

THE PHYSICS OF TIMELINESS

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ABSTRACT: The nature of time is yet to be fully grasped and finally agreed upon among physicists, philosophers, psychologists and scholars from various disciplines. Present paper takes clue from the known assumptions of time as - movement, change, becoming - and the nature of time will be thoroughly discussed.

The real and unreal existences of time will be pointed out and presented. The complex number notation of nature of time will be put forward. Natural scientific systems and various cosmic processes will be identified as constructing physical form of time and the physical existence of time will be designed.

The finite and infinite forms of physical time and classical, quantum and cosmic times will be delineated and their mathematical constructions and loci will be narrated.

Thus the physics behind time-construction, time creation and time-measurement will be given.

Based on these developments the physics of Timelessness will be developed and presented.

KEYWORDS: physical time, psychological time, finite and infinite times, scalar and vector times, Classical, quantum and cosmic times, timelessness, movement, change, becoming

INTRODUCTION:

“Our present picture of physical reality, particularly in relation to the nature of time, is due for a grand shake-up—even greater, perhaps, than that which has already been provided by present-day relativity and quantum mechanics” [1]. Time is considered as

one of the fundamental quantities in physics. Second, which is the duration of 9,192,631,770 cesium-133 atomic oscillations, is the unit. We generally believe that we know what time is. But our understanding of time is not unique [1-17].

EVOLUTION OF CONCEPT OF TIME:

Time has many forms, structures, natures and has been viewed, defined and understood variedly [2-17]. Ancient Indian thinking contributed to the concept of time. The essence of ancient Indian thought on time appears to be the identification of three major characteristics of processes i.e., the beginning, the ongoing and the end. Ancient Indians stated that time passes in a cyclic way [6].

Ancient Chinese felt that time is discontinuous. It is with the Greek philosophers, the different and mutually *contradicting* views about time started flourishing. Plato is the first to distinguish time as it is in itself from our awareness of time and from events in Time. He regarded Time as being actually produced by the revolutions of the celestial sphere. Zeno related Time to motion. Pythagoras tended to identify the chronological with the logical. Aristotle, possibly influenced by Pythagoras felt Time as counting of motion in respect of before and after. He regarded Time and motion as reciprocal. He concluded that Time does not exist without motion. Thus for Aristotle, Time is a numerable aspect of motion. Plotinus objects to this aspect of Time when he says “*motion time can not be, since motion takes place in time*”. For Heraclitus time signifies the period of world from its function to its destruction and rebirth.

Galileo has represented time as a geometrical straight line. Barrow said that time is the continuance of anything in itself in its own being. Newton felt that an “absolute time” exists, whose equable flow is independent. Thus he says “Absolute, true and mathematical Time of itself and from its own nature flows equably, without relation to anything external. Leibniz felt the order of successive existents as time. Kant perceived time as an aspect of our experience and denied it an existence in external reality. Einstein criticized the classical concept of universal simultaneity. He provided the term relative time. Human experience and observation sense two existences of time. They are physical existence and psychological existence [6]. Modern physicists like Stephen Hawking talk about real and imaginary times and also about the shape of time [3, 5].

Natural sciences such as physics, chemistry and biology understand physical existence of time variedly. *Movement, change and becoming* as given by Zwart [2] are three classifications of physical time. These may be understood by observing physical, chemical and biological processes as follows.

PHYSICAL TIME:**TIME IN THEORETICAL PHYSICS: THE PHYSICAL THEORY OF TIME:**

i) **Movement:** Matter and energy are engaged in all natural, man-made or man-initiated processes. Matter can exist as solid, liquid, gas (vapor) or plasma (ionic form of matter) at a given time and space. Energy can exist in many forms. Matter and energy can be in i) a state of rest or ii) in a state of motion. Aristotle opined Time as counting of and reciprocal to motion. Motion associated with matter can be translation, rotation and vibration and periodic or non-periodic. Plato opined Time to be generated by cosmological movements¹. Thus movement has been construed to be Time and also the cause of Time.

Time associated with movement, gives direction to time and sustains it as *vector* time. The same becomes *scalar* time when counting of that duration of movement is done. Position changes with velocity. But velocity need not change with position. (Ex; uniform or constant velocity)

**TIME OF THERMODYNAMICS, CHEMISTRY, BIOLOGY AND
EVOLUTIONARY BIOLOGY: PHYSICOCHEMICAL, CHEMICAL AND
BIOLOGICAL TIMES:**

Time is generally defined considering physics and cosmology only [3, 5]. But time occurs and plays a role in the same sense in chemical, biological and other natural sciences also which can be understood in terms of changes in and to matter, energy and entropy [4, 6].

ii) **Change:** The phase or state of matter is changed by energy and the form of energy is changed through matter [6]. Thus transformation of phase or state of matter or form of energy takes place with mutual influence. Natural or non-natural processes involve transformation of both matter and energy bringing out changes within or without of matter. Heat energy changes ice (solid) into water (liquid). This is the macroscopic change of phase of matter which reflects the microscopic change of phase of matter – atomic or molecular changes within the matter. Changes in the nucleus of an element also take place at the respective Energy and Time scales giving rise to nuclear changes of matter.

The atomic and nuclear changes take place involving rest and change of place (movement) of electrons, atoms and molecules in atomic and molecular spaces relating to respective micro-energy and Time-Scales Human sense organs can not sense all the magnitudes of these micro-energy changes and Time-durations which take place in micro (10^{-6} sec), nano- (10^{-9} sec), pico- (10^{-12} sec), femto (10^{-15} sec) times in micro- and

nano- spaces (nm, 10^{-9} m). Only specific sophisticated instruments alone can sense, monitor and gauge these micro – energy changes happening in micro (10^{-6} sec), nano- (10^{-9} sec), pico- (10^{-12} sec), femto (10^{-15} sec) and atto (10^{-18}) times [13]. Time associated with change and course of change gives direction to time and sustains it as *vector* time. The same becomes *scalar* time when counting of that duration of change is done. Thus all physical, chemical changes are *constructed* as Time with varied durations and intervals.

iii) ***Becoming***: Biology is the natural science dealing with living systems. We will be aware of physical changes of an organism – the result of physicochemical changes within - as growth or decay. A plant *becomes* a tree. A girl *becomes* youthful. These two *becomings* are growth of organisms. Tree *becomes* dead wood. Youthful woman *becomes* an old woman. These two *becomings* are decay or degeneration of the organisms. The psychological process of a human being *becoming* angry and *being* peaceful after the anger subsides are also biological processes involving changes in and changes of psychic energy. Human knowing, learning, thoughts, perceptions, understandings and experiences are other mental processes which are *becomings* in psychic energy [9]. Evolution of universe; chemical evolution; molecular and macromolecular evolution, evolution of proto-cells, cells, tissues, organs and organisms, evolution of consciousness, all come under physical, physicochemical, chemical and biological times.

Thus all physical, chemical, biological matter has *phases* of origin, being/becoming and dissolution (cessation) which are *becomings* associated with matter and energy. Thus *becoming* has also been *construed to be* and *constructed as time*. Change and becoming are constructed as *scalar time*; Change in entropy taking place during change or becoming in chemical and biological processes gives direction to time. Thus time associated with change and becoming gives direction to time and sustains it as *vector* time. The same becomes *scalar* time when counting of that duration of change or becoming is done.

The above three insights of time as time essentially concern changes. Thus changes of phase or place of matter or change of form of energy can be construed as time. External monitoring of duration of these changes are measurements of time and passage of time. All these measurements concern physical time. Thus physical time consists of changes and measurement of duration of such changes. Simply, change is time [6].

All the above-mentioned time-intervals are the result of various physical-mechanical, thermal, optical, electrical, magnetic, electromagnetic, atomic, nuclear - changes or processes give raise to various intervals of time which help measurement of time through these respective spectroscopies developed. (See Table III, and V to VII).

THE MISSING OF TIME - TIMELESSNESS

A period is absent in the absence of a *process*. Duration is absent in the absence of a period. 'Time' is *absent* in the absence of duration. Thus time is *missing* in the absence of a process, natural or non-natural. Time is dependent on a natural or non-natural process for its being. It has no independent existence from the process or event or happening- physical, chemical, biological, psychological, cosmological, social, political, or likewise [6]. Such a physical existence as period and flow of a happening is the physical time.

Thus the being and becoming of matter/anti-matter and energy in a natural scientific process or cosmic process is physical time. The absence of such a happening is the missing or absence of time or timelessness. Thus missing of happening of a process, natural scientific or cosmological will be timelessness as no matter changes its phase by the aid of energy or energy changes its form through matter. (See tables I and II).

In this sense theory of relativity is not dealing with any physical time.

ON THE REAL AND UNREAL EXISTENCE OF TIME:

In light of expression of varied, (Tables I to III), contradicting and different views of time, philosophers tended to divide themselves into "process philosophers" and "philosophers of the manifold" to understand and express about the nature of time. "Process philosophers" hold that the flow of time (or human advance through it) is an important metaphysical fact. But the "philosophers of the manifold" hold that flow of time or human advance through time is an illusion. Here an attempt is made to consolidate currently available different views, concepts and senses in relation to time in natural sciences, cosmology, ancient Indian expressions of time and comment on our keeping universal time, the notion and experience of passage of time and on the existence of absolute, true and mathematical time separate from processes and timelessness from physics point of view.

Our observation and experience recognize physical and psychological existences to time.

THE CONSTRUCTIONS, STRUCTURES AND MANIFESTATIONS OF TIME - (TABLES V TO VII):

The *construction, structure and manifestation* of time in the various disciplines is different from that of modern physics and cosmology (see Table V). It is discussed here various constructions and structures of time in natural systems, including manmade.

CONSTRUCTION OF NATURAL SCIENTIFIC SYSTEMS OR PROCESSES AS TIME: PHYSICAL EXISTENCE:

Human observation and experience recognize physical and psychological existences of time.

Thus :

Movement has been construed to be time and also the cause of time.

All physical and chemical changes are constructed as time.

All physical, chemical and biological matter has phases of origin, being / becoming and dissolution (cessation) which are becomings associated with matter and energy.

Thus becoming is construed as time.

And time manifests in various ways during happening of these physical (including cosmological), chemical, physicochemical, biological as various physical quantities. (See Fig I and Table V).

The observation of them demonstrates that the locus of time-flow is none other than the course of the path and direction of the course of the process selected. Actually there is no passage of time. There is only ongoing of processes involving changes to matter and energy. If the ongoing of process is not taking time is not present and it is timelessness.

PHYSICAL TIME MEASUREMENT AND FLOW OF TIME:

When we analyze it would be interesting to note that in all time-measuring devices, internally an energy transformation takes place (Table III). This energy transformation within; takes place as, a non-periodic, linear or periodic process. The energy-presence (being) and energy transformation (becoming) there-in, are the result of a mechanical, electrical, electronic or atomic process taking place and going on within the clock and the same is manifested as movement of hands or display of digits on the dial depending on the technology used. Thus *energy-presence* and *transformation* of that energy from one form to another form are essential for time-measurement, to monitor passage of time and even *for time to exist*.

Energy-Presence (Being) gives scope for durational aspect of time. Thus *Energy-Presence* is *Time-Space*. Time-space as Energy-Presence can be termed *Static Time* or *Time at Rest*. Transformation of such an Energy-Presence creates time-flow or passage of time. This time-flow within a clock monitors the time-flow or time-taken concerning an *external* on-going process-physical, chemical, biological, astronomical, cosmological or psychological. Energy-Transformation is the time-flow aspect of time which when divided as seconds etc., becomes metrical aspect and is the dynamic aspect of time. So energy-transformation is *Dynamic Time* or *Time in Motion*. The measure of this Energy-

Transformation decides the speed of respective time-flow.

From Newton's laws of motion we know that a body is in a state of rest or uniform motion unless acted upon by external force. Inertia signifies the state of rest and velocity signifies the state of motion. Potential energy is the state of rest and kinetic energy is the state of motion for energy. State of rest or uniform motion (being) gives time-space and change in these (becoming) gives time-flow. Thus inertia (potential) and movement (kinetic) are implicit and associated with a body/charge/particle in a physical phenomenon. Mass is inherent to inertia and location and shape of matter and static-charge to potential energy and velocity is inherent to movement and time is explicit and non-inherent to a physical phenomenon. Change of velocity and/or acceleration can influence movement but change of time can not and will not. Thus the above discussed nature of time as dependent on energy and energy transformation points to review the status of time as a fundamental physical quantity.

The concept and notion that processes take place in time is not the reality. Time does not pre-exist processes-natural or non-natural- and is only constructed as duration by natural forces initiating, sustaining and terminating such respective processes. The reality that change - as movement or change or becoming - defines, manifests and constructs time is to be realized. Time is a consequence and not cause of processes. The presence of a universal time passing either absolutely or relatively is to be denied. A lot of contemplation about the non-presence of time: annihilation of time; eternity; instantaneous happening; absence of happening must take place for arriving at a clear insight of nature of time.

Matter or energy at rest or in motion or under transformation is the physical manifestation of time and constitutes physical time. The physical manifestation of flow of time or passage of time is ongoing of processes involving transformation of energy through matter or change of phase of matter by the aid of energy. Matter- or Energy-Presence is **Time at Rest** or **Static Time** or **Time-Space** or **Durational** aspect of time. Matter- or Energy-Transformation is **Time in Motion** or **Dynamic Time** or **Time Created** or **Metrical** aspect of time. Time-Space is defined, created, controlled and ceases to be depending on Energy-Presence and the energy/matter available and amenable for and cause of transformation. Time is not a physical quantity. Time is awareness. Time is a sense. Passage of time is an observation and a mental experience in a particular conscious state of mind. Rise and fall of and flow of conscious states of mind and thoughts and other mental functions constitute psychological time. Psychological past is a record of happenings and psychological future is an apprehension about happenings caused by the egoistic mind during the passage of physical time. Both psychological past and psychological future are thought-

forms in the physical present involving psychic energy transformations in the wakeful and dream conscious states of mind.

THE FOLLOWING PHENOMENA ARE NORMALLY ASSUMED AS THE
PASSAGE OF TIME [10] -TABLES IV TO VII):

- a. Movement –translation, rotation or vibration– (or transition) of matter in space.
- b. Changes in the state or phase of matter (by the aid of energy).
- c. Transformation of energy from one form to another form either through matter or otherwise.
- d. Being and becoming (growth and decay) of organisms.
- e. The in-built order of happenings guided by natural forces in natural or non-natural processes.
- f. The ability of human mind to perceive, record, retrieve and expect various happenings taking place in physical time.

If any of the above is not taking place, time is not passing and this duration is vast time-space (durational) of timelessness.

QUALITATIVE TIME (VECTOR OR IMPLICIT TIME):

Time is thus an implicit physical quantity like mass only in the sense that it is constructed by respective natural forces, phases of matter, forms of energy and interactions among them during the course of the process.. Time is also an inherent physical quantity like velocity, force, energy etc, only when the duration and course of the process are constructed by above mentioned physical quantities. Time differs in *quality* when *constructed* in different processes-physical, chemical, biological and cosmic. Quality of qualitative time depends on nature of phase of matter and natural forces constructing the duration and the nature of energy-forms involved and their range. The durations are *constructed* differently for different processes-physical, chemical, biological, cosmological, psychological etc., *Qualitative time is constructed by the respective process guided by respective natural forces and never pre-exists the process.* Thus time is caused by the processes and follows the course of processes forming its locus and is solely determined by the natural forces that cause the course of the process. *The direction of the course of the process is the direction of time and its passage*

QUANTITATIVE TIME (SCALAR OR EXPLICIT TIME):

Quantitative time is *external* measurement of or count of, elapse of durations of

qualitative time created by natural forces involved. Quantitative time never influences the duration or course or otherwise of the processes.

Momentum and velocity can be simultaneously precisely measured for macroscopic bodies because of their large masses and sizes and also “less” velocity associated with them when they are in motion.

In addition the energy transformation associated with such processes is *continuous*.

Momentum and position of a fundamental particle cannot be simultaneously precisely measured (uncertainty principle) because of the tiny size and small mass but normal values of charge and large magnitudes of velocities attained or proximity in nano - spaces for the exchange of charges associated with ionic phase of matter. Mass plays dominant role in macroscopic world. Charge and velocity associated with the particle play dominant role in micro- and nano-scopic world. We cannot conduct an experiment in reality where ‘a photon’ strikes ‘an electron’. Such an experiment is only a thought-experiment. Existence and consciousness of time and passage of time are of three kinds: Annihilation of time is termination of a process or eternal happening; instantaneous happening or absence of happening.

Duration of time of happening of a process or course of a process changes with energy transformation, energy absorption or energy emission or energy transfer (velocity change, frequency of rotation or vibration etc.), but energy transformation etc., will not change with change of time in a clock. Actually energy transformation etc., create passage of time and time interval. Division of passage of time as past, present or future is only human concern and is the result of human time-consciousness, memory and imagination or expectation. Shape of a wave is locus of mass or particle in motion. Time is created and constructed by physical, chemical, biological, psychological or cosmological processes or changes. Time originates with start of the process, evolves as duration entwined to the course of the process and gets terminated with the completion of the process. Durations of all phenomena (scientific, social, political, etc.) are correlation of these constructed times as durations with a uniform process going on in a clock or time-measuring device or calendar. This correlation by human mind is time-measurement and time-sense. When this correlation is done as hours, days, years etc., with an egoistic mind time-sense is created within and time-conscious mental world is created within of a human-being. Two differentiations/integrations take place at the same time and energy is expended to cover the distance/ displacement/ angular displacement/ amplitude of vibration

LOCI OF PHYSICAL TIME PASSAGE:

Figure I displays various propositions on the locus (Path) of time while ‘flowing’. Ancient Indians proposed cyclic path. We all modern people are following the idea of Galileo that path of time flow is a straight line, i.e., linear passage of time.

MATHEMATICAL CONSTRUCTIONS OF PHYSICAL TIME:

IMPORTANT PHYSICAL QUANTITIES ASSOCIATED OR CONNECTED WITH THE PHYSICAL QUANTITY TIME:

Time is constructed and manifested in different ways in the natural sciences. Velocity (v , m/s); acceleration (a , m/s²); force (N , kg. m/s²); Watt (W , power, heat-flow rate, J/s); frequency (Hz, 1/s); becquerel (Bq, 1/s); catalytic activity (kat, mol/s); inductance (H , Wb/A); magnetic flux density (T , Wb/m²); Weber (Wb, magnetic flux, V.s); volt (potential/electromotive force, W/A); coulomb (C, Electric charge, A.s); action (J.s) are important structures and manifestations of physical time. See also Tables I to VII and Figure I.

In the above physical quantities time occurring in numerator relates to duration of process while time in denominator relates to rate of conversion of energy.

The above physical manifestations of physical time associated with various physical quantities can be understood using mathematics as follows:

CALCULUS:

Time is always explicit to process as external monitoring measurement and never influences the course of the process [6, 7]. *Time only measures the duration of the process and never determines the duration of the process.* Duration of the process is determined solely by phase of matter/anti-matter or forms of energy undergoing change and the natural forces causing the change. The time intervals are only indicators of extent of happenings and are mere numerical measure of such extensions. Differentiation is measurement/counting of time and gives an idea of speed of happening of and the course of the process. Integration gives an idea of duration of the process.

Velocity = change in position/change in time = $v = dx/dt$, the first derivative
 Acceleration = change in (change in position/change in time)/ change in time = $a = d^2x/dt^2$ = second derivative.

This is the traditional representation of velocity and acceleration. The same thing can be viewed as follows:

Velocity is integrated acceleration over a time period (with respect to external

monitoring of speed and duration of energy transformation causing movement). Distance is integrated velocity over same time period (with respect to external monitoring of duration of movement). Energy or its transformation is integrated entropy over a period of time (with respect to external monitoring of duration of change or becoming). Reaction is integrated rate of reaction over a period of time (with respect to external monitoring of duration of reaction).

An object moves only because of its velocity and not because time is passing (moving). Actually velocity creates time (in a reciprocal way) and acceleration gets integrated into velocity during the same 'time of happening' as provider of 'direction' to elapse of time constructed during the process (movement). Integration of velocity into distance is consequence of integration of acceleration (by expending energy) into velocity. The time taken to cover a distance is thus constructed by simultaneous (or consequent) to integration of acceleration into velocity and subsequent integration of velocity into time of elapse of process (movement). Depending on acceleration (quicker transformation of energy which moves the body forward) or deceleration (relatively slower transformation of energy which moves the body in the reverse direction) make the velocity increase or decrease and hence the time duration decrease or increase many times during a motion and thus influence the overall period of duration of motion. If the velocity is uniform, then there is a constant rate (in relation to monitoring clock) of transformation of energy as acceleration i.e., constant rate of change of energy transformation reflected as uniform velocity.

Thus velocity integrates over time to cover distance. Acceleration integrates over time into velocity causing movement by converting energy into motion. The 'time' here is specific and absolute to the movement under study and is not related or the effect of passage of external universal time.

If a is acceleration, v velocity and x distance covered or displacement taken place, in time dt , we can mathematically represent,

$$\begin{aligned} \text{Velocity} = v &= \int a \, dt \\ \text{Distance covered or displacement taken place} = x &= \int v \, dt = \int \int a \, dt \end{aligned}$$

Acceleration pre-exists velocity. Conversion or transformation of energy creates acceleration and if the transformation is in the opposite direction, deceleration is created. These further create or de-create increase or decrease velocity. Velocity helps the body to cover the distance or displacement takes place. This reverse construction of velocity and distance covered or displacement taken place as single and double integrals respectively of acceleration which in turn is manifestation of energy transformation is to be studied to have a correct insight of time as constructed in all

movements and associated changes. Velocity, the manifestation of acceleration which in turn the reflection of transformation of energy, is responsible for the construction of duration (time-period) of happening; the happening can be covering a distance.

It is well-known that a state of rest or a state of motion is available to a body at a given time. Inertia signifies and represents state of rest or uniform velocity (rotational inertia). Velocity which is indirect manifestation of energy transformation represents the state of motion of a body. Relativity comes into picture only when human concern of motion of a body sets in. Else left to it, it is just the ongoing of a movement or process.

The relativity concept initiated by Galileo has evolved into special and general theories of relativity profoundly influencing our concept of time and space. Such an evolution and its physics implications are separately dealt in another following section in detail.

Velocity also signifies and represents energy conversion and *passage of time* in rotational and vibration motion. Angular acceleration, angular velocity and angular displacement take the places of their linear counter parts. In vibration motion also velocity plays the same role and in addition frequency also represents and signifies energy conversion. This frequency becomes prominent when atomic, molecular, nuclear processes and transitions, and electromagnetic radiation are considered. Dual nature of matter and energy further turn the concept of time, the insight of manifestation of energy-presence and transformation more complex. Quantum processes are created when energy transformation, emission, absorption or transfer happens in discrete quantities. The discontinuous nature of energy transformation defines structures and manifests time differently in quantum processes. Thus the *quality* of time in and associated with quantum processes is different from the classical nature of time associated with classical processes in which the energy transformation is continuous.

Thus *classical* and *quantum* times associated with classical and quantum transformations of energy and or matter/anti/matter are structured, constructed and manifested differently. The same is true about cosmic time, the time associated with origin etc., of the universe or cosmos. This cosmic time is mistaken as universal time. As is pointed out by Ramabrahmam [7], no universal time exists in an absolute or relative way.

In the light of this understanding, an idea about the evolution of relativity concept and its culmination as special and general relativity and their implications on the construction and concept of time will be useful to comment on theories of relativity, origin of universe and related changes associated with universe become clearer and concept of time will be rid of intellectual confusions, and clarity sets in.

RIEMANN MATHEMATICS AND GEOMETRY: INFLUENCE OF CURVATURE OF SPACE ON PHYSICAL WORLD:

The next substantial step in the development of the geometry of space was by Bernhard Riemann. It is about the hypotheses lying at the foundation of geometry. He incorporated into his theory the mathematical apparatus available then for describing the geometry of two-dimensional curved surfaces and his own new concept of a multi-dimensional manifold (multiply extended geometrical objects). A surface is thus a two-dimensional manifold; a space is a three-dimensional manifold. All the ideas and methods used to describe two-dimensional surfaces can be directly applied to three-dimensional curves spaces. Among the notions used, the most important one is the metric, i.e., the quadratic form for the differences between coordinates, which describes the length of the interval between two neighbouring points in a curved manifold.

This successful integration of ideas enabled Riemann to advance when constructing both particular cases of non-Euclidean spaces and a theory of arbitrarily curved spaces. Riemann's gets the credit for the development of our ideas about the relationship between geometry and physics. Einstein emphasized that this contribution of Riemann led us to the challenging idea that the geometrical relationships between bodies might depend on a physical cause, that is, on forces. Thus, by way of a purely mathematical analysis he discovered that geometry and physics might combined. (This was actually realized seventy years later in the general theory of relativity, which combined geometry and the gravitation theory).

Earlier William Clifford developed the idea that the physical properties of matter and the properties of curved space were related. Clifford wondered whether we could be wrongly interpreting as physical changes that in reality arose due to the curvature of space. He felt that it might be that all or some of the forces that we call physical originate from the geometry of our space. Ernst Mach clearly understood the weaker aspects of classical mechanics and was close to the general theory of relativity. He played an important role in the preparation of the conditions for the creation of the general theory of relativity. His idea was that geometry is brought to life through mathematics applied to our experience gained with relation to space.

In 1903, i.e., on the very threshold of the creation of general relativity, Mach gave a detailed analysis of the mathematical and physical aspects of the geometry of space in a paper called *Space and Geometry from the Viewpoint of the Natural Sciences*. In the same article he cited and explained the contributions of the appropriate scientists such as Lobachevski, Bolyai, Riemann, and Gauss. His idea was that geometry is brought to life through mathematics applied to our experience gained with relation to space. It is

interesting that Einstein's creative genius was influenced by Mach's ideas. Whilst he was working on the general theory of relativity, he was convinced that he was realizing Mach's ideas.

In retrospect we can say that early in the 20th century all the ground work necessary for the formulation of the general theory of relativity had been laid. The scientific community of the time was ready to assimilate the physical manifestations of the curvature of space. A number of outstanding geometers had developed the necessary mathematics of curved multidimensional manifolds (Riemann geometry), but two elements were still missing. First there was the unification of space and time in the framework of a four-dimensional manifold, which was completed in the special theory of relativity.

Secondly, the theory of gravitation was to catch the eye of physicists. Finally, both elements came into being Henri Poincare in his *About the Dynamics of the Electron*, took the first step since Newton towards a real gravitational theory; he attempted to build it into the framework of the space-time of the special theory of relativity.

A close study and further contemplation of the above presentations about evolution of relativity and Riemann mathematics and geometry together with the discussion about kinds of time- classical, quantum and cosmic- discussed in the earlier part of the article, informs that mathematics has to only help in expressing physical phenomenon and cannot and should not replace physical natural forces present and associated with matter, anti-matter, charge and relevant energy forms and their transformations. And when it does not tell anything about physics involved, it ceases to help in the further understanding of physical phenomenon. Thus physical significance about physical phenomenon must not be allowed to be lost in advanced and higher mathematical representations. Mathematics must highlight and express and explain the physical phenomenon and must not obscure or confuse understanding of physical realities. At no time geometry of space can determine about matter, anti-matter, charge and their actions, reactions, interactions and the like but only relevant physical forces and energy transformations which initiate, guide, sustain and terminate physical phenomenon must get attention, prominence and priority. This aspect is further discussed as follows.

In all the above presentation, the matter or energy or their transformation are not at all referred to. All this is completely mathematical with no physics involved. These are mere Gedanken experiments and intellectual exercises with no physical significance. This clearly shows the dominance of advanced mathematics over physical principles and physics insight of processes, time and passage of time.

ON THE BEING AND BECOMING OF MIND – TIME SENSE AND TIME
TRANSCENDENCE AND TIMELESSNESS (9, 10, 13-14):

Physical present is same everywhere in the universe and only observation and counting are at different instants. Counting of physical present is a function of geographical location. Continuous presence or continuous flow of matter or energy without transformation or change is Time-transcendence or Thought-transcendence or Timelessness. That means continuous state of rest or of uniform motion is Timelessness. Time flow signifies the speed of conversion of energy in a process. It is manifested as acceleration in movement and as entropy in change and becoming. ***Time flow is a measure of Being (presence) and Becoming (transformation) of matter and energy in space.*** An *energy- presence* and the *transformation* of that energy from one form to another form are essential for time flow, time-measurement, to monitor the passage of time and even for *time to exist*.

Time is explicit and non-inherent to a physical phenomenon. Time is a consequence of and consequence with processes. There is no time exclusive of process influencing the process.

Inertia, static charge or non-activity concerning matter/antimatter or energy or atomic and nuclear energy levels confers the scope for time-space. Change or transformation of inertia or static charge or activity of matter/antimatter or energy or energy transitions creates time-flow.

There is no time by itself. And there is no passage of time. There is only ongoing of processes.

An when there is no ongoing of processes – natural scientific, man-made or cosmological) the “period of timelessness sets in.

PSYCHOLOGICAL OR MENTAL TIME:

Philosophy of mind and thought processes:

IDEAS OF INDIAN SCHOOLS OF THOUGHT ON THE NATURE OF TIME:

(a). *Upanishads:*

Prajnaanam Brahmaa : Awareness of Self (Atman) is Time (Upanishads).

Prajnanam is divided as Jagrat, Swapna, Sushupthi and Jagrat-sushupthi is Atma Dasa.

DRISTYAHA --- CONSCIOUSNESS AND AWARENESS ATMA DRISTIHI SADAA VIDYATE : Maanasika dristihi atmadrityaam upari adhyasa. Mental awareness is superposition over the Consciousness.

Atma dristihi Visranta dristihi (Unoccupied awareness): Maanasika driste dve; Bahirmukha Dristihi (awareness of without of the body) Aantarmukha Dristihi (awareness of within of the body) iti.

Pure Consciousness transcends Time and Space Consciousnesses.

(b). *Suddhaadvaita*:

Consciousness of Time and Space are not real.

(c). *Saktaadvaita*:

Time and space are synonyms of energy

(d). *Vedaanta*:

Transformation of *Chit* (psychic) energy is Time (*Vedanta Darsana*).

Kaalah parinaamaha (Time is transformation); kaalaha saktyaaha parinaamaha (Time is transformation of chit-energy. (Viswa Meemaamsa).

(e). *Nyaya - Vaisesika System*:

In the *nyaya-vaishika* pluralistic school time along with space are but two of nine equally fundamental realities. As one of the transcendent realities, time is conceived as static; it does not flow as described by western scientists like Newton. As such Time cannot be directly perceived but only inferred from motion or change. Nevertheless, time is regarded as a necessary condition for change and movement. In other words, changes are time, time itself cannot change.

(f). *Samkhya-Yoga System*:

For the dualistic *Samkhya-Yoga* schools, time and space are irreducible realities. *Purusha* (Consciousness) and *prakruti* are the underlying ground or principle which makes possible all movement and becoming. In these traditions, time is considered absolutely inseparable from change, or becoming or motion which are essential characteristics of *prakruti*. It has been said that the contact of *prakruti* and *purusha* is affected through the element of time. (this is nothing but consciousness becoming, the combination of awareness – mood, thought/feeling, utterance).

(g) : *Advaita school of Samkara*:

Only timeless *Brahman* is real, time itself has no absolute reality. The ultimate individual Self, also beyond the ensnaring concerns of this world, is *Atman* -- the indestructible spirit of Brahman present in men and women.

Time, Space and the Universe are seen as but transient manifestations which arise from repetitively during the *jagrat (bahirmukha dristi state)* and *swapna (antarmukha dristi state)* conscious states and return to *Brahman* during *sushupti* and *jagrat sushupti* conscious states of mind also known as *visraanta drishti* states.

Kaalaha tu avidyaiva tasyaa eva sarvaadhartaat – Siddhanta Bindu, Pa: 16

Time is sensed because of perception of mind of energy transformation as thoughts consciously or otherwise during the wakeful and dream conscious states.

The individual's experience and observation of time and passage of time:

Human-beings perceive past, present and future during the course of their lives.

Past and future exist only because of human observation, concern, monitoring, counting, recording and expectation in the physical present.

Human experience of time as past, present or future and observation of time as an elapse taking place during course of a process are different. The physical time flow associated or absorbed in an ongoing process is never experienced by humans. It is only measured. Natural or non-natural processes are eternally present guided by respective natural forces irrespective of human observation.

Ancient Indian View: (6,9)

All the events that take place during the physical time are followed by humans with an egoistic mind. Such an identification of 'I', 'me' and 'mine' with individual (himself or herself), objects, persons, events, ideas, nations... etc., creates a "psychological time in us". Such a 'mental time' is created in the *Jagrata* (Wakeful/Awakened) Conscious State of mind. Wakeful/Awakened, Dream (*Swapna*), Deep Sleep (*Sushupti*) and Wakeful Sleep (*Jagrata Sushupti*) - are different conscious states of mind creating different phases of mind. They are structure and phases of Mental Time-Space.

Humans know/learn and express/teach in these conscious states of mind. These conscious states or phases of mind are the result of transformations of mental energies in the Unchanging and Ever-Present Awareness present as Energy-Presence during all these conscious states'. *Upanishadic* wisdom calls such an Awareness as *ATMAN* or *BRAHMAN*. *Atman* is normally referred to as SELF. *Atman* is present in us and is the result of the breathing process. According to Upanishads *Atman* is the Source of Mental-Energy. In modern scientific terms *Atman* can be termed as a bio-oscillator/bio-maser, which issues out psychic or mental energy pulses. *Atman* is the oscillating psychic Energy-Presence denoting and providing Mental Awareness and Time-Space.

As *Prajnanam*, or Continuous Conscious Awareness, *Atman* witnesses all our mental activities, related body activities and happenings within and without body and body's reactions as thoughts and organ-movements to these happenings. Being such an Awareness, *Atman* provides the energy required for guiding the mind to know/cognize/learn through sense organs, perceive, think, experience, understand, etc., and store such an information and retrieve the same in the conscious states described above and makes us conscious of ourselves and within and without ourselves. Such *continuous and simultaneous or alternate rise and set of the conscious states or phases of mind is an aspect of psychological time and its flow.*

Upanishads term Awareness of Self (*Atma Drishti*) as time. Awareness of the Self (*Atma Drishti*) is the mental phase without cognitions or cognition-related experiences taking place or retrieved (the Wakeful Sleep Conscious State). The three other conscious states – the Wakeful/Awakened, the Dream and Deep Sleep-Conscious

states are alternate super-impositions over this continuously present conscious state. This Wakeful Sleep conscious state of mind transcends both physical and psychological times and time-flows. This is the *original, normal or ground* state of mind and all mental activities are *excited states* of mind. *Antahkaranas* (inner mental tools) perform various mental activities which are transformations of psychic energy (virtual *chit-energy-maya*) to cognize and create or retrieve thoughts/perceptions/experiences/understandings/meanings/urges etc., in us. *Thought-flow within us, which is the psychic-energy change during conscious states, also constitutes and constructs psychological time, time-flow and sense of passage of physical time.* Thought process and thought-flow is the *becoming* of mental energy which makes us conscious of time and time-flow.

FEELING OF PASSAGE OF TIME-TIME-CONSCIOUS, TIME-UNCONSCIOUS AND TIME-TRANSCENDENT PHASES OF MIND

We are not conscious and aware of passage of time in the sense of physical time and also as the rise and set of conscious states or phases of mind and flow of thoughts/other functions of mind in the sense of psychological time, in deep sleep (*Sushupti*) conscious state of mind. Actually physical time measurement is only our concern and monitoring of various physical, chemical, biological, psychological, cosmological, political, historical, social etc., happenings. We are used to physical time being associated with the simultaneous revolution of earth around itself and the Sun and appearance and disappearance of Sun. This is a highly simplistic view. A more comprehensive view based on a cosmological happening which gets repeated every sixty years is the basis for the preparation of Indian almanacs¹⁵. Universal Time is our creation and maintained by atomic clocks for our usage and reference.

Consciousness becomes *consciousness plus awareness* during mental functions. Such a phase of awareness is the series of durations of single *chit* (psychic)-energy pulses of period $1/10^{\text{th}}$ of a second. These energy pulses when reflected in *Medha* (medulla oblongata/reticular formation?) form *Chidabhasa* (reflected *chit*) pulses. *Chidabhasa* is also called as *Maya* (the Current of Awareness) and *Pranavam* (Primordial Sound) [9].

When the reflected *chit-energy* (mental energy) pulses, constituting the current of awareness, are not transformed in *Medha* as *antahkaranas* and flow untransformed in the body, this phase of Mental Time-Space is known as Wakeful Sleep (*Jagrat Sushupti*) conscious state. When these reflected *chit-energy* pulses or *chidabhasa* or *maya* (virtual *chit-energy*) transform in *Medha* as *antahkaranas* – inner mental tools - *manas, buddhi ahankaram and chittam* - the Awakened/Wakeful (*Jagrat*) and Dream (*Swapna*) conscious states are on and function. These inner mental tools in the interplay of these two

phases of mind in the ever-present Wakeful Sleep (*Jagrat Sushupti*) conscious state cognize/know/learn objects and object-energy forms through active participation of sense and action organs, react through action organs, be aware of mental processes such as thoughts, perceptions, meanings, understandings experiences etc., During this phase of mental activity we are Time-Conscious, both of physical and psychological times which are energy transformations within and without body.

When the above mental activities involving reflected or virtual *chit* (mental) energy *-maya-* transformation cease to be and we are *conscious* but not *aware* of the calmness within us which is the result of such a cessation of mental activities, this phase of mind gives rise to Deep Sleep (*Sushupti*) conscious state. This conscious state is similar to zero in number system and vacuum in physical science. This *absence of mind* conscious state is useful in the cognition activities. This phase of mind is thought-free. Hence is time-consciousness-free mental state. During this mental state we are unaware of the passage of physical time and no psychological time passage takes place in the form of change of conscious states or rise and set of thoughts. Then experience of peace of mind exists and experienced and though we are unaware of this peace during this phase we will be aware of remnants of this blissful, peaceful, silent and time-conscious-free experience during the twilight of Deep Sleep and Awakened/Wakeful conscious states. This twilight phase is the phase of experience of the Self (*Atman*), also known as unoccupied awareness or pure consciousness. This is the already referred to Wakeful Sleep (*Jagrat Sushupti*) conscious state. Peace, Bliss, Silence and Time-transcendence are experienced during this phase because of absence of transformation of psychic energy *maya* (reflected or virtual *chit*-energy pulses) into *antahkaranas* (inner mental tools); and hence mental activities are also absent but mind is alert possessing awareness and functions producing respective mental activities if willed and required. This state of mind transcends both physical and psychological times and time-flows.

Ego, the self-consciousness, the collection of thoughts about 'I' as body and associated personality traits, social status, 'me' and 'mine', creates *vasanas* (impressions/experiences/memories) within us. All cognition/perception/volition/urge-related experiences are created and retrieved by the *antahkarana* (inner mental tool) *chittam*. Egoistic thoughts and actions (with the thought and sense of 'I', where 'I' is identified with respective individual) in Awakened/Wakeful and Dream conscious states creates memories (*vasanas*). These memories get activated later (with reference to physical time passage) and cause happiness or unhappiness accordingly in the present of physical time. The phase of mind bereft of egoistic thoughts, memories or other cognitions /perceptions/experiences is the state of Self (*Atman*, Ego-free, blissful, peaceful and is

Time-transcendent). The three other conscious states – the Awakened/Wakeful, the Dream and Deep Sleep Conscious states are transient super-impositions over this state simultaneously/alternately.

Memories and record of our experiences is our psychological past and our fears, anxieties, imaginations, expectations etc., are our psychological future. The thought-flow concerning these past and future in the form of memories activated as remembrances and fear, anxiety, anticipation, apprehensions, imaginations etc., consist of our psychological past and future and gives us the awareness of time and feeling of passage of time. Thus thought-flow (reflected *chit*-energy transformations) is the psychological time and its flow. Living in the ‘past or future’ in the present leads to peacelessness. The aim of spirituality is to enable one to cultivate the habit of living in the physical present with peace.

DISCUSSION:

No construction of classical and quantum times happens when no manifestations of energy or entropy transformations or change of phase of matter with the aid of energy in natural scientific or man-made processes, then timelessness sets in.

The structure and manifestation of time is different in different domains of activity and they constitute different branches of physics and other natural, cosmology and social sciences and philosophy. Time is also manifested as change and becoming in addition to movement. The two manifestations of time as change and becoming play important role in understanding the various physicochemical processes going on in living organisms and in the ageing process of organisms. Many biological processes are irreversible and time-asymmetric.

Matter or charge or energy in a state of rest is in *potential* form. Matter or charge or energy is in *kinetic* form in a state of motion or change. The potential form of matter or charge or energy is available and amenable to move, change or become resulting in a physical process². Similarly matter, charge and energy in *kinetic* form, under transformation or change or in the process of becoming in forward or reverse directions are *Time in Motion* and constitute physical and psychological times². These transformations, transitions, changes or becomings have finite durations and are physical manifestation of time and construct physical and mental times.

Thus Matter- or Energy-Presence without transformation is *Infinite Time-Space* and *Time at rest*. Matter- or Energy-Transformation is *Time in Motion* or *Dynamic Time* or *Time Created* or *Metrical* aspect of time. In this form time has finite nature. Finite Time-Space as duration of a happening is defined, created, controlled and ceases to be depending on Energy-Presence and the energy/matter/antimatter available and

amenable for and cause of transformation guided solely by the four natural forces. *Continuous* presence or continuous flow of matter or energy without transformation or change or *activity* is Time-transcendence or Timelessness. That means continuous state of rest or of uniform motion is infinite presence of time or Timelessness. Time flow signifies the measure of conversion of energy in a process. Time flow is a measure of **Being** (presence) and **Becoming** (transformation) of matter and energy in space. All physical, chemical, biological and cosmological processes create, contain and manifest time and its passage. Time has no existence in the absence of processes. Time becomes extinct when activity involving matter or energy ceases to be. *Activity is manifestation of transformation of energy.*

*If the transformation of energy is continuous and finite **classical time** is created. If the transformation of energy is discontinuous, discrete and finite, **quantum time** is created. The changes of and to the universe which are infinite in nature create **cosmic time**.*

Thus depending on the nature of energy transformation in the process, time can be classified as *classical time*, *quantum time* or *cosmic time* [7]. Classical time is created and constructed when energy absorption or emission or transformation is continuous. Quantum time is created and constructed when energy absorption or emission or transformation is discrete or discontinuous. Cosmic time is created and constructed by respective natural actions and interactions when happenings to Universe are concerned and observed. And it should be noted that these “*times*” are created and constructed by respective natural forces causing respective actions and interactions involving matter or anti-matter in respective processes taking place in respective ranges of space and durations of time-periods, and exist simultaneously independent of one another without influencing one another in any way, and observed just as durations of respective processes. There is no single independent universal time whose equable flow is absolute, or relative, true and mathematical of itself and of its own nature, flowing equably without relation to anything external. All “*times*” are the reflection and result of energy transformation taking place through matter or change of phase of matter or anti-matter by the aid of energy or otherwise.. Acceleration manifests and represents *passage of time* during motion or movement. Change of entropy manifests and represents *passage of time* in all other natural or non-natural systems. Systems change not because time is progressing but because of and under the influence of respective natural forces, forms of energy, nature of energy-transformation, absorption and emission, and phases and properties of matter involved.

SHAPE OF TIME: TIME HAS NO INDEPENDENT SHAPE OR LOCUS:
(TABLES V TO VII)

Just as time does not exist separate from space, time does also not exist separately from the process either in macroscopic or microscopic or cosmic processes. There cannot be a purely mathematical time devoid of or unrelated to any physical event even if such a one is constructed it remains only a mental conjecture.

The shapes or loci or forward and backward movement of time just as engine on a rail track, future meeting past etc., are mere human logical guesses and descriptions given to time in an attempt understand its nature. There is no path for time as there is no time independent of process. All paths of time are actually the courses taken by the processes. What appears bent is moving matter, when we talk about curling of time-space or warping of time. Here time is viewed as associated with motion or time is solely defined by motion or observation of motion (of matter). Time is just not motion but is also change or becoming. Merger or absorption of time dimension with the three space dimensions considers time to have an existence. Concept of time is only a creation of human mind to observe or follow the course of processes. Time is only a human notion. Time is only a human sense - the seventh sense. Passage of time is only ongoing of processes. Time needs processes for its being. In the absence of processes time is missing. Such a reality associated with time gives to time so many shapes, forms, loci and figures and all these attributions are human intellectual exercises only.

Time has no shape of its own. Just as liquid takes the shape of the vessel containing it and we assume that is the shape of liquid so also time takes the shape and locus of the process which is under observation and is studied to understand the nature of time. Events happening, processes taking place involving respective changes in matter/anti-matter and/or energy *in universe* are finite phenomenon. Events happening, processes taking place involving respective matter and/or energy *to universe* are *infinite*. Accordingly time becomes finite or infinite in relation to observed phenomenon.

Finiteness and infiniteness of time are relative to the domain of activity and the observer. Presence of observer is responsible for speculation and counting of time. Absence of observer to phenomenon relieves the necessity for time to exist in all its aspects. Time then is only the duration of start or initiation, going on and cessation of a phenomenon, the duration being solely controlled by the respective natural forces acting in relation to matter, anti-matter, energy and nature and contents of surroundings involved. Passage of time and *speed* of passage of time concerning an event are functions of the presence of an observer and also relative motion between the frames of reference holding event and observer.

Thus the time occurring in various branches of physics and other natural sciences

cannot be defined and structured in the same way though in measurement may be gauged as the duration of occurrence in seconds or fractions of second depending on the forces; the energies involved are different in nature and magnitude. Time and processes are intertwined with space. Also time is intertwined with processes. Space is necessary for processes to take place. Time need not pre-exist for processes to take place. Time is not responsible for processes to take place but *time starts, evolves and ends in tune with state or phase of processes*. The four natural forces concerning matter/anti-matter and energy are responsible for the initiation, sustenance and cessation of processes. Time is a *consequence* of actions and interactions among matter, anti-matter and energy.

If no action and interactions among matter anti-matter and energy in classical or quantum forms takes timelessness is said to be present.

REAL AND IMAGINARY TIMES: ORIGIN OF UNIVERSE ETC. AND NATURE OF COSMIC TIME AND COSMIC TIMELESSNESS:

Origin of the universe or other phenomenon concerning universe as expansion or contraction or beginning or end seem to dominate the expressions about the concept, nature and structure of time¹². Concerning time solely with the universe is side-stepping the study of nature of time. Deciding nature of time in relation to universe alone is incomplete assessment of nature of time and understanding of time. Our imprecise understanding of origin etc., of universe need not prevent us to have a clear understanding of the nature of time. The notion that higher and advanced mathematics alone can lead us to definiteness about the nature of time seems to be not in tune with the reality. Clubbing time with details of universe can be unnecessary. Nature of time can be conceived independent of origin of and other matters related to universe. Understanding the nature of time is different and separate to understanding the nature of origin of universe etc.,

On observation of nature including cosmos, it is evident that what can have a beginning and/or end is process, event or happening and not time. Time is as long as the process lasts and is absolute to the process. Zillions and zillions of such absolute times exist simultaneously associated with zillions and zillions of respective processes going on in the universe simultaneously, some affecting each and one another and most others not affecting any other at all.

What exists, therefore, is ongoing of processes - physical, chemical, physicochemical, biological, cosmological etc.,; that is all. There is no passage of time. The time associated with the origin etc., of universe is solely associated with the respective phenomenon concerning universe. String theory, M-theory, imaginary time, etc., can not make sense when time in music or ageing process or evolution is studied,

defined and counted. Universal time in the sense we are keeping can in no way influence the zillions and zillions of physical and chemical and other natural and non-natural processes taking place in the universe. Only the natural forces initiate, sustain and cause cessation to the processes. *Time period of happening is the consequence and not the cause of the processes.* The shape of time etc., relating to time concerning the universe can not be a model for times associated with the infinite number of various other macroscopic and microscopic simultaneous processes taking place in the universe untouched by the happenings to or in the universe. Theories of relativity, quantum gravity, String theory, M-theory, brane theory etc., have no relevance when nature of time is to be understood and expressed and explain the happenings, their sustenance and cessation in various living and non-living systems taking place in the universe individually, independently and simultaneously.

Just as different biochemical and biophysical processes take place in the human body simultaneously and parallel in a related or independent way so also zillions and zillions of physical and chemical and physicochemical processes take place simultaneously in the universe independently or affecting one another together with changes to universe.

Physical present is the real time. Both past and future are imaginary times. The real time becomes past as memory and real time becomes future as fear, imagination, apprehension, doubt or worry. Both past and future are thought forms in the physical present (Figure I). Imaginary nature of time is psychological; it is neither real nor physical. In the absence of human concern or monitoring or memory or apprehension or planning no past or future exist. Then even their imaginary nature becomes extinct. The reality which was, is and will be, is simultaneous ongoing of process, physical, chemical, biological, cosmological etc., unrelated or unconnected or non-influencing, each other or one another. Classical, quantum and cosmic times are originated, created, constructed, sustained and terminated depending on the phases of matter, forms of energy, their actions and interactions in the domain of activity, solely initiated, guided, and terminated, by relevant nature forces.

Unending processes taking place in this vast universe happen endlessly and it is also called timelessness in the ongoing of processes. Thus ongoing, natural scientific, man-made or cosmic processes, creates time and cessation of them is end of time for those respective processes. Cessation of taking of these processes is timelessness. Also ongoing of universal processes unendingly is also timelessness.

Velocity/rate of reaction and acceleration/entropy/quantum action are physical manifestations and measures of energy transformation and are inherent to motion/change/becoming and are responsible for the course of the process. Passage of

time, which is only our notion, is non-inherent and explicit to process and can in no way influence the course of the processes. Just as different biochemical and biophysical processes take place in the human body simultaneously in a related or independent way so also zillions of physical, chemical, biological and cosmological processes take place simultaneously in the universe independently or affecting one another. Time is constructed differently in different physical, chemical, biological and cosmological processes in structure, magnitude and direction. *A single theory about time can not explain the differently constructed times-classical, quantum and cosmic.*

Time is the consequence of processes and not the cause of processes. Time needs processes for its being. In the absence of processes time is missing. Time does not exist separately from the process. Origin of the universe or other phenomenon concerning universe as expansion or contraction or beginning or end need not and can not monopolize concept, nature and structure of time. Concerning time with the universe alone is side-stepping the study of nature of time. Deciding nature of time in such a way is only to mislead ourselves. Our imprecise understanding of origin etc., of universe need not prevent us to have a clear understanding of the nature of time in other disciplines. Higher mathematics can alone lead us to definiteness about the nature of time is not in tune with the reality. Clubbing time with universe is unnecessary. Nature of time can be conceived independent of origin of the universe. Understanding the nature of time is different and separate to understanding the nature of origin of universe etc.,. The sense and consciousness of time and experience of time-passage are felt because of the presence of the observer - the human mind, its concern and consciousness.

INSIGHT GAINED BY ABOVE PRESENTATION AND DISCUSSION ON TIMELESSNESS:

1. Time is classified as movement, change or becoming. As movement the phenomenon create vector time. As change and becoming, the processes create, also vector time,- the manifestation, reflection, direction to the course of process and influence of relevant natural forces by energy transformation and entropy change-but is considered as scalar time. Physical Time is of three kinds- classical, quantum and cosmic. Time is both analog and digital as duration or counting. Time measurement is a correlation of courses or on-goings of two parallel unconnected processes, the measured and the measuring. The course of the measured process is solely guided by respective natural forces and the course of the second, the time-measuring processes is manifestation and division of energy transformation from one form into another in the clock that is counting and exhibiting time-flow and time-period as fractions of second,

seconds, minutes etc.,.

2. Continuous presence or continuous transformation of matter, charge or energy is manifestation of physical timelessness.

3. The property of a physical quantity is a function of its nature constructed and defined by natural forces influencing and guiding it and material with which it is made up of and is not a function of observer's relative position or relative velocity.

4. The extension of a time interval is decided by nature and amount of mass or charge or energy that is transforming or getting transferred and the natural forces acting in that domain.

5. The time interval is constructed along with, and does not pre-exist or shapes, natural or non-natural processes.

6. *Kinds of Time*. (Tables VI, VII).

Physics is a natural scientific discipline which studies and contemplates on actions, reactions and interactions concerning mass and charge and also matter and energy in time and space. We have idea of space. But our concept of time is varied and exact nature of time is unclear. Equivalence of mass and energy is established in fundamental particle physics. Energy is time. Energy transformation is time flow or passage of time. Transformation of energy takes place through contact of matter or by induction (Field) through a material medium or vacuum. Depending on this we have 'digital' and 'analog' nature of time. Activity is time. Cessation of activity is extinction of time. Eternal activity is Timelessness. Activity is manifestation of transformation of energy. If the transformation of energy is continuous and has *finite* duration *classical time* is created. If the transformation of energy is discontinuous, discrete and has *finite* duration, *quantum time* is created. The changes of and to the universe which are *infinite* in nature create *cosmic time*. None of these times is universal time being kept and followed by us.

Qualitative time is constructed by the respective process guided by respective natural forces and never pre-exists the process. Quantitative time is *external* measurement of or count of, elapse of durations of qualitative time created by natural forces involved. Quantitative time never influences the duration or course or otherwise of the processes.

Classical time is analog in nature. Chronons and Quantum time are digital in nature.

Quantum time-discretization of time in tune with discontinuous and discrete transformation, transmission, transfer, emission or absorption of energy; Digital nature of time; Squeezing of time-interval packing with energy

Cosmic time is time associated with the origin, being, oscillation, etc., associated with universe.

Energy is manifested in stationary or moving matter or anti-matter or mass or charge. Time has two aspects – durational and metrical.

Time is the consequence of processes and not the cause of processes.

We need transformation of energy to happen for action to take place. Transformation of energy can be change of form of energy through matter or anti-matter or change of phase or state of matter or anti-matter by the aid of energy.

The physical quantities speed, velocity, acceleration, entropy, impulse, action, frequency, wave (quantum energy) or matter as sub-atomic, nuclear fundamental particles) pulse given in Tables from III to VII cause, create and manifest time. The absence of such activity by such physical quantities be called timelessness.

7. Uncertainty principle: Complex Time:

Complex conjugates: position x momentum p
 $a+ib$ $a-ib$

a = value of position relating to present
 past or future

b = value momentum relating to

Energy E

Time t

$x+iy$

$x-iy$

x = value of energy relating to present
 relating to past or future

y = value or instant of time

8. Time of conscious awareness and mental time: Present, past and future are the real and imaginary dimensions of physical time in human time-sense, time-awareness and notion of passage of time. *Present is real dimension and past and future are imaginary dimensions of physical time.*

9. The concept and notion that processes take place in time is not the reality. *Time does not pre-exist processes-natural or non-natural- and is only constructed as duration by natural forces initiating, sustaining and terminating such respective processes.* The reality that change - as movement or change or becoming – defines, manifests and constructs time is to be realized. Time is a consequence and not cause of processes. The presence of a universal time passing either absolutely or relatively is to be denied. A lot of contemplation about the non-presence of time: annihilation of time; eternity; instantaneous happening; Absence of happening must take place for arriving at a clear insight of nature of time.

Appendix:

Physical present is the real time. This is what we deal with in all disciplines of natural and social sciences and technology. The physical

present is stated to last for one tenth of a second and flows as a series of awareness and this awareness changes every one tenth of a second or the mental pulse frequency is of the order of 10 Hertz; the brain waves get frequency modulated and the frequency ranges from 3 Hz to 40 Hz depending of mental functions and conscious state of mind. Both past and future exist only as thought forms.

Thus both past and future are imaginary times. The real time becomes past as memory and real time becomes future as fear, imagination, apprehension, doubt or worry. Both past and future are thought forms in the physical present. Imaginary nature of time is psychological; it is neither real nor physical. In the absence of human concern or monitoring or memory or apprehension or planning no past or future exist. Then even their imaginary nature becomes extinct. The reality which was, is and will be, is simultaneous ongoing of process, physical, chemical, biological, cosmological etc., unrelated or unconnected or non-influencing, each other or one another. Classical, quantum and cosmic times are originated, created, constructed, sustained and terminated depending on the phases of matter, forms of energy, their actions and interactions in the domain of activity, solely initiated, guided, and terminated, by relevant nature forces. Physical present is Being and past and future are becoming of mental awareness.

Table I

EXPRESSIONS ABOUT THE NATURE OF TIME THROUGH GENERATIONS

-
- 1) *Plato*: Time is produced by revolutions of celestial sphere.
 - 2) *Zeno*: Time is related to motion.
 - 3) *Pythagoras*: Time is the identification of the chronological with the logical
 - 4) *Aristotle*: Time is counting of motion in respect of before and after and is reciprocal to motion.
 - 5) *Polonius*: Motion time can not be, since motion takes place in time.
 - 6) *Heraclites*: Time signifies the period of world from its function to its destruction and rebirth.
 - 7) *Galileo*: Time is a geometrical straight line.
 - 8) *Barrow*: Time is the continuance of anything in itself in its own being.
 - 9) *Newton*: Absolute, true and mathematical Time of itself and from its own nature flows equably, without relation to anything external
 - 10) *Leibniz*: Order of successive existents is Time.
 - 11) *Kant*: Time is an aspect of our experience and time has no existence in external reality
 - 12) *Einstein*: Special Theory of relativity: Time is relative (because of motion between event and observer).
 - 13) General relativity: Space and time are always together and inseparable. Space-time continuum is the reality.
 - 14) *Stephen Hawking*: One cannot say what time actually is and all one can do is to describe what has been found to be a very good mathematical model for time and say what predictions it makes. Time has a beginning and end. Time has shape. Past can be visualized by the concept of light cones.
 - 15) *String theory*: If original strings are viewed as uninterrupted in history in time, the resulting strings are a string world sheet.
 - 16) *M-theory*: There is a web of relationships, so-called dualities that connect all five string theories as well as eleven-dimensional super-gravity. The dualities suggest that different string theories are just different expressions of the same underlying theory.
 - 17) *Imaginary and real time*: One can construct a mathematical model in which there is an imaginary time direction at right angles to ordinary real time. The model has the

rules that determine the history in imaginary time in terms of the history in real time and *vice versa*.

18) *Brane theory*: 3-brane—a four dimensional (three space plus one time) surface that is the boundary of a five dimensional region, with the remaining dimensions curled up very small.

19) Time is movement, change or becoming.

20) *Ramabrahmam*²: ***Es gibt keine Zeit. Es gibt nur proze*** ***βe****There is no time. There is only ongoing of processes. There is no passage or consciousness of time unconnected with a process or phase of mind.*

Table II

DIFFERENT VIEWS, CONCEPTS, SENSES

(a) Views

a) *Idealist*: Time is nothing but a concept and therefore dependent on (human) consciousness only.

b) *Realist*: Time is self-sufficing entity, which is not dependent on anything else.

c) *Relational*: Time is also a concept, and therefore dependent on consciousness, but at the same time it is a function of the events happening in nature.

(b) Concepts:

a) Time of theoretical physics

b) Time of thermodynamics and of the evolutionary sciences such as biology.

c) Time of conscious awareness.

© Senses:

a) A moment, an exact date, a point of time.

b) Period of time, a span of time and time interval.

c) Duration, the length of time period.

d) An all embracing period of time.

(d) **Other Insights**: [6]

Classical time is continuous time. Quantum time is discrete time. Both are Finite times

Cosmic Time is Infinite time

Cosmic time construed as mathematical time is real or complex (possesses real and imaginary components)

Time at rest (Static time) Time-space aspect

Time in motion (Dynamic time) Metrical aspect

(e) Universal Time - The metrical aspect of time and time-keeping:

Universal time being kept by us as 2018, October, 2, Thursday etc., and followed is not physical in nature and *is set by us* in clocks. Universal time set and kept by us can not influence the remaining simultaneous and parallel happenings in the universal space. The rest of the happenings other than the universe expanding, contracting or oscillating happen and their times of duration as flow or passage of time are monitored by clocks absolutely and independent of cosmic time. The energy-transformation taking place within various clocks is never affected by the passage of universal time which is created by us and is completely arbitrary, fictitious and non-natural. Universal time kept by us at no time represents the period of happening as the universe is expanding, contracting or oscillating

(f) Nature of time: [6] - Cessation of various processes and happenings given below is timelessness:

1. Matter or energy at rest or in motion or under transformation is the physical manifestation of time and constitutes physical time.

2. The physical manifestation of flow of time or passage of time is ongoing of processes involving transformation of energy through matter or change of phase of matter by the aid of energy.

3. Matter- or Energy-Presence is **Time at Rest** or **Static Time** or **Time-Space** or **Durational** aspect of time.

4. Matter- or Energy-Transformation is **Time in Motion** or **Dynamic Time** or **Time Created** or **Metrical** aspect of time.

5. Time-Space is defined, created, controlled and ceases to be depending on Energy-Presence and the energy/matter available and amenable for and cause of transformation.

6. Time is not a physical quantity. Time is mere awareness. Time is a sense. Passage of time is an observation and a mental experience in a particular conscious state of mind.

7. Rise and fall of and flow of conscious states of mind and thoughts and other mental functions constitute psychological time.

8. Psychological past is a record of happenings and psychological future is an apprehension about happenings caused by the egoistic mind during the passage of physical time.

9. Both psychological past and psychological future are thought-forms in the physical present involving psychic energy transformations in the wakeful and dream conscious states of mind.

10. Physical present is same everywhere in the universe and only observation and counting are at different instants.

11. Count of physical present is a function of geographical location and religious and cultural background.

12. Continuous presence or continuous flow of matter or energy without transformation or change is Time-transcendence or Thought-transcendence or Timelessness. That means continuous state of rest or of uniform motion is Timelessness.

13. Time flow signifies the measure of conversion of energy in a process.

14 Time flow is a measure of **Being** (presence) and **Becoming** (transformation) of matter and energy in space

(g) **Assumptions of passage of time:** [6]: The following phenomena are normally assumed as the passage of time.

- a) Movement –translation, rotation or vibration– (or transition) of matter in space.
- b) Changes in the state or phase of matter (by the aid of energy).
- c) Transformation of energy from one form to another form either through matter or otherwise.
- d) Being and becoming (growth and decay) of organisms.
- e) The in-built order of happenings guided by natural forces in natural or non-natural processes.
- f) The ability of human mind to perceive, record, retrieve and expect various happenings taking place in physical time.

Table III**THE EVOLUTION IN TIME MEASUREMENT AND PHYSICS BEHIND TIME MEASUREMENT DEVICES**

- 1.) **Water Clock:** It consists of a bowl filled with water which escapes slowly from a tiny hole in the bottom. The amount of water left gives an indication of time which has lapsed. Stored water has Potential Energy and when allowed to escape Kinetic Energy will be associated and rate of Transformation of energy gives an idea of Time passage.
- 2.) **Sand Clock:** Here also the amount of sand remaining or has fallen gives an idea of Time passage, which is rate of conversion of Potential Energy into Kinetic Energy.
- 3.) **Mechanical watch:** Potential energy stored in the wound-spring gets converted into kinetic energy as the spring unwinds. Corresponding to the rate of conversion of energy the hands on the dial move, thus showing time.
- 4.) **Pendulum Clock:** The Kinetic energy associated with the harmonic motion of pendulum gets converted into movement of the hands on the dial, thus showing time based on the rate of conversion of Energy.
- 5.) **Electric Clocks:** These clocks operate from AC main and are driven by synchronous motors. The speed of such motors is controlled by frequency of electrical energy supplied. Here also electrical energy transforms into mechanical energy showing the passage of Time as rate of conversion of energy involved.
- 6.) **Quartz Crystal Clock:** The piezo – electric effect is made use of in these clocks. Because of this effect the frequency of an electronic oscillator can be controlled by a quartz crystal kept at constant temperature. Here also electrical (electronic) energy converts into mechanical energy and the rate of conversion of such energy shows the passage of Time.
- 7.) **Atomic Clocks:** Rate of conversion of atomic energy is used to display the passage of Time.
- 8.) **Laser Clocks:** Light energy associated with monochromatic laser pulses are used to measure frequencies and hence time periods with an accuracy of fifteen digits.

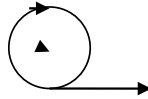
Measure of conversion of one form of energy into another form is the speed of passage of time in respect to external monitoring. All time-measuring devices use energy-presence present and energy-transformation going on within them to monitor and display passage of time.

FIGURE I

DIFFERENT LOCI AND GEOMETRIES OF PHYSICAL TIME AND ITS PASSAGE

Physical time: Classical, quantum and cosmic times (Quantitative and Qualitative):

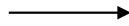
i *Classical: Ancient Indian View* - Cyclic



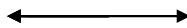
ii *Chinese View* – discontinuous:



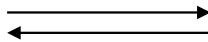
iii *Modern View* – linear



iv *Thermodynamic View* – reversal of a process



v *Fundamental Particle Physics View* – Time reversal



vi *Quantum time:* $\Rightarrow \Rightarrow \Rightarrow \Rightarrow$ $\Uparrow \Downarrow$ **Energy-time bits** transmitting, emitting and
 chronon $=h/E = 10^{-24}s$ $\Leftarrow \Leftarrow \Leftarrow \Leftarrow$ $\Uparrow \Downarrow$ absorbing photons / phonons/sub-atomic particles

vii *Special Relativity:* Speed of passage of time is a function of relative velocity between event and observer. And *no energy transformation or change of phase of matter* is under consideration.

viii *General Relativity:* Time-space inseparability –Possession of Shape; Warping

ix *Cosmology: cosmic time* (past) Imaginary and (present) real time

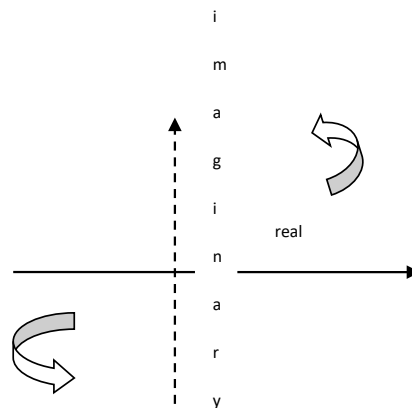


TABLE IV
DIFFERENT STRUCTURES OF TIME

Physical and Mathematical forms of qualitative time:

Time = *Distance/ speed; Time = Displacement/ velocity; dt = dx/dv*

Time = *velocity / acceleration*

Time = *angular displacement / angular velocity dt = dΘ/dω.*

Time = *angular velocity / angular acceleration*

Time = *Mass x displacement/ momentum*

Time = *Mass x velocity/force*

Time = *mass x velocity x distance/ energy*

Time = *Impulse/force*

Time = *Electric charge/ current*

Time- period = *1/frequency 1/n or 1/f or 1/ν*

Time = *Electric charge/ current density x area*

Time = *force/ electric charge x length x magnetic induction*

Time = *Action/ Energy being transformed*

Angular velocity, angular acceleration, angular momentum, phase, angular frequency, torque etc., contain and define time in rotational motion; Speed, velocity, time-period, frequency (n, f, ν), wavelength of a wave (λ) phase (Φ) etc., contain and define time in vibrational motion. Time = Time period, t; Time = 1/ n or f or ν frequency, Time = wavelength/ velocity of wave. Time=Planck's constant (h)/energy (hν)

Mental Time: Present, past and future: [6, 9-14]

Psychological time is three dimensional as - past, present and future. *Of these only present is real. Both past and future are imaginary. Psychological past and future exist only in and as thought forms.*

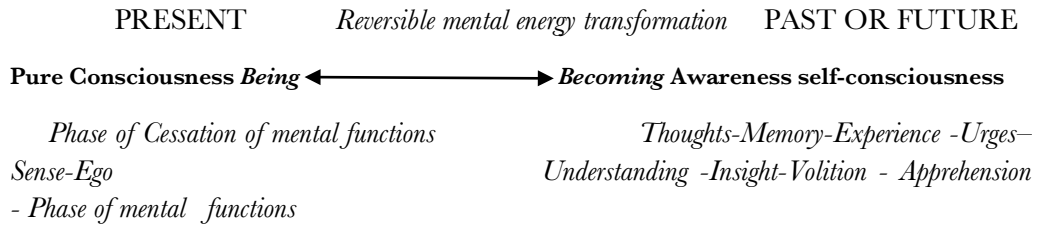


TABLE V
DIFFERENT MANIFESTATIONS OF TIME

Manifestation	Physical Quantity Manifesting	Physical quantity changing	Locus/ Shape	Nature of change	Existence	Role of Universal Time
Movement	Speed	Energy	Linear Cyclic	Finite / not reversible	real	Nil
Linear, rotational	Velocity	Energy	same	same	real	Nil
	Acceleration	Energy	same	same	real	Nil
	Phase of motion	Energy	Cyclic	same	real	Nil
	Impulse	Energy	Linear	same	real	Nil
Rotation Vibration	Velocity/ acceleration Wave/pulse	Energy	Cyclic	Finite periodic	real	Nil
Vibration	Frequency	Energy	same	same	real	Nil
Change and Becoming	Phase of matter	Energy /Entropy	Linear /cyclic	Finite reversible	real	Nil
Physical	Action	Energy /Entropy	same	same	real	Nil
Chemical	Action	Energy	same	same	real	Nil

		/Entropy				
Biological Evolution/aging Other processes	Action Same	Energy /Entropy Same	Linear Linear /cyclic	Finite Irreversible Reversible too	real	Nil
Cosmological	Action	Energy /Entropy	Not Clear	Infinite Reversibility Not known	Imaginary	Creates Cosmic Time
Psychological or Mental	Action	Energy /Entropy	Linear /cyclic	Finite Reversible	Real Imaginary	Nil

TABLE VI - KINDS OF PHYSICAL TIME

CLASSICAL TIME	QUANTUM TIME	COSMIC TIME
Has beginning/end along with respective change	Has beginning/end or continuous presence along with respective change.	Has continuous presence along with changes to universe since big bang
Created by all changes which undergo continuous energy transformation or transfer. Gravitational and electromagnetic forces cause the changes	Created by all changes where/when emission or absorption or transfer of energy is discontinuous and takes place in discrete values. Electromagnetic and strong and weak nuclear forces cause changes	Created by expansion, contraction or oscillation of universe. Gravitational forces cause change.
Exists as static time or time at rest	Exists as absence of transformation among electron or nucleon energy states	Ceases to be if universe vanishes or if universe is static
Exists as dynamic time or time in motion	Exists as dynamic time or time in motion. Always dynamic for quantum	Always dynamic and is incessant time in motion

	changes with no zero point energy	
Passive time interval or infinite time space possible	Passive time interval possible only in the absence of quantum processes	Passive time interval possible before big bang or on disappearance of universe
Observer essential. Relative time possible	Observer essential. Relative time not possible	Observer essential. Relative time not possible
Represents and manifests changes at macro-level	Represents and manifests changes at micro-level	Represents changes to universe
Becomes extinct after completion of change	Can never become extinct for some quantum changes due to uncertainty principle	Becomes extinct if universe disappears
Locus is straight line, circle, wave etc. Finite in magnitude. Real	Locus is not definite. Finite in magnitude. Real	Locus can be straight line, circle, wave, etc Both real and imaginary. Infinite in magnitude
Reversible or non-reversible depending on process being manifested	Time reversal happens for certain fundamental particles	Not reversible if universe only contracts or expands. Reversible if universe oscillates

Note: None of classical or quantum or cosmic time either creates universal time we are keeping or influenced by such universal time

Table VII

**DYNAMIC TIME-SCALES INVOLVING VARIOUS ENERGY FORMS—
EXAMPLES OF CLASSICAL AND QUANTUM TIMES**

Name and nature of Energy	Wavelength (meters) and Form of energy	Frequency (Hz)	Time Period (sec)	Manifestation and Use

Chronon	-	10^{24}	10^{-24}	Theoretical conception Might be unit of quantum Time/unit of minimum discrete or quantum energy-change
γ rays <i>Nuclear</i>	Electromagnetic $10^{-17} - 10^{-11}$	$10^{22} - 10^{17}$	$10^{-22} - 10^{-17}$	Cosmic /nuclear changes Radiation intensity count
X-rays <i>Atomic</i>	Electromagnetic $10^{-12} - 10^{-8}$	$10^{20} - 10^{16}$	$10^{-20} - 10^{-16}$	Inner-orbit atomic changes Diffraction, small angle scattering Medical
Ultra-violet (UV) <i>Atomic</i>	Electromagnetic $10^{-8} - 4 \times 10^{-7}$	$10^{16} - 7.5 \times 10^{14}$	$10^{-16} - 10^{-14}$	Electron transitions Electronic structure of molecules

Visible <i>Atomic</i>	Electromagnetic $4 \times 10^{-7} - 7.5 \times 10^{-7}$ Light	$7.5 \times 10^{14} - 4 \times 10^{14}$	10^{-14}	Electron transitions Electronic structure of molecules
Infrared (IR) <i>molecular</i>	Electromagnetic $7.5 \times 10^{-7} - 10^{-3}$ Heat	$4 \times 10^{14} - 10^{11}$	$10^{-14} - 10^{-11}$	Vibrational and rotational spectra of molecules
Micro wave <i>molecular</i>	Electromagnetic $1 \times 10^{-3} - 1$ Heat	$10^{11} - 10^8$	$10^{-11} - 10^{-8}$	Rotational spectra
Radio waves <i>kinetic</i>	Electromagnetic $1 - 10^3$ Electrical	$10^8 - 10^5$	$10^{-8} - 10^{-5}$	NMR
Ultra-Sonic <i>kinetic</i>	Below 16.8×10^{-3} Mechanical	Above 20 KHz	Below 0.05×10^{-3}	To probe structure or shape or defects of matter in solid phase
Audible sound <i>kinetic</i>	Between 16.8 and 16.8×10^{-3} Mechanical	Between 20 Hz and 20 KHz	Between 0.05 and 0.05×10^{-3}	Human communication and music
Infra-sonic	Above		Above	Stimulates Neuron

<i>kinetic</i>	16.8 Mechanical	Below 20 Hz	0.05	endings
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