SPACE, TIME AND EXISTENCE

FOR THE FIRST TIME READER

BY
N.KRISHNASWAMY

This beautiful bronze sculpture of Nataraja, the Lord of Dance, adorns the entrance of CERN, the European Center for Research in Particle Physics in Geneva, Switzerland. The sculpture depicts Nataraja in his Dance of Cosmic Creation which unleashes the energy that manifests as Space and Time, and all that exists within them. It symbolizes the process of Creation that SCIENCE seeks to understand at CERN

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Dedicated to

Sabriye

A living example of how
life can be filled with
rich meaning and high purpose

ACKNOWLEDGEMENTS

This book lays no claim to any originality but simply assembles facts and findings of other scholars and publications, and presented largely by that wonderful contribution to the spread of knowledge through the Internet, the Wikipedia. This book is intended to be a free distribution to a small circle of people who are moved by care and concern and seek to share and serve the same objectives as Wikipedia.

I am deeply grateful to John Grimes for his graceful Foreword to this book.

N.Krishnaswamy
Chennai, 1st August, 2013

FOREWORD

Space and Time (Akasa and Kala) by Krishnaswamy is a thought-provoking and most useful book for individuals interested in space and time. Every individual exists in space and through time and thus this is a subject that is intimately experiential by everyone. However, few are those individuals who stop to earnestly ponder exactly what space and time are. This little book is one doorway to their exploration.

Krishnaswamy introduces the reader to ancient Vedic conceptions and to ancient Western conceptions of space and time. This sets the background. He then illustrates these conceptions with stories. The book explores the Western scientific concepts all the way through Einstein?s revolutionary ideas. The book discusses the Calendar and the Clock, the Microscope and the Telescope, and some astrological events.

The reader will benefit greatly by reading this book and then pondering, in real earnestness, what Space and Time really are.

John Grimes
Professor, Michigan State University, USA

Chennai, 24nd. June, 2013

PREFACE

Space and Time for the first time reader ? Even the first time reader may look askance at the title of this book. Who does not understand Space and Time, he may well ask. But the obvious is often not as simple as it seems. When the reader attempts a simple definition of Space and Time, he will find himself struggling for words. After some effort he may find a definition he thinks simple enough : that they are the things in which events occur or objects appear. But are Space and Time things ? And what are things ? The reader will soon find himself in knots.

One ancient and profound definition of Time comes from the Bhagavad Gita. It is given by Krishna when he gives Arjuna a Vision of his Divine Form, as represented in the image below :

This Vision known as the Viswaroopa means a Vision of Worldly Existence. Arjuna was terrified and bewildered by the Vision that unfolded before him. Unable to understand what to make of it, Arjuna addressed the Vision and asked "Who are you ? " Krishna's answer was :

"I am Kala, the mighty Time, manifested Here,
as the World-Destroyer of all Existence".

We may note three key words in Krishna's answer. The first one is Time, declared to be a manifestation, something that emerges from an unmanifest. The second is Here, that refers to all Existence. The third is Destroyer, that which destroys this worldly existence.

We may also now note that Reality, which is Realized by us as Experience, is confined to a fleeting moment of the Present called Now. A moment later that experience is destroyed, to become a memory, a part of an Unreal Past. The next moment that is yet to come is still part of an Unreal Future. The Reality of the Present is thus a momentary Existence where the next moment brings its Destruction. The Death of all forms of Worldly Existence passing into the vast Past, is what is presented to Arjuna as the terrifying panoramic Vision of the Viswaroopa.

The Indian ancients were great at addressing knotty questions and understanding and explaining things. They envisaged a perspective of the physical manifesting from the psychological and spiritual. Physics evolved from Metaphysics and Spirituality. All substances, material and immaterial that constituted all of Existence clearly emerged stage by stage in a smooth progression from subtle to gross states where the processes of evolution, aggregation and transformation could exist only within the transient setting of Time and Space. And Time and Space were themselves comprised a vast content of an Ultimate Container, the ultimate Unmanifest ! This emergence from an Ultimate Absolute State, of the vast spectrum of Relative States of material and immaterial states, by stages is best illustrated in the *Chandogya Upanishad* in the discussion between the Sage *Uddalaka Aruni* and his son *Svetaketu*. With several examples the Sage explains to his son how all that exists and is perceived, ultimately comes from one essence, one Truth, that cannot be so perceived. He bids his son to bring him a fruit from the nearby banyan tree, break it open and see what is inside. When *Svetaketu* does so, and says he finds small seeds, the sage bids him break one seed and see what is inside. *Svetaketu* does so, he says he finds nothing in it. The Sage then explains that it is not nothing, but something that cannot be seen – it is a subtle essence from which springs the seed, and ultimately grows into the big tree that they behold. It is not 'nothing', says the Sage, that leads to the seed and the tree, but something that leads to all that exists, including you and me. The Sage sums up the discussion with the famous Maha-Vakya or Great Saying *"Tat Tvam Asi".*

This book sets out the different ways in which Time, Space and the other great fundamental Categories have been studied and presented in India and by different cultures of the world. The reader, it is hoped, will thereby get to better, if not fully, understand Time and Space, within which he and everything else exists for the moment.

INTRODUCTION

One wonders whether Space and Time creates Consciousness or whether Consciousness is the Creator. But be that as it may, Space and Time appear In human experience at two levels : though our Senses as objective experience; and through our Mind, as our subjective experience. The Senses and the Mind both function through Space and Time which provide the physical and temporal framework of all our Experience.

Man's earliest consciousness and experience of Space and Time were derived from his observation of the Sun, Moon and Stars and how they related to, indeed impacted on, his daily life. The Sun brought him the day time that set the hours when he could work and eat. The Moon brought him night time, when he could dream and sleep. The Pole Star marked the Northern direction from which he could determine the directions in which he should travel. The Sun brought the seasons, which brought the rains, or tell him when the plants would bear flowers and fruits, or when he could plough the fields, sow the seeds or harvest the crops. The Sun, Moon and Stars clearly thus represented a Divine source of power to be invoked by worship and adoration. This led to an extensive spread and establishment of religious sacrifices and observances addressed to them in all cultures. This also led to the systematic observation of positions and movements of the heavenly bodies and establishment of timings for the corresponding lifetime activities and religious observances. These activities led to the spread of religion and interest in Astronomy and Astrology across the world's cultures.

The centuries of Time saw Man progressing through the stages of a nomad, a hunter, a herdsman, a farmer, a trader, a citizen, a soldier, also as a scholar and a priest. History and Geography generated Economics and Politics while Philosophy and Religion turned away from the Worship of Nature towards Science for an exploitation of Nature, marked unfortunately by a degeneration of Human Nature.

Human knowledge of Time and Space, as stated earlier, as has been an evolving inevitably across the millennia and across cultures, as an amalgam of our physical experience of the external world and our mental experience of the internal world. The ancient perspectives were more philosophical, relying as they did on intuitive and intellectual speculations, what Science describes today as thought experiments. The modern perspectives of today rely more on empirical experience and physical experiments. Knowledge

ultimately rests on the inseparable interface of the Mind and the Senses. Philosophy and Physics with Metaphysics in between appear to be distinct disciplines but clearly integrate internal and external experience to constitute a continuum.

This book presents two perspectives : Space and Time as two separate entities, and Space-Time as a single integrated entity. They are also both presented in two time perspectives, the Ancient and the Modern. That Space-Time developed in the modern perspective of Science seems obvious to people today. But that Space-Time had an ancient perspective too, would take the reader by surprise. The Vedantic and Puranic perspectives, in many ways, anticipated, the Science of today in genres of both Fact and Fiction. Subhash Kak reads more into these ancient insights in terms of a knowledge of Physics in the following words :

> **It appears that Indian understanding of physics was informed not only by astronomy and terrestrial experiments but also by speculative thought and by meditations on the nature of consciousness. Unfettered by either geocentric or anthropocentric views, this understanding unified the physics of the small with that of the large within a framework that included metaphysics.**

We may therefore read on and find out that this is indeed true.

TIME AND SPACE – ANCIENT PERSPECTIVES

The Rig Veda, dating back perhaps to over five millennia ago, presents mankind's oldest and most perceptive references to Time and Space. Two hymns from the Rig Veda may be noted.

द्वादशारं हि तज्जराय वर्वर्ति चक्रं परि द्यामृतस्य ।
आ पुत्रा अग्ने मिथुनासो अत्र सप्त शतानि विंशतिश्च तस्थुः ।।

dvādaśāraṃ hi tajjarāya varvarti cakakraṃ pari dyāmṛtatasya
ā putrā agnē mithunāsō atra sapta śatāni viṃṃśatiśca tasthuḥ

The twelve-spoked wheel of the true (Sun) revolves round the heavens, never to decay, and (O Agni) seven hundred and twenty children in pairs, abide in it.

Rig Veda : I – 164 – 11

द्वे स्रुती अशृणवं पितृणामहं देवानामुत मर्त्यानाम् ।
ताभ्यामिदं विश्वमेजत्समेति यदन्तरा पितरं मातरं च ।।

dvē srutī aśṛṇavaṃ pitṛṇāmahaṃ dēvānāmuta martyānāṃ .
tābhyāmidaṃviśvamējatsamēti yadantarā pitaraṃ mātaraṃ ca

I have heard that there are two paths for gods and ancestors; all this universe between the paternal (heaven) and maternal (earth) proceeds on its way by these two paths.

RV – X – 88 - 15

These two hymns, as indeed much of the Rig Veda, speak largely in the form of metaphors. The first hymn clearly refers to the 12 months comprised of 720 day-night pairs that the Earth takes to complete a full circle around the Sun. The second hymn refers to the six monthly North-South movement of the Sun relative to the Earth marked at their ends by the summer and winter solstices and midway by the vernal and autumnal equinoxes, that mark the seasons.

Perceptive scholars of today have interpreted the central importance of and prominent references to the river Sarasvati in the Rig Veda to date this scripture to a period before the Second Millennium BC before that river went dry and ceased to exist. More explicit astronomy related date references appear in the later Vedic texts like the Brahmanas and Vedangas which are placed in the next millennia, when the Vedic culture shifted east from the Sarasvati-Sindhu region to the Ganga-Yamuna region. These later texts specify detailed astronomy-determined

time prescriptions for the performance of various sacrifices and astronomy- modeled shapes and dimensions for the altars where these sacrifices were performed.

These later texts had an elaborate method of reckoning time. The following table compares some Vedic units of time with their correspondence to present measures of time, which were used in a variety of contexts.

1 truṭi	8/13,500 second
1 vedha	8/135 second
1 lava	8/45 second
1 nimeṣa	8/15 second
1 kṣaṇa	8/5 seconds
1 Asu (or Prana)	4 (sidereal) seconds
1 kāṣṭhā	8 seconds
6 Asus	1 sidereal Pala (or Vighati or Vinadi or 24 seconds)
1 laghu	2 minutes
1 daṇḍa	30 minutes
60 Palas	1 Ghati (24 minutes)
1 prahara	3 hours
60 Ghatis	1 day (24 hours)
1 pakṣa	15 days
30 days	1 month
2 months	1 Ṛtū (season)
12 months	1 year
4,320,000 years	1 Yuga cycle
72 Yuga cycles	1 Manu (311,040,000 years)
14 Manus	1 Kalpa (1008 Yugas or 4,354,560,000 years)
2 Kalpas	A day and night of Brahma (8,709,120,000 years)
30 days and nights of Brahma	1 month of Brahma (261,273,600,000 years)
12 months of Brahma	1 year of Brahma (3,135,283,200,000 years)
100 years of Brahma	Life of Brahma (1 Mahakalpa or 313,528,320,000,000 years)

The Vedic ancients also had a complete set of angular measurements essential for determining astronomical positions and distances :

12 Rāśis	1 celestial circle
30 Lavas	1 Rāśi (Sign)
60 Lipta	1 Lava (or Bhaga or Aṁśā or degree)
60 Vilipta	1 Lipta (or Kala or angular minute)
60 Tatparas	1 Vilipta (or Vikala or angular second)
60 Pratatparas	1 Tatpara

The fascination of the ancients with the Sun, Moon and Stars clearly established Space and Time as inseparable concepts in the human mind. Space and Time provided the framework of all existence. Experience, we know, is the central characteristic of existence. And experience is what springs from activity. Motion in turn, is the central form of activity and all activity has to occur within the inseparable contexts of Space and Time. Motion itself is seen in two basic forms. one of physical matter, moving slowly over relatively short spans of time and distance and the other, of energy. vibrating as it were at a single point, but nevertheless transmitting its impulses in time-bound frequencies, but almost instantaneously, across the vast expanses of Space. The measure of motion in all its forms, is speed, which may range from the pace of an snail to the speed of light.

One of the fascinating constants established by modern Science is the Speed of Light. An astonishing finding derives this figure from a hymn of the Rig Veda. The finding comes from an interesting interpretation of the following hymn :

तरणिर्विश्वर्शतो ज्योतिष्कृदसि सूर्य ।
विश्वमा भासि रोचनम् ।। १-५०-४

taraṇirviśvarśatō jyōtiṣkṛdasi sūrya .
viśvamā bhāsi rōcanam 1-50-4

You, Surya, outstrip all in speed, you are visible to all; you are the source of light; you shine throughout the entire firmament.

Sayana, (1315-1387) a great Vedic scholar and Prime Minister in the Court Emperor Bukka-I of the Vijayanagar Empire, offered the following interpretation on this hymn :

"Thus it is remembered, you [O Sun] who traverses

2202 yojanas in half a nimesa ……."

Dr. Subhash Kak, a distinguished scientist of the University of Lousiana, USA, and a Vedic scholar of distinction, offers a well-reasoned interpretation of Sayana's comment. Kak concludes that it refers to the speed not of the Sun itself, but of the speed of light of the Sun. He further determines the distance measure of the Yojana and the time measure of the

Nimesha from a number of ancient standards such as occur in the Artha Sastra, and find's Sayana's figure almost exactly equivalent to 186000 miles per second !. Is this, asks Dr Kak, a mere coincidence, or a reasoned fact envisaged by the Rig Veda over 5000 years ago ?

Vedic Astronomy is based on a detailed understanding of naked-eye observation and record over long periods of time. The ancient Jyothishi, as the ancient astrologer was designated, was rooted in the ancient knowledge of Jyothisha, and had an intuitive grasp of the astronomical concepts and the relationships that bind the human and the cosmic in a common existence. A competent Jyotishi had to understand and visualize astronomical phenomena like the rotation of the earth and its revolution around the sun, the equinoxes and other movements of the sun causing the seasons, solar and lunar eclipses, the concepts of solar and lunar months, and movements of planets against the background of fixed stars in the sky constituting the Zodiac.

To this day, the Indian astronomer / astrologer places all the basic data of the stellar configurations for ready reference into an annual compilation called the Panchanga. This compilation is based on the rules set out in the Surya Siddhanta which was a systematic updating and codification by great astronomers like Varahimihira (6th Century CE) or of the more ancient Jyothisha – Vedanga text attributed to Lagadha (dated to 1568 BC by one modern scholar based on astronomical references) .

The Panchanga presentations are perhaps unique to Indian tradition, with widespread usage and going back to ancient times, not seen in other cultures. The word Panchanga means Five Divisions which represent five qualifying aspects of time during a day as follows : Tithi (one of 30 divisions of a synodic month) active at sunrise.; Vāsara, (Vāra in current usage), or weekday; Nakṣatra or ruling Star group (one of 27 divisions of the celestial ecliptic) of the moon's position at sunrise; Yoga (one of 27 divisions based on the ecliptic longitude of the sun and moon) active at sunrise; and Karaṇa (divisions based on Tithis) active at sunrise.

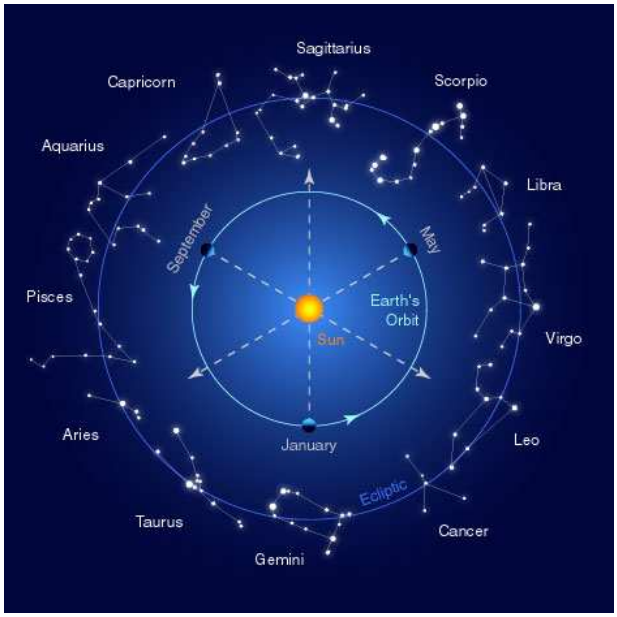
The Panchanga is prepared annually by traditional scholars and experts based on ancient rules of the Surya Siddhanta, and released on the New Year Day which varies from region to region in India. Apart for the daily starting time and duration of the above five details for each day of the year, the Panchanga also carries details of planetary positions through the year. This enables astrologers to cast or read horoscopes and determine auspicious or inauspicious times for undertaking important personal events. The Panchanga is an important reference book for priests and is also kept in most orthodox households throughout the country

Astronomy was a highly developed subject in Vedic culture. The Vedic astronomers were able to observe and predict the movements of the heavenly bodies with very accurate timings, without the aid of modern aids like computers or telescopes. Instead they developed devices and highly

sophisticated structures, as reconstructed in more recent times, like the Jantar Mantar, shown here, to observe heavenly bodies and calculate their present and future positions. Five versions of the Jantar Mantar were built at Delhi, Jaipur, Ujjain, Mathura and Varanasi by Raja Jai Singh of Jaipur between 1727 and 1734, having been requested to undertake this by the then Mughal Emperor, Muhammed Shah. The name Jantar Mantar is derived from the words Yantra and Mantra, representing associated sacred Forms and Sounds.

The Vedic sages were well aware that nothing in the universe is stationary. They were aware of Earth's motion around the Sun. and that the Sun is the center of the solar system. But the Earth, the other planets, the Sun and even the Galaxy are all in constant relative motion. To what referenced point do we relate all this movement? We live on the Earth and see the universe from this vantage point; so for Vedic astronomy, the most practical and convenient and relatively static point is the Pole star, named after Polaris which is known as Dhruva in Sanskrit. Yet, as we shall see shortly, in the context of the phenomenon called Precession of the Equinoxes, even the Pole star is not as static as we assume it to be. In the Universe, it would seem, even the static is relatively so ! Science tells us that the whole Universe is itself so continuously expanding !.

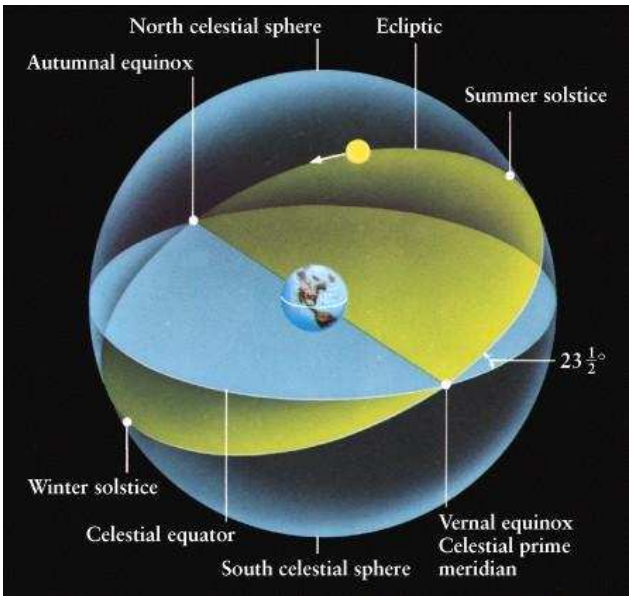
The Zodiac is the path that the planets follow as they move relative to the background of fixed stars. One can visualize the Zodiac as a belt in the sky, about 18 degrees of arc in width, running around the earth in an east-to-west direction. Several groups of fixed stars are studded along this imaginary belt, divided into groups called Rāśis and Nakṣatras. The following picture provides a good visualization :



The fixed stars are divided into two sets, one of twelve groups and another of twenty-seven groups. The twelve groups, based on the position of the Sun are called Signs or Rāśis; the twenty-seven groups of stars are called Nakṣatras, stellar mansions or asterisms. This imaginary belt, with 12 Rāśis and 27 Nakṣatras ranged along on it, is called the Zodiac.

The Zodiac and its divisions of Rāśis and Nakṣatras is the reference for establishing the position of any planet or star in the sky. Since it encircles the earth, it is comprised of 360 degrees. The twelve Rāśis each occupy 30° of arc along the Zodiac, and the twenty- seven Nakṣatras, being equal in size, each span 13°20'.

The heavenly bodies called planets or Grahas move, generally from west to east, in the foreground of the fixed Rāśis and Nakṣatras. The name Graha (graha = Sanskrit 'to grasp') derives from the fact that while moving against the background of the Nakṣatras, they appear to get control of one Nakṣatra after the other. Vedic astrology recognizes nine Grahas: Sun, Moon, Mars, Mercury, Jupiter, Venus, Saturn, Rahu and Ketu. Of course, the Sun is a star, the Moon is a satellite of the earth, and Rahu and Ketu are mathematical points on the Zodiac, but Vedic astronomy and astrology refer to all of them as Grahas. The Grahas (appear to) revolve around the earth along the path of the Zodiac.



The terrestrial phenomena of day and night spring from the relative rotation around its own axis with reference to the Sun, while the changes of seasons comes from a skewed revolution of the Earth with reference to the Sun, that shifts the direct overhead position of the Sun over the Earth over the Tropic of Cancer and Tropic of Capricorn to occur on the 20th March and the 21st September, referred to as the Summer and Winter Solstices and over the Equator on the 21st June and 21st December, referred to as the Vernal an Autumnal Equinoxes which can be visualized from the above image.

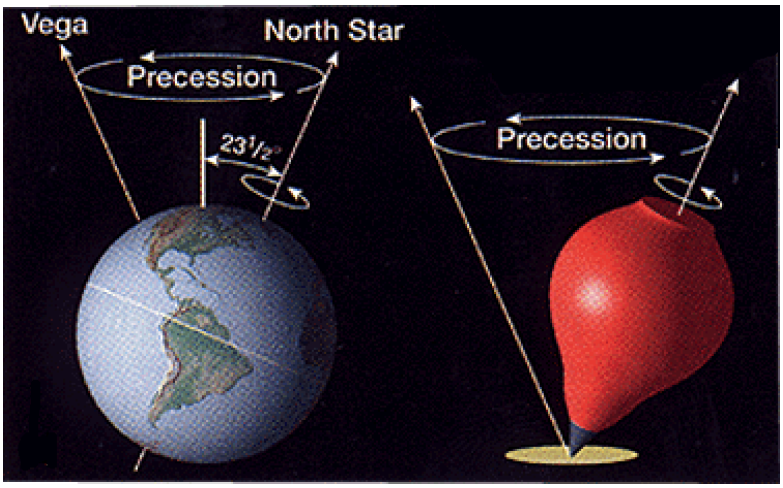
The earth revolves around the Sun once in 365 days, 5 hours, 48 minutes and 46 seconds. Considered from the earth, the Sun appears to complete one round of the ecliptic during this period, which is called a tropical year. The earth regains its original angular position with the Sun in the span of a tropical year. A tropical year is also called a year of seasons, since occurrence and timing of the seasons depend on this annual Earth-Sun cycle. If we consider the revolution of the Sun around the earth from one vernal equinox to the next, it takes exactly one tropical year.

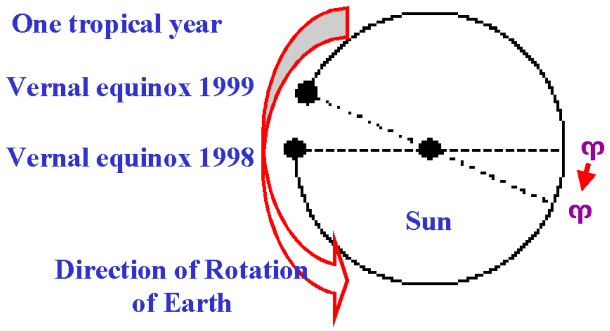
However, if we consider the position of the earth with reference to a fixed star of the Zodiac such as first degree of Meṣa (Aries) or the end of Revati Nakṣatra, at the end of a tropical year, the earth appears to lie some 50.26 seconds of celestial longitude to the west of its original position. In order for the earth to attain the same position with respect to a fixed star after one revolution, it takes a time span of 365 days, 6 hours, 9 minutes and 9.5 seconds. This duration of time is called a sidereal year. The sidereal year is just over 20 minutes longer than the tropical year; this time difference is equivalent to 50.26 seconds of celestial longitude. The

difference between the tropical year and the sidereal year is similar to the difference between the solar day and the sidereal day. Each year, the Vernal equinox will fall short by 50.26 seconds along the Zodiac reckoned along the fixed stars. This continuous receding of the Vernal equinox along the Zodiac is called the Precession of the Equinoxes.

Cause of the precession: The earth rotates around its axis with a slight skew like a spinning top that is slowing down. In doing so, its north pole (and, therefore, the celestial pole), describes a circle of some 47 degrees around the pole of the ecliptic. In other words, the point where the plane of the equator intersects the plane of the ecliptic is constantly shifting. This point, 0° Aries corresponding to the Vernal Equinox, moves westward at approximately 50.26 seconds of arc each year. The result of this precession of the equinoxes is a slow increase in the right ascensions of the Zodiac. This precession takes 25,800 years to complete one circle. An appreciation of this precession is of great importance in understanding the basic concepts of Vedic astronomy and is perhaps relatable to the ancient Indian celestial Yuga calendar.

The following images will enable us to visualize this phenomenon.





An interesting point emerges here. The ancients may not have fully figured out the how or why of many of the foregoing astronomical processes, but they were keen and systematic observers of the visible results. The shifting of the equinoxes has been noted by the star-gazers of ancient times and their timing by the ascendant star or sign of the Zodiac, finds explicit reference in the Vedas and other ancient texts. The following is a brief summary of such findings on the timing of such ancient events as cited in the ancient texts:

10,000 BC : Taittiriya Brahmana 3.1.2 refers to Purvabhadrapada Nakshatra's rising due east, a phenomenon occurring at this date (Dr. B.G. Siddharth of the Birla Science Institute), indicating this earliest known dating of the sacred Veda.

8500 BC : Taittiriya Samhita 6.5.3 places Pleiades asterism at winter solstice, suggesting the antiquity of this Veda.

6776 BC : Start of Hindu king's lists according to Greek references that give Hindus 150 kings and a history of 6,400 years before 300 BCE; agrees with next entry.

6500 BC : Rig Veda verses (e.g., 1.117.22, 1.116.12, 1.84.13.5) say winter solstice begins in Aries (according to D. Frawley), giving antiquity of this section of the Vedas.

5500 BC : Date of astrological observations associated with ancient events later mentioned in the Puranas (Alain Danielou).

3928 BC : July 25th: the earliest eclipse mentioned in the Rig Veda (according to Indian researcher Dr. Sri P.C. Sengupta).

3200 BC : In India, a special guild of Hindu astronomers (nakshatra darshas) record in Vedic texts citations of full and new moon at winter and summer solstices and spring and fall equinoxes with reference to 27 fixed stars (nakshatras) spaced nearly equally on the moon's ecliptic (visual path across the sky).

3139 BC : Reference to vernal equinox in Rohini (middle of Taurus) from some Brahmanas, as noted by B.G. Tilak, Indian scholar and patriot. Now preferred date of Mahabharata war and life of Lord Krishna

2500 BC : Reference to vernal equinox in Krittika (Pleiades or early Taurus) from Yajur and Atharva Veda hymns and Brahmanas. This corresponds to Harappan seals that show seven women (the Krittikas) tending a fire.

2350 BC : Sage Gargya (born 2285), 50th in Puranic list of kings and sages, son of Garga, initiates method of reckoning successive centuries in relation to a nakshatra list he records in the Atharva Veda with Krittika as the first star. Equinox occurs at Krittikia Purnima.

1424 BC : Mahabharata War occurs (dated from reference in the Mahabharata citing winter solstice at Dhanishtha, which occurs around this time). (conflicts with the 3139 BC)

1255 BC : King Suchi of Magadha cited in Jyotisha Vedanga, in a reference to summer solstice occurring in the Ashlesha Nakshatra.

Here then, we have the fantastic perspective of Space and Time as envisaged and observed by the ancients of India over time going back to over five millennia ago. These observations provide unequivocal proof of the chronology and historicity of ancient events, in a measure that is as reliable, if not indeed more reliable than any amount of archeological or other material evidence on which modern historians have tended to place almost exclusive reliance. We may now move on to consider how modern perspectives on Space and Time developed in the West and then go on to the evolution of the integrated concept of Space-Time

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SPACE AND TIME – MODERN PERSPECTIVES

With this detailed background of ancient perspectives drawn from India, we can now examine how the concepts of Time and Space developed through the ages in Western cultures.

CONCEPTS OF SPACE

Space is the boundless extent in which objects exist and events occur and have relative position and direction. Physical space is generally considered to be possessed of three linear dimensions, length, breadth and height. The concept of space is considered by scientists to be of fundamental importance to an understanding of the physical universe. Philosophers over the centuries have remained divided in their understanding as to whether to consider space to be a unique entity, or a relationship between entities, or part of a conceptual framework.

Debates concerning the existence of space, date back in the West to the ancient Greeks. In 5th century BC Greece, Antiphon in a fragment preserved from his chief work On Truth, held that: "Time is not a reality, but a concept or a measure." Parmenides went further, maintaining that time, motion, and change were illusions, leading to the paradoxes of his follower Zeno. Many references can be found in the works of Plato, Socrates and Aristotle The Greek language denotes two distinct principles, Chronos and Kairos. The former refers to chronological, time. The latter, literally "the right or opportune moment", relates specifically to metaphysical or Divine time. In theology, Kairos is qualitative, as opposed to quantitative. In Greek mythology, Chronos is identified as the Personification of Time and he is portrayed as an old, wise man with a long, gray beard, suggestive of "Father Time".

Many classical philosophical questions were discussed in the West during the Renaissance. Later from the 17th century onwards, specially with the early development of science, the philosophy of space and time emerged as a central issue in epistemology and metaphysics. Gottfried Leibniz, the German philosopher-mathematician, and Isaac Newton, the English physicist-mathematician, set out the two main opposing concepts of space. Leibniz held that space is just a collection of spatial relations between objects in the world, not an entity that exists independently of matter.

Isaac Newton took the other view and based his position on observation and experimentation. He used the example of water in a spinning bucket to demonstrate his argument. Water in a bucket is hung from a rope and set to spin, starts with a flat surface. After a while, as the bucket continues to spin, the surface of the water becomes concave. If the bucket's spinning is stopped, the water continues to spin and its surface remains concave. The concave surface is therefore apparently not the result of relative motion between the bucket and the water. Instead, Newton argued, it must be a result of non-inertial motion relative to space itself. For several centuries the bucket argument seemed to be the view that prevailed, that space must exist independently of matter.

In the eighteenth century the German philosopher Immanuel Kant developed a theory of knowledge in where he concluded that space and time are not discovered by humans to be objective features of the world, but are part of an unavoidable systematic framework of the mind in which experience is organized and interpreted.

Around 33 BC, Euclid pioneered the study of Geometry to study the structures in space and their properties. He presented his subject as a set of postulates or axioms, which for long conditioned Western understanding of Space. One of the postulates held that parallel lines could exist in a plane only if they passed through different points on that plane. In the 19th century, thinkers began to doubt the truth of the postulate and question whether it was necessarily axiomatic. Around 1830 János Bolyai and the Nikolai Ivanovich Lobachevsky separately published a type of geometry called hyperbolic geometry, and in the 1850s, Bernhard Riemann developed an equivalent theory of elliptical geometry, in which many but not parallel lines could pass through a point. In these departures from Euclid, of what were called non-Euclidian Geometry, triangles departed from the conventional 180° sum o f their angles and circles departed from the conventional ratio of circumference-to-diameter equal to pi or 22/7. These developments of geometry brought into focus the fact that space itself could accommodate an infinity of shapes and structures. In other words, space was simply not constituted or conditioned by what it contained.

Carl Friedrich Gauss, a German mathematician, was the first to consider an empirical investigation of the geometrical structure of space. He thought of making a test of the sum of the angles of an enormous stellar triangle and there are reports he actually carried out a test, on a small scale, by lines connecting mountain tops in Germany. Three such lines lying on different planes would form angles of a triangle that did not necessarily add up to 180 degrees.

Henri Poincaré, French mathematician and physicist of the late 19th century introduced an important insight in which he attempted to demonstrate the futility of any attempt to discover which geometry applies to space by experiment. In fact, scientists cannot in principle determine whether they inhabit a plane or sphere and, Poincaré argued, the same is true for the debate over whether real space is Euclidean or not. For him, which geometry was used to describe space, was a matter of convention. Since Euclidean geometry is simpler than non-Euclidean geometry, he assumed the former would always be used to describe the 'true' geometry of the world. In a sense, Poincare was shifting from the physical domain of Science to the thought domain of Philosophy.

The big shift in Western thinking came with the new Physics of the 20th Century spearheaded by the Theory of Relativity of Einstein hat combined Space and Time into a single entity of Space-Time. This new concept is dealt with in the next two Chapters. At this point we need only to point to some remaining issues on Space an Time as separate entities. One related to the cosmological question of what shape the universe is, and where space came from. Modern Cosmology holds that Space was created in the Big Bang, 13.7 billion years ago and has been expanding ever since. The overall shape of space remains unknown, but all that is known is that Space is expanding rapidly and endlessly.

Geography is the branch of science concerned with identifying and describing the Earth, utilizing spatial awareness to try to understand why things exist in specific locations. Cartography is the mapping of spaces to allow better navigation, for visualization purposes and to act as a vocational device. Geographical space is often considered as land, and can have a relation to ownership usage (in which space is seen as property or territory). While some cultures assert the rights of the individual in terms of

ownership, other cultures will identify with a communal approach to land ownership, while still other cultures such as Australian Aboriginals, rather than asserting ownership rights to land, invert the relationship and consider that they are in fact owned by the land. Spatial planning is a method of regulating the use of space at land-level, with decisions made at regional, national and international levels. Ownership of space is not restricted to land. Ownership of airspace and of waters is decided internationally. Other forms of ownership have been recently asserted to other spaces—for example to the radio bands of the electromagnetic spectrum or Cyberspace. Psychologists have also, since the middle of the 19th century, been studying the way space is perceived. We may now switch over to how the concepts of Time have changed till the present day in the thinking of the Western world.

CONCEPTS OF TIME

Time has been understood across time and across cultures with perceptions ranging all the way from Unreality to Reality. Ancient cultures such as Incan, Mayan, Hopi, and other Native American Tribes, plus the Babylonians, Ancient Greeks, Vedic Indians, Buddhism, Jainism, and others have a concept of a wheel of time, that regards time as cyclical in repeating ages that happen to both the Universe and its inhabitants between birth and extinction.

The Judaeo-Christian concept, based on the Bible, is that time is linear, beginning with the act of creation by God. The general Christian view is that time will end with the end of the world. The Old Testament book Ecclesiastes, traditionally ascribed to Solomon (970–928 BC), time was traditionally regarded as a medium for the passage of predestined events. The Hebrew zman, was current, meaning time fit for an event, and is used as the modern Arabic, Persian, and Hebrew equivalent to the English word "time".

> **There is an appointed time (zman) for everything. And there is a time for every event under heaven – A time to give birth, and a time to die; A time to plant, and a time to uproot what is planted. A time to kill, and a time to heal; A time to tear down, and a time to build up. A time to weep, and a time to laugh; A time to mourn, and a time to dance, time to throw stones, and a time to gather stones; A**

time to embrace, and a time to shun embracing. A time to search, and a time to give up as lost; A time to keep, and a time to throw away, A time to tear apart, and a time to sew together; A time to be silent, and a time to speak. A time to love, and a time to hate; A time for war, and a time for peace.

– Ecclesiastes 3:1–8

Henri Bergson believed that time was neither a real homogeneous medium nor a mental construct, but possesses what he referred to as Duration. Duration, in Bergson's view, was creativity and memory as an essential component of reality. Martin Heidegger held that we do not exist inside time, we are time. Hence, the relationship to the past is a present awareness of having been, which allows the past to exist in the present. The relationship to the future is the state of anticipating a potential possibility, task, or engagement. It is related to the human propensity for caring and being concerned, which causes "being ahead of oneself" when thinking of a pending occurrence. Therefore, this concern for a potential occurrence also allows the future to exist in the present. The present becomes an experience, which is qualitative instead of quantitative. Heidegger seems to think this is the way that a linear relationship with time, or temporal existence, is broken or transcended. We are not stuck in sequential time. We are able to remember the past and project into the future - we have a kind of random access to our representation of temporal existence --- we can, in our thoughts, step out of sequential time.

J. M. E. McTaggart's 1908 The Unreality of Time argues that, since every event has the characteristic of being both present and not present (i.e., future or past), that time is a self-contradictory idea. These arguments often center around what it means for something to be unreal. Modern physicists generally believe that time is as real as space. Julian Barbour in his book The End of Time, speaks of a timeless realm containing every possible now or momentary configuration springing out as expressions of quantum equations representing the Universe.

At a more practical and prosaic level, man has inevitably to remain limited to measurements within the finite reaches of his existence. Space and Time are measured by the Metre and the Second, which are two of the seven fundamental physical quantities standardized and recorded for International use today by the International System of Units, in Paris. The seven basic units so defined are Kelvin (temperature), Second (time), Metre (length), Kilogram (mass), Candela (luminous intensity), Mole (amount of substance) and Ampere (electric current).

Currently, the International unit of time, the Second, is defined in terms of the duration of radiation emitted by radioactive caesium atoms in highly controlled conditions. The Metre as a unit of distance representing a dimension of Space, is defined by the distance travelled by light in a vacuum in 1299792458th. of a Second

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Space and Time provide an inseparable context for everything that exists. A basic characteristic of all that exists, involving both Space and Time, is Motion, which is most commonly measured by Speed. And the most fascinating Universal Unit of Speed established by modern Science, is the speed of light.

A variety of methods have been developed and used to determine the speed of light and the latest International Unit for it is 299,792.458 kilometres per second. The commonly used approximate figure is 186000 miles per second. The speed of light was first measured by Ole Rømer in 1676. He contested the prevailing belief that the

presence of light anywhere was instantaneous and proved that light travelled at a finite speed He established by studying the time difference between two different positions of Io, the moon of Jupiter. Greater accuracy was obtained later by various methods, One method devised by Fizeau and Foucault measured the time needed for light to travel to a mirror over a five mile distance and back.

Today's researches in the areas of Bio-medicine and Psychology are attempting to relate the role of the Mind in the relationship between external perception and internal conception in order to find and understand the Reality. We see a slow, perhaps inevitable convergence of insights of the ancient world and the findings of modern Science that may give us a better understanding of Space and Time as a Relative Reality or Space-Time as something perhaps closer to True Reality. To Space-Time we may now turn our attention.

SPACE-TIME : ANCIENT PERSPECTIVES

In the present day, we tend to associate the concept of Space and Time constituting a single undivided entity with a relative existence, with the work of Albert of Einstein. But the concept goes back even in recent times to the genre of Science Fiction, such as the Time Machine of H.G.Wells. More interestingly and importantly, it goes back to Vedic mythology of India of more than five millennia ago. Science Fiction today is largely dressed in the language of Science with an appeal to curiosity and perhaps also as something within the realm of possibility and the reach of Science. Vedic mythology however is built around a profound philosophy, with a deep appeal both to the intellect and religious faith rooted in the Vedic scriptures. It's stories are consciously designed to take us all the way from the Relative to the Absolute, from the Apparent to the Real.

The ancient Vedic stories present themes of mind boggling imagination and set in delectable language of high literary quality. The following three stories are taken from a vast corpus of stories of numerous worlds of Space across vast stretches of Time, forming an endless continuum of Space-Time, populated and traversed by gods, humans and countless forms of being.

The relativity of terrestrial and cosmic Space-Time scales are illustrated in the following charming story from the *Bhagavata Purana* of a character who traversed the vast span of cosmic space in the vast span of cosmic time of the first 27 *Mahayugas* of the current *Vaivasvata Manvantara*.

Kakudmi was a king who lived on earth in the *Satya Yuga* of the first *Mahayuga* of the current *Manvantara*. Searching for a good match for his beautiful daughter Revati, he went to *Brahma Loka,* the world of Brahma, to get his advice. There, he had to wait for around 20 minutes (on the cosmic scale) for Brahma to return from watching a dance performance. Seeing him, Brahma told Kakudmi that during this period of his waiting, 27 *Mahayugas* had already elapsed on earth. If he (Kakudmi) were to return now, he would find people on the earth enjoying the avatar of Krishna. In addition, he would also find in Krishna's brother Balarama, the right match for his daughter. Kakudmi followed Brahma's advice and thus it was that Revati came to be married to Balarama. Could this be true or was it just science fiction of that day ?

The next story, The Humbling of Indra, which is from the Brahma-vaivarta Purana runs as follows:

Indra, the King of the Gods suffered his greatest challenge from Vrtra who threatened the very survival of the Devas. During the period of his supremacy, Vrtra had destroyed the majestic mansions of Heaven, the capital city of the Devas. After finally killing Vrtra, Indra commissioned the divine architect Vishvakarma to reconstruct their heavenly capital. Within a year, Vishvakarma completed the task, with the extensive spaces filled with marvelous gem-laden palaces, and numerous gardens, lakes

and towers. But Indra had vaster visions and for fulfilling them he made exacting and unending demands on Visvakarma.

In frustration, Vishvakarma, sought the help of Brahma, who, assured him that he would get relief from the task the next day. Vishvakarma was consoled and went back to his work in Heaven. Meanwhile Brahma went to Vaikuntha , the residence of the Lord Hari, and sought the Lord's help. With a silent nod, Hari indicated that the request of Vishvakarma would be fulfilled.

Early next morning, a small Brahmin boy, about ten years old, smiling, and radiant with the luster of wisdom, made his appearance at Heaven's gate, seeking audience with the King. Sensing that the visitor might be important, Indra immediately hastened to welcome the auspicious guest and ascertain the purpose of his visit. The boy said "O King, I have heard about the construction of your wonderful city, and have come to seek your answers to a few questions I have in my mind. How many years will it require to complete your huge city that you expect Vishvakarma to build ? O King, I ask because no Indra before you has ever succeeded in effecting such a construction."

Greatly amused, Indra asked, "O Brahmin boy, tell me then, are there very many Indras and Vishvakarmas whom you have seen, or at least heard of ?" The boy calmly answered "I knew many people. I knew your father, Prajapati Kashyapa, your grandfather, Marichi, the latter's father Brahma, and even Vishnu, from whose navel Brahma was born. O King, I have known the dreadful dissolution of the universe, indeed countless universes created and dissolved again and again. Who can in this wide infinity of space, count the universes, each containing its own Brahma, Vishnu and Shiva? Who will number the Indras reigning in all the innumerable worlds or their predecessors or successors ? The life and kingship of one Indra endures seven yugas, and when 28 Indras have expired, that would make just just one day and night of Brahma. But the existence of one Brahma, measured in such Brahma days and nights, is only one hundred and eight years. Brahma follows Brahma, in an the endless series. There is no end to the number of Brahmas, to say nothing of Indras".

While the boy was speaking thus, a procession of ants had made its appearance in the hall. In an array, in a column four yards wide, the tribe paraded across the floor. The boy noted them and laughed aloud, but immediately subsided into a deep silence. Hearing and seeing all this, Indra became nervous. His throat, lips and palate had gone dry, and he stammered, "O Brahmin, why did you laugh? Who are you in the disguise of a boy? You seem to me an Ocean of Virtues".

The magnficient boy resumed, "I laughed because of the ants. There is a secret here of an axe that smites the tree of worldly vanity. This secret is a lamp to those groping in ignorance. This secret is the living air of those Yogis who renounce and transcend mortal existence; but it crushes the pride of foolish worldlings."

Indra, now in great anxiety said "O Brahmin son, I do not know who you are in the guise of a boy, but you seem to be Wisdom incarnate. Please reveal to me this secret, this light that dispels darkness."

The boy replied, "You see this long parade of ants. Each ant was once an Indra, but now, through their Karma through many rebirths, each has become an ant. This army of ants is an army of former Indras. Piety and high deeds elevate the inhabitants of the world to the glorious stature of Brahma, Vishnu or Shiva, but wicked acts sink them into the worlds beneath, into pits of pain and sorrow, involving reincarnation among birds, insects, vermin, pigs or wild animals or even trees. Death administers the law of time".

Indra, the King of the Devas, for all his celestial splendor, had by now been cut down to size. He became humble, and gave up his ambitious plans for rebuilding Heaven on a grand scale. Visvakarma was left in peace.

The third and final story is from the great philosophical work of the Yoga Vasishta, ascribed to Valmiki. It is a vast work of 10000 verses in delectable Sanskrit, and presents the whole spectrum of Vedic knowledge in the form of stories, narrated as a teaching to Rama, by his preceptor, the Sage Vasishta, One tiny story is typical. The story of the Crow and the Coconut is a well-known story in India for thousands of years. It is the story of a crow landing on a branch of a coconut tree. At just the instant the crow lands, a ripe fruit falls from the branch above and lands upon the head of the crow, killing it. Here is a story illustrating the seeming simultaneity of events and their seeming connection as cause and effect – a Space-Time theme, developed five millennia later, by Albert Einstein, undedr the umrella of Science. However, the Story of Lila that is next presented here is a larger and more profound one and it runs as below.

Vasistha said - Rama, in order to relieve you from this dubious predicament of yours and to attain quiescence of mind, I shall tell you a story about a King named Padma. This King had a wife named Lila who loved him dearly. Reflecting one day that death could separate them, she consulted the priests on whether there was any way she ensure perpetuate the youth of her husband and have him with her for all time. The priests advised that death could not be avoided but Mantras and austerities could bring her some psychic powers that could help. Accordingly she engaged in prolonged austerities in worship of the Goddess Sarasvati. Responding to her yearnings the Goddess appeared before her and asked her to state her desires. Lila asked for two boons : first, to allow her husband's Soul remain in her house, even after his death; and secondly that whenever she needed, the Goddess would appear before her.

The Goddess granted her the boons. In due time King Padma died. The Goddess Saraswati then told Lila to cover her husbands body with flowers. The flowers alone will then will fade but the King's body. Without the soul quitting it would remain in the

house. Lila could then rest in his arms and could overcome her grief. Lila acted accordingly, but her satisfaction was brief. After some time, she invoked Sarasvati thus " I can no longer endure the parting from my King; please take me soon to him, wherever he is."

Thereupon Saraswati explained "Akasa, (Space) presented itself in one of three states, viz. Chid-Akasa, (Spiritual), Chitta- Akasa, (Mind) and Bhuta-Akasa (Material-Gross) Chitta-Akasa is that intermediate state in which the Mind flits between the objects of the Bhuta-Akasa. When the Mind is freed of object-centered thoughts, then alone does the Chid-Akasa (Consciousness) which is subdued till then, begin to shine. It then manifests itself as the entire universe. If one becomes convinced of the unreality of the visible objects, then, through that Self Knowledge, does one at once attain Chid-Akasa. May you attain that Chid-Akasa (Supreme Consciousness) through my grace." Through this blessing, Lila went into the deep state of Nirvikalpa Samadhi and was able to escape out of her body by becoming desireless, egoless and with quiesence of the Mind. There in the heart of Chid-Akasa, (also called Jnana-Akasa), she saw a large town, where there was a palace. There she saw the King and recognized him to be her dear husband. After visiting many temples and holy places in this Kingdom, she returned to her home and her entered her body o become conscious again.

Praying again to the Goddess Sarasvati, and greeting her when she appeared, Lila questioned her how it that was that her husband even after his death, has subjected himself to another creation which was as illusory a bondage as his earlier.

Sarasvati replied thus "The Supreme Para Brahma (Infinite Consciousness) who was one Janna-Akasa manifests as Souls within the constraints of the two lesser levels of the Akasa. Just as a wave may think of itself as a wave and not as part of the ocean, the Mind identifies itself with the lower physical state. ocean identifies itself as a wave. Similarly, the Mind instead of identifying with the Supreme Para Brahma, identifies with the physical body with which it is associated. Illusions abound as long as the Mind fails to recognizes them for what they are. King Padma was an illusion and was now reborn as King Viduratha.

The Goddess continued with another story to illustrate her point, There was a town called Girigrama. There lived in it a great Brahmin householder called Vasishta. He had a pious, obedient, well mannered and beautiful wife named Arundhati. One day the local King passed by that area with a grand retinue. Seeing him, Vasishta was seized by an intense desire to be a King of great power and riches and all that that the heart could desire. Seeing him so obsessed, Arundati invoked the Goddess Sarasvati for help, on which the Goddess blessed her with two boons just as in Lila's case. Vasishta died with his longing ungratified, but with his soul remaining in his body in the house. Vasishta, being originally of the nature of the Jnana Akasa, became a King. After his death, Arundati too died and joined him in his subtle body. In her former birth, Lila was the wife of Vasishta and she went by

the name of Arundhati. But all these transient creations, Vasishta, King Padma and even Viduratha, who Lila had seen, were illusions like images reflected in water."

Lila could not believe this incredible story and asked the Goddess to explain how she could have been Vasishta's wife who belonged to a distant place in a distant age. The Goddess then explained that space and time were but an unreal play of an Infinite Consciousness What appears like a lifetime in the consciousness of the dream state is nothing but an hour in the consciousness of the waking state. What appears like a year in one world is one day in a different world. There are worlds within worlds, just as a man can experiences different levels of consciousness in the dream, waking and deep sleep states.

Lila was satisfied with the explanation, but nevertheless asked the Goddess to gratify her desires, and show her the place where Vasishta lived. The Goddess explained that this required one to attain a state of pure Self Knowledge, or Jnana, by ceaseless effort, where one needs to be free of all duality and realize the certainty that of Brahman alone exists.

With such guidance and practice, Lila went into Swarupa Samadhi free together with the Goddess, rose high up in Space, traversed vast worlds and reached Girigrama in the Loka where Vasishta lived. There they found the family members in great distress over Vasishta's demise. Making themselves visible, they comforted the family members and left.

Passing through the Sky by the dint of Yoga power, they went to where Padma was and saw his body. After that, they went to where the king Viduratha was. At this juncture, Viduratha had suffered a defeat in a terrible war that had broken out. The Goddess and Lila came up to where the was resting in his palace. The King was greatly delighted by the visit of his divine visitors. The Goddess blessed him to be able to recall the events of his former births. The King was then able to recognize himself in the body of king Padma and recall the company of Lila.

After the Goddess explained how all these experiences were the illusions arising from the work of Maya, Viduratha asked her when he would be able to resume former existence as Padma. The Goddess replied that he would perish in the present war and soon thereafter, he would return to his Padma body. In that event, said Lila at this point, she would like to return to her body to be with Padma wherever he was. To which the Goddess nodded assent.

Soon after Viduratha was felled by an enemy arrow and died. Lila now requested that she be allowed to join her husband. With the blessing f the Goddess, Lila became light and after traversing several worlds, reached soon the immeasurable and endless Reality of Chid-Akasa at last. There she went to the place where Padma's dead body was lying, There she sat beside his body and fanned it gently. The Goddess then let the soul of Viduratha enter into Padma's body in the form of Prana, the life energy, and

Padma came to life. With Lila and Padma thus reunited, the Goddess blessed them with long life. With that blessing Padma attained the Jivanmukta state in his life on earth and finally the state of Videhamukti which merges into the eternal state of Sat--Chit-Ananda.

What do we make today of these mind-boggling stories that come to us from five thousand years ago ? Frits Staal considers these stories as reflecting an amazingly sophisticated tradition of cognitive and analytical thought. But they do tell us that human destiny lies beyond the finite measures of the Second and the Metre, beyond even the dimensions of the combined Space-Time, and has to understood in the perspectives of Infinity and Eternity coalescing into an indivisible Reality

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SPACE - TIME : MODERN PERSPECTIVES

From the age of Newton until Einstein's profound reinterpretation of the physical concepts associated with time and space, time was considered *absolute* and to flow *equably* in Newton's words, for all observers. For a long time mind-set of science right from the time of Newton has been committed to the view of the physical world as an independent self-contained existence, subject to its own laws. The great paradigm shift from this view came in the 20th century with a recognition of the participative contribution of the observer in the shaping of the physical events he was observing. Science is as yet wary of the scope, processes and implications of the observer's role.

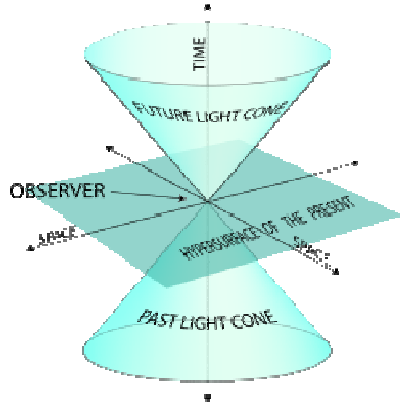
Newton's concept of "relative, apparent, and common time" would appear to provide a framework of shared human experience of a past and future divided by a momentary present. This moment enables us to synchronize clocks around the world. In the late nineteenth century, physicists encountered problems with this understanding of time, in connection with the behaviour of electricity and magnetism. Einstein resolved these problems by using the constant, finite speed of light as the determinant of observers moving at different speeds relatively to one another. At relative speeds approaching the speed of light, the observers would register the same event reaching them at different times. But in practical experience where relative speeds are far smaller, the same event would appear simultaneous, to enable people to synchronize their clocks and go on to relate some sequential events in terms of cause and effect.

In 1905, Albert Einstein published a paper on a special theory of relativity, in which he proposed that space and time be combined into a single construct known as spacetime. In this theory, the speed of light in a vacuum is the same for all observers—which has the result that two events that appear simultaneous to one particular observer will not be simultaneous to another observer if the observers are moving with respect to one another. Moreover, an observer will measure a moving clock to tick more slowly than one that is stationary with respect to them; and objects are measured to be shortened in the direction that they are moving with respect to the observer.

Over the following ten years Einstein worked on a general theory of relativity, which is a theory of how gravity interacts with spacetime. Instead of viewing gravity as a force field acting in spacetime, Einstein suggested that it modifies the geometric structure of spacetime itself. According to the general theory, time goes more slowly at places with lower gravitational potentials and rays of light

bend in the presence of a gravitational field. Scientists have studied phenomena confirming the predictions of Einstein's theories and non-Euclidean geometry is usually used to describe spacetime. Spacetime was a new concept given a mathematical formalism by Minskowski, and indeed it is in modern mathematics that new multi-dimensional concepts like spacetime can be postulated. There are many diverse mathematical objects that are called spaces that have infinite numbers of dimensions governed by abstract relationships. Einstein's general theory of relativity brings gravitation into play in spacetime, giving it a geometric curvature, governed by new mathematical equations. Experiments are on that have been attempting to directly measure gravitational waves described as moving ripples of spacetime.

Travelling at or near the speed of light, such as may happen among sub-atomic events observed in a laboratory, would have the sequence or relationship of observations turning topsy-turvy. Time and reason would have totally different meanings from those at normal human cognitive levels. The following image would give us some idea of the different frameworks of Time.



Two-dimensional space depicted in three-dimensional spacetime.

Time travel is the concept of moving backwards and/or forwards to different points in time, in a manner analogous to moving through space, and different from the normal "flow" of time to an earthbound observer. In this view, all points in time (including future times) "persist" in some way. Time travel has been a plot device in fiction since the 19th century. Traveling backwards in time has never been verified, presents many theoretic problems, and may be an impossibility. Any technological device, whether fictional or hypothetical, that is used to achieve time travel is known as a time machine. A central problem with time travel to the past is the violation of causality; should an effect precede its cause, it would give rise to the possibility of a temporal paradox. Some interpretations of time travel resolve this by accepting the possibility of travel between branch points, parallel realities, or universes. These possibilities would at

present appear to belong to the domain of modern Science fiction, or Vedic mythology.

One aspect of the observer's role is the subject of modern researches in Biopsychology. The brain's judgment of time is found to be determined by several parts of the brain, like the cerebral cortex, cerebellum and basal ganglia. This is to be distinguished from the basic circadian rhythm that regulates the timing of the alternating activity of day and night.

Psychoactive substances, stimulants and depressants have different effects on one's judgment of time. These effects come from neurotransmitters such as dopamine and norepinephrine. These chemicals either excite or inhibit activity, causing the brain to register the occurrence of more or less events within a given interval, giving the effect of time speeded up or slowed down. Mental chronometry is a technique that measures response time in perceptual-motor tasks to infer the content, duration, and temporal sequencing of cognitive operations.

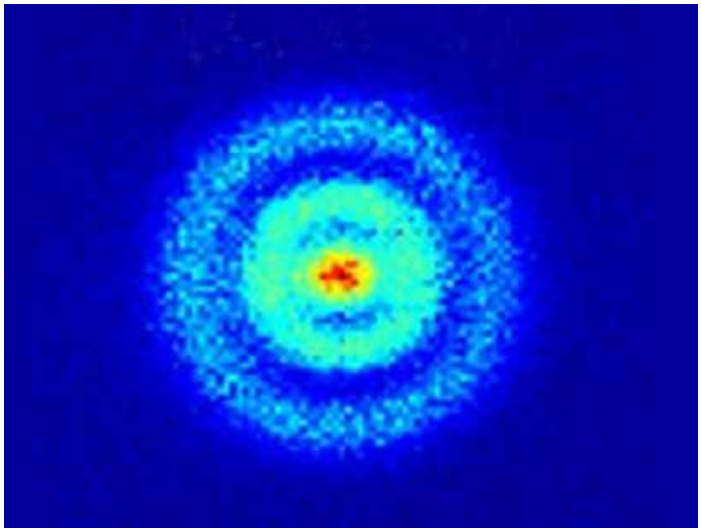
Judgments of time can be altered also by temporal illusions, age, and hypnosis. The sense of time is impaired in some people with neurological diseases such as Parkinson's disease and attention deficit disorder. Psychologists assert that time seems to go faster with age, but the literature on this age-related perception of time remains controversial. Those who support this notion point to the increased presence of excitatory neurotransmitters in young people and the role that new experiences plays in time perception.

SIZES IN SPACE :

THE MICROSCOPE AND TELESCOPE

The modern insights of Science in respect of the content of Space have been built on physical observation by a wide variety of sophisticated instruments, Two instruments in particular may be considered path breaking in the exploration of space : the microscope that explored the depths of atomic space and the telescope that explored the distant reaches of cosmic space. The atom and the star have held a profound fascination for man from the time he realized that there were worlds, macroscopic and microscopic, far beyond the limits of what he could physically see. We may now have a closer look at how the intimate details of the contents of space, small and big, have been explored by the Microscope and Telescope. We begin with the Microscope.

THE MICROSCOPE



THE FIRST PHOTOGRAPH OF A HYDROGEN ATOM

(The proton at the core looks solid enough, but the ring of dots around it is the image of a single electron whizzing around the proton, at a speed that registers as successive dots.

A microscope (a word derived from the Greek *mikrós*, meaning "small" and *skopeîn*, meaning "to look") is an instrument used to see objects that are too small for the naked eye. The science of investigating small objects using such an instrument is called microscopy.

There are many types of microscopes, the most common and first to be invented is the optical microscope which uses light to image the sample. Other major types of microscopes are the electron microscope (both the transmission electron microscope and the scanning electron microscope) and the various types of scanning probe microscope.

The first microscope was made in 1590 in Holland and attributed to two eyeglass makers, Hans Lippershey and Zacharias Janssen. Giovanni Faber coined the name microscope for Galileo Galilei's instrument in 1625 The first detailed account of the structure of living tissue based on the use of a microscope appeared around 1644. It was not until the 1660s and 1670s that the microscope was used extensively for research in Italy, the Netherland and England. Antonie van Leeuwenhoek discovered red blood cells and spermatozoa and other micro-organisms. In 1893 August Köhler developed a key technique for sample illumination which is central to modern light microscopy. This method of sample illumination led to vastly improved images.

An ant as imaged using a scanning electron microscope

The early 1900s saw development of the first electron microscope. The transmission electron microscope works on the same principle as an optical microscope but uses electrons in the place of light and electromagnets in the place of glass lenses, an approach that allows a much higher resolution. In 1925 the transmission electron microscope was followed by the development of the scanning electron microscope.

In 1965 the first commercial scanning electron microscope was developed. This was followed in the 1980s by the first scanning probe microscopes and the atomic force microscope. The most recent developments centre on the rise of fluorescence microscopy in biology, particularly in the post-genomic era, with many techniques for fluorescent labeling of cellular structures were developed. The rise of fluorescence microscopy drove the development of a major modern microscope design, the confocal microscope in 1957 resting on laser technology. It was not until 1978 developed the first practical confocal laser scanning microscope and the technique rapidly gained popularity through the 1980s.

Much current research (in the early 21st century) on optical microscope techniques is focused on development of super-resolution analysis of fluorescently labeled sample. Ultraviolet light enables the resolution of microscopic features, as well as to image samples that are transparent to the eye. Near infrared light can be used to visualize circuitry embedded in bonded silicon devices. The traditional optical microscope has more recently evolved into the digital microscope. In addition to, or instead of, directly viewing the object through the eyepieces, a type of sensor similar to those used in a digital camera is used to obtain an image, which is then displayed on a computer monitor. These sensors use CMOS or charge-coupled device (CCD) technology.

We may now move on from the microcosmic to the macrocosmic scale , from the microscope to the telescope.

THE TELESCOPE

A PHOTOGRAPH FROM SPACE OF THE EARTH AND THE MOON

The first telescopes used for observing images in visible light of terrestrial and astronomical bodies were invented in the Netherlands at the beginning of the 17th century. Their development is credited to three individuals: Hans Lippershey and Zacharias Janssen, who were spectacle makers and Jacob

Metius. The earliest telescopes used lenses in which refraction of light presented shape and colour aberations. This was solved by later using reflecting parabolic mirrors. In 1668, Isaac Newton built the first practical reflecting telescope, of a design which now bears his name, the Newtonian reflector.

The invention of the achromatic lens in 1733 enabled the construction of shorter, more functional refracting telescopes. Metal mirrors were used at first, but suffered problems of tarnishing and this led to the introduction of silver coated glass mirrors in 1857 and aluminized mirrors in 1932. The maximum physical size limit for refracting telescopes was about 1 meter (40 inches), and therefore the vast majority of large optical researching telescopes built since the turn of the 20th century have been reflectors. The largest reflecting telescopes currently have objectives larger than 10 metres. .

The 20th century also saw the development of telescopes that worked in a wide range of radiation wavelengths. Telescopes are now classified by the wavelengths of light they detect. They include X-ray telescopes, using shorter wavelengths than ultraviolet light; Ultraviolet telescopes, using shorter wavelengths than visible light; Optical telescopes, using visible light; Infrared telescopes, using longer wavelengths than visible light; and sub-millimetre telescopes, using longer wavelengths than infrared light

As wavelengths become longer, it becomes easier to use antenna technology to interact with electromagnetic radiation (although it is possible to make very tiny antenna). Another threshold in telescope design, was that photon energy increases with shorter wavelengths and higher frequency resulting from the use of fully reflecting optics rather than refracting optics. Telescopes reflecting extreme ultraviolet, produced higher resolution and brighter images than otherwise possible.

An optical telescope gathers and focuses light mainly from the visible part of the electromagnetic spectrum (although some work in the infrared and ultraviolet range. Optical telescopes increase the apparent angular size of distant objects as well as their apparent brightness. In order for the image to be observed,

photographed, studied, and sent to a computer, telescopes work by employing one or more curved optical elements, usually made from glass lenses and/or mirrors, to gather light and other electromagnetic radiation to bring that light or radiation to a focal point. Radio telescopes are directional radio antennas used for radio astronomy. The dishes are sometimes constructed of a conductive wire mesh whose openings are smaller than the wavelength being observed. Radio telescopes are also used to collect microwave radiation, which is used to collect radiation when any visible light is obstructed or faint. Different types of telescope, operating in different wavelength bands, provide different information about the same object. Together they provide a more comprehensive understanding.

The foregoing account of microscopes and telescopes tells us how they give us a close-up view of all the content of space, irrespective of size or distance within Space. It is now important for us to know how these instruments enable us to see by using another fundamental content of Space. This Energy that pervades the entirety of Space. This is spread across what is called the the electromagnetic spectrum characterized by wavelengths ranging from less than 0.01 nanometer to over 1 millimetre, ranging from the Gamma-ray to the Radio bands of the spectrum. This component is Energy, is but a sub-set of what the Indian ancients called Prana, that underwrites the life and activity of all that exists in Space and Time.

DURATIONS IN TIME
THE CALENDAR AND THE CLOCK

The Mind thus brings within our transient existence, finite and transient bits of the Infinity of Space and the Eternity of Time to give us a sense of that Ultimate Reality. We try to sharpen our sense of Reality by measuring space and time in standardized finite units such as the Metre and the Second. Real, Really, Realize, Reality ...., all play around the same word. So, really speaking, our sense of Reality lasts for just a fleeting moment of Real-time, which we call the Present or Now. We realize that just a moment later the Present moment passes into the Past, while later moments are still in the Future, yet to become real. Yet the Mind has the remarkable capacity to encapsulate Past, Present and Future instantaneously into the Present moment, to give us a sense of Reality presented as an unbroken continuity of time.

Man is inevitably conscious of his life being limited by time. Keeping a measure of the passage of time has therefore always interested man across all cultures and has led to the development of a variety of solutions and mechanisms of time keeping. By convention, the day is the smallest calendrical unit of time. More strictly, time-keeping refers to the measurement of fractions of a day. The calendar on the other hand, is a system of organizing units of time over extended periods. For a long time, the sun and moon served both purposes, till later, the calendar and clock were developed as separate specialized mechanisms.

For early man, the Sun served as both calendar and clock. Man had only to look at the position of the Sun to judge the hour of the day or the sequence of seasons. Soon he discovered it was easy to make these judgments by looking at the shadow of an upright pole that the Sun cast on the ground. He soon learnt to read more into the shadow, indeed both time and season, from its length and direction. It was an obvious next step to draw radial lines on the ground from the base of the pole to mark the hourly intervals where the shadow would fall. The upright device came to be known as the Gnomon, while its later developments became the Sundial. Here then was man's first clock-cum-calendar. Over the centuries this facility was gradually improved and refined till finally it would be transferred to a small device on his wrist as his wrist-watch. We will follow the fascinating story of how this happened in this Chapter.

THE CALENDAR

The periodicity and predictability of natural events and their inevitable influence on human activities were seen to follow closely from the movements and positions of the Sun, Moon and Stars. Knowledge about them thus developed in terms of both Astronomy and Astrology. The principal astronomical cycles are the day (based on the rotation of the Earth on its axis), the year (based on the revolution of the Earth around the Sun), and the month (based on the revolution of the Moon around the Earth). The complexity of calendars arises because these cycles of rotation and revolution do not comprise an integral number of days, and are neither constant nor perfectly commensurable with each other, The complexity was enhanced by the disparate solutions developed over time across the world's cultures, resulting in a proliferation of conflicting calendars.

The largest of these time units, the *tropical year,* is defined as the mean interval between vernal equinoxes; it corresponds to the cycle of the seasons. However, the interval from a particular vernal equinox to the next may vary from this mean by several minutes. The

next time unit, the *synodic month*, is defined as the mean interval between conjunctions of the Moon and Sun, and corresponds to the cycle of lunar phases. Any particular phase cycle may vary from the mean by up to seven hours. The lengths of the tropical year and synodic month are now defined today in terms of days which are defined by a standard duration of 86400 seconds of International Atomic Time.

When the cycles change slowly with time, a calendar year of an integral number of days cannot be perfectly synchronized to the tropical year. Approximate synchronization of calendar months with the lunar phases is more complex and requires a complex sequence of months of different number of days. For convenience it is common to speak of a lunar year of twelve synodic months, or 354.36707 days. Three distinct types of calendars have resulted from this situation. A *solar calendar*, of which the Gregorian calendar in its civil usage is an example, is designed to maintain synchrony with the tropical year. To do so, extra days are inserted (the technical word used is intercalated) to increase the average length of the calendar month or year. A *lunar calendar*, such as the Islamic calendar, follows the lunar phase cycle without regard for the tropical year. Thus the months of the Islamic calendar systematically shift with respect to the months of the Gregorian calendar. The third type of calendar, the *luni-solar calendar*, has a sequence of months based on the lunar phase cycle; but every few years a whole month is intercalated to bring the calendar back in phase with the tropical year. The Indian, Hebrew and Chinese calendars are examples of this type of calendar.

The celestial bodies were always thought to represent divine agencies which provided time markers to start activities leading to human welfare, and for offering thanksgiving to the gods through rituals and sacrifices to be conducted or festivals or other events. Dates and Times had therefore to be computed and recorded for the timely observance of such events in what came to be established as calendars. Initially these calendars served religious purposes and were maintained in what in India were called Panchangas. In later times, when formal governments were established, their objectives were set into calendars to also serve civil or administrative purposes.

The calendar had always to be set by a count from a fixed reference point of time in respect of say, the hour, the day, the month and year, and also based on a fixed duration of each of these time units. The first fixed point in India was the start of the Yuga cycle on the Divine scale, such as the Kali Yuga considered to correspond to the year 3102 BC; or the establishment of a prominent ruling dynasty in history like the Sakas, corresponding to 72 AD; or to 1 AD, corresponding to the presence of a great personality who changed the course of history, like Jesus Christ. When many personalities start eras, as in India or elsewhere, we get many conflicting calendars vying for acceptance. According to a recent estimate (Fraser, 1987), there are about forty calendars used in the world today. In India, the Saka era is officially recognized today though calendars prevail, based on other eras like the Kali Yuga.

The start of the Christian Era with 1 AD has an interesting history. It is considered to have been proposed by a Roman priest, Dionysius Exiguus, and designated by the name Anni Domini Nostri Jesu Christi meaning The Year of our Lord Jesus Christ. It was intended . to efface the memory of the Roman calendar and of the Roman Emperor Diocletian, who had mounted the last and most severe persecution to stem the spread of Christianity. The computational basis of the Roman calendar remained and continued to contribute to a gradual recession of dates of events like Easter. The final reform of the calendar with an inbuilt corrective mechanism was finally effected by Pope Gregory in 1582. Ten days were deleted from the calendar, so that 1582 October 4 was followed by 1582 October 15, thereby causing the vernal equinox of 1583 and subsequent years to occur about March 21. And a new table of New Moons and Full Moons was introduced for determining the date of Easter. The revised calendar named after him as the Gregorian calendar introduced rules for an extra day to be added every fourth year, called the Leap

Year, to offset the calendar slippage to correspond to the slippage of the Sun's position over the Solar Year duration. The simplicity of the Gregorian calendar resulted in its wide acceptance, which today is virtually world-wide.

In order to establish a national calendar in India for both religious and civil purposes, India the Government of India set up a Calendar Reform Committee in 1957 to study the problem and make recommendations. The Committee's recommendations were largely accepted and implemented Pending the evolution of a World Calendar by the United Nations, it was decided to maintain the Gregorian calendar already adopted for civil purposes during earlier British Rule. For an official Indian calendar as an alternative to the numerous local calendars found to be in use, the Saka Era was adopted for common use. For religious purposes, the many versions of Panchangas serving regional traditions and practices were respected, though they were urged to use scientific astronomical data for their computations and presentations, for which tabulations of the religious holidays are prepared by the India Meteorological Department and published annually in *The Indian Astronomical Ephemeris*.

The World Calendar has its roots in the proposed calendar of the Abbot Marco Mastrofini, a proposal to reform the Gregorian calendar year so that it would always begin on Sunday, January 1, and would contain equal quarters of 91 days each. The 365th day of the solar cycle would be a year-end, "intercalary" and optionally holy day. In leap years, a second "intercalary day" follows Saturday, 30 June.

A revised reform of the World Calendar was proposed by Elisabeth Achelis of Brooklyn, New York in 1930. This envisaged a 12-month, perennial or perpetual calendar with equal quarters. Each quarter begins on Sunday, ends on Saturday. The quarters are equal: each has exactly 91 days, 13 weeks or 3 months. The three months have 31, 30, 30 days respectively. Each quarter begins with the 31-day months of January, April, July, or October.

The World Calendar also has the following two additional days to maintain the same new year days as the Gregorian calendar. Firstly, last day of the year following Saturday 30 December. This additional day is dated "W", equivalent to 31 December, and named Worldsday. It would be a year-end world holiday and would be followed by Sunday, 1 January in the new year. Secondly, a Leap year Day is similarly added at the end of the second quarter in leap years. It is also dated "W", equivalent to 31 June, and named Leap year Day. It is followed by Sunday, 1 July within the same year. The World Calendar treats Worldsday and Leap year Day as a 24-hour waiting period before resuming the calendar again. These off-calendar days, also known as "intercalary days", are not assigned weekday designations. They are intended to be treated as holidays.

Because any three-month sequence repeats with the same arrangement of days, The World Calendar can be represented uniformly and concisely as below :

	Jan, Apr, Jul, Oct					Feb, May, Aug, Nov				Mar, Jun, Sep, Dec			
S	1	8	15	22	29	5	12	19	26	3	10	17	24
M	2	9	16	23	30	6	13	20	27	4	11	18	25
T	3	10	17	24	31	7	14	21	28	5	12	19	26
W	4	11	18	25	1	8	15	22	29	6	13	20	27
T	5	12	19	26	2	9	16	23	30	7	14	21	28
F	6	13	20	27	3	10	17	24	1	8	15	22	29
S	7	14	21	28	4	11	18	25	2	9	16	23	30
30th December, Worldsday follows 30th June, Leap year day follows (only on leap													

years)

Throughout the 1930s, support for the concept grew in the League of Nations, the precursor of the United Nations. Following World War II, Achelis solicited worldwide support for The World Calendar. As the movement gained international appeal legislation was introduced in the United States Congress, but this was deferred pending international acceptance through the United Nations.

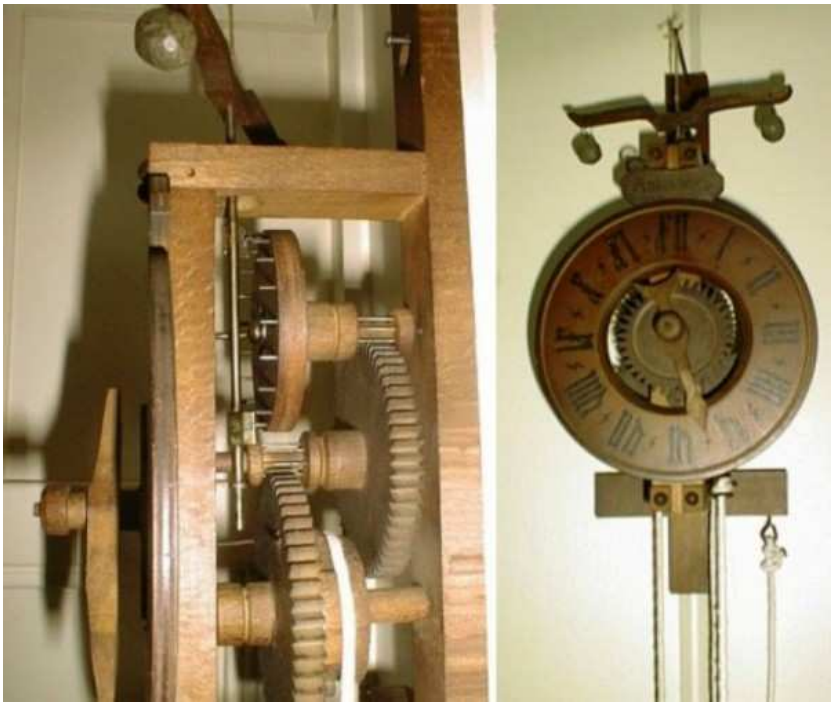
The main opponents of The World Calendar in the 20th century were leaders of religions that worship according to a seven-day cycle. For Jews, Christians and Muslims, particular days of worship are ancient and fundamental elements of their faith. The World Calendar, was also considered not compatible with the international standard ISO 8601, which is based upon, but differs from, the Gregorian calendar. In the United Nations, the issue of world calendar reform was formally raised by India in 1953. Various delegations expressed opposition to the reform because of the undesirable effect it would have on many aspects of religious life. Eventually, discussion on the issue was adjourned sine die (without fixing a day for future action or meeting) by the UN's Economic and Social Council in 1956. Since then, there has not been any worldwide initiative to reform the Gregorian calendar.

THE CLOCK

Unlike the Calendar, the Clock has seen a smoother course of development and wide acceptance across cultures. The hour and its sub-divisions and their durations obviously had no social, economic or religious implications like the day and its place in the month or the year. The Gnomon was a simple pole set up vertically on the ground so that the length and direction of the shadow it threw on the ground indicated the time of the day. Obelisks an sundials were improvements on this. Ancient Egyptian obelisks , constructed about 3500 BC, are also among the earliest such shadow clocks. The obelisk also indicated whether it was morning or afternoon, as well as the summer and winter solstices.

The limitation that shadow clocks were effective only for daytime observation, provided the impetus fro development of other methods that could keep time day and night. One common solution was the hourglass, where time was measured by the flow of sand by gravity through a small hole connecting to two glass globes,

8. Clepsydra



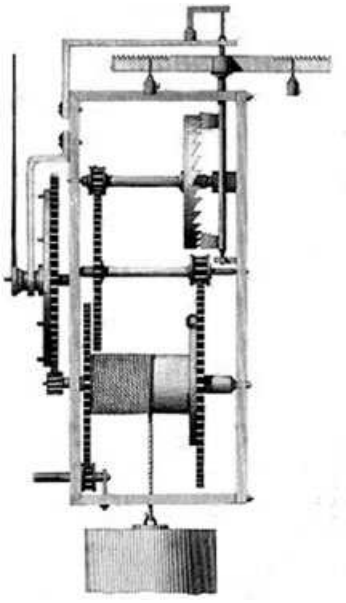
A Clepsydra or water clock measures time by the regulated flow of liquid into (inflow type) or out from (outflow type) a vessel where the amount is then measured. The bowl-shaped outflow is the simplest form of a water clock and is known to have existed in Babylon and in Egypt around the 16th century BC. Other regions of the world, including India and China, also have early evidence of water clocks

A candle clock shown above is a thin candle with consistently spaced markings (usually with numbers), that when burned, indicate the passage of periods of time. While no longer used today, candle clocks provided an effective way to tell time indoors, at night, or on a cloudy day.

Incense clocks as shown above were used in China and Japan and were fashioned in several different forms. Incense clocks were first used in China around the 6th century; Several types of incense clock have been found, the most common forms include the incense stick and incense seal. An incense stick clock was an incense stick with calibrations sometimes having threads, with weights attached, at even intervals. The weights would drop onto a platter or gong below, signifying that a certain amount of time had elapsed.

Mechanical clocks replaced the old water clocks, and the first clock escapement mechanism appears to have been invented in 1275. All had the same basic problem: the period of oscillation of the mechanism depended heavily on the driving force of the weights and the friction in the drive. In later Mediaeval times elaborate clocks were built in

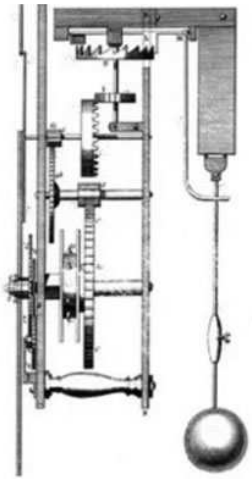
public places. Shown below is the Astronomical clock in Prague, parts of which date from about 1410.



Here the weight rotates the drum which drives the toothed wheel which gives the mechanism its "tick-tock" movement

Prague Astronomical Clock
Showing the Zodiac Circles and early versions of the digits 2, 3, 4 and 7

The earliest surviving spring driven clock can be found in the science museum in London and dates from about 1450. Replacing the heavy drive weights with a spring permitted smaller and portable clocks and watches.



The pendulum moves the lever which creates the rocking movement of the escapement

Christian Huygens made the first pendulum clock, regulated by a mechanism with a "natural" period of oscillation in 1656. Galileo studied pendulum motion as early as 1582, but his design for a clock was not built before his death. Huygens' pendulum clock had an error of less than 1 minute a day, and his later refinements reduced his clock's errors to less than 10 seconds a day.

It was not until 1884 that a conference at Greenwich reached agreement on global time measurement and adopted Greenwich Mean Time as the international standard. Today we rely on atomic clocks for our most accurate time measurements. The Gregorian Calendar, Greenwich Mean Time and the International Standard Unit of time, the Second, remain today the standards that command the widest universal acceptance.

EXISTENCE – PERSPECTIVES OVER TIME

Having dealt so far with the concepts of Space and Time as separate entities and Space-Time, as a single entity, we may now look at all that they contain and sustain, the living and non-living totality that we call Existence. We may, as before, look at this from both an ancient and modern perspective. The ancient perspective is best seen in India, as it presents the perhaps oldest and most insightful known to us in human history.

In their investigations, the ancient Rishis of India, relying on their higher perceptions, postulated a remarkable concept of Existence as One Ultimate Entity which they named Brahman. They described it as an ultimate Existence that was Unmanifest, and that periodically presented itself as a Manifestation of a transient Existence, It would then appear that this Manifest, inheriting the vast powers of manifestation from the Divine, in turn, created a framework of Space and Time, within which it proliferated into a vast multiplicity of form and function, one of which was the human being, The Rishis then postulated that the Manifest Existence in all its forms, cycled through Time and Space through transient states of Life and Death. The human being was endowed with a Consciousness that could envisage all this, and also accept his inevitable existence as rooted in the physical domain, that is subject to the finite limitations of space and time, and therefore, to its constraints and compulsions.

Several philosophical streams of thought developed later that sought to explain the origin and emergence of this manifestation of Existence and its purpose. Six main schools of philosophy thus emerged : Nyaya of Gautama, Vaiseshika of Kanada, Sankhya of Kapila, Yoga of Patanjali, Mimamsa of Jaimini, and Vedanta of the three schools, based on the Upanishads, viz. Advaita of Sankara, Dvaita of Ramanuja and Vishtidvaita of Ramanuja. Two of these schools in particular are relevant to the human dimension of Existence.

Of them, the Vaiseshika School postulated an atomic basis for all physical existence, including the body and the mind. The basic elements of Earth, Fire and Water were considered as being constituted of fundamental particles in constant motion, interaction, combination and transformation, which meant constant creation and dissolution. One may see that the Earth principle here could represent the totality of atomic elements recognized by modern chemistry. The Fire principle would represent all forms of energy that drive all physical and chemical transformations; and Water would represent the fluid medium enabling the flow, pervasive reach and interaction of all matter. Vaiseshika also postulated three principles, Dravya, Guna and Karma, analogous to Substance, Property and Action, which can be taken to represent the basic properties of all that exists, living or otherwise.

Finally it was left to Sankhya and Yoga to address these questions of existence at both Cosmic and Individual levels, in greater detail. While Sankhya addressed existence in a larger Cosmic context, Yoga had its focus more on the Individual, though both stressed the point that the latter context is an integral part of the former, and therefore both need to be addressed in a joint holistic way. The material components and the non-material influences determining behaviour at both these micro and macro levels are traced back to their very origin from the two eternal principles of Purusha or Consciousness and Prakruti or Nature. The combination of Purusha and Prakruti leads to all creation of all form and function and ultimately to their to dissolution. What is remarkable is that this occurs as a seamless continuum across this vast matrix of basic materials and influences, and evolves in stages from subtle to gross forms and states. One can readily recognize analogues of these ancient concepts presented in modern science such as in the example of Energy, now seen as a single fundamental entity differentiated over a vast spectrum of frequency bands, identifiable as heat, light, electro-magnetism and other forms with different properties. Particle Physics tells us that there is no dividing line between Matter and Energy,

Einstein has reduced their equivalence to a mathematical equation. And Astrophysics tells us how energy is seen to shift into the state of physical matter and take the form of the stars and the other vast forms of matter that comprise all that we know as existence. Sankhya further holds that all that is created physically within the framework of Prakruti is subject to its three basic properties, the three Gunas, viz. Sattva, Rajas and Tames. These three properties have a generic character manifesting in specific forms affecting different facets of all that exists, whether at the cosmic or individual levels. At a material level these properties respectively contribute equilibrium, dynamic change and passive inertia. All these concepts certainly anticipate Newton's Laws of Motion and the Laws of Thermo-dynamics.

The word Tattva is another similar concept having a bearing on Existence. The word Tattva means the principle and derives from the word Tat, which signifies the Infinite, Eternal Existence, called Brahman. The word Tattva therefore refers to what we may consider a Principle, or Element or Component of Existence. The widely accepted Kashmir Saiva tradition conceives of a total of 36 Tattvas originating from Siva, the Absolute state, that lead to the ultimate physical entities that comprise worldly existence physical states through progressive manifestation. The 36 Tattvas, which are listed below, fall within the three broad categories :

- **(a) The Ashuddha Tattvas or Impure physical level, resting on the material, sensorial, the organs of action, the mind and the ego, the domain of objectivity and duality;**
- **(b) The Shuddhaashuddha Tattvas, or Pure-Impure transitional level of the soul within limitations, the domain of knowledge; and**
- **(c) The Shudda, or Pure Tattvas (internal aspects of the Absolute) being the domain of transcendental unity and non-differentiation.**

1 – 5 : The five mahābhūtas :

1. pṛithvī - earth; 2. jala - water; 3. tejas - fire; 4. vāyu - air; and 5. ākāśa - ether.

6 – 10 :The five tanmātras - subtle mediums of the sensations :

6. gandha - the transit medium for the olfactive impressions; rasa - the transit medium for the taste sensations; 8. rūpa - the transit medium for the visual sensations; 9. sparśa - the transit medium for the touch sensations; and 10. śabda - the transit medium for the auditive sensations.

11 – 15 : The five karmendriyas -organs of action :

11. pāyu - the excretion organ; 12. upastha - the sexual organs; 13. pāda - the locomotion organ; 14. pāni - hand, the organ of apprehension; and 15. vāk - the speech organ,

16 – 20 : The five jñānendriyas - sense organs :

16. ghrāṇa - nose; 17. rasanā - tongue;
18. cakṣu - eye; 19. tvak - skin; and
20. śrotra - ear.

21 – 25 : Antaḥkaraṇa - the inner instrument :

21. manas - the lower mind; 22. ahaṃkāra - the empirical ego; 23. buddhi - the intellect ; 24. prakṛti tattva; and 25. puruṣa.

26 – 31 : Ṣat kañcukas :

26. niyati - spatial limitation; 27. kāla - limitation in time; 28. rāga - incompleteness, the limitation of desire; 29. vidyā - the limitation of knowledge;
30. kalā - limitation in power; and 31. māyā - the origin of illusion and duality

32 – 36 : Śuddha tattvas :

32. śuddha vidyā; 34. sadāśiva; 35. śakti; and 36. śiva.

The Highest Divine as the Ultimate State of all Existence is represented by the name Sat – Cit – Ananda, standing for three states of Truth, Consciousness and Bliss. These states condition all

later evolutes of existence. At the level of human existence, Bliss represents a state of freedom from pain and sorrow; Truth is an understanding of why these arise in human experience; and Consciousness enables such understanding. And more importantly, it seeks to help the Mind to look further, far beyond the horizons of physical existence, into the vast perspective of spiritual existence, where alone, the true meaning and purpose of existence is to be discovered. The final finding of the Vedas is that the individual, is aware of his own dual identity at two levels : a higher identity which is Spiritual, the true "I" which is possessed of the faculty of Consciousness; and a lower identity which is Physical, the pseudo "I" that identifies with the physical body and its external physical world, and which is possessed of the faculty of Intelligence. Both identities reside in his Mind, the higher keeps the individual on the path of a higher spiritual destiny, while the lower enables him to cope with the problems of physical existence.

The Vedas stressed that the human as an endpoint in a chain of creation originating in the Highest Divine must therefore have an inheritance of that divinity. The point that is now urged here is that Intelligence resident in an earlier creation is inherited by everything that is created later in this chain, and indeed, pervades everything that exists. Intelligence is here to be understood, not in the narrow conventional sense of the human faculty, but to that larger principle that controls the predictable behaviour of all matter, organic and inorganic, sentient or insentient. It must be further clarified here, as will that Intelligence is not a faculty that is limited to the human mind but is a generic faculty that guides energy to take different forms of matter and pervades all forms of matter comprising the entire physical body, and indeed, the entirety of physical Universe. Intelligence in the individual originates in the faculty of the Buddhi or Intellect, that interprets and takes decisions on whatever is brought to it by the Ahamkara or Ego from the Sensory complex.

Human Cognition itself addresses two levels of reality : an Absolute and a Relative, a Conceptual and an Empirical, a Mental and a Physical. We cognize existence as a matrix of Energy, Space and Time. We utilize Energy in the form of Sound, and Sound in the form of Speech to relate to all these levels. The Veda itself rests on the articulated word, which we use for identifying the different levels of existence that are presented to our cognition. At the physical level we relate to a world of activity in an environment of objects. The Vedas use the Word to present an integrated view of the inner world of the Mind and the outer world of Object and Activity. The Scripture uses the words Mantra, Yantra and Tantra to symbolize Thought, Object and Activity . That integrated view is what we call meaning.

The modern perspective on Existence may be considered to have taken shape with the new directions that Science took in Europe with the formulation of Rene Descartes (1596-1650) the French philosopher who finally set a strict physical domain as the boundary of all Science. His position arose from a need to steer clear of the hostility of the Roman Catholic Church which questioned any religous belief which the Church held and visited it with the harsh excesses of the Inquisition. With Science thus distancing itself progressively from the deeper perspectives of Religion and Philosophy, the issues of Existence got to be addressed exclusively in terms of physical existence. The smallest particle of matter was postulated in 1805 by John Dalton to be the atom. By the end of the 20th Century, however the perspectives changed dramatically. The smallest particle of matter today is not the atom, but the sub-atomic particle, where too, uncertainty surrounds the boundary between the particle of matter and wave of energy. Science has moved from physics and chemistry into biology and psychology, with uncertainty prevailing here too on the boundary between mind and matter. Science is today almost on the threshold of Vedanta with the issues of existence being addressed in terms of cognition and the higher faculties.

APPENDIX

WISE SAYINGS ON SPACE AND TIME

These sayings are but small aids to give us sense and value to the space and time through which we pass in a Transient existence.

I : SAYINGS ON SPACE

Heavier-than-air flying machines are impossible.

--- Lord Kelvin, 1892

The aeroplane will never fly.

--- Lord Haldane, Minister of War, Britain, 1907 (statement made four years after the flight of Kitty Hawk.)

It is the policy of the United States that activities in space should be devoted to peaceful purposes for the benefit of all mankind.

--- Space Act of 1958

The future cannot be predicted, but futures can be invented.

--- Dennis Gabor

I had the ambition to not only go farther than man had gone before, but to go as far as it was possible to go.

--- Captain Cook (on his voyage to the Pacific)

The important thing is not to stop questioning.

--- Albert Einstein

Man's mind and spirit grow with the space in which they are allowed to operate.

--- Krafft A. Ehricke, rocket pioneer

There shall be wings! If the accomplishment be not for me, 'tis for some other. The spirit cannot die; and man, who shall know all and shall have wings

--- Leonardo da Vinci (1452-1519)

Destiny is not a matter of chance. It is a matter of choice. It's not a thing to be waited for - it is a thing to be achieved.

--- William Jennings Bryan

Here men from the planet Earth first set foot upon the Moon July 1969, A.D. WE CAME IN PEACE FOR ALL MANKIND.

--- Apollo 11 plaque left on Moon.

In the long run men hit only what they aim at.

--- Thoreau

The dogmas of the quiet past are inadequate to the stormy present.

--- Abraham Lincoln

Education is a progressive discovery of our own ignorance.

--- Will Durant, American historian

The committee judged the promises and offers of this mission to be impossible, vain, and worthy of rejection: that (it) was not proper to favor an affair that rested on such weak foundations and which appeared uncertain and impossible... - Talavera Commission, 1491, turning down Christopher Columbus' proposal for finding a new trade route to the Indies.

--- Queen Isabella of Spain later funded the project.

Even if you're on the right track, you'll get run over if you just sit there.

--- Will Rogers, American Humorist, 1879-1935

If you don't know where you're going, you'll probably end up somewhere else.

--- Yogi Berra, former New York Yankee catcher

The man with a new idea is a crank until the idea succeeds.

--- Mark Twain

There is nothing so far removed from us to be beyond our reach, or so far hidden that we cannot discover it.

--- Rene Descartes

Quotation from Charles A. Lindbergh -- "Whether outwardly or inwardly, whether in space or time, the farther we penetrate the unknown, the vaster and more marvelous it becomes."

--- Robert Wise, Director of "Star Trek"

Space by itself, and time by itself, are doomed to fade away into mere shadows, and only a kind union of the two will preserve an independent reality

--- Douglas Adams

Space flights are merely an escape, a fleeing away from oneself, because it is easier to go to Mars or to the moon than it is to penetrate one's own being

--- Albert Einstein-

That intelligent creatures exist in outerspace is proven by the fact that they have not contacted us

--- Joseph Joubert

This is the first convention of the space age - where a candidate can promise the moon and mean it.

--- Thomas Mann

SAYINGS ON TIME

The best thing about the future is that it comes one day at a time.

--- Abraham Lincoln

Patience and time do more than strength or passion.

--- Jean de La Fontaine

Time is what we want most, but what we use worst.

--- William Penn

We must use time wisely and forever realize that the time is always ripe to do right.

--- Nelson Mandela

Until you value yourself, you won't value your time. Until you value your time, you will not do anything with it.

--- M. Scott Peck

The future is something which everyone reaches at the rate of 60 minutes an hour, whatever he does, whoever he is.

--- C. S. Lewis

You can never plan the future by the past.

--- Edmund Burke

You may delay, but time will not.

--- Benjamin Franklin

I must govern the clock, not be governed by it.

--- Golda Meir

The time I kill is killing me.

--- Mason Cooley

--- Everything happens to everybody sooner or later if there is time enough. George Bernard Shaw

Wisdom is the power to put our time and our knowledge to the proper use.

--- Thomas J. Watson

What then is time? If no one asks me, I know what it is. If I wish to explain it to him who asks, I do not know.

--- Saint Augustine

Time moves in one direction, memory in another.

--- William Gibson

But time growing old teaches all things.

--- Aeschylus

Lose not yourself in a far off time, seize the moment that is thine.

--- Friedrich Schiller

Both young children and old people have a lot of time on their hands. That's probably why they get along so well.

--- Jonathan Carroll

Time brings all things to pass.

--- Aeschylus

Time has a way of demonstrating that the most stubborn are the most intelligent.

--- Yevgeny Yevtushenko

Time is the longest distance between two places.

--- Tennessee Williams

I want to go ahead of Father Time with a scythe of my own.

--- H. G. Wells

Time is the wisest counselor of all.

--- Pericles

Time goes, you say? Ah, no! alas, time stays, we go.

--- Henry Austin Dobson

Time, whose tooth gnaws away everything else, is powerless against truth.

--- Thomas Huxley

Time is the father of truth, its mother is our mind.

--- Giordano Bruno

Well-timed silence is the most commanding expression.

--- Mark Helprin

Time is the school in which we learn, time is the fire in which we burn.

--- Delmore Schwartz

The trouble with our times is that the future is not what it used to be.

--- Paul Valery

There's time enough, but none to spare.

--- Charles W. Chesnutt

Time is a dressmaker specializing in alterations.

--- Faith Baldwin

In everyone's life, at some time, our inner fire goes out. It is then burst into flame by an encounter with another human being. We should all be thankful for those people who rekindle the inner spirit.

--- Albert Schweitzer

Our greatest weakness lies in giving up. The most certain way to succeed is always to try just one more time.

--- Thomas A. Edison

I value the friend who for me finds time on his calendar, but I cherish the friend who for me does not consult his calendar.

--- Robert Brault

Change will not come if we wait for some other person or some other time. We are the ones we've been waiting for. We are the change that we seek.

--- Barack Obama

Your time is limited, so don't waste it living someone else's life. Don't be trapped by dogma - which is living with the results of other people's thinking. Don't let the noise of others' opinions drown out your own inner voice. And most important, have the courage to follow your heart and intuition.

--- Steve Jobs

The tree of liberty must be refreshed from time to time with the blood of patriots and tyrants.

--- Thomas Jefferson

We must reject the idea that every time a law's broken, society is guilty rather than the lawbreaker. It is time to restore the American precept that each individual is accountable for his actions.

--- Ronald Reagan

You can fool all the people some of the time, and some of the people all the time, but you cannot fool all the people all the time.

--- Abraham Lincoln

We shall not cease from exploration, and the end of all our exploring will be to arrive where we started and know the place for the first time.

--- T. S. Eliot

All the world's a stage, and all the men and women merely players: they have their exits and their entrances; and one man in his time plays many parts, his acts being seven ages.

--- William Shakespeare

Time is too slow for those who wait, too swift for those who fear, too long for those who grieve, too short for those who rejoice, but for those who love, time is eternity.

--- Henry Van Dyke

Our greatest glory is not in never falling, but in rising every time we fall.

--- Confucius

Children begin by loving their parents; after a time they judge them; rarely, if ever, do they forgive them.

--- Oscar Wilde

Whenever you find yourself on the side of the majority, it is time to pause and reflect.

--- Mark Twain

Patriotism is supporting your country all the time, and your government when it deserves it.

--- Mark Twain

Experience hath shewn, that even under the best forms of government those entrusted with power have, in time, and by slow operations, perverted it into tyranny.

--- Thomas Jefferson

The time is always right to do what is right.

--- Martin Luther King, Jr.

There is no better than adversity. Every defeat, every heartbreak, every loss, contains its own seed, its own lesson on how to improve your performance the next time.

--- Malcolm X

In a time of universal deceit - telling the truth is a revolutionary act.

--- George Orwell

It is wonderful how much time good people spend fighting the devil. If they would only expend the same amount of energy loving their fellow men, the devil would die in his own tracks of ennui.

--- Helen Keller

Failure is simply the opportunity to begin again, this time more intelligently.

--- Henry Ford

Time you enjoy wasting, was not wasted.

--- John Lennon

Education is an admirable thing, but it is well to remember from time to time that nothing that is worth knowing can be taught.

--- Oscar Wilde

- **An intelligent man is sometimes forced to be drunk to spend time with his fools.**
  --- Ernest Hemingway
  The only time a woman really succeeds in changing a man is when he is a baby.
  --- Natalie Wood
  Someone's sitting in the shade today because someone planted a tree a long time ago.
  --- Warren Buffett
  If patience is worth anything, it must endure to the end of time. And a living faith will last in the midst of the blackest storm.
  --- Mahatma Gandhi
  If you have an important point to make, don't try to be subtle or clever. Use a pile driver. Hit the point once. Then come back and hit it again. Then hit it a third time - a tremendous whack.
  --- Winston Churchill
  How did it get so late so soon? Its night before its afternoon. December is here before its June. My goodness how the time has flewn. How did it get so late so soon?
  --- Dr. Seuss
  Our duty is to encourage every one in his struggle to live up to his own highest idea, and strive at the same time to make the ideal as near as possible to the Truth.
  --- Swami Vivekananda
  Someday, after mastering the winds, the waves, the tides and gravity, we shall harness for God the energies of love, and then, for a second time in the history of the world, man will have discovered fire.
  --- Pierre Teilhard de Chardin

All things are subject to interpretation whichever interpretation prevails at a given time is a function of power and not truth.

--- Friedrich Nietzsche

Employ your time in improving yourself by other men's writings, so that you shall gain easily what others have labored hard for.

--- Socrates

The fear of death follows from the fear of life. A man who lives fully is prepared to die at any time.

--- Mark Twain

Always remember that the future comes one day at a time.

--- Dean Acheson

Nothing in life is to be feared, it is only to be understood. Now is the time to understand more, so that we may fear less.

--- Marie Curie

When we were children we were grateful to those who filled our stockings at Christmas time. Why are we not grateful to God for filling our stockings with legs?

--- Gilbert K. Chesterton

I suppose leadership at one time meant muscles; but today it means getting along with people.

--- Mahatma Gandhi

The test of a first-rate intelligence is the ability to hold two opposed ideas in mind at the same time and still retain the ability to function.

--- F. Scott Fitzgerald

The only reason for time is so that everything doesn't happen at once.

--- Albert Einstein

The time you enjoy wasting is not wasted time.

--- Bertrand Russell

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