Some can escape into interstellar space, while others are hurled towards the Sun, approaching it along a highly elliptical orbit. In the process, the core gradually heats up and releases molecules and dust that scatter sunlight producing a hairy coma and a spectacular tail that can reach millions of kilometres.

Note that the tail always points away from the Sun.

The chemical composition of comets dates back to the earliest ages of the Solar System, before planets were formed. Cometary nuclei are particularly well-preserved fossils. Their study is relevant because they may have influenced the evolution of our planet by bringing water and organic matter to it… NASA's Deep Impact probe collided with Tempel 1 Comet in 2005, allowing scientists to learn directly about the surface of a comet and the materials that conform it. The European Rosetta mission reached comet 67P/Churyumov-Gerasimenko in November 2014 and deposited a module named Philae whose task was to study the structure of this cometary nucleus which has been unaltered and will be able to tell us what the Solar system was like at birth.

In the words of Edmond Halley: Aristotle's opinion… that comets were nothing else than sublunary vapours or airy meteors… prevailed so far amongst the Greeks, that this sublimest part of astronomy lay altogether neglected; since none could think it worthwhile to observe, and to give an account of the wandering and uncertain paths of vapours floating in the Ether.

Fears, Stupors and Tremblings

Comets were often seen as harbingers of natural disasters, like war or the death of well-known public figures. Pliny the Elder reports that "comets are stars that generally spread terror". If the year 1000 was not the time of despair

that the historian Michelet described in his *History of France*, many fears were expressed at the passage of extraordinary phenomena like the appearance of the "frightening" comet of 1014.

The oldest European representation of a comet, Halley's, can be seen embroidered on the Bayeux tapestry of Queen Matilda. It appeared in April 1066. The tapestry reflects the Norman view of the Battle of Hastings on October 14, 1066, from which William the Conqueror emerged victorious. It shows a group of five onlookers who have just witnessed the coronation of Harold as King of England. Harold had broken his oath to William not to take the throne that was rightfully his. This five characters turn around, worry, notice and point to the comet. On the English side, the event is read as a very bad omen. On the Norman side, on the other hand, victory is in the air.

In 1446, Halley's Comet returned. Pope Callixtus III saw it as a sign of divine wrath and to ward off the Turkish danger ordered a fervent crusade of prayers. He asked that the bells be rung three times a day and that three prayers be said each time. The fear of the "Turk" was so great at that time, that when the "Turk's bell" rang, people fled en masse from the countryside to seek refuge behind the walls of their towns.

The fear of comets did not spare educated people either. For instance, the eminent surgeon Ambroise Paré wrote in 1527 the following testimony:

"This Comet was so horrible and dangerous that it caused great terror to the common people. Some died of fear, while others fell ill". His case was not isolated even if there were some men of good sense to fight against these unfounded beliefs. It was not until the Danish astronomer Tycho Brahe work that comets began (and we emphasise "began") to lose their reputation as messengers of doom. With Isaac Newton, they became simple starry bodies subject to universal gravitation.

Later on in 1773, Voltaire sarcastically reported: "All of Paris was in alarm, it was obvious that a comet would dissolve our globe on the 20th or 21st of May". And more than sceptical he added 2 years later, "I am very persuaded that no comet can take any planet by surprise".

Yet in the 20th century, popular terrors are back even in Europe. The great comet of 1910 was blamed for the catastrophic flooding of Paris. A real panic was caused by Halley's Comet again, this time for false scientific reasons! It was supposed to pass on May 18, 1910, exactly between the Sun and the Earth, and it was feared that its tail would envelop our planet. The reason was that a few years earlier, the astronomer Camille Flammarion had mentioned the presence of deadly cyanogen gas in the comet's tail. The public was gripped by a collective psychosis, … on a planetary scale: prayers and masses were said, suicides could not be avoided, human sacrifices were organised, fortunes were

squandered on cruises and testamentary parties, divorces and orgies multiplied. Flammarion defended himself as best he could and thought it useful to comment shortly before the fateful date: "The end of the world will not happen on May 19! Still he probably influenced writers like Arthur Connan Doyle in *The Poison Belt*, published in 1913, who worried that the tail of Halley's Comet would be poisonous for earth life".

Cometary Happy Ending

Sometimes a comet heralds happy events. Halley's Comet in 1301 remained visible for six weeks with such exceptional brilliance that the Italian painter Giotto decided to depict it on a fresco in the Scrovegni chapel in Padua instead of the Star of Bethlehem. This was highly transgressive, surprising for the time which was marked by a constant phobia of these hairy stars, to which no one would have thought of attributing the heralding role of the star of the Magi.

Halley's Comet was the origin of the comet game, a card game invented to entertain King Louis XV and which today is similar to the yellow dwarf. Madame de Sévigné wrote (tongue in cheek because of its double meaning) in 1681, during its passage: "We have here a comet which is well extended; it is the most beautiful tail that it is possible to see".

However, Halley, based on his observations and Newton's laws, explained that comets that appeared in 1531, 1607 and 1682 were the same single one making a complete orbit around the Sun in 76 years. He predicted its return in 1758. When the comet reappeared in December of that year, it was a triumph.

For the first time, science had demonstrated its ability to anticipate a celestial phenomenon, an act that had previously been the territory of magical thinking… and the sky complied. This prediction made it possible to definitively establish Newtonian mechanics in France, and at the suggestion of Nicolas-Louis de Lacaille, the object was named "Halley's Comet". Neither of the two protagonists, Newton nor Halley, were alive to enjoy the event. The last appearance of Halley's Comet was in 1986 and occurred in Europe in a climate that had become more receptive to these celestial phenomena. The next visit is expected in 2062!

The great comet of 1811 was so beautiful that Napoleon thought it was a good omen for his plan to invade Russia. We know what happened next. But please rest assured, its appearance coincided with the famous *Wine of the comet* (that year the wine had been so good that it was called wine of the comet as if

the comet was responsible)! The astronomer Michel Festou and his colleagues in their book *Les Comètes, mythes et réalité* (Comets, myths and reality), tong in cheek, insinuates that "the exceptionally beautiful and warm summer and autumn of that year were perhaps not foreign to the quality of the wine". One can see how scientists can be ironic about their own refusal to believe!

The Most Beautiful Tails

The word comet remains isolated and without a semantic counterpart but just one or two expressions that have fallen into disuse, such as the tail of the comet, which marks the end of history. Even today, the French expression *tirer des plans sur la comète* (to build plans on the comet) mocks those who build convoluted projects, whose effectiveness remains doubtful. In other words, *to build castles in the air,* to make overly ambitious plans, to chase rainbows, pie in the sky!

Because of their spectacular appearance and long tails, the word is associated with a number of different objects or animals. For poachers, a comet is a male pheasant with a long tail. It is also a species of Brazilian long-tailed beetle, a hearse for transporting small children and a bookbinder's edge. In slang, it is a vagabond, or an individual who brings bad luck in a game. Pyrotechnics enthusiasts joyfully fire comets, rockets whose heads and tails shine powerfully.

Their shape and their aura of mystery and speed make them a choice name for the most modern or attractive means of transport. The Blue Comet steam train ran near New Jersey in the United States from 1929 to 1941 and its cars were named after famous comets: Halley, Encke, Tuttle, Tempel, etc. Comet was also the first commercial jet plane built in 1952 by de Havilland in England, and Comet was also an automobile built in 1951 by the Ford company, based on the design of the famous Italian designer *Battista "Pinin" Farina*.

Musician Bill Haley took advantage of his cosmic-sounding name to call his rock band Comet Band. One of their cult songs Rock Around the Clock appeared in 1955 on the soundtrack of the movie Blackboard Jungle. For some, it heralded the musical revolution that opened the door to Elvis Presley and many others after him.

Filer comme une comète (flying like a comet or to go away very quickly) creates a strong image and is a way to escape from an unpalatable issue. *Comète* was an important escape network during the Second World War, which originated in Belgium and spread to the north of France on its way to England.

Let us leave the last word to the poets who have sung them.

Quotes

Blaise Cendrars, traveller of incandescence (by his first name of ember and his surname of ash), wrote: "The hats of passing women are comets in the evening fire" ("From the World to the Heart of the World", Contrastes).

Isaac Asimov: How bright and beautiful a comet is as it flies past our planet provided it does fly past it.

J. Swift: Old men and comets were revered for the same reason: their long beards and their claims to predict events.

And, in the words of **William Shakespeare:**

By being seldom seen I could not stir,
But like a comet I was wondered at.

Planets

apogee aubade dawn jovial martial merchandise mercurial orbit perigee saturnalia serenade terraforming twilight uranium urinate vespers vespertilio

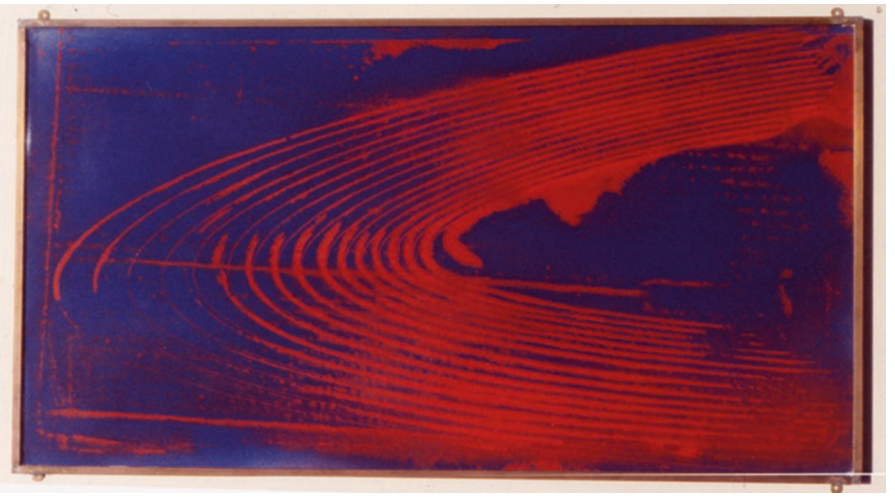
The word planet, from the Latin *planeta*, itself taken from the Greek *planetes,* designates the "wandering stars", sometimes moving unpredictably in the sky. However, their course around the Sun presents a well-oiled regularity that can be contemplated during sessions in a planetarium, these places of recreational education where sky lovers gather. Blaise Cendrars already described them in *Le lotissement du ciel*: "… The humming of all these automatic mechanisms [of the stars] regulated like the clockwork of the Jena planetarium, which I had visited in detail".

The word is originally derived from *planasthai* (uncertain etymology), to wander from here to there, to be uncertain, floating. In Greek, it referred to a traveller, a wanderer or even to intermittent fevers. It was not until the 18th century that the word took on its meaning of "celestial body orbiting the Sun" (see box). In its current assent, the word has been generalised to any object rotating around a star, even extrasolar planets.

Nowadays, the use of the word planet is expanding. In our highly "mediatised" world, planet and its adjective planetary take on the meaning of "global" and "particular world", even "closed world". We talk about the limited resources of the planet (i.e. the Earth), or about a planetary view of social relations (i.e. global), and about planetary rather than global war. Tragedies on a planetary scale (e.g. Chernobyl, Fukushima) impact all of us.

D. Kunth, E. Terlevich, *StarWords*, Springer Praxis Books,
https://doi.org/10.1007/978-3-031-49024-8_9

Planet America



Orbits. **Courtesy of Bernard Moninot, artist**

Today, Saint-Dié, a small town in the Vosges, has become the global village where an annual geography festival is held and a worldwide forum has been organised to discuss nuclear power and global warming. It is moving to discover that this small town, once famous for printing geography maps, was the one that named the New World "America". The story is brilliantly told by Stefan Zweig in his book *Amerigo*. America could have been called Colombia, but it was Amerigo Vespucci, who without even claiming to have discovered the continent, gave it its name.

The anecdote claims that Amerigo had the merit to relate his journeys in a flowery and punchy style and his writings perdured. His written document reached Saint Dié, and then by a series of chances and misunderstandings, the cartographers published the first maps of this new continent that they named America, from the name of the one they wrongly considered as the real discoverer of this new Eldorado!

Closer to those who like to get their hands dirty, planetary refers to the bevel gears in the gearbox differential that allow the wheels of a car to adjust their speed in a curve (since the outside wheels must turn faster than the inside wheels).

Figuratively speaking, the word is used to designate a place or a delimited context where particular events take place, as in *Planet of the Apes* (book by Pierre Boulle and a film by Franklin J. Schaffner) or *The Planet of Words* (a book on linguistics by Marina Yaguello) or the Planet World Museum in Washington, D.C. We see that its meaning has largely drifted, from "wandering star" to "revolving around the Sun", and then "revolving around a star in general", while narrowing to "our world" seen as a whole and to "a specific world".

The World of Georges Perec

The planets describe elliptical orbits around the Sun that occupy one of the foci of the ellipse. It is not uncommon to use the word orbit to describe the area of influence of someone or something.

From our perspective as privileged observers on Earth, these orbits can be reconstructed from the positions that the planets occupy in the firmament. Thus, apogee (-gee is the Greek root for Earth) is the furthest point in the elliptical orbit of a star or any artificial celestial body from the centre of the Earth. By metaphor, the word designates a dazzling summit in the career (or any particular activity) of a person. On the other hand, perigee designates the point where an object is closest to Earth.

Eccentricity is a word of astronomical origin that figuratively describes a way of acting in opposition to conventional wisdom and of being far from the centre. We use this concept in astronomy to describe the trajectory of a planet or an asteroid around the Sun or a star. Eccentricity measures the flatness of the ellipse. The longer the ellipse, the larger the eccentricity. Conversely, the more circular the orbit, the smaller the eccentricity.

The Sun occupies one of the foci of the ellipse described by the Earth; this ellipse paradoxically takes us further away from the Sun in the Northern summer than in winter contrary to a common opinion: this slightly moderates the seasons in the Northern Hemisphere. In reality, the origin of the seasons is not the distance between the Earth and the Sun which remains more or less the same throughout the year. The orientation of the polar axis explains why the days are longer than the nights in summer and why it is much warmer than in winter. Of course, seasons are reversed in the Southern Hemisphere.

Asteroids are mostly located between the orbits of Mars and Jupiter. Others originate from distant regions well beyond Neptune and Pluto. Some have very elongated orbits that can come dangerously close to the Earth, they are called NEO: near-earth objects. The yellow press is quick to exploit fears of possible collisions that could threaten us. NASA and the European space agencies take these matters seriously and many avoidance strategies have been considered, but that's another story.

However, the eccentricity is mathematically symbolised by the letter "e". This is why asteroid number 2817, discovered in 1982 and very eccentric (e = 0.18) was named "Georges Perec" after the whimsical author of *La Disparition* (The disappearance, 1969), a novel that strictly and purposely avoids the use of the letter "e", the most common letter in the French language. A fitting nod from celestial geometry to an architect of words.

But What Is a Planet (Scientific Description)?

If we look at the sky night after night, we can see that objects like Venus and Mars move among the stars. This is why the word planet was borrowed from the Latin planeta, to designate the "wandering stars" that were observed moving against the background of the fixed stars. Nicolaus Copernicus proposed that they revolve around the Sun.

Galilée added: The Sun, with all these planets orbiting under its rule, still takes time to ripen a bunch of grapes, as if there was nothing more important.

The planets of the Solar System have been extensively explored over the past 40 years partly through the use of probes and robots. These explorations have made it possible to contemplate their diversity, but also to discover the incredible variety of their satellites. All the planets are contemporary and were initially formed by the agglomeration of dust grains that surrounded the Sun at the time of its formation. They do not have an internal energy source from thermonuclear reactions as is the case for stars. Unlike stars, they do not generate their own light, but simply reflect the light that reaches them from the Sun.

Those closest to the Sun, called telluric planets – Mercury, Venus, Earth and Mars – are covered by a solid crust; they have not been able to retain the very light gases such as hydrogen and helium that form the atmosphere of the giant planets. Their study is a matter of comparative planetology and allows a better understanding of the phenomena concerning the Earth and its evolution. Farther from the Sun, the so-called "giant" planets are gaseous: Jupiter, Saturn, Uranus and Neptune. Formed far from the Sun in much colder regions, they have retained the primitive composition of the Solar System and are 99% composed of hydrogen and helium. An exception: Pluto, the most distant of all planets, which is Moon-like in size, is composed of ice. The giant planets are massive and surrounded by beautiful rings of matter and countless natural satellites.

Since antiquity, the only planets visible to the naked eye are Mercury, Venus, Mars, Jupiter and Saturn. Uranus was not discovered by William Herschel until the 18th century, shortly before the French Revolution, while, as astrologers claim, the discovery of Neptune by Le Verrier coincided with the social movements of the mid-19th century.

In August 2006, the International Astronomical Union meeting in Prague made headlines by adopting a new definition of planets. Thus, the tribute paid to knowledge was to sweep away certain avenues of history. But let's be clear:

A planet must first be in orbit around the Sun. It must have enough mass for gravity to keep it in a nearly spherical shape. Finally, it must have swept "out its front door", i.e. eliminated any body or debris likely to move in or around its orbit. What remains true for the other planets is no longer true for Pluto which moreover allows itself to orbit in a plane that is very inclined with respect to the ecliptic! As a result, Pluto is now part of the family of dwarf planets with Eris, Makemake and Haumea recently discovered which are certainly in orbit around the Sun, have a quasi-spherical shape but have not cleaned their orbital environment.

As far as we know, our Solar System is unique in its composition. For centuries, people have wondered whether, like the Sun, other stars are surrounded by planets and whether some of them are inhabited. Already, in 2024, more than 5500 planets (called exoplanets), with masses ranging from three times that of the Earth to masses close to that of Jupiter, have been discovered. The first was observed around the star 51 Pegasus by two astronomers from the Geneva Observatory. Current techniques already make it possible to detect an Earth-like planet in the vicinity of a distant star. One of the great goals of astronomy in the

(continued)

21st century will be to find new forms of life. There must be nearly 1000 billion habitable planets in our Galaxy.

Could one of them harbour life or is our Earth unique? Whatever it is, the Earth is the only house we have. As Sitting Bull pointed out: The Earth does not belong to man; it is man who belongs to the Earth.

Is anybody out there? **This cartoon reflects our infinite feeling of loneliness. Jean-François Batellier, artist; property of Daniel Kunth**

The Wandering Stars

Mercury, Venus, Mars, Jupiter and Saturn have been known since ancient times and were first named according to their appearance, their location in the sky or their mobility. Thus, Mars was Pyroeis, the fiery one, and Mercury, Stillbon, the spark detached from the Sun. The philosopher Plato, much later, took up the tradition of the Babylonians and Egyptians of associating these five planets with the deities of mythology. When astrology gradually spread to the West and into the Roman Empire, the Greek deities had to give way to their Latin counterparts. Thus, Zeus became Jupiter, Hermes gave way to Mercury, Ares gave way to Mars, Aphrodite to Venus and Cronos to Saturn. We have inherited them.

The sky returned the favour since these same words were used to designate the days of the week compounds, not to mention the names or qualifiers

derived from the appearance of the said planets or the attributes that the ancients lent to their gods. We believe that this characterisation is not as fanciful as the reader might think, for our ancestors, fervent observers of the sky, took care that the attributes of the gods, for some of them at least, corresponded to the appearance or behaviour of the planets whose colours they bore. On the other hand, astrological medicine has long thrived, without much success for patients, on presumed associations between the planets and metals (see box below).

We now know how dinosaurs have disappeared. 2020, Courtesy of Jean-François Batellier, artist

Alchemist Association Between Metals and Planets and Products Derived from Them That Could Be Found in Chemists or Apothecaries

Sun: gold
Mercury: mercury (or quicksilver), mercury of the philosophers
Venus: copper, Venus crystals (copper acetate), Venus vitriol (copper sulphate), Venus spirit (acetic acid)
Moon: silver, moon vitriol (silver sulphate), moon crystals (silver chloride)
Mars: iron, Mars saffron (iron oxide), Mars dye, Mars salt
Jupiter: tin, jovial pills (tin salts)
Saturn: lead, Saturn extract (dissolution of lead subacetate), Saturn water, Saturn vinegar, Saturn sugar, Saturn salt
Uranus: uranium
Neptune: neptunium
Pluto: plutonium

Mercury

Mercury is the smallest telluric planet of the Solar System and the closest to the Sun which makes it difficult to observe from Earth. It can only be observed at most two hours just before sunrise or after sunset. Thus, Mercury, the elusive planet with the shortest period of revolution (88 days) evoked the messenger of the gods. Among the Greeks, Hermes was the spokesman for Zeus. It is not surprising that his name was associated with the European space shuttle project (now abandoned).

The word mercury has replaced the old word quicksilver which was more logical in a sense, as this liquid metal is surprisingly mobile and elusive (hence, a mercurial personality). With the development of chemistry and its increased knowledge of the atomic structure, mercury was recognised as a simple element in the periodic table of elements. It was used in the composition of household products such as the antiseptic mercurochrome (from khroma, "colour of mercury").

This word because of its symbolic meaning is found in the press and publishing: *Le Mercure galant* (1672), the *Mercure de France or El Mercurio*, well known to European astronomers, which is one of the most official daily newspapers in Chile (host country of ESO (European Southern Observatory)).

Hence, Mercury is supposed to protect merchants and travellers. It is quick and versatile and by symbolic analogy, it is also said to be skilled in the art of deception. Its name, probably of Etruscan origin, has left us merchandise and indirectly *merci*, i.e. thank you. Originally used to qualify the price of a product or the salary of a mercenary before evolving into the meaning of reward and becoming a formula of politeness.

The French Ministry of Agriculture's mercurials provide food industry professionals on the *Service des Nouvelles des Marchés* website with information on the prices of fruit and vegetables and other fresh perishable products. This has become the name of the bulletin that publishes the official prices of commodities sold on a public market.

Better known to users of Paris ring road, and visible from it, the Mercuriales towers are two skyscrapers in the eastern suburbs of the city Bagnolet. Real business centres, they are called the Eastern and Western Tours (Levant and Ponant).

From the 15th century onwards, magistrates used to meet on Wednesdays (Mercury's day) to denounce the abuses committed by the judiciary. The speeches they made in this assembly were called mercurials. The criticisms could be so sharp that the word has passed into literature to mean a remonstrance, or even a reprimand of a certain vivacity.

Mercurial (or "Mercury grass") is a botanical weed, quite poisonous but sometimes used in small doses as a laxative. Anyone can forge an analogy with our justice system and our purse.

Mercury (Scientific Description)

Mercury is difficult to observe with the naked eye because it is very close to the Sun. It passes just in front of the Sun about a dozen times a century (this is called transit). The last transit took place on November 11, 2019. The next will take place on November 13, 2032.

It is the first planet from the Sun, small with a diameter barely half that of the Earth. Visited by an American probe in 1974, Mercury's landscape is reminiscent of the Moon. Nothing can grow there, not even a mercurial plant: its surface is scorched during the day by a blazing Sun, and there is no protecting atmosphere. At night, the temperature drops below -180 °C. Mercury's surface is riddled with craters that nothing can erase, due to lack of geological and volcanic activity, water and wind. Its large iron core gives it the properties of a magnetic spinning top. It rotates on itself in just over 58 days and around the Sun in 88 Earth days. It is therefore daylight three times a year on Mercury!

In 1855, Le Verrier observed an anomaly in the motion of Mercury: its perihelion (the point of its orbit closest to the Sun) rotates around the Sun a little too fast compared to his calculations. This is called Mercury's perihelion advance. Assuming that this anomaly was due to a new planet, just like that of Uranus disturbed by Neptune, he postulated that the orbit of this hypothetical planet should be inside that of Mercury, very close to the Sun. It was given the name: Vulcan. However, no one could see it. In 1915, the true solution, quite radical, was found: there is no new planet, and as Einstein showed that year, the anomaly comes from the use of Newtonian mechanics in the calculation of the motion of Mercury, while the gravitation is better explained with the theory of general relativity. The difference is very small for planets farther away from the Sun, because the gravitational attraction is less strong, but is sufficiently strong in the

case of Mercury to lead to the observed anomaly. The ultimate calculations of general relativity naturally lead to the right value.

Mercury is so close to the Sun that it moves in its orbit at an average speed of 60 km/s and is difficult to reach with a space probe. The technique used to achieve this is the so-called interplanetary billiard and was invented by the Italian engineer BepiColombo. A probe bearing his name was launched in 2018 to arrive in Mercury in December 2025.

Venus

Venus occupies a very special place in the sky and in our hearts. For the Babylonians, she represented the goddess Ishtar, eponym of beauty and love. At the time of Pythagoras (4th century BC), Venus had two names, Hesperos, "she of the evening", or Eosphoros, "she who brings the dawn". It was believed that these were two different stars.

When they realised that Venus was a single celestial body the Greeks associated it with the goddess of love Aphrodite. This symbol of femininity fits this celestial body like a glove! It appears sometimes in the cool of the morning, sometimes in the languor of the twilight. Aubades and serenades are the tributes paid to the beloved, which accompany the rising or setting of this star.

Venus is the matutinal star (also called morning star), the one that announces the coming of the day. When the astronomer Camille Flammarion was astonished by the qualifier precursor affixed to Saint John the Baptist in the Bible, he wrote in his *Astronomie populaire* (*Popular Astronomy*): "As for John the Baptist replacing Venus, I spent a few minutes before I understood the reason for it, when I realised that he was indeed 'the matutinal star of Jesus, the precursor of the Sun'".

Known to the Romans as Vesper: the star of the evening this time, it has passed on to us as vesperal, vespers and *vespertilio* a species of mouse-eared bat that takes flight in the evening. Love celebrates the mountain of the same name (mons pubis or mons veneris), but popular jargon pokes fun at it when a kick from Venus announces a syphilitic accident: "With another drug, we drive away the evil caused by kicks from Venus", we read in one of the tantrums of *Père Duchesne*, a satirical newspaper of the French Revolution, referring to venereal diseases.

Much more tasty, the *Navel of Venus* is a kind of beautiful green plant that can be accommodated in a succulent salad. Well appreciated by the top chefs!

Venus (Scientific Description)

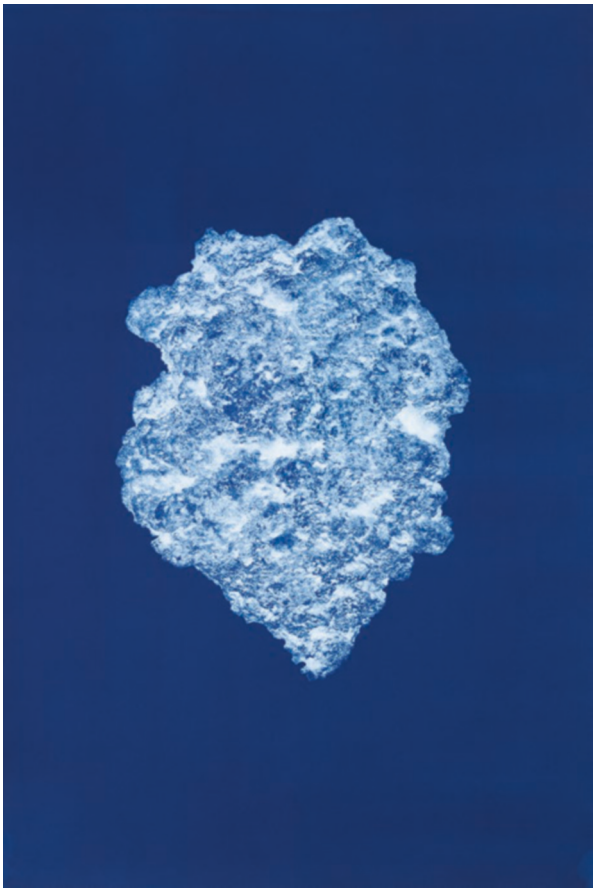
Venus is the second planet from the Sun after Mercury and is similar in size to the Earth. It owes its brightness to the thick atmosphere that covers its surface and whose clouds reflect the light of the Sun. It is the brightest luminary seen from Earth (after the Sun and the Moon). Improperly called the "shepherd's star", it is seen in the west in the evening and eastward in the morning. It revolves around the Sun in 224.7 days on an orbit internal to that of the Earth which generates a cycle of phases very similar to that of the Moon. The planet has another particularity: it turns on itself in 243 days but in a retrograde direction.

Probed for 20 years by space missions using sonar technology, the soil of Venus is now known with a precision greater than that of a road map. Under its veil of water vapour and acid droplets, the appeal of Venus is irresistible. Its unexpected landscapes reveal extinct volcanoes, faults and a few mountain ranges (the highest is the 11.8 km high Mount Maxwell). The Venusian crust is probably very young as the meteorite impacts are only 800 million years old. Its numerous plains are surrounded by high plateaux of several kilometres in altitude, unfortunately swept by violent winds of carbon dioxide and sulphuric acid that annihilate any desire to stay for a long time or any project of love walk. Besides, why stay? The pressure on the sulphurous planet is a hundred times higher than on ours and the average temperature is 400 °C, while the atmosphere saturated with carbon dioxide is of course unbreathable. No water; therefore, no life; no moonlight either, as this planet has no satellite.

Mars

If Venus evokes in our minds a romantic appeal, it is not the same for Mars who in all mythologies has a wild and terrifying character due to his red colour which makes us think of iron and blood spilled during fighting. In Rome, Mars was the god of war, whose love affair with Venus was sung by Lucretius. In Greece, Aristotle identified him with Ares, god of war and youth. Is it not said that men come from Mars and women from Venus?

Mars leads quite naturally to martial! One can be *court-martialled* or be subjected to the law of the same name which justifies, in certain cases, the use of armed forces. As if to endorse it, the alchemists associated it with iron! The old martial pyrites have now become ferruginous pyrites, and Mars saffron and Mars tincture were used in pharmacopoeia.



***Norite, 2017*, This norite is a nice reminiscence of a cosmic asteroid. Photo ©Hugo Deverchère, artist Cyanotype print on Arches Platine paper, poplar plywood, 122 × 86 × 6 cm/48 × 337/8 × 23/8 inches. Courtesy of the artist and Le Fresnoy – Studio national des arts contemporains.**

A parenthesis is useful to point out that symbolic language has limits that keep it at a distance from the realities of the physical world. Let us beware of easy analogies. In the example of the planet Mars, the red colour evokes for the astrologers the flowing of blood and therefore war and death; for the astronomers, on the other hand, the colour red can have many causes; only experience can tell. Tests carried out during the first space missions to Mars showed the presence of iron on the surface of this planet: the red colour may partly come from its oxidation. Oxidation requires the presence of oxygen, particularly in the form of water which the surface reveals. Water is

synonymous with life on Earth, so it is legitimate to ask whether life exists on Mars. Did life exist in the past; can it be found underground in a primitive form? We are still only formulating hypotheses, which will only be decided during future exploratory missions. "Mars-red-war-blood-and-death", a symbolic chain that functions on analogy has thus given way to "Mars-red-iron-water-and-life", which calls for strict causal links.

That the rusty planet, a simple reddish stone covered with iron oxide, could have been adorned with the virtues of the god of war is still acceptable. We can see how a relevant observation – that of the colour – gives rise to a simple and elementary symbolic interpretation. But the fact that this associative game can continue once the nature of the celestial body in question is known shows that such naiveties survive even after they have lost all meaning.

Mars, recognisable by its orange glow, can turn fully red when it is low on the horizon, and the Romans found a rival in our latitudes: the star Antares, which has the same colour. This one shines on summer evenings in the constellation of Scorpio: it is literally the anti-Ares (which opposes Mars). The Arabs called it Calbalacrab, "the heart of Scorpio", the heart that beats, the heart that loves, the heart that kills!

Let's go back to Mars, the planet. It has two satellites, Phobos and Deimos, respectively fear and terror; they are the ones who drive the chariot of Ares to battle. Curiously, these two satellites appeared in *Gulliver's Travels*, written by Jonathan Swift, and in Micromegas by Voltaire (admittedly, under a different name) well before their discovery!

At the end of the 19th century, astronomers, led by the Italian colleague Giovanni Schiaparelli, believed they had observed channels on the surface of the rusty planet. Many attributed an artificial origin to these fictitious channels. To observe them, the American Percival Lowell invested his entire fortune in the construction of an observatory near Flagstaff in the Arizona desert. He obtained pictures which, according to him, revealed canals never seen before and undoubtedly the work of intelligent beings. In fact, today, we observe gigantic sandstorms that last for long weeks and locally modify the colour of the planet. Atmospheric turbulence, the imperfection of the instruments used at the time and especially the imagination of some observers did the rest.

Nonetheless, novelists have seized upon the red planet and the theme of inhabited worlds. Martians invaded our vocabulary and became peaceful neighbours as in Ray Bradbury's The Martian Chronicles (1950) but sometimes dangerous conquerors. Herbert George Wells' War of the Worlds (1898) and Tim Burton's Mars Attacks (1996) cultivate the terrifying fiction, often mixed with humour, of an extraterrestrial threat. The paroxysm was reached

in 1938 by Orson Welles (on the basis of H. G. Wells' book) when he caused panic to thousands of Americans by making them believe on a public radio channel that a bloody invasion by the Martians had indeed begun. M C Solaar (in Baby Love) provocatively considers that *Women come from Venus. Men eat Mars*.

Mars (Scientific Description)

Mars is the fourth planet from the Sun and can be seen with the naked eye. Its orange colour has earned it the name "red planet". Mars has a low density and a diameter half that of Earth. The Martian atmosphere is less than 1% of the pressure on Earth and would not allow a human being to live in the open air. However, there are many similarities to our planet. It has clouds and deserts, canyons and volcanoes and two ice caps that change with the seasons. Mars has a great deal of weather and climate activity, which is a favourite of meteorologists. Because of the inclination of its rotational axis to its orbital plane, the seasons follow each other at an annual rate of 687 days. The ice melts in summer and the summer temperature reaches 20°C. In winter, patches of white frost crystallise and the thermometer registered -100°C. Some of the water remains in the form of ice, buried in the ground and constitutes the permafrost.

The volcanoes reach prodigious heights. They are extinct. Mount Olympus, the highest mountain in the Solar System, towers more than 27 kilometres above the surrounding plains. These dizzying heights are unknown on Earth where continental plate drift has interrupted the flow of volcanic lava.

In 2021, we had about 262 meteorites, fragments ejected from the planet Mars, which fell to Earth and were collected several thousand years after. They are volcanic rocks. One of them has tiny spherules that could be the result of the decomposition of Martian bacteria. This thesis which has been the subject of much ink is not unanimously accepted, but one question arises: could life have first hatched on Mars and then colonised the Earth?

The Viking missions in 1976, and then the Pathfinder probe that landed in 1997 with its Sojourner robot, have confirmed that there was once abundant liquid water on Mars. No sample analysed on site has revealed so far the slightest trace of life. Mars now appears to be hostile to all forms of life at least on the surface. The next probe, in particular ESA's ExoMars (2018), was aimed to look for possible living fossil organisms in the Martian soil. Unfortunately, due to the ongoing war in Ukraine, ESA acknowledged the present impossibility of carrying out the cooperation with Roscosmos with a launch in 2022 and mandated the ESA Director General to take appropriate steps to suspend the cooperation activities accordingly.

If life appeared there, why did the climatic conditions change? One can imagine a few irresponsible Martian generals who have led their planet to its doom. Would this be a free warning? These climatic changes might be due to the considerable deformation of Mars' orbit over time, as shown by the numerical simulations of astronomer Jacques Laskar and his colleagues.

Many astronomers, engineers and physicists dream of "terraforming" the planet, literally modifying its climatic and biological conditions to allow settlers to live and prosper there. By playing on the greenhouse effect, the astronomer

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Carl Sagan proposed to bring frozen water back to a liquid state. The process would make it possible, in less than a millennium, to program new and poetic destinations for lovers in search of escape. However, the journey, which would take 9 months, would not be without danger due to the unavoidable showers of high-energy particles from the Sun. The Interior Exploration using Seismic Investigations, Geodesy and Heat Transport (InSight) mission was a robotic lander designed to study the deep interior of Mars. The mission launched on May 5, 2018, and successfully landed at Elysium Planitia on Mars on November 26, 2018. InSight was active on Mars for 4 years, 19 days, and studied the interior of the planet, including registering the first quake outside Earth. The Mars Society is an organisation that advocates for Mars exploration and eventual colonisation by humans. We are very far from reaching this goal! Founded by Robert Zubrin aims to make missions to Mars as lightweight and feasible as possible. The Mars Society members include Buzz Aldrin and Elon Musk.

Ceres

The word *cereal* is based on the name of Ceres, the Roman goddess of the harvest. Ceres was a latecomer to the Solar System. Its story is also tasty by all meanings.

A celestial body was missing between Mars and Jupiter, and the idea of searching for an unknown planet was first proposed by Bode in 1788. In 1800, a methodical search campaign was launched and a crop of new asteroids was reported, but it was by accident that Ceres was discovered by the Sicilian astronomer Piazzi on January 1, 1801. He suggested calling this object "Ceres Ferdinandea" after the Roman goddess Ceres of harvests and agriculture and King Ferdinand III of Sicily. Ceres was the patroness of Sicily and Ferdinand III her patron. For diplomatic reasons, only the first part of the name was kept.

Ceres is the smallest dwarf planet in the Solar System (950 km in diameter!) and the only one located in the asteroid belt. Its surface is composed of a mixture of water ice and various mineral hydrates such as carbonates or clay. More than two centuries after its discovery, scientists are turning their attention to this most beautiful object in the asteroid belt and are dedicating an expedition towards it. The Dawn probe has grazed Ceres in 2018, the same year as the New Horizons flyby of Pluto (see below). Dawn has also reached Vesta, the second largest body in the asteroid belt after Ceres.

Jupiter

In the middle of a moonless night, Jupiter is the brightest light in the sky, illuminating it with an extraordinary white fire that would make Sirius, the most radiant of the stars, seem almost pale. It was known at the time of Pythagoras (6th century BC) under the name of "Phaeton the Scintillating".

Jupiter is likened to the Greek god Zeus who maintains order and justice in the world. Zeus is the son of Cronos. Cronos, suspicious and jealous of his descendants since a prophecy announced that one of his sons would dethrone him, thought he would escape his fate by devouring his children each time they came out of the womb of Rhea, their mother. Unfortunately, Zeus, removed from his father by a clever subterfuge of Rhea, returned a few years later to emasculate Cronos (the famous murder of the father?), and this put an end to his reign, inaugurating what has been called "the golden age", the one where everything becomes possible again!

Jupiter, supreme god of the Romans, is also god of lightning and thunder. It was this lightning that killed his lover Semele, who was pregnant by the god's works. Jupiter extracted the child from his mother's womb and sheltered it inside his thigh until the end of the pregnancy. This child is Dionysus. The French expression to be "taken out of the thigh of Jupiter" expresses the high idea that someone might have of himself. Another version is that Dionysus was taken to the rain-nymphs of "Nysa", who nourished his infancy and childhood, and for their care, Zeus-Jupiter rewarded them by placing them as the Hyades among the stars and formed the Hyades star cluster.

Its abundant beard is rivalled only by the houseleek *jovibarba* (from the Latin *Jovis barba*, precisely "Jupiter's beard"), a modest mountain plant, probably sown on Earth by Jupiter himself, and supposed to protect against lightning! It is not by chance that in the Middle Ages a superstition gave the houseleek the power to ward off lightning. It was planted on the roofs and an attentive visitor will often see flowers made in stone, adorning churches and gothic cathedrals. Its leaves were also used as an emollient for wounds. They were cultivated as a medicinal plant.

Those born under the sign of Jupiter, king of the Olympian gods, were promised a happy destiny, expressed by the adjective jovial (from the Latin *Jovis*, Jupiter). The word originally meant "that which relates to Jupiter". Later, caught by the phonetic proximity of joy, the meaning became close to "strong, permanent cheerfulness": "He was a man of jovial mood".

The alchemists, relayed by the apothecaries, saw in Jupiter the colour and the beneficial virtues of tin. The jovial pills contained tin salt and were supposed to make people happy!

Jupiter (Scientific Description)

The fifth planet in the Solar System, located 780 million kilometres from the Sun, has a revolution period of 11.9 years.

Jupiter occupies a prominent place in the Solar System. It weighs two and a half times the mass of all the other planets combined. Its diameter is 142,000 kilometres, 11 times that of the Earth and one-tenth that of the Sun. It rotates on itself in only 9 hours and 55 minutes. However, some people say that it is a failed star, a Sun that did not make it! Not everyone can become a star. Yet Jupiter is still contracting and … radiating more energy than it receives from the Sun.

Despite its weight and roundness, its surface neither begins nor ends, all dressed in gas. You don't land on Jupiter; you enter it. Diving into this universe of gas is not easy because the planet spins so fast that it brings with it whirlwinds and winds of rare violence. Weather reports show cloud bands circling Jupiter at more than 600 km/h and cyclones that can last for months or more. The best known of these is undoubtedly the "red spot" which has lasted for at least three centuries.

The nights on Jupiter are illuminated by polar auroras and luminescent phenomena that are much appreciated by the Jupiterians. At depth, the pressures become so great that an impassable wall of metallic hydrogen is quickly reached at a depth of 25,000 km and a temperature of 11,000 °C. The planet emits a strong radio emission, discovered in 1955.

Because of its imposing mass and its position in the Solar System, it plays the role of a sky switch, intercepting numerous projectiles, deflecting them and even ejecting them. In a way, Jupiter protects us from external intrusions, particularly those of the countless comets that orbit the edges of our planetary system. In 1994, for example, many observatories and space probes followed the spectacular fall of comet Shoemaker-Levy 9 into the Jovian atmosphere live for several days.

Diffuse and extremely tenuous rings surround the planet. Confirmed by the Voyager probe, they are 6000 km wide and located more than 57,000 km from Jupiter's upper atmosphere. They are composed of particles as fine as cigarette ash.

Jupiter has 63 known natural satellites. The four largest, Io, Callisto, Europa and Ganymede, were discovered by Galileo in 1610: they are called "Galilean". His observations sounded the knell for geocentrism.

He found that the four moons revolve around this giant planet and that their position changes significantly in the space of a few hours: a miniature Solar System with Jupiter at its centre! These satellites are real worlds, discernible with simple binoculars. Io orbits so close to Jupiter that under its gravitational influence, the ground cracks and releases molten lava topped by huge volcanic plumes. It is the site of exceptional volcanic activity to the extent that its surface is covered with sulphur and ice, giving it a red, orange and brownish colouration with some touches of green. The other three satellites are as varied as they are strange. Their ice worlds are sometimes smooth like a billiard ball for Europa, sometimes riddled with craters like Ganymede and Callisto. Europa is probably home to an underground ocean that could be reached, after a costly drilling of more than 30 kilometres thick, to find, at least we imagine it (for free this time), a priceless treasure: extraterrestrial life forms! ESA (European Space Agency) is planning to launch Europa Clipper in 2025 for this purpose.

The ESA's Jupiter Icy Moons Explorer (JUICE) sent on April 14, 2023, will make detailed observations of the giant gas planet and its three large ocean-bearing moons – Ganymede, Callisto and Europa.

Quotes

Mehmet Murat Ildan: In Jupiter, there are Earth-Size storms; and in Earth, there are Jupiter-Size lies!
Jean-Paul Sartre: What do I care about Jupiter? Justice is a human issue, and I do not need a god to teach it to me.
Roberto Benigni: I would like to be Jupiter, and lie down in the firmament and make love to everybody.
Ovid: Gifts, believe me, captivate both men and Gods, Jupiter himself was won over and appeased by gifts.

Saturn

Visible in summer with a simple amateur telescope, one feels a strong emotion when watching for the first time Saturn floating in space and giving a three-dimensional feeling.

***Waste around the world*. Courtesy ofJean-François Batellier, artist**

Saturn is slow to move among the stars: its rotation period around the Sun is about 29 years – a generation! Saturn, as the French poet Georges Brassens sings, "is a very disturbing god" who reminds us of the passage of time,

representing death waiting for its time in the guise of an immobile skeleton holding a scythe. This slowness of movement leads us to symbolise it as a prudent, serious and sad old man.

Saturn is in Greek mythology Cronos, son of Ouranos (Heaven) and Gaia (Earth), the king of the Titans and father of Zeus (Jupiter in Roman mythology). He is often confused with his homophone Chronos, the primordial deity of time in the Orphic traditions who gave us chronology and chronometer. Cronos is assimilated to Saturn in Roman mythology.

A pallid planet, its livid colour does it a disservice. The alchemists, noticing Saturn's dull yellow and leaden colour, linked it to lead, and this is why *saturnicus* was the early Latin name of lead. From these associations come expressions like *Saturn water* and *Saturn salt* or the word lead poisoning. Lead poisoning still refers to the fatal disease caused by contamination to the drinking water by lead pipes of certain slums or in children's lead toys of old.

Saturn embodies melancholy, impotence, bad luck and paralysis. It took centuries for melancholy, the premise of madness, the typical illness of the intellectual guilty of the sin of knowledge (as illustrated by the engraver Albrecht Dürer in Melancholia) to become synonymous with nostalgia, dreams and sadness. Are not Verlaine and Yeats' saturnine poems charged with the anguish and solitude of the creator?

> Do not because this day I have grown saturnine
> Imagine that lost love, inseparable from my thought
> Because I have no other youth, can make me pine;…
> W.B. Yeats in "Under Saturn".

We mentioned the fate of Zeus; that of Saturn is strangely similar: his father, Ouranos in Greek, also jealous of his offspring put the child in the womb of Gaia. Furious, she incited her children, the Titans, to revolt against him. Only Cronos accepted the challenge and broke the fatal curse by emasculating his father with a sickle.

As the historian Jean-Pierre Vernant reported in *The Universe, Gods and Men*, Cronus threw the manly member of Ouranos over his shoulder. By separating the sky and the earth, he created a free space where the Earth could produce new generations. As for the sperm of Ouranos poured into the sea, it formed with the waves a foam from which Aphrodite, goddess of love was born.

Alas, we have seen how in spite of this liberating gesture, he inherited the same destiny as his father and how, to ward off the fate that was promised to him, he devoured his own children.

The Romans associated Cronus with Saturn and it is Cronus that the painter Francisco Goya depicts as the father who eats his children. This striking painting on display at the Prado Museum in Madrid is said to symbolise the political situation of Spain in the early 19th century.

The Saturn of the Romans has some more sympathetic features: he is the god of sowing and reaping. Saturnalia was celebrated at the end of each year during the shortest days to celebrate the rebirth of the Sun. Unbridled festivals where the man became a woman, the master a slave and vice versa. Today, there is still the carnival, where, under the mask, societies grant themselves, for a brief moment, the right to socially disorganise everything.

Saturn (Scientific Description)

Located more than a billion kilometres from the Sun, this planet is certainly a dream for everyone. Its equatorial diameter is 9.4 times that of the Earth and its mass 95 times greater. Eight times less dense than the Earth, its density of 0.7 would allow it to float on water.

It rotates so fast (in less than 11 hours) that long bands stretch across the equator while the poles flatten out. Saturn's atmosphere is as turbulent as Jupiter's, with violent winds of up to 2000 km/h and vortices as unstable as whipped cream. Its poles are not to be outdone, with cyclones, particularly at the south pole which is distinguished by a central eye, a sort of deep well encircled by a vast wall of clouds 75 kilometres high and full of moisture.

The images of Saturn are prodigious in their beauty and they always surprise. After 2004 and for 13 years, the Cassini spacecraft mission has provided us with data and images of the planet and its rings and satellites.

The most iconic one was obtained in September 2006, when the planet was photographed against the sunlight. The image can be downloaded from NASA's website and one can notice a barely visible tiny spot, which is none other than the Earth seen from more than 2 billion kilometres away. A sobering view, it is already almost invisible.

Saturn's ring system, discovered by Ch. Huygens in 1655, is the most remarkable in the Solar System. It extends more than 300,000 km from the centre of the planet.

The greatest names in science have studied the enigma of these rings. When Galileo turned his telescope on Saturn, he thought he had recognised two small solid ears. Fifty years later, Huygens identified the rings and put forward three hypotheses on their nature: they were liquid, made of blocks of stone or formed a solid plate. The Frenchman Jean-Dominique Cassini discerned two distinct rings in 1669 separated by a gap. But it was the Scotsman James Clerk Maxwell who, in 1857, solved the thorny problem of their stability and nature, before being immortalised by his theory of electromagnetism.

The launch of the Voyager probes in the mid-1970s revolutionised the observation of the ringed planet. These have tens of thousands of structures and rings with sharp edges covered with water ice and composed of an incredible number of particles of all sizes, from microns to kilometres, which turn like a silent merry-go-round. The roundness of the planet can be seen through the almost transparent rings. We can even make out tiny satellites that act as guardians, preventing the rings from dispersing.

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The 60 satellites of Saturn are extremely varied and all have remarkable characteristics. Their names are Pandora, Prometheus, Janus, Mimas, Tethys, etc. One of them, Enceladus, has a diameter of barely 400 kilometres and a uniformly bright white shiny surface. However, its southern region is particularly active. During the 2005 flyby, images revealed several particle jets peaking more than 500 kilometres above the surface. These are veritable geysers of water vapour that eventually condense into ice crystals.

The most beautiful of all is undoubtedly Titan, which has long intrigued astronomers (and still does!). This body, 5150 km in diameter (larger than Mercury), is shrouded in a thick atmosphere that hides its surface. The Cassini-Huygens probe has been on a 6-year journey to explore this distant world. Arriving in November 2004, it parachuted extremely sophisticated instruments into its atmosphere, laden with methane and nitrogen. The satellite reveals landscapes with morphological similarities with the Earth, but strikingly there are lakes of hydrocarbons, rivers and mountains covered with methane snow, all accompanied by volcanoes erupting ice lava. This world may harbour a complex chemistry described as prebiotic.

A giant laboratory! A primitive Earth that has remained in a frozen state, and all the reasons to discover the mechanisms that give birth to life. Indiana Jones' paradise!

Quotes

Mark Russell: The scientific theory I like best is that the rings of Saturn are composed entirely of lost airline luggage.

Georg Buchner: Revolution is like Saturn; it devours its own children.

Walter Benjamin: I came into the world under the sign of Saturn – the star of the slowest revolution, the planet of detours and delays.

Uranus

Discovered much later, Uranus, Neptune and Pluto were also designated by names borrowed from Greek mythology but did not make it into the weekly calendar.

Uranus owes much to the astronomical muse Urania for the word comes from the Latin god *Ouranos*, literally *vault of heaven*. We have seen how Ouranos, castrated by his son, suddenly moves backwards, separates from Gaia and forms the sky and the space in which future generations were created.

But the Greek cosmogony adds that Ouranos poured a fertilising rain on Gaia. This rain became Oceanos, the great river of fresh and pure water that surrounds the Earth. It is therefore logical that Ouranos is linked to the verbal

root meaning "to rain". Hurricane or even urinate and urethra come indirectly from Ouranos. It is likely that the castration of the god is the origin of the didactic term uranism which designates, as in German, male homosexuality. Another interpretation links uranism to Ourania, one of the nicknames of the goddess Aphrodite, born as we pointed out, from the castration of Ouranos.

Observing the sky makes us true uranoscopus, literally "sky viewers", just like this goldfish with two pairs of eyes, one of which is directed towards the sky which are able to see out of the water watching for the prey.

The word uranium, so prized by nuclear plants, uranium oxide (discovered in 1789), derives from the name of the planet, discovered by W. Herschel earlier in 1781.

Neptune

"Le Verrier saw the new star at the end of his pen", wrote Arago, the French astronomer and mathematician, Le Verrier's mentor.

To evoke its very blue colour and to continue the tradition of naming the planets after the deities of mythology, it was agreed to give it the name of Neptune, son of Saturn and Rhea, who was almost devoured by his father and was saved by Jupiter, his brother.

After dethroning their father, Jupiter shared the universe: he granted himself the Heaven and the Earth and entrusted Neptune with the empire of the oceans. This strong and impetuous God of the sea is represented armed with his trident, riding the waves on a chariot harnessed to fiery sea horses.

He was one of the most honoured gods in Greece and Italy. The Romans dedicated the month of February to Neptune, but the festive Neptunales were celebrated in July.

After the creation of the Paris Observatory in 1667, a first campaign of triangulation surveys took place on the coasts of France, and the results were published in a collection of nautical charts called the *Neptune François* published in 1693 by Hubert Jaillot and the director of the Observatory, Jean-Dominique Cassini. These maps from the royal printing house were very well made (scale of about 1/100,000 on average). The Neptune François was initially commissioned by Colbert to allow French navigators to use "a modern and efficient knowledge tool of the European coastline".

Diderot and d'Alembert's *Encyclopédie* reports that poets named Neptune most of the unknown princes who came by sea (in French "acoster") to settle down in some new country or those who were recognised by their victories or the establishment of a trade.

And the Encyclopaedia adds a "Neptune, bonnet of", the name given by botanists to a remarkable species of sea fungus, never attached to any solid body but always found loose, moving on the bottom of the sea.

Quotes

William Herschel: We see it [the as-yet unseen, probable new planet, Neptune] as Columbus saw America from the coast of Spain. Its movements have been felt, trembling along the far-reaching line of our analysis with a certainty hardly inferior to that of ocular demonstration.

Mike Brown: Neptune controls Pluto's orbit. Neptune is the bully of that neighbourhood.

Noam Chomsky: Either you repeat the same conventional doctrines everybody is saying, or else you say something true, and it will sound like it's from Neptune.

Giuseppe Garibaldi: Bacchus has drowned more men than Neptune.

Uranus and Neptune (Scientific Description)

Both are ice giants though Neptune is slightly smaller than Uranus. They were discovered with telescopes in the 18th and 19th centuries, although Neptune's existence was predicted earlier as a body causing the small disturbances observed in Uranus orbit (see below).

Uranus has an amazing feature: it turns on its side like a child rolling down a grassy slope. The ride around the Sun lasts a whopping 84 years and its thin rings are only visible by us for 42 years. One hemisphere remains sunny for the whole period, while the other plunges into winter night. The reason for Uranus's unusual axial tilt is not known with certainty, but the usual speculation is that during the formation of the Solar System, an Earth-sized protoplanet collided with Uranus, causing the skewed orientation.

On March 13, 1781, nearly two centuries after the invention of the telescope, the English astronomer William Herschel discovered Uranus, initially believing it to be a comet. As a tribute to King George III of England, he named the planet "George's Star", citing the precedent of Galileo who dedicated the satellites of Jupiter to his benefactor Cosimo de' Medici.

But who can appropriate a planet, even if only by name, to the detriment of all humanity? Moreover, it was to upset the tradition that the identity of the planets was derived solely from Greek mythology. His suggestion provoked a general outcry, until Johann Bode (the proposer of the law that predicts the distances to the first seven planets and bears his name) suggested Uranus, father of Saturn, which had the advantage of continuing the genealogical line initiated with Jupiter.

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The visit of the Voyager 2 probe in 1986 clarified our knowledge of this cold planet. Its disc remains disappointing and reveals only few outstanding details. On the other hand, the largest moons of Uranus are remarkably interesting and were scrutinised during the Voyager flyby. The nomenclature of these moons is essentially taken from Shakespeare's plays. In the order of their discovery, we find Titania, Oberon, Ariel, Umbriel and finally Miranda. This last one, the smallest, is surprising. Half rock, half ice, made of bricks and mortar, it looks like a giant boat rather than a sphere. Impressive tectonic structures mark its surface. This is how we can observe gigantic features that sometimes are more than 5000 metres high. No explanation has yet been found for such geological deformations on such a modest aster which in principle is incapable of developing volcanic activity.

Neptune is the eighth planet from the Sun. Its discovery was one of the most beautiful intellectual achievements in astronomy. Its existence was deduced by calculation, thanks to the perturbations it exerts on the orbit of Uranus.

Indeed, after the discovery of Uranus, scientists noticed that its orbit did not conform perfectly to Newton's laws.

The confirmation discovery in 1846 by the German astronomer J. Galle was celebrated with enthusiasm.

The previous year at the Paris Observatory, Le Verrier had consecrated the triumph of celestial mechanics and Newton's law of gravitation by demonstrating that "the anomalies observed in the motion of Uranus" came from an unknown disturbing object. It was eventually found at the expected location in the constellation of Capricorn. John Couch Adams, a young student at Cambridge University in England, was disappointed when he was told that this remarkable discovery had been made. For 2 years, he had brandished in vain to the indifference and disbelief of his peers some evidence in favour of the unknown planet!

A conflict arose between the French and the British. The British brought out Adams' papers and claimed that the discovery was theirs. For their part, the French recalled that only an official publication can be validated. Le Verrier tried, in vain, to give it his own name by proposing rather awkwardly to rename Uranus to that of Herschel, its discoverer. The moral of the story, for young researchers the world over: publish your results as soon as you are sure that they are correct!

Neptune's atmosphere is surprisingly active. Some spectacular vortex formations were photographed by Voyager. Chemists have just revealed that it does not rain cats and dogs but diamonds on Neptune! According to them, a large amount of methane trapped in the mantle is under great pressure as it sinks below the surface reaching a depth of 2500 kilometres where it dissociates into carbon and hydrogen.

This shower of diamonds through the mantle would make Neptune the best endowed planet in the Solar System.

It has 13 satellites all named after aquatic deities. The most remarkable of these is undoubtedly Triton. The Voyager 2 probe transmitted images of this small frozen body, discovering a wide variety of landscapes punctuated by volcanoes, wide plains and calderas flooded with frozen lava, ammonia and methane. On the night of August 24–25, 1989, astronomers witnessed the live eruption of several nitrogen geysers driven by very strong winds over more than 100 kilometres high.

But one of the most extraordinary discoveries, mostly by French astronomers, was the finding of three arcs and thin rings surrounding Neptune detected

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during the occultation of a star. The observation was made in Chile by astronomers André Brahic and William Hubbard in 1984. The four arcs were photographed shortly afterwards by the Voyager 2 probe. They are named after universal values: Courage, Liberty, Equality and Fraternity. Their first letters spell the word CLEF, i.e. KEY in English, which represents the enigma contained in these arcs and which astronomers hope to solve one day: the formation of planetary systems.

Neptune has been captured in a new light by spectacular images obtained by the James Webb Space Telescope in 2022, which display the clearest view of its rings.

Pluto

It was for a long time the furthest small planet from the Sun, which makes it difficult to observe even with ground-based telescopes. DK remembers in 1978 an observation made with the large 5 m telescope on Mount Palomar, which strangely revealed that the image of Pluto was not quite circular but had a very small blister on one side, a rounding defect in fact! In reality, we were dealing with not one but two very close bodies, Pluto and its companion Charon discovered shortly before by the American astronomer J. Christy.

But let's get back to Pluto. It was discovered in 1930 by Clyde Tombaugh, according to the predictions of the American Percival Lowell. Naming this planet (which is no longer a planet; see box!) was a great mediatic moment that America wanted to stage.

In honour of P. Lowell, it was decided to name the newcomer after his own initials, P and L. A call for ideas was made in the United States. Of the many names suggested, Pluto was suggested by an Oxford schoolgirl, Venetia Burney, then 11 years old. Her great-uncle, Asaph Hall, had already discovered and named the two satellites of Mars, Deimos and Phobos. It was a family affair.

Pluto, god of darkness, the underworld and death, and brother of Neptune and Jupiter, was universally accepted because of his mythological background. The darkness at the edge of the Solar System seemed to be the natural home of a god like Pluto.

In the following months, Walt Disney created a new companion for Mickey, a faithful dog, whom he named Pluto.

Derived from Pluto, plutonium is a radioactive element discovered in 1948 and formed from the bombardment of uranium nuclei by neutrons during the explosion of atomic bombs.

Pluto (Scientific Description)

Pluto is the ninth and last planet in the Solar System, and since 2006, it has been downgraded by the International Astronomical Union to being only a dwarf planet (see box "What is a planet?"). Faintly luminous, barely contrasting among millions of stars, it still remains in many ways very mysterious. Its orbit is so elongated that it sometimes crosses Neptune's, so that between 1979 and 1999, it was no longer the most distant planet in the Solar System. Some scientists even suspected that it may have been a satellite of Neptune that broke away from it, but most astronomers relegated it to the rank of a distant asteroid.

In any case, Pluto's trajectory is synchronised with Neptune's and its motion around the Sun is itself remarkable. Its orbit is so eccentric that it rises and falls 17 degrees above and below the ecliptic! The last amusing feature is that Pluto rotates on an axis that is inclined 30 degrees to its orbital plane. It is said to be positioned on its side (like Uranus) in a "roasting" mode. But at this distance from the Sun, Pluto won't be roasting anytime soon!

Pluto lives as a couple. In 1978, its companion, Charon, was revealed to the astronomical community by James W. Christy. Nearly 30 years later, two very small satellites named Nix and Hydra were discovered by the Hubble Space Telescope. They are only about 50 km in diameter and wisely describe circular orbits around Pluto.

To learn more about the true nature of this distant star, Pluto has been visited in 2015 by the New Horizons probe. Its journey began in January 2006 from Cape Canaveral and still remains fully operational with the goal of exploring additional so-called Kuiper belt objects (KBOs). Note that this journey could not be postponed for too long as Pluto is moving further away from Earth every day and will not come close again for another two centuries!

The Pluto flyby revealed an unexpected complexity and diversity of terrain, from nitrogen glaciers to towering mountains of rock-hard water ice. New Horizons photographed a stunning sight: a huge, heart-shaped feature on Pluto's reddish surface. Contrary to expectations, Pluto is not a dead system. New Horizons' observations suggest that the dwarf planet has an ocean of salty liquid water sloshing beneath its surface. There are indications that other ingredients crucial for life – carbon-containing organic molecules and an energy source – may be abundant on Pluto as well (NASA source).

Calendar

august calendar july leap-year monday month tuesday weekly year

Revolution

In astronomy, revolution refers to the periodic movement by which a celestial object returns to its starting point in its orbit. Then in the 18th century, the word expressed the time it takes for the earth to travel in its orbit. This evolution is curious to say the least, since it moves the word from a spatial category to a temporal one. Even more surprisingly, the word first designated the completion of a cycle and then became synonymous with a radical change (French or Russian Revolution), this time indicating the impossibility of going back!

It was the Polish astronomer Copernicus who, in the early 1600s, overturned scientific thinking by arguing that the Earth revolves around the Sun, not the other way round. This idea has become known as the Copernican revolution and describes a radical challenge to what was taken for granted.

The revolution of the Earth around the Sun takes one year … by definition! Everyone knows this… and forgets it. Daniel Kunth remembers the fifth grader who was asked "how many times have you already gone around the Sun? He saw the kid's eyes light up as he realised that at eleven years old he had already made eleven revolutions around the Sun…"

> It is true that the cost of living is high, but we forget that it includes every year a free trip around the Sun.
>
> Anonymous

D. Kunth, E. Terlevich, *StarWords*, Springer Praxis Books,
https://doi.org/10.1007/978-3-031-49024-8_10

It says in Genesis: "Let there be lights in the expanse of the heavens to divide the day from the night: they shall be for signs to mark the seasons, the days, and the years".

If the calendar exists, it is due to this theatre of light and shadow where the Sun and the Earth, arbitrated by the Moon, organise the passing of time.

The year is the time it takes the Earth to revolve around the Sun, and the French word *année* derives (as the Italian and Spanish ones) from the Latin *annus* (unit of measurement of the year). This unit of measurement appeared in French in the 2nd century. The Latin root *annus* gives origin to a populous family with annual and all their derivatives (annal, centennial, quinquennial, anniversary, annuity, perennial, etc.).

The English word (year) derives from Old English of Germanic origin. It is related to Dutch *jaar* and German *Jahr,* from an Indo-European root shared by Greek *hōra* "season". Light years is a concept that we commonly use in astronomy and expresses not an elapsed time but a distance, the distance that light travels in 1 year.

We perceive the solar year to flow with the regular change in the height of the Sun above the horizon from season to season. As for the lunar year which was very common in the first calendars, it is based on the phases of the Moon and records the incessant ballet of our satellite around the Earth, night after night. A month then represents a lunation and lasts an average of 29.53088 days.

Calendar comes from *calendarium*, a simple register where the Romans recorded their debts and paid the interest on the first day of each month (*calendas*). The Greek *calends* obviously do not exist as Greeks did not mark time passing by *calendas*!

The French word *calendrier* was derived from *calendier* still in use in Provence, the ***r*** was inserted later on.

Month, derived from the Latin *mensis*, originally meant the lunar month. But *mensis* is linked to a more ancient root meaning *to measure*, the Moon being the celestial tool that measures time. The association between the Moon and measurement is preserved in many European languages such as moon and month in English but also *maan* and *maand* in Dutch or *mond* and *monat* in German, among others. This notion of measurement is found in the adoption of the word mètre by the French revolutionaries who were anxious to choose a universal term usable by all, without any ideological or political connotation. The month has indeed taken on the meaning of "12 th division of the year" but nowadays retains the archaic value of menstruation in the plural: having one's menstrual periods or menses.

The calendar is regulated by astronomical factors but also by climatic or social factors. The week does not correspond to any observable regularity in

the sky. In old English, week is related to the Dutch week and German *woche* and probably refers to a sequence series (source: Wiki). The 29 days of the lunar month are, to the nearest day, divisible by 7 and by 4, yet many civilisations have preferred 4-day weeks.

In Java, a 5-day week was used. In France, the decadal system was adopted from the Roman system during the French Revolution and again but briefly during the Commune. The Arabs first had a lunar calendar, which was readjusted to keep it in harmony with the solar calendar and the seasons. This is no longer the case in the Muslim lunar calendar which lags behind the course of the Sun by 11–12 days each year and has no connection with the seasons.

All Saints' Day in November, Christmas in December...

Romulus, wishing to give his people a new calendar, divided the year into 10 months of 30 days and dedicated the first of these months to the god Mars, from whom the Romans claimed to have descended. This year of 10 months being neither solar nor lunar is known in history as the martial year. The Roman year, inaugurated in March, allows us to understand why our months of September (literally the seventh month of the year), October, November and December, which were named after their rank, are no longer in their place in our modern calendar.

It was the legendary king Numa Pompilius who, around 713 BC, changed this order by adding the months of January and February to the calendar and fixed the beginning of the year at January 1.

January comes from *januarius* in honour of Janus, the Roman god of doorways, passages and gates (*jani*) to whom the January calendar was dedicated. Janus has two faces, one turned towards the past year and the other towards the beginning of the new one. February, the nefarious month par excellence, honoured Februa, the Etruscan god of death, while March celebrates the Roman god of war.

April does not derive, as one might think, from the Latin word *aperire*, which means to open, on the pretext that in this month, the buds begin to bloom or the earth is covered with new vegetation. It is now known that Romans gave the month that follows March the name of Aprilis in honour of the goddess Aphrodite. May honoured Maia, the Greek goddess of growth, while June was dedicated to Juno, queen of the Roman gods.

Undoubtedly, the most surprising nominations are those of July and August, which are owed to the emperors Julius Caesar and Augustus. These tributes have deep and amusing historical reasons. The Romans realised that there was a growing and embarrassing discrepancy between the calendar year (the one on which we regulate our habits, make our appointments, pay our taxes, etc.) and the solar year. Troublesome because in the end, they ended up celebrating winter in the middle of summer or levying taxes more often than necessary which does not please anyone.

These problems had not escaped them. So Julius Caesar called on the Greek astronomer Sosigenes of Alexandria to solve the problem. Sosigenes imagined inserting a day every 4 years. But when?

***Maya Calendar*. Illustration inspired by the Sacred Mayan calendar known as TZOLK'IN. This calendar consists of a series of 20 glyphs, each representing 20 days, combined with Mayan numbers ranging from 1 to 13, totalling 260 days. The circular representation is characterised by small circles with a stone-like texture, symbolising the passage of time. This design sits atop a starry background representing space. Authors: Maria Esther Martínez Valencia, Itza Nallely, Caneda Vigueras and Eric Corona Cortez (Design Department, INAOE Puebla/Mexico)**

February marked the end of the Roman year, so it was not an auspicious month: there was no call for lengthening it! So it was agreed instead to place the extra day not at the end of February but between February 24 and 25.

A 24th February-bis if you like with the advantage of not altering the nomenclature in use. This day was called "24 February a. d. VI Kal. Mart.", or *ante diem sextum Kalendas Martias*, which means "the sixth day before the calendas of March". A leap year thus consists of 366 days. The intervening day is called the leap day. Later, when the leap day was placed on the 29th of the month, the Latin method of counting days was abandoned and only the name leap year survived. The French language acknowledges the repeated day by calling this leap year "bissextile".

Caesar promulgated this reform in 44 BC, and in his honour, the month of July is named after him (the month was previously called quintillis). Alas! Caesar was assassinated during the Ides of March, and Sosigenes with him (the dangers of being an astronomer). The reform was misunderstood and misapplied, i.e. a day was added every 3 years instead of every 4 as it should have been. What historians call the "years of confusion" ensued.

The emperor Augustus took it upon himself to repair the error. Legend has it that in 8 BC, the Senate dedicated the month sextilis to Augustus by giving it his name (our month of August) while ensuring that he had as many days as Julius Caesar. That's why August has, like July, 31 days (the extra day was taken from February since it was better to keep it short, as it was considered evil!).

In France, in the time of Charlemagne, the year began at Christmas. Not only did this day celebrate the birth of Jesus Christ but astronomically close to the winter solstice it announced the renewal of the year. Later, the year began at Easter, or rather on Holy Saturday after the blessing of the Paschal candle, until the promulgation of the edict of Charles IX in 1567, which returned to the first of January the start of the year.

In the past, March was the month of fasting, of abstinence. *To arrive like March in Lent* means to be without sins at the right moment, just when you need to. The expression is self-evident since March, inevitably the month of Lent (Lent is also named Carême from the popular Latin *quaresima*: fortieth), is included in the 40 weekdays before Easter. It is the origin of the Irish and Scottish Gaelic word *carghas*.

When Tomorrow Was Yesterday

If no one cares much about the accuracy of the calendar these days, it is obviously because we no longer have any problem with it. This was not always the case.

The vagaries of the calendar made life difficult for people. The Romans had already complained about this and imperfections had to be corrected. It was not easy. The solar day is an important unit of time for humans. A year does not have a whole number of days which is very inconvenient. Just think that there are 365.2422 days in a solar year!

After the reform of Julius Caesar, the calendar year lasted on average 365.25 days, thanks to the addition of the leap year every 4 years. But even corrected, the new calendar was still 11 minutes and 14 seconds longer than the solar year.

At first, no one noticed this small gap which was hardly detectable over only a few years. But between the death of Julius Caesar and the fateful year 1582, the gap had reached 10 days!

The spring equinox came much too early, not on March 21 but around March 11! The Christians, who were anxious to fix the date of Easter precisely, were upset by this.

However, one does not decide to shake up a calendar without foundation or authority. It was the catholic Pope Gregory XIII who proclaimed the new calendar rules on February 24, 1582. This calendar is the one we use today. It stipulates that years divisible by 4, but not by 100 – except those divisible by 400 – would be leap years: thus 2000 and 2012 were leap years, while 1900 was not. We can live with this because it is accurate enough for our daily lives.

But in promulgating this reform, Gregory XIII also had to correct the errors already accumulated by the Julian calendar. He ordered that year that the day following Thursday, October 4, 1582, would be Friday the 15th (instead of the 5th). A jump of 10 days! It is hard to imagine the disorder that this papal bull caused in Europe. For superstitious, religious and political reasons, it took a long time to be applied, and the changeover from the Julian to the Gregorian calendar took place at different dates in different countries. Great Britain and the Protestant countries did not adopt the new calendar until the 18th century, preferring, according to the amused astronomer Johannes Kepler, "to disagree with the Sun rather than agree with the Pope". Practically in England and the American colonies, it did not disappear until after an Act of Parliament decreed that September 2, 1752, should be the last date for the official use of the Julian calendar and should be followed by September 14, of the Gregorian calendar. It means that for 170 years, then, the champions of the Julian and Gregorian calendars had disputed and argued, to the annoyance of later chronologists. Advocates of both were forced to

adopt the custom of adding O.S. (for Julian) or N.S. (for Gregorian) to dated letters and documents, or, on specially important papers, use double dating[1].

In Northern countries, Saint Lucia (December 13) is celebrated as the darkest day in the year. It is very picturesque, with little girls dressed in white and wearing lighted wreaths. It contains an error, in that the days do not really begin to grow until after the winter solstice (December 21 or 22). However, December 13 in the Julian calendar corresponds today to December 23, the darkest date on which the length of the day actually begins to increase. It is to be understood that this festivity dates back to 1582 and has survived not forgotten, even after the calendar had been changed.

Days of the Week

The days of the week, seven in number, are the origin of hebdomadal (i.e. weekly), derived from the Greek *hebdomas*, group of seven. They are named after the planets which were only five (before Uranus' discovery by W. Herschel) and the two luminaries, the Moon and the Sun. Nowadays, this classification is almost universal, due to international trade and communications. This recourse to the planets is used by nearly half of humanity.

Our week then proceeds as follows:

Monday: Moon day.

Tuesday: Mars day. Old English Tīwesdæg "Tīu's day"; Tiu was a Germanic god of war and the sky; translation of Latin *dies Marti* "'day of Mars", the god Tīw being equated with the Roman god Mars. Can be compared with Swedish *tisdag*. In the Bible: on Tuesday God gathered the waters in one place giving rise to dry land.

Wednesday: day of Mercury. Old English Wōdnesdæg "day of Odin", named after the Germanic god Odin or Woden, the supreme god; translation of late Latin *Mercurii dies*, as Odin corresponds to the Roman god Mercury. The word is parallel to the Dutch one *woensdag*.

Thursday: day of Jupiter. *Jueves* in Spanish, Old English Thu(n)resdæg "day of thunder", named after Thunor or Thor, the Germanic god of thunder; translation of late Latin *Jovis dies* "day of Jupiter", Thor being equated with

[1] Aitken, R. G, Astronomical Society of the Pacific Leaflets, Vol. 5, No. 246, p.376

the Roman god Jupiter. It corresponds to *donderdag* in Dutch and *Donnerstag* in German.

Friday: day of Venus. *Viernes* in Spanish, Old English Frīgedæg "day of Frigga", named after the Germanic goddess of married love Frigga, wife of the supreme god Odin; translation of late Latin *Veneris dies* "day of Venus", Frigga being the equivalent of the Roman goddess of love, Venus. It corresponds to the Dutch word *vrijdag* and German one *Freitag*.

Saturday: day of Saturn (from the Latin *Saturnus dies*). Old English Sætern(es) dæg, translation of Latin *Saturni dies* "day of Saturn".

Sunday: the day of the Lord Old English Sunnandæg "day of the Sun", translation of Latin *dies solis*.

The French, Spanish and Italian languages mostly keep the link to planet names, e.g. *Lundi* (*lune*), *Mardi* (Mars), *Mercredi* (*Mercure*), *Jeudi* (Jupiter) and *Vendredi* (Venus) with the exception of *Samedi*, i.e. the Sabbath day, and *Dimanche*, the Lord's day (originally *dies Solis* day of the Sun). Christians in order to fight against the effects of paganism decided that the day of the Sun should become the day of the Lord (*diedomenicu*, in memory of the resurrection). The Catholic Church also succeeded in eliminating the day of Saturn, substituting the Sabbath day that among the Jews is dedicated to rest. The French modern *Samedi* is simply a distortion of the popular Latin *sambatidies*. This is why Saturday and Sunday interrupt the sequence of the luminaries which we find intact in English and in German.

The order of the days of the week can feel surprising. Why Tuesday after Monday, why Mars after the Moon? From Sunday to Saturday through the other days of the week, do we go from the brightest to the faintest body? Certainly not, nor from the biggest to the smallest. Nor does the sequence reflect apparent size or speed.

We know that the Greeks organised their planets according to the presumed order of decreasing distances between the celestial vault and the Earth that was placed at the centre of the world: Saturn, Jupiter, Mars, Sun, Venus, Mercury and Moon.

The Egyptians adopted this order, but shifted by three (Sun to Moon, then Moon to Mars, then Mars to Mercury, etc.), in agreement with their religious beliefs. We suggest that for fun, you continue the exercise! to arrive at the sequence we know well, Sun, Moon, Mars, Mercury, Jupiter, Venus and Saturn, later on adopted by the Romans.

Nap Time

The Romans had the idea of introducing sundials on which they divided the day into 12 hours of equal duration, between sunrise and sunset. The days being shorter in winter than in summer caused variations in the duration of Roman hours during the year. Noon (mi-dies: half day), the hottest hour of the day, was called the sixth hour. The Spaniards considered it very suitable for resting, for taking a "siesta" (literally *hora sexta*: sixth hour).

Correction to: StarWords: The Celestial Roots of Modern Language

Correction to: Chapters 3 and 4 in: D. Kunth, E. Terlevich, *StarWords*, Springer Praxis Books, https://doi.org/10.1007/978-3-031-49024-8

The original version of this book was inadvertently published with a few errors in Chapters 3 and 4. The figure captions in these chapters have now been updated with the copyright information as follows.

The updated version of these chapters can be found at
https://doi.org/10.1007/978-3-031-49024-8_3
https://doi.org/10.1007/978-3-031-49024-8_4

D. Kunth, E. Terlevich, *StarWords*, Springer Praxis Books,
https://doi.org/10.1007/978-3-031-49024-8_11

Figure in Page 31 bottom

***Ciel no 20, Cygnus nebula*. 1979. Oil and metal with bullet impacts 214 × 151 cm. Free interpretation of the artist showing the Cygnus nebula, a remnant of a stellar explosion. Jacques Monory (1924–2018), © 2023, ProLitteris, Zurich**

Figure in Page 39 bottom

Ciel no 2, Nebula in the Milky Way, **1978. Oil 150 × 150 cm. Free interpretation of the artist showing a complex of gas, stars and dust in the Milky Way. Jacques Monory (1924–2018), © 2023, ProLitteris, Zurich.**

Figure in Page 64 top

Ciel n0 16. **The centre of our Galaxy. 1979. The centre of the Milky Way is located by a box. In this location lies the black hole that has been recently discovered. Oil 250 × 400 cm, Collection MAC VAL Musée d'art contemporain du Val de Marne. Jacques Monory (1924–2018), © 2023, ProLitteris, Zurich.**

Epilogue

There are more stars than grains of sand...

The sky certainly fascinates us but why this infatuation with an inaccessible and inhospitable place?

Consider this: stars are burning, Venus is poisoning, Mars is unbreathable and other worlds lie frozen or desolate. The interstellar void is infinite, incredibly cold and dark, and we could only breathe with the help of masks and oxygen tanks, which are heavy and cumbersome.

Should we mention the fascinating black holes sometimes presented as terrifying? They are cosmic maelstroms capable of swallowing anything that comes within their reach, large or small. Mini black holes, introduced into the world of astrophysics and cosmology by Stephen Hawking, were once objects of great concern. The origin of the fear was that even very small ones would be capable of engulfing our planet. A curious and risky alliance between particle physics and science fiction.

Finally, let's count the very high-energy cosmic rays, from which we still don't know how to protect ourselves and which heavily compromise our future trips to the planet Mars or anywhere outside our planet.

But what is hostile fascinates! Anguish can stimulate desire and hell attracts as much as heaven. Crime scenes captivate more than stories with happy endings. Volcanoes are a big seller in travel agencies and who among us has not dreamed of getting dangerously close to a burning crater?

D. Kunth, E. Terlevich, *StarWords*, Springer Praxis Books,
https://doi.org/10.1007/978-3-031-49024-8

Huge universe. We are incredibly small... and we have recently learned how true this is. The planet Earth is a drop of life plunged into the immense cold and sterile Universe and we cling to it conscious of our fragility. One example that strikes us is that of the most remote scientific bases built today in Antarctica on an isolated site called Concordia station, operated by French and Italian scientists. In spite of the many facilities, life is still very trying on a daily basis. The return home is experienced as a great relief when after several months away from their loved ones, the residents hear the rumble of the plane that will take them back to the comfort of modern life. We are riveted to our habitat and have so little latitude in the temperatures and atmospheric pressures we can endure. We are anxious when loneliness catches us by surprise.

This earthly compartmentalisation, however reassuring it may be, may condemn us.

The father of space exploration, Konstantin Tsiolkovsky, said: "The Earth is the cradle of humanity, but you don't live in a cradle forever". Since Icarus, the most adventurous have been asking their dreams to take them beyond the horizon. "The grass is greener elsewhere" and the Universe is the ultimate elsewhere. It is the bottomless pit of our hopes... One day, who knows!

Astronomers now proclaim that our destiny is part of the history of the universe. Life only appeared when the conditions were right. We are composed of atoms born before us, mostly originated in a few stars that are now extinct.

The most astonishing thing, however, is not our smallness, but our isolation. "Are we alone?" is one of the great questions that we ask ourselves, and we will doubtless continue asking it for a long time to come. We have no close neighbours. We can't go knock on their door when we run out of sugar. We have no external enemies. Unfortunately, in their absence, we fight among ourselves.

The stars exalt our spirit. Imagine, even for a moment, what our lives would be like if we only had a dark canopy over our heads? Without these starry points of light, would we have been able to dream of the unattainable? We remain convinced that they are the repository of our dreams and constantly feed our desire to surpass our own limits. Still, our heavenly inspired vocabulary does not contain any word synonymous with fear or anxiety, violence or hatred. Let us meditate on this and rejoice.

Light compensates our inability to cross these vast spaces; it is our only messenger from the cosmos. All that we know, we owe to light, the only link that connects us to the Universe.

The academician Jean d'Ormesson happily notes in his book *C'est une chose étrange à la fin que le monde* (It is a strange thing in the end that the World):

Light. It is what allows the world to be created, to be seen, to be measured, to be understood and explained.

It is thanks to this link and also to the intelligence of men that we measure our place.

That there is a kind of connection between the light of the universe and the lights of the mind is a permanent miracle.

If we can speculate that there are more stars in the sky than grains of sand on Earth, our singularity remains a mystery. If panspermia postulates that life would have followed the celestial way to fertilise Earth, still a very speculative hypothesis, indeed there are still missing without doubt, countless new words to describe the complex mechanisms of our origin.

Glossary

The words described in this book can be found in this section. Others do not appear in the text but their celestial affiliation is obvious.

A

Abri: from the Latin *apricari* "expose to the Sun". The Romans likened it to *aperire*, "to open", in the sense of a place "open to the Sun". The meaning shifted and ended up designating a shelter that protects from the elements.

Alb: from the popular Latin *alba*, feminine of *albus*. White vestment used by priests. Derivatives: hawthorn (French: *aubépine*), *albugo* (white patch on the cornea), albedo, albino, album, albumen albumine. First names: Alba, Alban, Albert.

Albedo: from low Latin albedo, "white substance", derived from *albus* "white", hence Albion. In astronomy, albedo is the quotient of the flux returned by the planet in all directions to the flux of sunlight it receives.

Alfalfa (in French: *luzerne*, a special forage, from Latin *lucerna* "lamp"); forage with a shiny seed.

Almanac: from medieval Latin *almanachus*. It is a transcription of the Arabic *al-manach*, a calendar with astronomical and meteorological observations.

Altaïr: Arabic name *Al nasr al tair* which means "the Eagle in flight". It is the brightest star in the Eagle constellation.

D. Kunth, E. Terlevich, *StarWords*, Springer Praxis Books,
https://doi.org/10.1007/978-3-031-49024-8

Annus (the year): from Latin, in the sense of a unit of time. This word originates: anal, *antenais* (yearling), anniversary, annual, annuity, biennial, quinquennial and millennium, more recent. Derivatives: year, light year, sidereal year.

Angel: from the Latin angelus (borrowed from the Greek *angelos*), "messenger". Heavenly being by definition, created by God, as a messenger to mankind. By extension, a gifted person to perfection morally or physically.

August: from the popular Latin *augustus*; it is the name given to this month, until then named *sextilis* (sixth month), in honour of the Roman emperor Augustus. Derived from it: august (grand), augustness (the quality of being noble), the name Augustine.

Apex: Latin word meaning "point". The culmination of one's career. In astronomy, the point in the sky towards which the Sun seems to be heading.

Aphelion: derived from the Latin *aphelium*, composed of the Greek *apo* (far) and *helios* (Sun). The furthest position from the Sun reached by a planet or comet in its orbit.

Apogee: a Renaissance word borrowed from the scientific Latin *apogæum*, which in Ptolemy's system designates the furthest point from the Earth. Figuratively, the highest degree that can be reached when speaking of a feeling, a status or the evolution of a phenomenon.

April: from the Latin *aprilis,* in honour of the goddess Aphrodite.

Apsis or apse: from Latin *apsida*, the point in a planet's orbit where it is at its greatest (also called aphelion) or smallest (perihelion) distance from the Sun. The word has become part of the jargon in astronomical and architectural terminology; more recently, it refers to the extension of a tent.

Arctic: from the Latin *arcticus*, derived from the Greek *arktikos*, adjective from *arktos* "bear". It refers to the Bear, i.e. the Polar Star and, by extension, to the regions close to the North Pole, located under the Big Dipper. Symmetrical to Antarctic, in the Southern Hemisphere, both words are used instead of boreal and austral.

Arcturus: from the Greek *arktos*, "bear", and *ouros*, "guardian", literally "guardian of the Bear". The brightest star in the constellation of Bootes, which can be seen in the extension of the tail of the Big Dipper.

Ascendant: from Latin *ascendens*, rising. Sign of the zodiac that rises to the east on the horizon at the time of one's birth. It has become synonymous with dominant influence (in the ascendant: successful, powerful) and qualifies the authority, empire, hold, charm, fascination, etc. that someone has over others. Also, direct ancestor and most important point of the astrologer's chart with the "solar sign". There are two signs important for the astrologers: the solar

sign (the one defined by the presence of the Sun the day of your birth and the other one, i.e. "ascendant", the rising sign at the time of your birth).

Aster: from the Latin aster, "star". Decorative plant with star-shaped flowers. Derived from: Asteraceae (plant family).

Asteria: from the Latin *asteria*, an iridescent gemstone (a phenomenon called "asterism"). Also the learned name for the starfish is asteroidea.

Asterisk: Latin from Greek *astericus*, "little star". A star-shaped sign.

Asterism: arrangement of stars, constellation (or part of).

Asteroid: in astronomy, a small celestial body circulating between Mars and Jupiter and whose diameter does not exceed 700 kilometres. In zoology, a class of echinoderms whose type is the asteroid: starfish. In medicine, a small white, opaque, star-shaped spot on the transparent cornea.

Astragalus: from ancient Greek *astragalos*. Anatomy: ankle bone; Botany: an herb, used in Chinese medicine.

Astral: from the Latin *astralis*, which relates to the stars, but also astral body: aura, ectoplasm supposed to surround the human body.

Astre: from the Latin *astrum*, "celestial body". A luminous celestial body visible to the naked eye or with an instrument. The name refers to the stars as well as the planets. Figuratively: "beautiful as a star". Used also as hearth or home; and *astrer* or *astrier*, in law, someone belonging to the hearth or home.

Astro-: prefix corresponding to *astre* or aster, forming noun or adjective compounds, mainly in astronomy, biology, botany and zoology. Examples: astrograph, astronef, astrometry, astrophanometer (instrument for measuring the rising and setting of stars), astrophobia (fear of the elements), astroblast (synonym of astrocyte), astrokinetic, astrophore, astrophyllite (crystalline opaque stone with concretions in the shape of stars), astrostatic, etc. Some are explained below.

Astrocyte: composed of the prefix astro- (because of the radiating ramifications of these cells) and the suffix -cyte. A cell of the grey matter of the nervous systems which has very numerous and radiating ramifications.

Astrolabe: from the Greek *astrolabium*, "star catcher". An ancient instrument used to measure the height of a star above the horizon to determine its location.

Astronaut: a person who travels in a space vehicle outside the Earth's atmosphere.

Astronautics: originally, practical astronomy used in navigation; the science of studying and performing space navigation.

Astronomical: relating to astronomy. Figuratively: enormous (astronomical numbers, astronomical prices). Out of proportion.

Atlas: from the name of a character in Greek mythology who carried the vault of heaven on his shoulders. Collection of maps.

Aubade: a concert given in the morning under the window of a person, usually a woman or a young girl. A morning love song.

Aurora: from the Latin *aurora*. Name given by the Romans to the goddess of dawn. The moment following dawn and preceding sunrise. By extension: symbol of hope, renewal, purity.

Austral: from the Latin *australis*. That which is south of the globe. The name of the continent Australia is derived from this.

Azimuth: from the Arabic *ar-samt*, "the path". Angle formed by the vertical plane of a star and the meridian. In all azimuths means figuratively speaking: in all directions. Azimuth thruster in shipbuilding is a propeller that can be rotated horizontally.

B

Betelgeuse: brightest star in the constellation Orion. Name of Arabic origin *ibt al-ghül*, meaning "the shoulder of the giant" or perhaps, due to mis transliteration, "the arm of the giant" (Orion) as opposed to "the hand of the giant".

Beyond: another world, inaccessible in our daily experience, hell or paradise according to beliefs.

Big Bang: English name meaning "big explosion". Introduced as an irony by the English astrophysicist Fred Hoyle, it refers to the event of the origin of the universe. Figuratively: an event that causes a real upheaval.

Bissextile: from Latin *bisextilis* from *bi* and *sextus*, sixth. Year of 366 days, the extra day being February 29 (it is called leap year).

Black hole: when not associated with alcohol abuse, it is a celestial body whose gravitational field is so intense that even light cannot escape. Figuratively speaking: a dark, invisible world.

C

Calendar: from the Latin *calendarium*, firstly "register where accounts were recorded".

Calende: the first day of the month in the Roman calendar, when debtors had to pay their debts. The Greeks, on the other hand, opted for a method of counting time without calendars. The emperor Augustus was the first to introduce the non-existent Greek calendars to refer to the more than hypothetical

date of repayment of insolvent debtors! To postpone to the Greek calendars means to postpone to a date that does not exist, and therefore will never arrive!

Canicula: from the Latin *canicula,* diminutive of *canis,* "little bitch", adapted from the Greek for the star Sirius (Orion's dog). By metonymy, a period of great heat during which this star rose slightly before the Sun (heliacal rising!). We find this link in English, where the days during a heat wave are called "dog days" and in Russian kaniculy depicts holidays.

Celesta: musical instrument resembling an upright piano that produces a very soft sound that evokes celestial harmony.

Celestial: from the Latin *caelestis*, which concerns the sky: celestial music, celestial vault, celestial vision, etc. The Celestial Empire is also the name given to the Chinese Empire.

Celestine: Celestines are a religious order founded by Pope Celestine (5th century).

Celestine: mineral composed of natural strontium sulphate, whose name is inspired by the Latin *caelestis*, celestial, alluding to the colour of its first samples.

Cereal: from Ceres, Roman goddess of agriculture and harvest. Ceres is an asteroid (see below) in the Solar System.

Ceres: the smallest dwarf planet in the Solar System. Located in the asteroid belt between Mars and Jupiter. Named after Ceres, the patron goddess of Sicily, where Piazzi, the astronomer who discovered it, was from. Derivatives: cereal, cereal growing.

Chaos: in mythology, an immense undifferentiated space pre-existing all things, and notably light. The Latin poet Ovid in the Metamorphoses describes the birth of the world from the original Chaos to the apotheosis of Julius Caesar.

Circadian: from the Latin circa (around, about) and diem (day); said of a rhythm that groups biological processes whose period is about 24 hours.

Ceiling: from Middle English to conceal, to cover, probably derived from Latin *caelum*: heaven, sky.

Comet: from the Greek *kometes*, "hairy". Small icy celestial body with a luminous trail, a few kilometres in diameter, orbiting the Sun generally in a very elliptical orbit. By metaphor: narrow, satiny ribbon used as a trim in lingerie; headband in bookbinding, long-tailed pheasant for poachers... Derived from: cometary, concerning comets.

Consider: from the Latin *cum*, "with", and *sidus, sideris*, "star". Pertaining to the contemplation of the stars; to look carefully at one thing in itself or in its relation to another. To make a case of. Derived: consideration, unconsider

Constellar: from *constellatio*. To scatter with stars, bright things. By extension: to scatter, to spangle.

Constellation: from Latin *constellatio*, derived from *stella* "star". A group of stars that appear close to each other in the sky to which a particular name has been given. Figurative: a group of objects or illustrious or learned persons.

Cosmetic: from the ancient Greek *kosmetikè*, derived from kosmos (order). Beauty products. Part of hygiene that deals with beauty.

Cosmic: having to do with the Universe. Figuratively speaking: which is of the dimensions of the Universe (e.g. an event of cosmic proportions).

Cosmogony: account of the formation of the universe. Genesis is a cosmogony.

Cosmology: the science of the formation and evolution of the universe through the natural laws of physics.

Cosmonaut: from the Greek words *kosmos*, "universe", and *nautes*, "navigator". Pilot or passenger of a space shuttle (specifically used by the Russians).

Cosmopolitanism: cosmopolitanism is a concept defined by Diogenes, from *cosmos*, the universe, and *polites*, citizen. It expresses the possibility of being a native of a place and touching universality, without denying one's particularity.

Cosmos: from *kosmos*, "ordered world" in Greek. Refers to the universe as a whole, which has order, as opposed to chaos. Plants of the genus *Cosmos*.

Crescent: which develops gradually whether under the effect of external factors or not. Piece of disc concave on one side and convex on the other like the phases of the Moon. By extension: croissant (pastry).

Cuddle: formerly, said of animals that rest in the shade during the heat. Today, to participate in lovemaking. To embrace.

D

Day: duration (time interval between sunrise and sunset). Light ("it is daytime"). Later generalised as 24 hours. Derivatives: daily, days of the week.

Decan: in astrology, a decan is one of three subdivisions of a sign, lasting 10 days. From late Latin *decanus*, chief of ten. Dean derives from it.

December: from the Latin *december* (from *decem*, ten) because it was the tenth month of the ancient Roman calendar that started in March.

Decline: to move away from the equator. To move away from a given direction. Figuratively: to lean towards the end. Also, to reject an offer. Derived from: declination.

Deity: from the Latin *deus*, itself derived from the Indo-European root *deiwos*, "light" of the sky, of the day.

Disaster: from Italian *disastro*, derived from astro "star" and dis with a pejorative value (bad star). A disastrous event, a great misfortune or the effects resulting from it.

Desire: deverbal of desire. Aspiration to, wish. To desire: from the Latin *desidesare* composed of *de*, "absence", and *sidus*, "star", on the model of considerare (to consider). In the sense of "to cease to contemplate the star", "to note the absence" implying a strong feeling of regret. Figuratively, to seek to obtain, to wish.

Diurnal: from the classical Latin *diurnus*, "of day, which is done every day". That which is accomplished during the day.

E

Eccentricity: from medieval Latin *eccentricus,* "outside the centre". Ratio between the separation of the two foci of the ellipse and the length of the major axis. Figuratively speaking: a way of behaving that deviates from the norm. An act that reveals an eccentric way of being.

Eclipse: the disappearance of a star as it passes through the shadow or penumbra of another star or planet. By extension: that appears and disappears intermittently, or due to the brilliancy of something or someone else.

Ecliptic: large circle on the celestial sphere representing the annual path of the Sun as seen from Earth. Plane of the Earth's orbit around the Sun.

Elucubration: from Latin *elucubrare,* to work by the light of the lamp. To work out something by careful study (during all night). By extension: unreasonable, extravagant conclusion.

Ellipticity: measure of the flatness of an ellipse. It is between the values 0 and 1, the first case corresponding to a circle and the second to an infinitely elongated ellipse, i.e. a segment of a straight line.

Empyrean (or Champs-Elysées): the highest part of the sky inhabited by gods and heroes.

Ephemeris: from the Greek *eph hêmera*, "on the day". A book giving the position of celestial objects for a year.

Equinox: from Latin *æquinoctium*, from *æquus* ("equal") and *nox* ("night"); each of the two times of the year when day and night have equal duration.

Estelle: first name from the Occitan *estela*, itself from the Latin *stella*, "star".

Ether: originally the primordial God of Greek mythology. Aristotle used the term "Aether" to designate a supposed fifth element, making up the celestial sphere, which was opposed to the other four, Earth, Water, Fire and Air. Reintroduced in the 19th century to explain the propagation of light, it was

supposed to fill the void in the universe. Its existence was refuted by the experiment of Michelson and Morley and then by Einstein in the context of the theory of special relativity in 1905. The ether reappeared in the 21st century, in a different form, to account for the properties of the cosmic vacuum. It remains a subject of debate. Also a highly volatile compound formerly used as an anaesthetic.

Evening: from Old English *æfnung* "the coming of evening, sunset, time around sunset", verbal noun from *æfnian* "become evening, grow towards evening", from *æfen* "evening" (see eve). As a synonym of even in the sense "time from sunset to bedtime".

Exoplanet: a planet orbiting a star other than the Sun.

F

Facula: from Latin *facula,* "little torch". Bright part of the solar disc.

February: from the Latin name of the month *februarius,* itself derived from the verb *februare* meaning "to purify". Originally, the Roman calendar consisted of 10 months, totalling 304 days; the 61 days of winter were not part of any month. Around 713 BC, King Numa Pompilius added the months of January and February, extending the year to 365 days.

Firmament: From the Latin *firmamentum,* "support". Vault of heaven perceived as the "firm" part of the sky.

Flu: from the Latin *influere*, "to influence". Anglo-American name for influenza. In Italian: influenza.

G

Galaxy: borrowed from the Latin g*alaxias*, itself borrowed from the Greek *galaktikos* "milky". Initially, it referred to the Milky Way (this is still true, when Galaxy is written with a capital letter); nowadays, it designates vast groups of stars, dust and gas whose cohesion is maintained by gravitation. By metaphor, it is used to name large ensembles (information galaxy, Gutenberg galaxy, etc.).

Galaxite: name of a microcline, mineral of the group of silicates. For esotericism, it symbolically represents the galaxy and would have presumed links with the planets of the Solar System.

Gravid: from Latin *gravis,* "heavy". A pregnant woman.

Gravitation: the force of attraction that all bodies with mass exert on each other. This force is described by Newton's laws.

Gravity: the phenomenon that draws a body towards the centre of the earth. Figuratively, serious or heavy is grave. Said of a sound or voice of low frequency.

H

Half-moon: in Architecture: shapes like a half-circle. The base of the nails, also called lunula.

Helianth: from the Greek *helios*, "Sun", and *anthos,* "flower". A family of flowers with large yellow heads often compared to Suns (sunflowers and Jerusalem artichokes are helianths).

Heliocentrism: a system that places the Sun at the centre of the Universe, as opposed to geocentrism (which places the Earth at the centre).

Helios: god of the Sun in Greek mythology. Element used in the construction of many learned words: heliogram, heliogen, heliophile, heliophobe, heliochromia, heliotype, heliopathy, heliograph, heliosensitivity, heliophobia, heliothalassotherapy, heliocomet, heliostation, heliotrope, etc.

Helium: The scientists Joseph Lockyer, Georges Rayet, C.T. Haig, Norman Pogson and John Herschel detected this element during a solar eclipse in 1868. It was named after the Greek word for the Sun helios. A simple, very light element; it is an inert noble gas. It was subsequently confirmed by the French astronomer Jules Janssen who is often credited with detecting the element jointly with Lockyer.

Horoscope: from the Latin *horoscopus,* in turn from the Greek *hora* and *skopein* "to examine the time". Analysis by astrologers of the astral chart at the time of an individual's birth.

Horizon: from Latin *horizon -ontis.* Astronomical term and limit of the view. A circular line where the earth and sky seem to meet. Figuratively speaking, it extends to a line of thought or activity. Derivatives: horizon line, blue horizon, new horizon, horizontal, etc.

I

Illuminate (to): to light up, to clarify; borrowed from the Latin *vulgar alluminare*, derived from *luminare*, itself derived from lumen, "light". In the same family: luminary, lamplighter, lighter.

Influence: from Latin *influentia* "action of the stars on the destiny of men". By extension, it designates the continuous and prolonged action in time (emanating from objects, physical or moral persons, etc.) which is exerted on things, persons, ideas...

Influenza: old word borrowed from Italian. From the presumed action of the stars on health, designates the flu.

J

January: from the Latin *januarius*, month named after Janus, Roman god of apertures. First month of the Gregorian and Julian calendars.

Joubarbe (hayleek): from the Latin *jovibarba*, "Jupiter's beard"; succulent plant, with hairy stems, reddish and furnished with leaves, whose shape evokes that of an artichoke and whose most common species usually grows on old roofs and walls. In ancient times, superstition attributed to it the power to ward off lightning and thunder, hence its association with the god Jupiter.

Journal: formed on *jorn*, from Latin *diurnalis* "day". Pertaining to each day, daily news bulletin.

Jovial: derived from *Jovis*, Jupiter. One who is cheerful, prone to laughter, good-humoured.

July: Roman senators renamed Quintilius, the fifth month of the Roman year, to Iulius to pay tribute to Julius Caesar after the promulgation of the so-called leap year.

June: from the Latin *junius*. Name probably given in honour of the Roman goddess Juno.

Jupiter: the largest planet in the Solar System is named after the Roman god Jupiter. In botany: Jupiter flower, Jupiter helmet. Derivatives: jovial pills (tin salt), jovibarba (houseleek), jovial.

K

Kamikaze: Japanese word composed of *kami*, "divine" and *kaze*, "wind". Originally refers to two storms that destroyed the invading Mongol fleet in 1274 and 1281, and at the end of the Second World War took on the meaning of "suicide mission pilot", as well as the aforementioned aircraft.

Kaniculy: Russian word, meaning holiday and derived from "canicule", period of great heat (see canicule).

L

Leuk: old Indo-European root for the act of "shining" found intact in the Greek root *leukos* (i.e. white) from which leucocytes (white blood cells) and leukaemia, leukoma or leucorrhoea are derived. It is also the origin of the Latin roots lux, lumen, lustrum and luna.

Levant: derived from Latin *levare*, used adjectively to refer to a star that rises, especially the Sun. Former name of the Japanese empire: Empire of the Rising Sun. East wind. The Levant (with capital l) refers to the countries along the Mediterranean coast, especially those East of Italy. Derived from: levantin (native of the Levant).

Light: from the Indo-European *leuk,* meaning light, from which are derived lux, lumen and luna, which gave rise to their respective word families. Makes visible the things that surround us. Derived forms: light year, light cover (artillery term), century of light. Ashen light: light from the Earth reflected by the Moon.

Lucifer: proper name meaning "Light Bearer". One of the names given to the planet Venus by the Romans. In the Bible, he is Satan, the archangel fallen for defying God.

Lucubration: from Latin *elucubrare,* to work by the light of the lamp. To work out something by careful study (during all night). By extension: unreasonable, extravagant conclusion. Now obsolete.

Luire: glow in English. The French word translates from the Latin *lucere*, to shine, derived from lux "light". Figuratively, "to be apparent", to manifest with brilliance. Words derived from *luire*: *luisant* (glowing), *ver luisant* (glow worm), *reluire*, *lueur* (glow, also used in many metaphors such as *lueur d'esprit*: glimmer of mind). French slang: *luisard* (the Sun), *le luisant* (the day).

Lumen: Latin root of light, is a unit of measurement. Derivatives: luminous flux, light up, luminescent, illuminated, illumination, illustration.

Lumignon: from lumen. Refers to a small, pale lamp or a small piece of candle.

Luminary: borrowed from Christian Latin *luminare*. Originally meant "star" (especially both the Moon and the Sun). Designates a lighting device and lamps or candles used in Christian worship. It also refers to a person that is bright, influential in their field. Derived from: luminarist or luminist.

Luminous: borrowed from Latin *luminosus*, "bright", "remarkable". Luminous sign, luminous explanation. Derivatives: luminosity, luminescent, luminescence, photoluminescence, electroluminescence, luminance.

Luna: Latin root for light. Derived from: lunation, Monday, lunette, lunula, half-moon.

Lunation: interval of time between two new moons.

Lunatic: mad, madness, lunatic asylum.

Lunula: from Latin *lunula*, "small moon, small crescent". Used in anatomy, liturgy, geometry, zoological description. Inner edge of nails.

Lunette: originally a diminutive of Moon. Optical instrument (it is a refractor) intended to magnify distant objects (astronomical lunette, lunette of approach). Also designates a round opening (in a window, a roof). Lunette of water closets, back of a car, a ring fixed to a vehicle, by which it can be towed.

Lustre (French word) (candlestick): from the Italian *lustro*, "light", "brightness". A decorative lighting fixture. By metaphor, it is said of what has relief, brilliance. The origin of lustre as a unit of time worth 5 years is a false friend. Derived from: lustre, lustrer, lustrine.

Lustrum: Latin root of light. Derivatives: lustre, lustrer, lustrine, illustrate, illustrissimi.

Lux: derived from the Latin root of light. Derivatives: Luce, Lucette, Lucie, Lucien, Lucifer, Lucille, lucid, lucidity, elucidate, lucubration, luciole, luire, glow: lueur. Lux is also a unit of measurement of illumination that has had difficulty gaining public acceptance. Illuminance is measured with a lux meter.

M

Malotru: This curious word is only used in French and related to the Latin male *astracus*, "ill-born", "puny", "born under a bad star". Today, a person with bad manners and morals.

Mars: ancient Italic deity identified with the Greek god Ares. Fourth planet of the Solar System. Derivatives: martial, Martian, March saffron, March dye.

March: from Latin *martius* (*mensis*), "month of the god Mars", third month of the Gregorian year. Diurnal butterfly.

Martial: from the Latin *martialis*, "of Mars", the Roman god of war. Denotes a warlike character. Related to fighting and war. Also, a surname and a first name.

Martian: presumed inhabitants of the planet Mars.

May: from Latin *maius mensis*, "the month of May", from the name of Maia, an Italic deity, daughter of Faunus and wife of Vulcan. Name of the fifth month of the Gregorian or Julian calendar. By extension: general protest movement "to know a new May", by reference to the events of May 1968 (not in English).

Menstrua: from Latin *menstrua*, plural of *menstruum* ("month, period of a month"), from *mensis* ("month"). An old word that designates the bloody effusion to which women are subject every month. Derived: menstrual cycle.

Merchant: from the Latin *mercator,* of the same origin as *Mercurius* alias Mercury. An older form *merx,* of unknown etymology, could have an Etruscan origin. Person who trades. Derivatives: market, mercantile, mercenary, mercurial: trade.

Merci: derived from *merces,* "favour", which itself comes from *merx*, as does merchant, merchandise and the fast-moving planet Mercury.

Mercurial: fickle. Term which designated in the history of France the general assembly of the chambers of a Parliament convened every 15 days on Wednesday (day of Mercury). The president denounced abuses in the administration of justice. By extension, *engueulade*. Also, plants known under two species, of undergrowth or gardens, whose seeds are disseminated by ants and the shoes of gardeners ... which according to some sources would explain the origin of the name (Mercury, god with winged feet, is the god of trade and travellers). A free distributed revision control tool for software developers.

Mercury: first planet from the Sun. From Mercurius, Roman god of merchants and messenger god with winged feet, in connection with the mobility of this liquid metal (quicksilver). Derivatives: mercury of the philosophers, mercurial and the name of newspapers such as *Mercure de France*, *Mercure Galant* and *El Mercurio*, a daily newspaper of the national press of Chile.

Mercury of the philosophers: main ingredient of the "philosopher's stone".

Meridian: from Latin *meridianus*, noon, middle of the day. Derived from: meridional.

Meteor: luminous trail visible during the re-entry into the Earth's atmosphere of bodies from space, also called shooting stars. Airborne meteors are related to atmospheric phenomena. By metaphor, it is said of a dazzling but temporary phenomenon. Derived from: meteorite, a solid body from the interplanetary medium that reaches the Earth's surface.

Milky Way: a long, whitish ribbon of stars and dust that stretches across the night sky. It is our Galaxy seen on edge.

Monday: from the popular Latin *Lunis dies*, "day of the moon".

Month: from the Latin *mensis*. Its original meaning is that of the lunar month. *Mensis* is linked to an Indo-European root

Moon: as used in English is derived from the Greek *men* (from Proto-Germanic: this word designated the star, the associated divinity, the lunar month in the 17th century), meaning to measure: the moon was the star that allowed us to measure time. Derivatives: menstruation, menopause, monthly, honeymoon, moonstone: opalescent stone that evokes the clarity of the Moon,

moonfish, water-moon, mooning, etc.… In French the Latin *luna* means "the luminous one". French derivatives are *lunation*, *demi-lune*, *luni-solar*, *alunir* and *alunissage*: to land on the moon, lunar, sublunar, semi-lunar, lunatic (whimsical), *luné* (good or bad mood), *lunians* (inhabitants of the Moon).

Morning: from the Latin *matutinum*, adjective from *matutinum tempus*, "morning time". The beginning of the day announced by the rising of the Sun. As a metaphor: beginning, start.

N

Nadir: word of Arabic origin meaning "opposite". It is the direction opposite to the Zenith.

Nebula: from Latin *nebulosus,* "where there are mists". In astronomy, it refers to a star with a blurred appearance. Figuratively, something that is obscure, difficult to understand. Derivatives: nebular, nebulous, nebulosity, nebulium (chemical element introduced by W. Huggins to explain the spectrum of nebulae and which turned out to be doubly ionised oxygen).

Neptunium: from the planet Neptune. Chemical and radioactive element that follows uranium in the periodic table, as Neptune follows Uranus.

Night: from Latin *noctem*, *nox*, *noctis* in the sense of darkness and duration as opposed to day.

Nocturnal: from Latin *nocturnus*, "of the night", which acts at night, as opposed to *diurnus* "diurnal", of the day.

Noon: middle of the day.

November: Latin, the ninth month of the Roman year as the Roman calendar began in March.

Nyctalopia: from Greek *nyctalops*, "night blindness". Curiously, it has also taken the opposite meaning of one who has the ability to see well in the dark or at night.

O

Observatory: an establishment or building designed to study the sky and stars. Figurative: a place from which to observe, an observation post.

Occident: from Latin *occidens*, present participle of the verb *occidere*, composed of *ob* (object) and *cadere* (to fall). Means to fall to the ground, to succumb and when speaking of a celestial object, to "set". It refers to the cardinal point where the Sun sets. From the 12th century, it refers to the whole

western portion of the Earth when spelled with a capital letter. Derivatives: occidental, occidentalism.

October: originally eighth month of the Roman year which started in March.

Orbit: from Latin *orbita,* "trace of a wheel", used in astronomy in the 18th century to designate the path of a planet, and in the 20th century also the closed trajectory of an artificial satellite. Used metaphorically and figuratively. Derived forms: orbital, orbiting.

Orient: from Latin *oriens*, one of the four cardinal points, present participle of *orire*, "to rise", especially in relation to a star. The Orient is the geographic region corresponding to the place where the Sun rises. By extension, the countries around the Eastern Mediterranean. Derivatives: Far East, orient, oriental, etc.

P

Palladium: a rare chemical element of the platinum group, named after the asteroid Pallas discovered 1 year earlier.

Panspermia: from the Greek *pan*, all, and *sperm*, seed. A scientific theory that asserts that the Earth was impregnated from the outside, by extraterrestrial means.

Parasol: from *para*, against, and *sole*, Sun. A portable device to shield the Sun (when used to protect from the rain, it is called an umbrella).

Pentacrine (echinoderm) that lives at the bottom of the sea. The star-shaped fossil is a segment of the animal's body.

Perigee: from Greek *peri*, "around", and *gaia* "earth". The point of an Earth orbiter closest to the Earth. Figuratively speaking: the highest degree!

Perihelion: from ancient Greek *peri*, "around", and *helios*, "Sun". The point in its orbit where an object is closest to the Sun.

Phosphorus: from the Greek *phos*, "light", and *phoros*, "carrier", literally "carrier of light". A chemical element with the symbol P; white phosphorus emits light when exposed to air. Derivatives: phosphor, phosphoric, phosphorescent.

Planet: from the Latin *planeta*, "wandering star", as opposed to the apparently fixed stars. The word is derived from *planasthai,* "to wander here and there", to stray from the path. A non-luminous celestial body orbiting the Sun. Figuratively, a particular world, a particular domain, a strange behaviour (to inhabit another planet, to come from another planet). Derived: planetoid, planetologist, planetology.

Planetarium: From modern Latin, designates the dome and the auditorium of a sort of "cinema" where one can attend shows representing a theme directly related to astronomy, thanks to a projection device called the "planetarium", designed to represent the starry vault, the constellations, the movement of planets in the sky.

Planetary: relating to the planets. Extending to the whole planet. On the scale of the planet, a phenomenon that extends to the whole world. In mechanics, it refers to the bevel gears of a gearbox differential allowing the wheels of a car to adjust their speed when turning a corner. Projection apparatus for planetariums. A projection system designed to show the movement of stars and planets on a dome.

Pleiades: group of seven stars which constitute a small cluster grouped in the constellation of Taurus and very clear on winter nights. Name given to a group of seven French poets of the 16th century. Derivative: a pleiad, a large quantity (ask a pleiad of questions).

Plutonium: after the planet Pluto, follows neptunium in the periodic table of elements. Plutonium is a very dense heavy metal produced in nuclear reactors.

Precession: from Latin *praecessio,* "action of preceding"; used in astronomy to designate the movement of the Earth's axis of rotation around a mean position.

Pulsar: short for pulsating radio source. Name given to compact stars that are subject to regular and very rapid pulsations with periods ranging from a millisecond to a few tens of seconds. These remnants of the explosion of very massive stars are "neutron stars". The name is used for a watch brand marketed by the Japanese firm Seiko.

Q

Quasar: contraction of quasi-stellar radio source. An important class of active galaxies, extremely luminous because of the activity at their centre, due to the presence of a very massive black hole.

Quintessence: from the Latin *quinta,* feminine of *quintus,* "fifth" and *essentia*, "essence, substance". Aristotle so called the ether (see this word). By extension: the most concentrated or subtle form of a substance or idea. Notion reintroduced in modern cosmology.

R

Rainbow: (*arc-en-ciel* in French) taken from the Latin *coelestis arcus*. Refers to the colourful arc that originates after the rain in the atmosphere when it is illuminated by the Sun. It is used in expressions such as "to go through all the colours of the rainbow" (under the effect of emotions), to designate iridescent fish (rainbow trout) or as an adjective of colour (rainbow shirt). According to some, it symbolises the alliance of Earth and Heaven.

Revolution: during an orbital movement, a celestial body has made a revolution when it returns to the same point of its orbit. By analogy, the sudden overthrow of the political regime of a nation, of the government of a state, by a popular movement... without any intention of return! In astronomy: sidereal revolution. Derived: revolutionary.

S

Saffron: iron oxide. "Saffron of Mars at the Dew", iron filings exposed to the dew... Saffron is also the part of a boat rudder. The origin of the term remains obscure, possibly from alchemy.

Saturday: the sixth day of the legal week, from the Low Latin *Sambati dies*, a variant of Greek origin of *Sabati dies*, meaning "Sabbath day". Also, Saturn day.

Saturn water (an old recipe used by astrologers practising medicine): if water has recently been found on Saturn, the so-called "Saturn water", composed of lead acetate, was highly prized by astrological doctors in the Middle Ages.

Satellite: from Latin *satelles*, "bodyguard, soldier" or "companion, servant, auxiliary, accomplice". Formerly: man attached to the service of another whom he escorts and to whom he serves as bodyguard. Astronomy: celestial body orbiting around another to which it is linked by gravitation and which it accompanies in its revolution. By analogy: nation, country politically or administratively dependent on another. Artificial satellite: body placed by humans in orbit around another one.

Saturn: the sixth planet of the Solar System is named after the Roman god Saturn (Cronos in Greek). Derivatives: Saturday, saturnalia (preceding Christmas celebrations), saturnism, salt of Saturn, Saturnin.

Saturnism (lead poisoning): name of the disease corresponding to an acute or chronic intoxication with lead or lead salts. Named after the planet Saturn, symbol of lead in alchemy.

Saturn salt: combination of vinegar acid with lead, when this combination is solid; Saturn extract: this same combination, when it has the consistency of syrup; and Saturn vinegar, when it is liquid. Lead acetate. The ancient Romans boiled "sour wine" in lead vessels to produce a sweet tasting syrup called *sapa*, rich in lead acetate, which caused lead poisonings in the Roman aristocracy.

Season: from Latin *sationem*, accusative of *satio* "action of sowing, planting, favourable season for doing something". The 3-month period between an equinox and a solstice, whose climatic alternation during the year is caused by the inclination of the polar axis to the plane of the earth's orbit. Derived expression: to season.

Seasoning: in the 15th century, "to conduct the cultivation and use of the earth according to the seasons". Later: to add (e.g. spices) to a dish in order to enhance its flavour.

Selenites: from *Selene,* goddess of the moon among the Greeks. Name formerly given to the presumed inhabitants of the moon.

Selenium: name derived from Selene (the Moon). Light-sensitive semiconductor element discovered in the same ore as tellurium (from the Latin *tellus*: earth) and linked to it as are the Earth and the Moon.

September: from the Latin *september* (*septem* for seven). The seventh month of the ancient Roman year, beginning in March.

Septentrion: from the Latin *septentrio,* formed from *septem*, "seven", and *trionis*, "oxen", "seven oxen of labour". Name of the constellation later called the Great Bear. By extension: north wind, north pole, northern regions. Septentrion competes with the Chariot, just as septentrional competes with Nordic.

Septentrional: located in the north (see septentrion).

Serenade: from the Latin *serenus,* first to express a serene weather, a serene night, then a concert given in the evening under the windows of a person one wants to enamour.

Shepherd's star: this is not a star, but the planet Venus, so named because it is very easily visible in the morning just before sunrise, and in the evening just after sunset.

Sidereal: relating to the stars. We speak of sidereal year, sidereal hour, sidereal day, sidereal clock, sidereal revolution, sidereal time and sidereal light. Sidereal plants have the property of taking nitrogen from the air, thanks to the Sun, and fixing it on their roots, which are used for fertilising the soil (sideration).

Siderate: from Latin *siderari,* "to suffer the harmful influence of the stars". To cause someone to lose consideration or esteem. To greatly surprise someone. To strike violently (obsolete).

Sideration: borrowed from the Latin *sideratio*, "disastrous action of the stars; insolation". In astrology, sudden influence exerted by a star on a person. Used in medicine to describe a sudden paralysis of a part of the body.

Sirius: the brightest star of the constellation of the Great Dog. The brightest in the sky. Figuratively speaking: the "Sirius point of view" consists in keeping a certain distance from worldly matters.

Sky: from proto-Indo-European *keu* (to cover, to conceal): undefined space in which the stars move... The sky is used as a metaphor in many expressions: mine sky, quarry sky, bed sky, my husband sky, storm sky, sky roads, sky switch, sky strike, from Earth to heaven (but not the other way round!), fall from heaven, come from heaven, Earth, sky cross on guard (fencing term), praise the sky, pray to the sky, be in heaven or go to heaven (to be dead or to die), skyscraper. In the plural, heavens refers to the abode of supernatural powers and gods. In other languages: ciel (French), *himmel* (German), *cielo* (Spanish). Gender: neutral or masculine.

Solstice: from the Latin *solstitium*, from *sol*, "Sun", and *stare*, "to stop". Each of the two periods when the Sun is farthest from the equator and when the night is shortest (summer solstice) or longest (winter solstice).

Spaceship: spacecraft.

Spectrum: the set of colours obtained by breaking down the energy of electromagnetic radiation. The rainbow is a natural spectrum, the one that results from the decomposition of the light of the Sun by water droplets into several coloured fringes.

Spicule: from Latin *spiculum* "bee sting", "point of an arrow", "sunbeam" (derived but transformed from *spicum* "ear"). Jet of matter in the solar chromosphere. Also used in botany and zoology.

Star: from the Latin *stella*. A bright spot in the night sky. In astronomy, stars that produce energy through nuclear reactions or gravitational contraction. Figuratively: sources of light, symbols of the spirit. Also a person who is very famous and talented.

Starfish: echinoderm animal that usually has five arms from a centre and evokes the symbolic shape of a star.

Stella: from classical Latin "star"; visible star that twinkles in the firmament. Used to forge stellar (serves as an adjective for star, but originally referred to a plant with star-shaped flowers like chickweed), *stellio* (star lizard, so named because of the starlike spots on its back), interstellar (between the stars).

Sun: word from the popular Latin *soliculus*, of Indo-European origin. Refers to the star that gives light and heat to the Earth. Derivatives: sunny, solar, solarium, solstice, parasol, solarisation, insolation, sunlit, sunflower, sundew, heliotrope, helium, muscle soleus at the back of the leg, Sun visor.

Sunday: it translates from *dies solis*, the "day of the Sun". Also in German (*Sontag*).

Sunset: the time of day when the Sun sets. The point on the horizon where the Sun disappears. Metaphor: the decline, decadence, end of something or someone.

Sunflower: from the Italian *girasole* "that turns with the Sun". Also called "big Sun", a large annual plant of the Asteraceae family, whose flowers are grouped in a large capitula.

Sunlight: Anglo-American word. "Sunlight", a powerful projector, used in the studio for filming.

T

Taikonaut: from the Chinese *tàikong* "space"; woman or man travelling in space.

Telescope: borrowed from the Latin scholarly *telescopium,* an instrument used for the observation of distant objects. The telescope refers to a cyprinid (a Japanese carp) with protruding eyes. Also telescopefish, a small, deep-sea fish with bizarre telescopic eyes.

Tellurium: from the Latin *Tellus,* Roman goddess of the Earth. Chemical element of the metalloid group. See also selenium.

Thursday: Day of Thor, adapted from the Latin *Jovis dies*, "day of Jupiter". Fourth day of the civil week, fifth day of the Christian, Jewish and Muslim week.

Tincture of Mars: the so-called "astral" tinctures were used in alchemy to act in the "Great Work". Thus, the tincture of Mars was a preparation that was supposed to give all metals the strength of iron. Also the homeopathic remedy obtained from devil's club root (*Oplopanax horridus*) harvested on a Tuesday (Mars-day).

Tohu-bohu: from the Hebrew *tohou oubohun*, meaning chaos before the creation of the world. Today, it refers to a state of disorder, confused noise or tumult.

Tomorrow: "to the morning", on the day immediately following today. Old and middle English contraction of to and morwen.

Tramontana: word from the 13th century (meaning behind the mountains). A Polar Star that was once used as a guide by navigators, before the

discovery of the compass. Refers to the north, then to the wind blowing from the north of the Alps towards the sea. To lose the tramontana: to lose the north.

Tuesday: from Latin *Martis dies* (Martedi), day of Mars, second day of the week, identified with the Germanic Tiw, god of war.

Twilight: atmospheric glow present before sunrise or after sunset. By extension: that which declines, that which is close to disappearing.

U

UFO: unidentified flying object that many people believe they see in the sky, especially since the 1950s.

Universe: all that exists. Grand Universe: fine pulp paper used in stationery for lithography (dimensions 1 m x 1.30 m). By extension, a world in itself.

Urano: element from the Latin *uranos* "vault of heaven" and "veil of the palace", from the Greek *ouranos* "sky". *Ouranos* has no certain etymology and probably means the one who gives rain, who fertilises. Urano was used to form learned words in astronomy: uranology, uranography, or in medicine uranoplasty which designates the surgical restoration of the soft palate, uranoplegia, paralysis of the soft palate.

Uranism: formed either from the Greek *Ouranos*, who was castrated by his son Cronos, or from the Latin *Ourania*, one of the nicknames of Aphrodite. The word refers to male homosexuality as in German. Derivatives: uranian, uranist.

Uranium: radioactive chemical element, symbol U, whose name refers to the discovery of the planet Uranus by William Herschel 8 years earlier (1781).

Uranoscope: derived from *ouranos*, "sky", and *scopein*, "to observe". A fish with eyes directed towards the sky. Astronomical observatory, even a "popular" observatory.

Uranus: planet of the Solar System discovered by W. Herschel in 1781.

Urethra: the outlet of the bladder. Like urinating, this word is said to be distantly related to the Greek word *ouranos*, meaning "sky". The root of these words would go back to the Sanskrit *varsà*, "rain". This verb would therefore have been a euphemism for urination.

Urinate: see urethra.

V

Vault of heaven: the apparent vault of the sky above our heads.

Vega: Brightest (alpha) star in the constellation Lyra. It can be seen near the zenith from the mid-latitudes of the Northern Hemisphere on summer evenings. European Space Agency launcher built in collaboration with the Italian Space Agency, capable of placing a 2-ton payload into a low earth orbit.

Venereal: derived from the Latin Venus, name of the goddess of love. Relating to sexual intercourse, physical love. Mostly used in medicine, referring to sexually transmitted diseases.

Venus: second planet from the Sun and located between Mercury and the Earth. Known as the star of the Shepherd. Derivatives: vespers, vesperal, Venus crystals, Venus hoof. Navel of Venus: very tasty leaf used in salads, round in shape.

Venus crystals: copper acetate.

Vesperal: relating to the sunset, which takes place in the evening.

Vespers: the part of the Divine Office between nones and compline, celebrated in the afternoon or formerly in the evening.

Vespertilion: derives from the Latin *vespertillio*, itself from *vesperalis* ("setting star"). A bat that is seen at night.

W

Waning: decreasing steadily. Qualifies the phase of the Moon, which takes place between the full and the new Moon.

Week: artificially devised with no astronomical basis. Associated with ancient Jews and biblical "creation", 6 days for God's work and a seventh one for resting. Perhaps borrowed from Mesopotamian unit of 7 days (one for recreation) dividing the year. They also named the days after the five then known planets, the Sun and the Moon. Roman names Monday, Saturday and Sunday are retained in English. The other 4 days owe their name to the corresponding gods in Teutonic mythology.

Wednesday: old English *woden*, from Odin, assimilated to the Latin *Mercuris dies*, day of Mercury.

Weekly: old English from Proto-Germanic and old Norse. Reinforced by ancient Jewish 7-day week. Related to the week: every week.

Z

Zenith: word derived by mis-transcription (ni for m) from the Arabic *semt*, "path above the head". A point on the celestial sphere located vertically above an observer's head. Figuratively: highest degree, highest point. An artist at the zenith of their talent; to be at the zenith; to be at the zenith of their reputation.

Zodiac: from the Latin *zodiacus* "circle containing the twelve signs traversed by the Sun" borrowed from the Greek *zoon*, "animal figure, sign of the zodiac". Circular zone of the celestial sphere, above and below the ecliptic, about 18 degrees wide, in which the Sun, Moon and planets seem to move (except for Pluto, which often deviates). Adjective: zodiacal.

Bibliography

Bloch Oscar and von Wartburg Walter, Dictionnaire étymologique de la langue française, Presses universitaires de France, 2008.
Couderc Paul, Le Calendrier, Que Sais-je, PUF, 1993.
Dubois Jean and Dubois-Charlier Françoise, Locutions en français, Aix-en-Provence, 2004.
Festou Michel, Véron Philippe, Ribes Jean-Claude, Les comètes, Mythes et Réalités, Flammarion, 1985.
Frankel Charles, Dernières nouvelles des planètes, Seuil, collection "Science ouverte", 2009.
Guillon J.C. and Kunth Daniel, Chroniques des "Mots du Ciel", Alliage from number 29, 1997.
Kunth Daniel and Zarka Philippe, L'Astrologie est-elle une imposture? CNRS éditions, 2018.
Le Boeuffle André, Astronymy, Burillier, 1996a.
Le Boeuffle André, "Les animaux dans le zodiaque", Alliage n° 28, Fall 1996b, p. 55–60.
Noël Bernard, Le Livre de Coline, Fata Morgana, 1973.
d'Ormesson Jean, It is a strange thing at the end that the world, Robert Laffont, 2010.
Picoche Jacqueline, Dictionnaire étymologique du français, Le Robert, 2009.
Rey Alain, Dictionnaire historique de la langue française, Le Robert, 2011.
Rolland Jean-Claude, Les Grandes Familles de Mots, e-book, 2000.
Sébillot Paul, Le folklore de France : le ciel, la nuit et les esprits de l'air, Imago, 1982.
Verdet Jean-Pierre, Le ciel ordre et désordre, Gallimard, 1987.
Walter Henriette, Des mots sans-culotte, Laffont, 1989.

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https://doi.org/10.1007/978-3-031-49024-8

Characters

Adams, John Couch, 1819–1892, British astronomer. His most famous discovery was the prediction by calculation of the existence and position of the planet Neptune. At the same time, but without either of them knowing it, the same calculations were made by Le Verrier.

Arago, François, 1786–1853, French astronomer, physicist and politician. Director of the Paris Observatory, also an educator and great populariser of science.

Asterix. Comic book character by Goscinny and Uderzo. Small as an asterisk, but he's a reign of terror in the Roman legions.

Bessel, Friedrich Wilhelm, 1784–1846, German astronomer. He established the first measurement of the parallax of the star 61 Cygni, thus giving the first correct estimate of stellar distances (1838).

Bode, Johann Elert, 1747–1826, German astronomer. He calculated the orbit of Uranus and popularised the Titius-Bode law, often called Bode's law, an empirical relationship between the radii of the orbits of the planets of the Solar System.

Boyle, Robert, 1627–1691, Irish physicist. Co-inventor of the air pump, famous for his research on gasses and his polemic with Thomas Hobbes on the existence of the vacuum.

Brahe, Tycho, 1546–1601, Danish astronomer. He compiled a catalogue of 777 stars. His observations of Mars allowed J. Kepler to establish his laws of planetary motion.

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https://doi.org/10.1007/978-3-031-49024-8

Brahic, André, 1942–2016, French astrophysicist. Planetologist, known to the public for having discovered the rings of Neptune as well as its arcs to which he gave the names of Liberty, Equality, Fraternity and Courage.

Cassini, Jean-Dominique, 1625–1712, Italian astronomer and engineer, naturalised French in 1673, first director of the Paris Observatory. He is credited with the discovery of four satellites of Saturn, the main division of Saturn's rings (which bears his name), the rotation periods of Mars and Jupiter and a very accurate map of the Moon.

Chéseaux, Jean-Philippe Loys de, 1718–1751, Swiss astronomer and physicist. Known for proposing a modern version of Olbers' paradox, known as the "Dark Night Paradox".

Copernicus, Nicolaus, 1473–1543, Polish astronomer. Founder of the heliocentric planetary system. We now speak of a Copernican revolution when a new vision frees us from the old dogmas.

Descartes, René, 1596–1650, French mathematician and philosopher. Founder of geometric optics. Contributed a vision of the universe based on the theory of vortices.

Einstein, Albert, 1879–1955, German physicist. Nobel Prize in Physics in 1912. Author of the theory of relativity (special and general). The latter postulates that gravitation is a geometric property and opened the way to cosmology.

Festou, Michel, 1945–2005, French astronomer. Director of the Besançon Observatory. Planetologist and comet specialist.

Galileo, Galileo Galilei, 1564–1642, Italian astronomer and physicist. Founder of modern physics. First user of the telescope in 1609. Discovered the four satellites of Jupiter, the phases of Venus, the craters and seas of the moon and the spots and rotation of the Sun and finally established that the Milky Way is composed of "innumerable stars".

Halley, Edmond, 1656–1742, English astronomer and physicist known for his study of the movement of comets. One of them, very famous, bears his name and reappears every 76 years.

Hawking, Steven, 1942–2018, English theoretical physicist and cosmologist. Known for his contributions to cosmology, quantum gravitation and black holes.

Herschel, Caroline, 1750–1848, German-born British astronomer. Discoverer of several comets. Younger sister and collaborator of William Herschel. First woman to receive salary as a scientist and first woman in England to hold a government position. First woman to publish scientific results in the Philosophical Transactions of the Royal Society. Gold medallist of the Royal Astronomical Society.

Herschel (Sir) William, 1738–1822, English astronomer and musician, discoverer of the planet Uranus.

Hoyle, Fred, 1915–2001, British astronomer. The main critic of the Big Bang theory, to which he opposed a so-called "steady-state" theory. To denigrate the theory, he himself coined the term Big Bang, which was immediately popular.

Hubble, Edwin Powell, 1889–1953, American astrophysicist, observed the redshift of galaxy spectra which led to the idea that the Universe is expanding.

Huygens, Christiaan, 1629–1695, Dutch astronomer. Discoverer of the ring system of Saturn and its first satellite Titan.

Kant, Immanuel, 1724–1804, German philosopher. Author of the work *General History and Theory of the Heavens* (1755) in which he postulates the existence of Universe-Islands, analogous to our Milky Way.

Kepler, Johannes, 1571–1630, German astronomer, supporter of the heliocentric system. Established "Kepler's laws" on the properties of the orbits and motions of the planets.

Kuiper, Gerard Peter, 1905–1973, American astrophysicist of Dutch origin. He proposed the existence of a zone known as the "Kuiper belt" beyond Neptune and composed of small bodies, remains of the formation of the Solar System. Thousands of objects have already been discovered in this zone, including dwarf planets (Pluto, Makemake, Haumea, etc.).

Lacaille (de), Nicolas-Louis, 1713–1762, French astronomer. Carried out a long mission in the Southern Hemisphere during which he named 14 of the 88 constellations in force. His scientific rationalism and the taste of the time lead him to name these 14 constellations in the following way: Pneumatic machine (Antlia, Ant); Chisel (Caelum, Cae); Compass (Circinus, Cir); Furnace (Fornax, For); Clock (Horologium, Hor); Table (Mensa, Men); Microscope (Microscopium, Mic); Ruler (Norma, Nor); Octant (Octans, Oct); Painter (Pictor, Pic); Compass (Pyxis, Pyx); Reticule (Reticulum, Ret); Sculptor (Sculptor, Scl); Telescope (Telescopium, Tel).

Lalande, Joseph Jérôme, Lefrançois, 1732–1807, French astronomer. Measured the parallax of the Moon by triangulation. Calculated the orbital elements of the planets of the Solar System.

Laskar, Jacques, 1955–, French astronomer, member of the Académie des Sciences. Demonstrated in 1989 that the Solar System is a dynamic chaotic system.

Leavitt, Henrietta, 1868–1921, American astronomer. Her discovery on how to measure vast distances to remote galaxies led to a shift in the understanding of the nature of the Universe. Her work provided the first standard candle with which to measure the distance to other galaxies.

Lemaitre, Georges (Monseigneur), 1894–1966, Belgian Catholic canon, physicist and astronomer. Asserted that the universe is expanding and proposed its evolution from a "primitive atom".

Le Verrier, Urbain Jean Joseph, 1811–1877, French astronomer. Predicted by calculation the existence and position of the planet Neptune, which was later confirmed and first observed by the German astronomer Galle in 1846.

Lowell, Percival, 1855–1916, American amateur astronomer. Founder of the Flagstaff Observatory in Arizona. He was the originator of the discovery of Pluto and a fervent defender of the theory of canals on Mars, convinced of the existence of Martians.

Maxwell, James Clerk, 1831–1879, Scottish physicist. Author of the theory of electromagnetism and a draft of the kinetic theory of gasses. Demonstrated that the rings of Saturn cannot be solid but are composed of small bodies and particles.

Messier, Charles, 1730–1817, French astronomer. Discoverer of 16 comets, author of a catalogue of 103 nebulae, galaxies and star clusters, intended not to confuse these stars with comets.

Newton, Sir Isaac, 1642–1727, English astronomer. Author of the theory of universal gravitation, which explains the motions of the planets around the Sun, the precession of the equinoxes, the effects of tides and the flattening of the Earth. Built the first telescope.

Olbers, Heinrich Wilhelm Matthias, 1758–1840, German astronomer and physicist. Highlighted the paradox that the blackness of the night could be in contradiction with the idea of an infinite universe.

Poe, Edgar Allan, 1809–1849, American writer. In his prose poem Eureka, he proposes that the night is dark because the speed of light is finite and the stars have an age.

Sagan, Carl, 1934–1996, American astronomer. One of the founders of exobiology. He set up the SETI program to search for extraterrestrial intelligence and produced the popular science series COSMOS for television.

Schiaparelli, Giovanni Virginio, 1835–1910, Italian astronomer. Believed to observe rectilinear formations on Mars, which he called "canals".

Sosigenes of Alexandria, an ancient Greek astronomer. At the request of Julius Caesar, he proposed around 46 BC the Julian calendar with a year of 365 days divided into 12 months, and an intercalary day added every 4 years, during leap years.

Tombaugh, Clyde William, 1906–1997, American astronomer. Discoverer of the dwarf planet Pluto in 1930.

Wright, Thomas, 1711–1786, British astronomer. Known for postulating that the Earth lies at the centre of the Milky Way, a flat disc of stars. This idea was taken up by E. Kant.

From Daniel Kunth

Les Oreilles dans les Etoiles, with Michel Boujenah and Jacques Lanzmann, CD book, Ramsey, 1995 out of print

Les Quasars, Flammarion, coll. "Dominos", 1998 out of print

Histoires d'Univers, multimedia show for the Planetarium of Vaulx en Velin, Dec. 1999.

Can we think about Astrology: science or clairvoyance? with E. Collot, Le Pommier, 2000 out of print

Participation in 20 articles of the Dictionnaire Culturel des Sciences, Seuil-Regard, 2001.

Helios, 3-D film for the Cité des Sciences in computer graphics, April 2002.

"Les erreurs judicieuses de la science", in La Maladresse, Autrement, coll. "Mutations", 2003.

L'astrologie, PUF, coll. "Que Sais-je", 2005.

Le Grand Univers et nous, Bayard, 2005 out of print

"In what Universe do we live?", special issue of Sky and Space: Astrophysics and Philosophy, 2006.

"Origins and Desires", preface for the catalogue of the MACVAL exhibition STARDUST, Nov. 2007.

Les Balises de l'Univers : quasars, supernovae et sursauts gammas, Le Pommier, 2008 out of print.

From the Big-Bang to the grain of sand: permanent exhibition of the Planetarium of Vaulx en Velin, curator-author, February 2014

D. Kunth, E. Terlevich, *StarWords*, Springer Praxis Books,
https://doi.org/10.1007/978-3-031-49024-8