

THE FOURTH DIMENSION

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Enigma of Time

Dayalanand Roy, PhD



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The Fourth Dimension: Enigma of Time

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Dedicated to

My reverend parents
Smt. Sudha Roy
Sri Shabdanand Roy

And my beloved wife
Suneeta Roy

***WE ACQUIRE TIME BY GROWING OLD,
NOT THAT WE REQUIRE TIME TO GROW OLD.***

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Dayalanand Roy

PREFACE

Time I am. I am the great destroyer of the worlds. I am born to destroy everything and all people.

—(*Bhagvadgita*; 11.32)

In the great Indian epic *Mahabharata*, when Arjun asked Lord Krishna- his mentor, his friend and his charioteer too- to take his chariot in the middle of the battleground so that he could see who he was going to fight with, Lord Krishna did the same. Arjun could now visualize with full clarity whom he was going to fight with- his enemies were none other than his kith and kin, his great grandfather, his teacher, his brothers and his relatives. He was caught into an intense ‘attachment’ with his ‘enemies’ whom he was expected to fight with, dropped his weapon, the Gandiv, and refused to fight. Now Lord Krishna rose to the occasion and enlightened Arjun with the great lessons of *Bhagvadgita*.

It was probably the only spiritual lesson delivered in the midst of a battlefield. Here Lord teaches Arjun the massive power of *time* and tells him that he is none to kill his enemies; it is the strong clutches of ‘time’- the *Kal*- that are going to kill them- rather they are already killed. You are merely required to perform your duty- your *karma*- only. The essence of *Bhagvadgita* is the doctrine of *Karma*, our duty towards life. It teaches us the lesson to go on performing our duties without having any attachment to them and without expecting any fruits out of our duty.

What is this ‘time’- the *Kal*- the massive power of which Lord Krishna is talking about, the strong clutches of which are going to kill the enemies of Arjun? Why does ‘time’ appear to us as a great *puppeteer* in the hands of which the entire cosmos- the sun, the moon, the stars, the earth and the human beings too- appear to be mere *puppets*? Probably all of us, at some

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or the other time in our life, have been compelled by our circumstances to feel like that, and so does feel Angelina Weld Grimke when she dives deep into her poem, ‘The Puppet-Player’-

Sometimes it feels as though some puppet-player,
A clenched claw cupping a craggy chin
Sits just beyond the border of our seeing,
Twitching the strings with slow, sardonic grin.

—Angelina Weld Grimke ‘The Puppet Player’

I have made a little attempt in this book to peep into the very nature of this *puppeteer*. Shall I succeed? I do not know. But, as *Bhagvadgita* has taught us through its doctrine of *Karma*, we should go on performing our duties without having any expectation for the fruits. This was a major inspiration for me behind writing this book on a subject I do not specialize.

Time seems to be intimately woven into the fabric of our universe; including our earth, our life, our culture, our thought processes, our happiness and our sorrows. So many things have been taught to us by our ancestors about the enigma of time- time is the most powerful entity in this world, time never remains the same, it never stops and always flows from past through present towards future; when someone is passing his life happily, it is said that his time is good; if someone is in sorrows, his time is said to be bad and he is consoled by saying that his time too will change, as it never remains the same. Time is said to heal every pain and every trauma of our life.

And Henry Van Dyke categorically summarizes all these fascinating properties of time as its *modus operandi* in the following thought-provoking words-

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

—Henry Van Dyke

Engrossed into all these wonders of time, I have been thinking about its real nature for the last about eight years and trying to find an answer.

Some of the great works on time have revealed a lot about its real nature. Einstein's relativity is undoubtedly at the top of them. Without the advent of relativity, it would have been very hard to *melt down* from our minds the *frozen absoluteness* of time. Einstein's theory of relativity tells us that time is relative and our modern concepts of time are based on its relative nature. In this work, I have tried to understand why time is relative and not absolute, why it is individual and not universal, and why does a moving clock slow down? I have tried to conceive a model that can possibly explain this nature of time.

Being a biology student, I have initially tried to understand the reality of time from a biologist's point of view. And whatever I could understand, I am presenting here as my views in this book. Lee Smolin, the author of *Time Reborn* asserts, "We should encourage diverse approaches to these hard questions."¹ This book is one such approach. I make no claim that whatever I say here is a genuine scientific model. I make no claim that whatever I say here may not be the viewpoint of any other worker. I make no claim that whatever I say here will ever be proved or falsified. I just wish to share my thoughts about time with all of you through this book. And I hope that the experts of the subject will forgive me for venturing into a field I do not specialize and for the possible serious errors that might have crept into my descriptions due to my ignorance or lack of deep knowledge of the subject. Before you start reading the book, I would like to humbly admit that, as I am neither a physicist nor a philosopher, this book is not about physics or philosophy. It is just about time. Of course, in some chapters, I have attempted to do a preliminary test of whether this model of time is compatible- at least to some extent- with the established physical theories of time or not. But overall, whatever I have presented here is just an opinion.

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CHAPTER 1

WE ARE ALL TIME TRAVELERS

“What is time? If no one asks me, I know. If I wish to explain it, I know not.”

—(St. Augustine in *Confessions*)

What is Time?

It’s unbranched and unclaimed,
Elusive and in vain.
It ebbs and it flows,
Wishing away as it goes.....

It heals the broken and bruised,
Has been abused and misused.
Infinite and untamed,
Only time will remain.

—Crystal Lewis, “Only Time Will Remain.”

These beautiful lines of the American poet and singer, Crystal Lewis beautifully describe the enigmatic time. Unbranched and unclaimed, yet infinite and untamed! But what is this unbranched and unclaimed time? What is that that only will remain infinite and untamed? Can our finite vision be ever able to peep into this infinite and untamed healer of the broken and bruised, the witness of our first breath and our ashes’ last cast?

None other quote than the one by St. Augustine in ‘*Confessions*’ that opens this chapter gives the answer to these questions in a better way. If no one asks me, I know. If I wish to explain it, I know not.

I am not a physicist. I study Biology. Like every lay person, I had never thought seriously about time before the year 2012. I, too, had the idea that time is something like a continually flowing entity, like an invisible river, that causes everything in this world, including us, to get old. It flows

always in one direction, from past towards future. We were taught in our childhood that it is the most precious thing we have got and that we ought to respect it and never waste it. It was a common riddle being asked among children that what it is that never stops, and the wise ones would answer- “time”. This was the background about the concept of time with which I, like most of us, grew up.

About two and half decades ago, I heard about Stephen Hawking and his book *A Brief History of Time*. Somehow (it was not available in the city I reside, nor was it a time of online shopping for us), I purchased a copy of it and got to know the stake of this great physicist on the subject of time. However, though I learned something about the basics of physics from this book, the secret of time remained obscured to me. At about the same time, I read an article of the physicist Sir Martin Rees, and wrote a letter to him. With his reply, he was kind enough to send to me a copy of his book, *Cosmic Coincidences* which I read thoroughly. These books created an interest in me to know more about the physical world. But unfortunately, I could not pay much attention to it for some years. Time still remained an enigma for me.

Time is something with which almost every one of us- a scientist or a non-scientist, an educated or an uneducated- at every moment of our life is intimately associated; yet it is an enigma. It is a subject for the study of which some of the great workers of past and present, from philosophy to physics, have devoted a large part of their lives; yet it is an enigma. According to Lee Smolin, most of the problems of the modern physics and cosmology are related to the question of time.²

In order to see why the question- “What is time?”- remains the most important question facing science, let us have a bird’s eye view of the views of some prominent workers about it. For our convenience, we can divide the development of the concept of time into two phases- the Pre-Relativity phase and the Post-Relativity phase.

The Pre-Relativity Phase of Time

It appears to me that the pre-relativity phase of time was mostly dominated by the view that time is something like an independent entity that flows in one direction at a fixed, universal and absolute speed. In a sense, it was conceived as an essential tool in the design of the universe. A tool that makes new-born babies grow; makes our world lightened up with the rise of the sun in the east every morning; causes the sun to set in the west and gets

our world engulfed by darkness every evening; causes periodic changes in weather and, finally, that is also the *cause* behind our aging and our last ritual too—the death.

It was this view of time that probably dominated Newton's mind too, led him to think of an absolute and constantly flowing time, at a fixed rate, and even while doing his epoch-making work on gravity, he did his best to accommodate it unharmed and unaltered. Newton's time flew at a uniform velocity in the big container called universe which contained everything. Thus, probably Newton's time was, as far as I can understand, substantial and real.

However, it is not so that there was no alternative view about time during the pre-relativity era. As early as in the 4th century BCE, Aristotle explained time as a mere number used for measurement, particularly, measurement of movement. Greek metaphysicist, Heraclitus (530–475 BCE) gave the concept of flux- the constant change that everything in the world experiences at each moment. This flux was in a way equivalent to time. According to his concept, time and change were inextricable. Heraclitus defined time and events by each other, making each necessary for the other. But still, he always thought that time flows at the same rate for all observers.

However, the nineteenth century English philosopher, Mc. Taggart strongly believed in unreality of time and defined it in either of the two ways- as past, present and future (which he called the A series), or, as earlier and later (the B series, as he called it). Further, he characterized time as the dimension of change. Immanuel Kant, the great eighteenth century German philosopher too believed in transcendental nature of time. According to him, "time and space are characteristics not inherent in things themselves but only in their relation to our sensibility". Similarly, Leibniz, a Newton's contemporary, too believed in relational theory of time, which implies that time's existence is related to some physical processes in the universe, such as a movement or a change in a field. He described time merely as a successive order of things in the famous Leibniz/Clark correspondence. According to this view, no change implies no time. Earnst Mach, the great nineteenth century physicist who is said to have made a great impact on the thoughts of Einstein, defined time merely as an abstraction- "It is utterly beyond our power to measure the changes of things by time..... time is an abstraction at which we arrive by means of changes of things". For a detailed history of the study of time and to have a glimpse of the views of different workers about time, I shall urge the interested reader to

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go through the 'Encyclopedia of Time: Science, Philosophy, Theology & Culture; edited by H. James Birx.³

And not only physics and philosophy, literature too was not far behind in giving an alternative meaning to time. In what is held as probably the first science fiction, *The Time Machine*, written in 1895 by H. G. Wells, the author explains time to be the fourth dimension of objects-

“Any real body must have extension in four directions: it must have Length, Breadth, Thickness and- Duration.There are really four dimensions, three of which we call the three planes of space, and a fourth, Time.”⁴

However, these alternative views could not undermine the dominance of the absoluteness of time, flowing nature of time; until Einstein came into picture.

Probably this is why, *The Time Machine* of Wells, which starts with such a beautiful reality of time, runs into such a beautiful fiction- and why should it not, as it is a fiction itself- that it sends its Time Traveler to the year 802701, to witness the humanity split into two bizarre races- the ethereal Eloe and the subterranean Morlocks, and then to further thirty million years into the future to have a tryst with a slowly dying earth and a bloated sun. It is no doubt a beautiful fiction as is evident by the fact that hundred and twenty two years after its first publication, it is still in print.

It appears to me that this fiction of H. G. Wells is not only a fiction; it reflects the way most of us think about time and successive events of the universe. We usually think of the successive events as if they are successive railway stations we pass through during a train journey, and during our return journey, we shall be passing through the same stations, though in a reverse order. But, as we shall see, it is not like that.

The Post-Relativity Phase of Time

In 1905, Einstein shocked the world by presenting his special theory of relativity. However, before Einstein, Henry Poincare (1854–1912) too criticized the concept of absolute time. Hereafter started the second phase of the development of the concept of time. Einstein proposed in his special theory of relativity the ground breaking concept that time is relative. Challenging

the Newton's absolute time that was constant for every observer, he proposed that time is not constant for every observer. It is local. It is personal. It said that the clock of an observer in motion may not agree with the clock of a stationary observer. Time can be slowed.

This was stunning. It is true that we often feel time to flow differently in different circumstances- it creeps, it strolls, it runs and it flows. And not only it flows, it sometimes goes. Henry Twells beautifully articulates these different appearances of time with our different phases of life in his lyrical rhyme, 'Time's paces'-

When as a child I laughed and wept,
Time crept.
When as a Youth I waxed more bold,
Time *strolled*.
When I became a full grown man,
Time RAN.
When older still I daily grew,
Time FLEW.
Soon I shall find, in passing on,
Time *gone*.
O Christ! Wilt thou have saved me then?
Amen.

—Henry Twells, *Hymns and Other Stray Verses*

However, in spite of enjoying these different experiences of time at different phases of our life, we could never surmise, before Einstein's special theory of relativity, that this could be a reality- time really flows at different speeds for different observers.

Even present, past and future lost their universal meaning and became personal. What we call 'now' became a mystery with the onset of relativity. However, this blurring of 'now' disturbed Einstein too. Dieter Zeh in his *The Physical Basis of the Direction of Time* quotes Carnap regarding the views of Einstein about 'now' - "Einstein said that the problem of the Now worried him seriously."⁵ Einstein knew that every man has a special meaning for the term now. All of us clearly distinguish our now from our past and future. But the physics he had developed had no special treatment for this 'Now'. So, he concluded "that there is something essential about the Now which is just outside the realm of science."⁵

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Thus, while on one hand, the theory developed by Einstein himself wipes away the notion of 'now'; on the other hand, this abolition of 'now' seems to be painful for him. But he is unable to locate the significance of this 'now' within the realm of science. How can it be that something so essential to man should be outside the realm of science? Can we make another attempt to seek this 'now' within the realm of science? I hope we can more clearly grasp the meaning of 'now' by considering an alternative concept of time itself.

Not only this much, the theory of relativity also fused time with space to create a new concept of space-time. And a decade later, when Einstein unveiled his general theory of relativity, the world came to learn that the space-time is not always flat but may be curved also.

Thus, time was present in a new getup before the world. It could be slowed; it- in association with space- could be curved. And the theory of relativity was not simply a theoretical model. Most of its predictions were confirmed, again and again, practically. It introduced the world with a completely virgin level of nature's architecture hidden in quite awesome properties of space and time.

But what did it tell the world about the very nature of time?

Julian Barbour, who has devoted a significant part of his life to the study of time, writes in his book, *The End of Time* about the concept of time in Newton's and Einstein's theories-

“Without question, their theories contain wonderful truths, but they both take time as given. It is a building block on a par with space, a primary substance.”⁶

It is said that when asked- “What is time?” Einstein once replied, “Time is what our clocks read”. However, since the entire theory of relativity is pivoted on space and time, we can expect this theory to convey a deeper meaning of time. On one hand, relativity dismisses the absoluteness of time, constancy of time, thus making it relative and personal. It appears, therefore, that Einstein did not consider time as an independent entity. On the other hand, relativity also claims that time can be slowed. If a man goes on a voyage in a spaceship, when he returns home, he finds he is younger to his twin who remained stationed at home. But how can time be slowed? If anything can be slowed, a common man can derive two meanings from it- that it is something, an entity, an independent entity and that it is moving at some speed.

Thus, while on one hand, relativity broke the substantial view of time, it also, on the other hand, seemed to reinforce it; though it never said that time is substantial.

'Timelessness' vs. 'Time is Real'

While Einstein denied the absoluteness of time, we have some great workers who deny the very existence of time itself and profess a theory of timelessness. Julian Barbour is one of them. He is so optimistic about the 'end of time' that he foresees- "... The unification of general relativity and quantum mechanics may well spell the 'end of time.'"⁷

Carlo Rovelli, too, belongs to the same school of thought and suggests to us to 'Forget Time'. But the picture doesn't end here. On one hand, Julian Barbour had to write *The End of Time* and Rovelli had to pen 'Forget Time' to express their disagreement over any independent existence of time. But on the other hand, another famous physicist Lee Smolin, though originally a supporter of timelessness, changed his mind and became a firm believer in the reality of time and wrote *Time Reborn*. Smolin admits, "I used to believe in the essential unreality of time". But later on, he flips over and blows some fresh oxygen into the windpipe of time, "In fact, I have swung to the opposite view: Not only is time real, but nothing we know or experience gets closer to the heart of nature than the reality of time."⁸ Two poles of views on the concept of time!

Another great physicist of the current era, Sean Carroll points out three aspects of time- time as a coordinate, time as a measurement of duration and time as a "medium through which we move."⁹ Everybody agrees with the first two aspects of time described by Carroll. However, though the third aspect given above may be a good way to describe what we experience about time, there is potential for debate on it.

Thus, we find that the post-relativity phase of time, too, is not very transparent. It is still chaotic as evinced by the so many different colors time has been painted with from time to time.

A Non-Physicist's Dilemma

The pre-existing concept of time in my mind was whacked by the statements of relativity and a time-whirl was created in my thoughts. What is time? Does time exist at all? Is it an independent entity? Does it flow?

What is meant by the speed of time? Can this speed be altered? What did Newton actually think about time? And finally, what did Einstein actually think about time? I was caught in a serious dilemma. But then I came across a paradox, called the 'twin paradox', predicted by the special theory of relativity itself. This twin paradox showed me a bright ray of hope.

The Twin Paradox

According to relativity theory, if someone is moving at a very high speed, time will slow for him and, consequently, he will age less in relation to a stationary observer. According to Twin paradox, a person traveling in space at a very high speed will remain younger to his earthbound twin sibling. I was mesmerized when I read about it. What is the relation between time and age of the traveling twin? How can time be slowed? How the age of a sibling traveling at a fast speed will remain less than that of his stationary twin sibling? If the traveling sibling ages less due to slowing of time, the latter appears to be an independent entity, one that may cause something to age. And hence, more time more age, less time less age; or, say, the faster the time, the more is the age, the slower the time, the lesser is the age. But probably none of us will agree that time is an independent 'entity'.

Though initially this paradox intensified my dilemma, but soon after, it showed a possible way to resolve it too. It convinced me that there is a distinct relationship between time and age of objects, both animate and inanimate, and that the secret of time lies somewhere in this relationship. Laws of nature cannot be different for animate and inanimate objects. Not only the traveling twin ages less, his watch too reads less time. But what is the relation between time and age? Is time a cause, or an effect of the age of the traveling twin or his watch? Or else, is age itself time? The secret of time probably lies in the answer to these questions. We shall try to find a possible answer in the succeeding pages.

Do We Create Our Own Time?

It was the summer of 2012, when one day, while attending to my 90-year old father, engrossed into his elegantly old and bearded face, I tried to get myself, my entire consciousness, sunk into his eyes- that were looking as still and calm as a pond, but as deep and reflecting as a lake. As I sank in, a turbulent wave of memories popped up out of his eyes. I experienced

a short up-thrust, but soon the wave engulfed and pulled me deep into the bottom of his eyes where a sandy, lustrous time-beach—a beach of our past—was waiting to welcome me. I was lost in a flashback remembering his youthful days, and my childhood days, too, spent with him. How did a young, tall, handsome and agile person get transformed into such a fragile body? And how did the child in me get metamorphosed into a middle aged person, a father of two children? I wondered. I wondered what a curious thing time is- it flows ever, stops never, and makes every mortal being older and older, until death embraces him or her and sublimates to ‘immortality’. Suddenly, my father’s face appeared to me as if it was my future-self; and I experienced my own face as if it was my father’s past-self. The present seemed to be in between us, playing a ‘time-mirror’- past this side, future that side. I imagined that our present-self, the time-mirror, got evaporated up and let the past and the future have a tryst with one another. I walked there for a while- on ‘the sandy beach of time’, murmuring Stephanie M. Lawrence’s wonderful poem, ‘The Sands of Time’-

I look in the mirror and see
A stranger looking back at me.
Who’s that person standing there
With wrinkled skin and such gray hair?
Could it be me?

Yesterday my hair was brown.
My skin was smooth, tan all around.
My shoulders straight, my posture proud.
My voice had strength to call out loud
My name,

—Stephanie M. Lawrence, from ‘The Sands of Time’

I felt as if time were an invisible, ever flowing river and me and my father, and our entire family were time travelers, sitting on its shoulders, riding on its waves. A common man’s most common intuition about time is that it is constantly flowing. So, I thought—where is it flowing from? And where is it flowing to? And more so, how can we say that there is a time flowing around us? What proof do we have about it? I tried again to experience the so-called flowing time. But, now, I couldn’t.

Suddenly, the thought flashed to my mind that there is nothing like an invisible river of time; time could not be an independent entity that