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On the Nature of Time*:*

A Dialogue on its Definition and Various Aspects

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Abstract:

In the following dialogue, on the nature of time, several definitions and related propositions, within the framework of a number of physical theories and philosophical systems, have been presented and discussed in detail. The primary objective, throughout the heated debate, between the three main characters of the current dialogue, is to investigate the notion of time, from as many perspectives as possible, and to highlight the similarities, as well as the differences, between various scientific approaches and philosophical viewpoints, with regard to the true nature of the essence of time and its most salient characteristics.

Keywords:

Universal now; flow of time; Laplace's demon; present; past eternity; Newton's mathematical time; Kant's antinomies; Parmenides' totality; relativistic time dilation; determinism; Heraclitus' constant change; free will; apparent time; McTaggart's series; duration; Einstein's block universe; moment; beginning of time; future eternity.

Introduction:

Dingleus:

According to the published testimonies of his most trusted biographers, when Albert Einstein learned of the death of his friend Michele Besso, he wrote in a letter to the Besso family: "*He has departed from this strange world a little ahead of me. That means nothing. For we convinced physicists, the distinction between past, present, and future is only an illusion, however persistent*" [***Ref. #1***]. Is this statement a necessary consequence of his two theories of relativity (*the general & the special*); or is it just a spontaneous utterance, by a grieving man mourning the passing of an old friend?

Sinbadus:

It's no spontaneous utterance. Albert Einstein, had held and made public such a view, on that particular notion since, at least, the Paris debate, about the nature of time, between him and the French philosopher H. Bergson, on April *6*, *1922*.

Cynicus:

Relativists would like to fancy themselves that their folk hero — Albert Hermann Einstein — had won the Bergson-Einstein debate. But, although H. Bergson was just a run-of-the-mill philosopher to begin with; and despite the fact that his so-called '*vitalism*' with its imaginary '*Élan vital*' was no match for any version of natural philosophy, he had actually won the Paris debate, fair and square, and emerged as an immensely towering figure of modern philosophy after his epic encounter, with the '*relativistic physicist*' Albert Einstein [***Ref. #2 & Ref. #3***].

Dingleus:

That is alright, Cynicus! Let's just leave the matters of winning and losing the Paris encounter to history to decide. It seems, to me, the bold statement that the '*distinction between past, present, and future is only an illusion'* does not follow, as a necessary or unavoidable consequence of relativistic physics. Take, for example, the case of uniform inertial motion, in Einstein's special relativity. According to this theory, every reference frame in uniform motion has its own time, along with its own past, present, and future. And it follows, therefore, that, instead of the distinction between past,

present, and future becomes an illusion, we have, within the context of Einstein's theory of special relativity, many instances of past, present, and future, running side by side, depending on how many reference frames are in uniform motion, relative to each other. And the same also applies, in the case of gravitation, in which, on the basis of Einstein's general theory of relativity, each point, along the gravitational potential, from the central mass to infinity, has its own past, present, and future. In brief, the instances of past, present, and future, appear to have multiplied and become abundant, contrary to the aforementioned statement, by Albert Einstein.

Sinbadus:

In relativistic physics, time does not exist, by itself, and independent of everything else. Recall the famous statement, by H. Minkowski: "*The views of space and time which I wish to lay before you have sprung from the soil of experimental physics, and therein lies their strength. They are radical. Henceforth space by itself, and time by itself, are doomed to fade away into mere shadows, and only a kind of union of the two will preserve an independent reality*" [***Ref. #4***]. The old distinction, between past, present, and future, therefore, no longer exists.

Dingleus:

This sort of union of those two essences does not seem to imply directly or indirectly that the '*distinction between past, present, and future is only an illusion'*. It still appears, on the face of it, that, with regard to the above statement, Einstein was speaking, only, as a philosopher, and not as a physicist or in the name of physics relativistic or otherwise.

Cynicus:

The fact of the matter is that the whole fish named '*relativistic physics*' is rotten from the head down; Dingleus! In particular, the concept of time, within the framework of Einstein's relativity, is too vague and muddled, in so many respects, to make any coherent sense, at all. Relativists assert and declare, over and over again, that uniform motion and gravity slow down the flow of time. How and by what physical mechanism? Relativists don't know. They don't care. And they don't give a damn about it. What is the precise definition of time, within their two theories of relativity? Again, the relativists don't know. They don't articulate. And they don't give a damn about it. Do motion and gravity, as supposed in their two theories of relativity, slow down the universal continuum of time as a whole, or only the durations and running rates of physical events? And once again; the relativists don't specify. They don't, really, know. And they don't give a damn about it. All in all, this so-called '*relativistic physics*' is a conceptually meager meal, which has been poorly prepared and badly cooked, by the philosophically impoverished, for the philosophically malnourished.

Dingleus:

I'm not a nutritionist; Cynicus! But it seems, to me, that Einstein's two theories of relativity have been the main diet for a lot of very bright physicists, over the past century, and over the present century as well. By what mechanism are motion and gravitation supposed to make the flow of time slow down? In my view, there can be no mechanism for that, because Einstein's relativistic theories are supposed,

from the start, to be theories of principles. And theories of principles, generally, do not provide any mechanisms of any kind, for the phenomena under investigation. Take Newton's gravitational theory, for example. Does Newton's theory of universal gravitation provide us with a mechanism or explain to us how the force of gravity is transmitted between two or more physical bodies? I guess not; or as Isaac Newton, himself, used to say, "*hypotheses non fingo*"; i.e., "*I feign no hypotheses*". However, I must agree with you on the issue of vague definitions of time in Einstein's physics. For it's clear, from the very beginning, that relativistic physics has no exact definition of time and makes no distinction, between time as a universal continuum composed of an infinite number of durations and running rates, and time as specific sets of a finite number of running rates and durations for a limited number of events and physical interactions and processes, inside a specific physical system. And this, for me, is a huge issue. Because the followers of Einstein, always, claim that the homogeneous continuum of time slows down, inside such and such physical systems. While, in fact, their physical theories can never go any further or anywhere beyond the realm of a finite number of running rates and durations related, exclusively, to physical events and interactions, inside some isolated systems.

Sinbadus:

Thanks a lot, Dingleus, for trying to silence Cynicus' constant, or I may add, somewhat cynical whining about the lack of physical mechanisms for the slowdown of time in both theories of relativity. But I, certainly, do take issue with your support, for his claim that there is no clear definition of time in relativistic physics. For it's, abundantly, clear, right from the very beginning, that the definition of time, in relativistic physics, is operational and based upon the solid foundations of experimental measurements. This operational definition is, neatly, summarized by the well-known statement that '*time is what the clock measures*'. And when Albert Einstein pointed out to Henri Bergson, during their Paris debate, that '*time is what the clocks measure*', and the rest is based on nothing but soft psychology, he, really, meant every word of it.

Cynicus:

Time is '*what the clock measures*'! How unsophisticated and naive can it get? That is, precisely, one of the main reasons why Henri Bergson won and prevailed over Albert Einstein, in their Paris debate. Can the lack of physical mechanisms, in Einstein's two relativistic theories be, somehow, justified? I would like to agree, with Dingleus, that theories, based upon principles, do not need physical mechanisms. But the truth is that they do need, truly, good principles to be based upon. Einstein's two theories of relativity do not have any very good principles, by any standard, to begin with. And, in fact, they have, only, false premises and arbitrary assumptions, at their very foundations. There is no good principle, in the world, that can justify or support in any imaginable way the curving of absolute space or combining space and time together inside that ridiculous Minkowski's union. And so, the formal distinction, between principle theories and constructive theories, constitutes little or no defense, at all, in the case of Einstein's two theories of relativity.

Dingleus:

We have to admit, Cynicus! Defining the concept of time is, extremely, difficult. Saint Thomas Aquinas, reportedly, once said: "*What then is time? If no one asks me, I know what it is. If I wish to explain it to him who asks, I do not know*" [***Ref. #5***]. I feel, about the definition of time, almost, the

same way. And I'm, for sure, interested, very much, in listening, very carefully, and observing, firsthand, how you, Cynicus, are going to define time more, precisely, and explain it, very clearly, to all of us, around here, during this discussion, about the nature of time.

Cynicus:

It's understandable and expected, all along, that Bishop of Hippo — Thomas Aquinas — was unable to define time, because he was a theologian. And like all theologians, through the ages, whatever definition of time, within his grasp, is, ultimately, going to be, fundamentally, inconsistent with the basics of his theology, and bound, sooner or later, to blast, knock down, and kick, in the end, his own beloved and dear deity out of existence, for good.

On the Definition of Time:

Sinbadus:

According to Isaac Newton: "*Absolute, true, and mathematical time, of itself, and from its own nature, flows equably without relation to anything external, and by another name is called duration: relative, apparent, and common time, is some sensible and external (whether accurate or unequable) measure of duration by the means of motion, which is commonly used instead of true time; such as an hour, a day, a month, a year*" [***Ref. #8***]. So, how did Newton's deity manage to survive such a sweeping definition of time? Tell us how, please, O Wise Cynicus!

Cynicus:

Sir Isaac Newton wasn't a theologian. Thus, he was neither very concerned nor, keenly, aware of the necessary conditions for the survival of his own deity, in the long run. And moreover, it wouldn't surprise me, the slightest bit, if it's confirmed, historically, that he kept the whole '*clock maker*' thing hanging on his shoulders, only, as a must-have relic of the required paraphernalia, for an honorable member of the Convention Parliament, and, more importantly, as a suitable ornament, for the master of the Royal Mint.

Dingleus:

I assume that the above Newtonian definition of absolute, true, and mathematical time is the same or almost the same as Cynicus' definition of time. Is this true?

Cynicus:

It's, almost, the same definition, Dingleus. But with much more details, and so much so that Isaac Newton, himself, could never dare to spell out or dive deeper into the specifics of which, without being

compelled, at once, to throw his cosmic '*clock maker*' out of every cosmic clock-making business and outside of the entire universe, altogether.

Sinbadus:

I presume, the '*devils*' are in the details!

Dingleus:

And the '*gods*', too, are in the details. Bring it on, Cynicus! And enlighten all of us, with your detailed definition of time.

Cynicus:

Let me start, right away, by pointing out that the essence of time is a universal and homogeneous continuum, within which durations as well as running rates are densely packed, in accordance with this very simple mathematical formula:

$$\omega = \frac{2\pi}{P}$$

where P is the duration; ω is the rate, at which that specific duration flows; and π is defined as the ratio of a circle's circumference to its diameter.

Sinbadus:

And how do you relate this definition of yours to the aforementioned definition of true and mathematical time, by Sir Isaac Newton?

Cynicus:

That is what Newton's true and mathematical time is all about. Do you have any other alternative mathematical expression of its meaning?

Dingleus:

That sounds promising and provocative too, to some degree! But I still don't see how a homogeneous continuum of this kind can have two different things packed together in the inside of it. Would you, please, explain, to us, more clearly, how durations and running rates go, hand in hand, together, within this one universal continuum we call '*true and mathematical time*'?

Cynicus:

It's simpler than simplicity, itself, Dingleus! Do you recall the early naive definition of time, by Albert Hermann Einstein and his followers: "*Time is what the clock measures*"? Well, the main problem with it, obviously, is that their clock has, only, three hands: The hour hand, the minute hand, and the second hand. Do you agree with this characterization of your Albert Hermann Einstein's mechanical master clock, Sinbadus?

Sinbadus:

Sure; just continue, and keep going!

Cynicus:

Good! The real clock of true and mathematical time has two sets of hands: A set of infinite number of hands, before the Einsteinian second hand, and a set of infinite number of hands, after the Einsteinian hour hand.

Sinbadus:

Engineers can build Einstein's clock, because it has, only, three hands. But no engineer, in the world, can build your imaginary clock, simply, because it's, already, assumed, by you, to have an infinite number of hands, not, only, on one side, but on two sides, at the same time.

Dingleus:

I would say that Cynicus' clock, with its infinite number of hands, is capable of representing and handling the universal continuum of time and its actual flow, more realistically and much better, than Einstein's clock, with its three hands.

Cynicus:

And more importantly, a clock, with an infinite number of hands, effectively, renders Newton's true and mathematical time far less abstract and much more concrete than ever before.

Sinbadus:

And just how are you going to assign definitive numerical values to the infinite number of hands on the face of your imaginary clock?

Cynicus:

Numerical values can be assigned to the hands of this universal clock, in so many ways. But I prefer, here, to follow the prevailing convection, and I assign numerical values to hands in the ancient Babylonian way, through the use of the sexagesimal positional numeral system, with its counting base of *60*. Accordingly, the value of every hand equals *60* times the value of the hand that precedes it, directly, in the ascending order; and *1/60* times the value of the hand that precedes it, directly, in the descending order, throughout this sexagesimal numbering system, and from the infinitesimally small to the infinitely large.

Dingleus:

It still sounds promising, Cynicus! But how are durations and running rates computed, in such a sexagesimal numbering system of this, infinitely, handy-dandy clock of yours?

Cynicus:

That task is very much simpler than simplicity, itself, Dingleus! In such a sexagesimal system, the numerical value of every hand, on the face of this marvelous clock, represents one and only one duration, along an infinite sequence of one-to-one correspondence, between the number of hands and the number of durations. As you can see, therefore, the values of durations, above the hour hand, approach infinity, as the number of hands, above the hour hand, approaches infinity. While, by contrast, the values of durations, below the second hand, approach the value of zero, as the number of hands, below the second hand, approaches infinity. And by using the following handy-dandy equation:

$$\omega = \frac{2\pi}{P}$$

where — P is the duration; ω is the rate, at which that specific duration flows; and π is defined as the ratio of a circle's circumference to its diameter — we can, easily, calculate the running rate of each duration, and consequently, we conclude that the rates of time flow, on the second-hand side, approach infinity, as the length of durations approaches the value of zero. And by comparison, the rates of time flow, on the hour-hand side, approach the value of zero, as the length of durations approaches infinity.

Sinbadus:

So, according to your definition, time is nothing more than a hugely massive collection of durations and rates that run from *0* to infinity. Is that what your definition of time means?

Cynicus:

That is what true and mathematical time is all about. Time is a humongous cache of durations and rates of flow, from which physical events, processes, and interactions can pick and choose whatever

durations and rates that suit them, from the value of zero and all the way to infinity.

Dingleus:

Straighten me out, Cynicus! How can we get a densely packed continuum out of this sexagesimal numbering system of the ancient Babylonians?

Cynicus:

You can't get it out of it, Dingleus! This clock counting system is used, here, for illustration purposes only. However, we can, quite easily, replace the sexagesimal number system with the real number system, in order to map out everything, within the densely packed continuum of time. But it is still true that all durations and rates, illustrated by using the sexagesimal numbering system, remain, always, an integral part of the densely packed continuum of time, as mapped out through the use of the real number system.

Sinbadus:

Tell us more, Cynicus! Where are the places of past, present, and future, inside this true and mathematical time of yours? Are past, present, and future still there? Or have they gone away forever?

Cynicus:

Don't worry about them, Sinbadus! They are still there, in all their majesty and glory.

Dingleus:

I can, clearly, see that all durations and rates of flow, within this continuum of true and mathematical time, have past, present, and future; except the utmost duration, on the hour-hand side, with length infinitely large and running at a rate of flow equal to zero. Is this the eternity hand of your universal clock, Cynicus?

Cynicus:

Surely, Dingleus, that is the hand of eternity! The true and mathematical time has three different types of eternity: Past eternity, present eternity, and future eternity. But, only, present eternity can have a hand for it, on the face of our universal clock.

Sinbadus:

Now, if that supposed hand of eternity, on the infinite face of your universal clock, is not flowing at any rate, at all, then it can have neither past cycles nor future cycles of it; i.e., it does not have any past or

future; none of whatsoever.

Cynicus:

It's just one hand, which is, always, non-running and at a complete standstill, among the infinite number of hands, on the face of this magnificent clock. Furthermore, present eternity is, strategically, located, between past eternity, on one side, and future eternity, on the other side. And hence, although its hand is, absolutely, at rest, present eternity does have, from any formal standpoint, glorious past and bright future ahead of it; unlike the space-time continuum of your two pet theories of relativity, which, even, their inventor and originator, Albert Hermann Einstein, himself, does not know how to make the distinction, between past, present, and future, on the basis of it.

Dingleus:

Don't jump the gun, Cynicus! There is a number of important topics to investigate and clarify, before discussing or criticizing the space-time continuum of Einstein's relativity. These important topics, in my view, should include the conceptual problems, associated with the hypothesis of the finite beginning of time, and with the hypothesis of the infinite past as well, which have been expressed, more eloquently, by Immanuel Kant, in his great book entitled: "***The Critique of Pure Reason***".

Cynicus:

I'm not trying to jump any gun, Dingleus! And furthermore, I'm not putting too much stock into Immanuel Kant's a*ntinomies* and his so-called '*Critique of Pure Reason*' either. Nonetheless, go ahead and bring it on.

The Beginning of Time Versus the Infinite Past:

Dingleus:

We, really, should, within the current context, take Immanuel Kant's antinomies, very seriously. This is how he pointed out, in that book, the following dilemma: "*The world must have a beginning in time, otherwise an infinite amount of time – an eternity – would have already passed in this world; but no infinite series can be completed. On the other hand, the world can't have had a beginning in time, because this would imply a period of empty time before the world came into being, and nothing (least of all, a whole world) can come into being in empty time, as there isn't anything to distinguish one moment in empty time from another*" [***Ref. #9***].

Sinbadus:

"*The world must have a beginning in time, otherwise an infinite amount of time – an eternity – would*

have already passed in this world; but no infinite series can be completed". What a powerful argument! Now, I understand, very well, why our greatest physics genius, Albert Einstein, who, undoubtedly, had read Immanuel Kant's book, in its original language, continued, throughout his life, to dislike the Newtonian hypothesis of '*infinite universe*'.

Cynicus:

Baloney! If your mentor, Albert Hermann Einstein, was that sensitive and too receptive of philosophical arguments, then why, on Earth, did he choose to turn a blind eye to this second horn of his Immanuel Kant's phony dilemma: "*On the other hand, the world can't have had a beginning in time, because this would imply a period of empty time before the world came into being, and nothing (least of all, a whole world) can come into being in empty time, as there isn't anything to distinguish one moment in empty time from another*"? At least, this second part of Kant's argumentation, and in spite of the ambiguous phrase '*empty time'*, is reasonable and more convincing than the first part.

Dingleus:

Okay, Cynicus; let's leave Sinbadus' physics hero alone, for the time being! But why do you think that the phrase '*empty time*', as used above, by Immanuel Kant, is vague and ambiguous?

Cynicus:

What did the brilliant philosopher — Immanuel Kant — want to say, by using the phrase '*empty time*'? Did he mean time, in the absence of matter? Or did he mean the absence of time, altogether? For it's self-evident that time can exist, perfectly well, in the absence of matter; but matter cannot exist, at all, in the absence of time. That is what true and mathematical time is all about, Dingleus.

Sinbadus:

I would like to agree, with you, that time might, actually, exist in the absence of matter, as in the case of the de Sitter universe — a cosmological solution to Einstein's field equations of general relativity — for example. Nevertheless, it's quite clear, to me, that time cannot exist, in the absence of space.

Dingleus:

No matter how hard you try, you will never be able to picture, in your mind, how time and space can be annihilated and put out of existence for good. It's just impossible, even, for the most powerful deity, to do it. In a way, it's almost as bootless and vain as trying, for example, to annihilate the differential equations of calculus or the three laws of logic: The law of identity, the law of non-contradiction, and the law of the excluded middle.

Cynicus:

Don't get too carried away, by Sinbadus' futile attempt at injecting Hermann Minkowski's discordant union of space and time, into Immanuel Kant's antinomies, Dingleus! Certainly, it's possible, in principle, to do away with space, by simply dividing it ad infinitum to oblivion. But if we try to do the same with time, we will have, in the end, something named '*moment*', the length or the duration of which is nil and running at an infinitely fast rate; i.e., the exact opposite of Immanuel Kant's '*empty time*'.

Sinbadus:

If we, simply, divide space ad infinitum, we will have, in the same way, something called '*point*' in geometry, which is very similar to the concept of '*moment*' in the case of time.

Cynicus:

As far as space's very existence is concerned, a geometrical point, with zero length, zero width, and zero depth or zero height, is as good for nothing as no space at all.

Dingleus:

I'm, quite, impressed by the extreme vitality of this thing labeled as '*moment*' of time. And I, really, wonder why the French philosopher, and the nemesis of Albert Einstein, H. Bergson didn't choose it, in his philosophy of '*vitalism*', instead of his sluggish '*Élan vital*'! However, it seems, to me, that neither of you — Cynicus & Sinbadus — have said or mentioned, so far, anything substantial, against this excellent and weighty argument, by Immanuel Kant: "*The world must have a beginning in time, otherwise an infinite amount of time – an eternity – would have already passed in this world; but no infinite series can be completed*". And I know, of course, that I, myself, have none to speak of.

Cynicus:

The above argument, by that beloved '*Prussian*' philosopher of yours, appears, superficially, to be coherent and somewhat compelling; but it's, as a matter of fact, contradictory, hollow from the inside, and, completely, incoherent, at heart! Look, please, very closely, at this statement of his; "*otherwise an infinite amount of time – an eternity – would have already passed in this world*". In order for any interval of time to pass and have its end, now, right here, it must, first, start, at a specific moment in the past and have, by logical necessity, its absolute beginning, in time, right there. In other words, Immanuel Kant has, implicitly and silently, assumed, in the one and the same statement, that eternity is infinite and finite, at the same time. And that, quite simply, is an outright and outrageous contradiction, on his part.

Dingleus:

Wait a minute, Cynicus! The past is called, in every language, on Earth, '*past*', because it's already has passed. Past eternity, likewise, has already passed. And you just can't rebut or debunk Immanuel Kant's argument this easy. Please, try again, a little harder, one more time.

Sinbadus:

That is a great counterargument, Dingleus! I like it very much.

Cynicus:

Examine it, very carefully, both of you! Immanuel Kant's argument can never survive the devastating contradiction, within its basic premises, which I've, already, pointed out, to you. An infinite amount of time, by its very definition, just can't have any beginning. That is crystal clear and very simple. From what starting point, and with respect to what, do we reckon that some certain amount of time has passed? Don't you agree that we, always, make judgments, like these, from the present, and with respect to the present? We start from the present and follow a specific series of intervals of time deeper into the past. And if we find their beginning, then we can, justifiably, say that those intervals of time have passed. Otherwise we must suspend our judgment and just keep looking for their presumed beginning. Certainly, our procedure of regression, into the past to search for true points of beginning, works, very well, in all cases of finite intervals of time. But it can, only, go on and on and on forever, in this one single case of past eternity. For, as you have known, already, past eternity is not just without any true beginning, but also, on the top of that, every amount of time, by which we regress, into the past, towards its supposed beginning, is, always, equal to zero, compared to its infinite amount of time. To put it, differently, any regression, into the past, is, always, nil, with respect to past eternity. And as a result, we are, always, at this very present moment, relative to past eternity.

Dingleus:

That is very nice, Cynicus; but it won't work! Because we make the conclusion that past eternity must have passed, not through the regression into the past; but because we know, for certain, that we're standing, right now and at this very moment, right smack at its exact end.

Sinbadus:

That is, truly, astounding, Dingleus! Now, I can see, very clearly, the most compelling reason why our greatest genius of physics — Albert Einstein — never accepted the idea of eternal universe.

Dingleus:

Ah; stay, please, quiet about it, Sinbadus! The proposition of a universe, with some supposed beginning, is as bad as the proposition of a universe, with no beginning, or even worse. And I suspect that people, always, arrive at their belief in the latter, through contemplating the inherent contradictions of the former; and vice versa.

Cynicus:

And also, we may, well justifiably, say that we are '*standing, right now and at this very moment, right smack at its exact*' beginning, as well. But not so fast; Dingleus! You have been posing questions, to us, most of the time. Allow me, now, to pose a very simple question that requires a straightforward and satisfactory answer, from you: On what grounds, and for what reasons, do you base your belief that an infinite amount of time is impossible to have passed?

Dingleus:

An infinite amount of time is impossible to have passed, because it's infinite.

Cynicus:

So, how come that, in *1734*, Leonhard Euler, was able to obtain the total sum of this infinite series of the inverted squared positive integers:

$$\sum_{n=1}^{\infty} \frac{1}{n^2} = 1 + \frac{1}{4} + \frac{1}{9} + \frac{1}{16} + \frac{1}{25} + \frac{1}{36} + \frac{1}{49} + \ldots = \frac{\pi^2}{6}$$

and to solve the Basel Problem [***Ref. #10***]?

Dingleus:

He didn't, really, solve it! He just hid it, in the π number, which nobody, really, knows where it ends; or more precisely, how many digits does it, actually, have, inside the guts of it.

Cynicus:

You're a formidable defender of your Immanuel Kant's transcendental idealism, Dingleus! Now, allow me, please, to borrow your mentor's favorite method of communication: In order to explain it, to you, verbally. The previous year was an infinite series of moments of time; and those moments of time all had passed. The previous century had an infinite series of moments of time; and in the same way, those moments of time all had passed. The previous millennium was made of an infinite series of moments of time; and likewise, those moments of time all had passed. Past eternity, too, was nothing more than an infinite series of moments of time. So, why do you think that it should be impossible, for past eternity, to have passed, as well? Is it because past eternity has no formal beginning attached to it? That is not a very good reason, for concluding that past eternity is impossible to have passed. I can understand why infinite things, generally. stir a little bit of unease, in the human mind. Because humans tend to take possession of things, by making sure where those things start, and where they end. But once again, social and evolutionary tendencies of this sort do not and cannot, fully, justify holding fast to any degree of belief in the impossibility of infinite past.

Dingleus:

You know; Cynicus; I, honestly, feel, right now, that my Kantian certitude, about the self-evident truth of the antinomies, starts to mellow, little by little!

Sinbadus:

Are you conceding defeat, Dingleus, this early, because of such metaphysical hot air that Cynicus has just breathed out, and which has no robust mathematical equations and no real physical experiments to back it up, even slightly?

Dingleus:

Conceding defeat? Hardy har har! I meant to say, only, that my objections to the idea of infinite past start to mellow, a little bit, and no longer feel as rigid and uncompromising, as usual and as used to be.

Cynicus:

Whether they start to mellow or not to start to mellow; the Prussian philosopher Immanuel Kant's baseless objections to the viability and validity of past eternity are, now, history.

Dingleus:

Whatever you say, Cynicus! Let's assume, for the sake of argument, that it's okay to stick to your belief in past eternity. What are the epistemological advantages, if any, that the hypothesis, which states that time does not possess any real or formal beginning, at all, has over the opposing hypothesis, which states that time does have an actual beginning to start finitely ticking from?

Cynicus:

The proposition of infinite past has clear epistemological and conceptual advantages over the supposition of finite past. It guarantees that the distinction between past, present, and future, is real, permanent, constant, and the same, throughout the universe. Since it's self-evident that every interval of time, regardless of the numerical values of its length, is always nil and exactly equal to zero, with respect to past eternity, as well as with respect to future eternity. This great proposition, also, guarantees that the chain of causality remains, always, universal, continuous, and uninterrupted by any arbitrary beginnings, artificial boundaries, or any other restrictive limits. Moreover, the proposition of infinite past clears away, at once, a whole host of paradoxical and absurd suppositions, such as first causes, prime movers, singularities, big bangs, little bangs, and so on, and so forth. And more importantly, the proposition of infinite past guarantees the eternal presence, coherence, and consistency of logic, mathematics, and laws of nature, everywhere in the infinite universe.

Dingleus:

Does the hypothesis of infinite past guarantee the presence of free will, everywhere in the vast

universe?

Cynicus:

I told you, years ago; and I tell you, right now, that a universe, in which the amounts of time, space, and matter are infinite, is the greatest guaranteer of the existence of free will, and the best of all worlds, for free will, to roam freely.

Sinbadus:

We don't have the time, for discussing that metaphysical subject, all over again. So, let's just ask Dingleus to outline, for us, very briefly, the next topic of this discussion.

Dingleus:

I'm afraid, Sinbadus, you will find our next topic, even, more metaphysical than the topic of free will!

Sinbadus:

Our next topic is about what?

Dingleus:

It's about Laplace's demon!

Sinbadus:

Well, I would presume, if that demon, really, belongs to P. Laplace, it can't go, too far, that metaphysically monstrous. And in any case, dash ahead; and tell us what it is.

Determinism Versus Indeterminism:

Dingleus:

In his *1814* essay, Pierre-Simon Laplace defines strict physical determinism, the so-called '*Laplace's demon*', this way: "*We may regard the present state of the universe as the effect of its past and the cause of its future. An intellect which at a certain moment would know all forces that set nature in motion, and all positions of all items of which nature is composed, if this intellect were also vast*

enough to submit these data to analysis, it would embrace in a single formula the movements of the greatest bodies of the universe and those of the tiniest atom; for such an intellect nothing would be uncertain and the future just like the past would be present before its eyes" [***Ref. #13***].

Sinbadus:

I, really, like this '*Laplace's demon*', so much, Dingleus! Because it demonstrates to me, very clearly, that when our greatest genius of physics, Albert Einstein, told Niels Bohr that '*God does not play dice*', he was seeing a lot further, because he was standing on the shoulders of a true giant.

Cynicus:

Pierre-Simon Laplace, in the above passage of his, is repeating Immanuel Kant's biggest mistake of replacing, silently and implicitly, infinity with finity, and treating the infinite chain of causation, throughout the infinite universe, as something finite, closed, enclosed, and ready to be encompassed and analyzed, at once, by the analytical mind of his fictional demon.

Dingleus:

Pierre-Simon Laplace uses, in his article, the phrase of '*the present state of the universe*' to refer, only, to the chain of causality, in the universe, at the present moment of time; and not throughout the infinite past.

Cynicus:

Of course, Pierre-Simon Laplace means by '*the present state of the universe*' the universe's chain of causation, at this universal moment of '*now*'. But the number of causes, at work everywhere in the infinite universe at this very moment named '*now*', is, necessarily, infinite.

Sinbadus:

And just how, exactly, can the present causal chain of the universe have an infinite number of causes, in the inside of it?

Cynicus:

The number of present causes, in the infinite universe, must be infinite, because the amounts of space and matter are infinite. And since Pierre-Simon Laplace cannot, even in principle, bring the infinite space, with everything in it, in one single package to his imaginary demon, that, supposedly, extremely intelligent, very analytical, and smart demon would have, by logical necessity, no total present state of the universe to analyze or to work on, in the first place; i.e., this whole *'demon thing'* is a non starter.

Dingleus:

I can see, now, that, in an infinite universe, Laplace's '*present state of the universe*' ought to be infinite! Does this imply that, in an infinite universe, physical determinism is impossible?

Cynicus:

Well, not exactly, Dingleus! Laplace's universal determinism, in an infinite universe, is, certainly, impossible. However, it's, always, possible to start with the present state of a finite part of the universe, analyze it, and then make predictions, about the future state of that finite part, for a specific interval of time. And furthermore, by gradually increasing the finite size of the analyzed part of the universe, the scope of predictions, about its future states can be extended into the future, indefinitely. But, no matter how large the size of the analyzed part is, and how long and extended into the future the interval of time is, the accuracy of predicting its future states is, necessarily, nil, in all cases, in which the size of the part to be analyzed, the extended interval of time into the future, or both are assumed, explicitly, or implicitly, to be infinite.

Sinbadus:

So, now, are you saying that the present states of any finite parts of the universe can be investigated and analyzed by '*Laplace's demon*', in order to predict their future states to any finite period in the future; but not the present state of the universe as a whole?

Cynicus:

That is, exactly, right, Sinbadus! And in addition to that, no prediction of any finite part of the universe can be extended, all the way to the infinite future.

Dingleus:

Can this sort of infinite universe, with its deterministic parts and indeterministic totality, be the best of all worlds, for free will to roam freely?

Cynicus:

Why not?

Sinbadus:

It's, obviously, because this so-called '*free will*' can have no place, inside those deterministic parts of your infinite universe. Is that a good reason, Dingleus?

Dingleus:

That is a very good reason, Sinbadus! Free will, by its very definition, is associated with finite persons. And finite persons can work and operate, only, in the finite parts of an infinite universe. And, therefore, if all of the finite parts of the infinite universe are deterministic, we will have to say farewell to free will; won't we?

Cynicus:

I'm afraid that I'm starting to suspect that your Immanuel Kant's idealistic speculations, on this particular subject, have made your mind a little bit cloudy, Dingleus! Free will is not something extraneous and coming from outside the universe. Free will is an immediate consequence and real effect of the causal chains at work in the physical universe.

Dingleus:

Then how come free will is free?

Sinbadus:

I don't think the deterministic nature of the chain of causality, in the physical universe, can give birth to anything free. It's, just, impossible.

Cynicus:

Oh, yeah! So, why are the free radicals free?

Dingleus:

Try, seriously, your best to answer this very important question, Cynicus: What makes free will, in this infinite universe of yours, truly free?

Cynicus:

Two things make free will, in the infinite universe, truly free: The abundance of choices and Aristotle's teleology [***Ref. #14***]. Do you see this fine point, very clearly, gentlemen? Among the terms of the infinite set of causality, in the infinite universe, free will is quite unique. The future goals of free, will as well as free will, itself, are, necessarily, normal effects of the chain of causation in the universe. But unlike all other future effects, which must remain inactive until they become present, the future goals of free will become active causes, in the present state of the world, right away. That is really unique and sui generis. No other type of future effects can play any active role in the present, except the future goals of free will. And that is what makes free will, in the infinite universe, truly free.

Dingleus:

Not so fast, Cynicus! Our next topic may, well, turn this argument of yours on its head and bring '*Laplace's demon*' back to the universe, smartly shining with all its might.

Sinbadus:

And our next topic, in the current discussion, is going to be about what?

Dingleus:

It's about the question of whether or not the two ancient philosophies of Parmenides and Heraclitus stir up any sort of trouble, for Cynicus' universal clock of true and mathematical time.

Cynicus:

No problem, at all, Dingleus! I'm quite certain that the two opposing views of Parmenides and Heraclitus, on the nature of time coincide, very nicely, with the two extremities of Newton's true and mathematical time.

Parmenides Versus Heraclitus:

Dingleus:

Although the ancient Greek philosopher Parmenides stated that '*time is infinite, without beginning, end, or middle*' [***Ref. #7***], he argued vigorously and persistently that the passing of time must be unreal. And that change ought to be an illusion of some sort. I wonder how the views of this ancient savant on the temporal essence of the universe can go, hand in hand, with Newton's true and mathematical time. Go ahead and demonstrate that, to us, Cynicus!

Cynicus:

I, certainly, agree with the great philosopher, Parmenides, that time is infinite without any beginning, and without any end. But I do disagree, with him, on the phrase '*without middle*' in his definition of time. That is because if time is taken for granted to be infinite, then, by logical necessity, every moment of it must be in the middle of it. In other words, infinite time, by its very definition, must have an infinite number of midpoints.

Sinbadus:

What does the sentence '*every moment of it must be in the middle of it*' mean, exactly?

Cynicus:

It means that every moment of infinite time is, always, between two eternities: Past eternity on one side, and future eternity on the other side. And therefore, it's, always, in the middle.

Dingleus:

Do you, in addition, agree with Parmenides' assertion that '*the passing of time must be unreal*'?

Cynicus:

Only with reference to eternity, the passing of time is unessential and unreal. With respect to every other duration, in the universal clock of Newton's true and mathematical time, the passing of time is actual and real.

Sinbadus:

So, are you claiming, now, that Sage Parmenides got, only, one hand of your universal clock right; and then he got, infinitely, wrong everything else?

Cynicus:

Well, at least, Parmenides got eternity right; unlike your supposed genius of physics — Albert Hermann Einstein — who was wrong, in every single thing, related to true and mathematical time.

Dingleus:

Eternity is immense. I suppose that Parmenides would have been delighted and very impressed by this answer of yours, Cynicus! But would you elaborate, a little bit more, on why the passing of time is unreal with respect to eternity?

Cynicus:

Eternity is very immense indeed, Dingleus! The passing of time is unreal, with respect to past eternity, because every finite interval of time, no matter how long and how large its value, must always remain equal to zero, with reference to past eternity. The passing of time is, also, unreal, with respect to future eternity, because every finite interval of time, no matter how long and how huge its value, must be always equal to nil, with reference to future eternity. And, of course, the passing of time is unreal, with respect to present eternity, because the hand of present eternity, on the face of the universal clock of

true and mathematical time, is, always, at rest and frozen, so to speak, at the universal instant of time called '*now*'. We know, for sure, that the past year was subtracted from future eternity. Does that subtracted year make future eternity less this year than the previous year? The answer is no. Future eternity is still the same. We, also, know, for sure, that the past year has been added to past eternity. Does that added year, to infinite past, make past eternity, this year, greater than past eternity, in the previous year? The answer is no. Past eternity is still, exactly, the same. And so, the above statement, by Parmenides, is, definitely, true, with reference to eternity.

Sinbadus:

That is quite sui generis! As far as I can remember, this is the first time, I've had heard someone claiming that the present moment we label as '*now*' is actually a non-flowing and non-running eternity and a frozen instant of time, so to speak! Where and how does the ever-flowing '*now*' of Heraclitus coincide '*very nicely*' with this forever frozen '*now*' of Parmenides?

Cynicus:

Relativists, or more precisely, Einsteinianists, take pride in their never-ending obsession with reference frames, points of origin, and points of reference, with regard to motion and moving objects. However, when it comes to the treatment of time, all reference frames, points of origin, points of reference, and explicit references to present, past, and future, are all ignored, glossed over, and forgotten, by every bright and every dim of them.

Dingleus:

Reportedly, Heraclitus stated that '*time is a game played beautifully by children*'; and that '*eternity is a child playing, playing checkers; the kingdom belongs to a child*' [***Ref. #11***]. Is there any sort of hidden wisdom or deeper insight, regarding the nature of time, in these two statements of his?

Cynicus:

Probably, Heraclitus, here, was, only, trying his best, to be the life of the party and a little bit more poetic and sui generis than his companions!

Sinbadus:

Well, at least, those two great oracles, by Sage Heraclitus, have stood the test of time.

Dingleus:

The ancient Greek philosopher, Heraclitus, also, stated that '*everything changes and nothing stands still*'. And that '*you could not step twice into the same river*' [***Ref. #11***]. And therefore, in his view, the flow of time is real. Is it, really, possible to reconcile Heraclitus's philosophical view, on the nature of

time, with that of Parmenides?

Cynicus:

It's, definitely, more than possible, Dingleus! Within the general ontology of Newton's true and mathematical time, Parmenides' definition of time is the correct definition, in all cases of every time interval whose duration is infinite and rate of flow is equal to zero. While, by comparison, Heraclitus's definition of time is the correct definition, in all cases of every time interval whose duration is finite and rate of flow is greater than zero.

Sinbadus:

The main difference, in this regard, I presume, is that Heraclitus' definition of time applies to the physical world; but Parmenides' definition of time does not.

Cynicus:

Both definitions of time apply to the same physical universe. Heraclitus' definition of time applies to everything, inside the physical universe. While Parmenides' definition of time applies to the physical universe, in its totality and as a whole.

Dingleus:

But what is, precisely, the exact definition of the physical universe, to which these two, diametrically, opposed definitions of time apply?

Cynicus:

Parmenides' definition of time and Heraclitus' definition of time can coexist in harmony and apply together, only, to an infinite universe, in which space is infinite; time is infinite; and the amount of matter is infinite, as well.

Sinbadus:

The amount of matter, inside the physical universe, cannot be assumed to be infinite, even if space and time are assumed to be both infinite.

Dingleus:

What is your evidence for that?

Sinbadus:

If we were to assume that the amount of matter is infinite, then matter would have filled infinite space; and density of matter, throughout our physical universe, would have become infinite.

Cynicus:

Oh, really? Why wouldn't you just go ahead and divide the infinite amount of matter, by the infinite volume of space, and find out, ASAP, for yourself, what amount of density you can actually get?

Dingleus:

This is quite interesting, Cynicus! The density of infinite amount of matter, throughout the infinite universe, is, precisely, equal to *0/0*. What does that mean, exactly? Does it, actually, mean that nothing can exist, in such a universe, besides infinite space and infinite time?

Cynicus:

A numerical result of *0/0* should mean, from any physical standpoint, to both of you, that the infinite universe, as defined above, has no universal value for matter density. And that the density of matter, in various parts of the universe, can have any value between zero and infinity. But the density of matter, in the universe as a whole, remains always undefined and equal to *0/0*.

Sinbadus:

This is very puzzling, Dingleus & Cynicus! Why can't the infinite amount of matter fill the infinite volume of free space?

Dingleus:

Maybe, because the range of increase for matter is, only, between *0* & ∞. While, by contrast, the range of increase, for space, is between ∞ & $-\infty$.

Cynicus:

Well, it's, quite, obvious, Sinbadus! The amount of matter increases, as a linear quantity. While the volume of space increases, as a cube quantity. So, matter just can't keep up with space.

Dingleus:

You can't, really, be so sure about it, Cynicus! It's infinity. And anything can happen.

Cynicus:

But I can be so cocksure, about its density. And I have *0/0* to back me up; don't I?

Sinbadus:

'*Matter increases linearly; and space increases cubically*'! It sounds just like comparing apples and oranges. It doesn't seem to make any sense, to me.

Cynicus:

Oh; so you don't know how to compare the apples of matter to the oranges of space; do you? Start with one unit of mass that occupies a volume of space equal to one unit sphere. Double the amount of mass, as well as the radius of the unit sphere. And then compare the oranges of space to the apples of matter. Double the doubled unit of mass and the doubled radius of the unit sphere. And compare the apples of matter and the oranges of space one more time. Repeat this process many times; until you feel satisfied. What do you find? You, necessarily, find that, as the mount of matter increases linearly, the volume of space that matter occupies increases linearly as well. By contrast, as the radius of the unit sphere increases linearly, the volume of space increases cubically. And moreover, the ratio between the volume of space that matter occupies, and the volume of space due to the increasing radius of the unit sphere, obeys the inverse square law, and approaches zero, as the amount of matter and the volume of space approach infinity.

Dingleus:

What can I say, gentlemen? Cynicus has just, successfully, compared the apples of matter to the oranges of space! What do you think, Sinbadus?

Sinbadus:

I think we can understand the main reasons why some people believe that space and time might be infinite. But I don't see how Cynicus can, logically or by any other means, justify his assumption that the amount of matter, in the universe, must be infinite, as well.

Cynicus:

Well, it's a piece of cake, Sinbadus! If we assume that space and time are infinite, then we must assume that the amount of matter, in the universe, is infinite too. Otherwise, infinite space and infinite time would have, by now, obliterated, dispersed, and thinned out the initial finite amount of matter, in the universe, to virtually nil or nothing at all. What do you think, Dingleus? Is this a good reason for assuming the infinity of mass?

Dingleus:

Oh; I guess, it's okay! Although I can't say that I have heard this kind of justification before.

Sinbadus:

Here's one of the major paradoxes of assuming an '*infinite space + infinite time + infinite mass*': Consider the sphere of space centered around you, Cynicus. If mass, time, and space, are infinite, then it must follow that, as the length of every radial line, within this sphere, approaches infinity, the number of exact copies of you, passed through and crossed by each radial line, approaches infinity, as well! Is this paradoxical result an inevitable consequence of your proposition, Cynicus?

Cynicus:

Not only the infinitely extended radial line meets an infinite number of exact copies of me; but also, it meets an infinite number of exact copies of every real physical possibility, including you, the relativist — viz. Einsteinianist — and of course, the transcendental idealist of ours, Dingleus! But why and on what grounds do you believe that such a highly desirable consequence is paradoxical?

Sinbadus:

What is the phrase '*real possibility*', in this context, supposed to mean, exactly?

Cynicus:

Real physical possibilities, in an infinite universe, mean everything that matter can do, including among other things, of course, every relativist, every transcendental idealist, me, the planets, the *O* stars, the *B* stars, the *G* stars, and the milky-way galaxy!

Sinbadus:

It follows, therefore, that if every infinitely extended radial line, within the sphere around you, meets an infinite number of exact copies of every real physical possibility, then this so-called '*infinite universe*' of yours is not only infinite; but, also, infinitely infinite. And that is, obviously, because the number of radial lines, within the sphere around you, is infinite. Is this result a valid inference from your proposition, Cynicus?

Cynicus:

Certainly; it's more than a valid inference, Sinbadus! The infinite universe is infinitely infinite. There is, absolutely, nothing paradoxical or wrong with the infinite universe to be infinite many infinite numbers of times over, or with being infinite in every conceivable direction. Since that is, precisely, what the infinite physical universe, by its very definition, is all about.

Sinbadus:

Don't you think that the second law of thermodynamics would, eventually, reduce all of the real physical possibilities, which matter is able to do, to just one single physical possibility: Total equilibrium, everywhere in this infinite universe of yours?

Cynicus:

The second law of thermodynamics is a hugely menacing giant in finite and isolated systems, like Ptolemy's cosmos and the spherically finite universe of your mentor, Albert Einstein. But, in a truly infinite universe, that humongous jumbo called '*the second law of thermodynamics*', itself, is, practically and effectively, reduced to a minute '*elf*' and part-time worker for taking care of isolated and tiny systems, scattered at random throughout the infinite universe.

Dingleus:

Although it feels unbelievable and horrendous, this particular inference doesn't strike me, at first glance, as paradoxical, Sinbadus.

Sinbadus:

The aforementioned consequence is paradoxical, because it violates the logical law of identity, which states that "*each thing is the same with itself and different from another*".

Cynicus:

The above consequence does not violate, in any way, the law of identity or any other law of thought, Sinbadus; trust me! In fact, the notion of an infinite number of copies of the same thing, existing, simultaneously, is very similar, in every respect, to the notion of an infinite number of instances of the same computer application running, at the same time. The exact copies of you or me are exact alright. But there are three important identifiers that guarantee the absolute uniqueness of each copy or instance of anything in the infinite universe and throughout the infinite history of the infinite universe. And these identifiers are: The mass identifier, the space identifier, and the time identifier. The first and the second identifiers guarantee the unique identity, in the case of all exact copies of things existing, throughout space at the same time. While the third identifier guarantees the unique identity, in the case of all exact copies of things, throughout the history of the infinite universe.

Dingleus:

So, based on these three identifiers, or ID tags, as one might say, is the well-publicized statement of the ancient Greek philosopher — Heraclitus — that '*you could not step twice into the same river*' true or false?

Cynicus:

It's, certainly, true, Dingleus! Because, even, if the value of the mass identifier and the value of the space identifier remain the same, the instance of you, during the first stepping, and the instance of you, during the second stepping, have, necessarily, different values of the time identifier.

Sinbadus:

And just where and what is the co-ordinate system, in your so-called '*infinite universe*', by the means of which those numerical values of your so-called '*ID identifiers*' can be, correctly, plotted and, precisely, reckoned?

Cynicus:

Don't worry about it, Sinbadus! Unlike the co-ordinate systems of your cute and adorable genius, Albert Einstein's general relativity, with their explicitly mentioned and attached qualifier '*suitably chosen*', the numerical values of those three identifiers can be easily mapped out and calculated with any degree of precision, by using any frame of reference or any co-ordinate system, anytime and anywhere in the infinite universe.

Dingleus:

Any co-ordinate system anywhere and anywhen? It seems, to me, these three ID tags are too general and quite handy. I wonder why Immanuel Kant, unlike Cynicus and Einstein, never tried, even once, to base any of his main arguments upon co-ordinate systems and reference frames!

Cynicus:

No wonder, Dingleus! Your adorable transcendental idealist — Immanuel Kant — never stopped arguing, in most of his books, for his idealistic belief, that mathematical reasoning cannot and should not be employed outside the domain of mathematics.

Sinbadus:

Well, in this case, I do think that the following semi-algebraic argument, by another idealist, might worry you quite a bit, Cynicus! According to John Ellis McTaggart, it may be the case that '*the distinction introduced among the series of positions in time running from the far past through the near past to the present, and then from the present to the near future and the far future, is simply a constant illusion of our minds*' [***Ref. #6***].

Cynicus:

Or, more likely than not, it may be not! By the way, I bet that McTaggart's *1908* article entitled: "***The Unreality of Time"*** was the sole source, behind your charming guru, Albert Einstein's bogus inspiration that: "*For we convinced physicists, the distinction between past, present, and future is only an illusion, however persistent*".

Dingleus:

False inspirations do not need sources, Cynicus! However, I find McTaggart's argument intriguing and quite relevant to the main subject of this discussion. Let's ask Sinbadus to summarize it, here for us, as briefly and concisely as possible.

Concerning McTaggart's Unreality of Time:

Sinbadus:

Well, I suppose, it might be just chickenfeed, to both of you, Dingleus & Cynicus, to take apart McTaggart's argument, concerning the unreality of time! At the start of his article entitled: "***The Unreality of Time"*** , J. E. McTaggart divides positions, in time, to two series: The *A* series, in which those positions run from the far past through the near past to the present, and then from the present to the near future and the far future. And the *B* series, in which the same positions run from earlier to later, and each position is earlier than some, and later than some, of the other positions. He then states that the distinctions of the *B* series are permanent, while those of the *A* series are not. And that is because if *M* is ever earlier than *N*, it is always earlier. By contrast, an event, which is now present, was future and will be past. And accordingly, McTaggart concludes that the *B* series is permanent, more objective, and more essential to the nature of time. But he believes, however, that this would be a mistake, and that the distinction of past, present and future is as essential to time as the distinction of earlier and later, while in a certain sense, it may be regarded as more fundamental than the distinction of earlier and later. And because the distinctions of past, present and future seem, to him, to be essential for time, he regards time as unreal [***Ref. #6***].

Dingleus:

Very concise and informing indeed; thank you so much, Sinbadus! What do you make of McTaggart's argument, for the unreality of time, Cynicus?

Cynicus:

McTaggart's argument, for the unreality of time, is, blatantly, bogus! It does not cut it. And it does not hold any water, at all, Dingleus.

Sinbadus:

Well, just dash ahead; become our big shot; and take aim at it, and then shoot it down!

Cynicus:

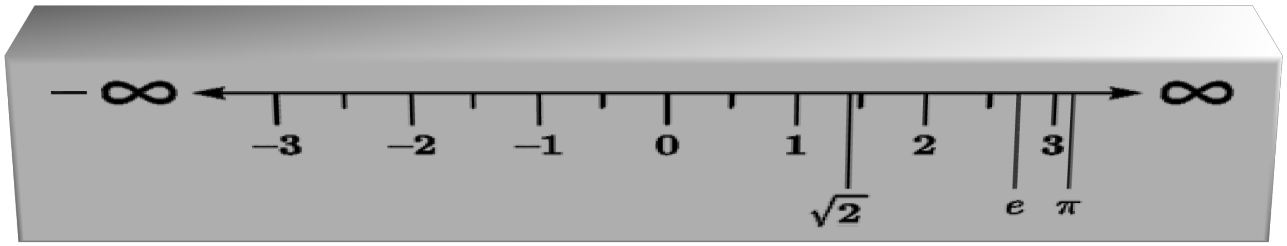
Ironically, that '*wannabe idealist*', published his *1908* article of ***"The Unreality of Time"*** in a philosophical journal named '***Mind***'!

Dingleus:

McTaggart was a superb philosopher; and every philosophical journal, in the world, was more than happy to publish his great article. Now, what do you have against McTaggart's argument, for the unreality of time, Cynicus?

Cynicus:

McTaggart's *A* series and *B* series are exactly the same. The infinite number of moments of time, from past eternity, through the present, and all the way to future eternity, can be represented by the following diagram for real numbers:



where $+\infty$ stands for future eternity; *0* stands for the present; and $-\infty$ stands for past eternity. Every moment, located anywhere between $-\infty$ and $+\infty$, is entitled to be selected as a point of reference and central moment of infinite time, and, in exactly the same way, every geometrical point in space is entitled to be picked out as a reference point and center of infinite space. And so, it's clear, from the above summary of his argument, by Sinbadus, that, in his *B* series, McTaggart has assigned to every moment of time the two attributes of position: Earlier and later, correctly. By contrast, in his *A* series, McTaggart has assigned the three main positional attributes: Past, present, and future, only with respect to one single moment of time: Universal '*now*'. And arbitrarily and without any justification, he has denied every other moment of time, between ∞ and $+\infty$, the right to be equally chosen as a point of reference, with respect to which the same three primary attributes can be assigned in a consistent and proper manner. And it follows, therefore, that McTaggart's distinction between the *A* series and *B* series is artificial and false. And that his entire argumentation is based upon mere

tautologies, nothing more and nothing less.

Sinbadus:

Just a minute, Cynicus! Your universal clock of true and mathematical time utilizes the infinite sequence of real numbers in sequencing the durations and running rates of its hands vertically. And now, you want to use the infinite sequence of real number in sequencing time from $-\infty$ to $+\infty$ horizontally. What is your justification, if any, for this wide-ranging and unrestricted utilization of the infinite sequence of real numbers?

Cynicus:

Well, that is self-evident, Sinbadus! The durations of the universal clock's hands are in one-to-one correspondence with the infinite sequence of real numbers. And therefore, the infinite sequence of real numbers must be employed in sequencing those durations vertically. Also, the running rates of the universal clock's hands are in one-to-one correspondence with the infinite sequence of real numbers. And hence, the infinite sequence of real numbers must be used in sequencing those running rates vertically as well. And likewise, the infinite number of moments of time, from the infinite past, through the present, to the infinite future are in one-to-one correspondence with the infinite sequence of real numbers. And correspondingly, the infinite sequence of real numbers must be utilized in sequencing this infinite number of moments of time horizontally, as well. And moreover, the duration of every hand of the universal clock is entitled to be selected for sequencing time from $-\infty$ to $+\infty$, horizontally, and to be in one-to-one correspondence with the infinite sequence of real numbers.

Dingleus:

According to J. E. McTaggart, each moment of time, in the *A* series, changes its main attribute from future to present and then permanently to past. Would you, please, Cynicus, elaborate a little bit more on how, exactly, those three major attributes can be equally assigned, in accordance with your above procedure, to any position in McTaggart's *A* series?

Cynicus:

It's always possible, Dingleus, to assign the three attributes of future, present, and past to any position located anywhere along McTaggart's *A* series, and regardless of whether that particular position, with respect to the universal instant of time called '*now*', is currently located in the future, the present, or the past. Let's take the year *1000 A.D* as an example. With respect to the year *1000 A.D*, the year *1500 A.D* is always in the future; and the year *500 A.D* is always in the past. That was true, when the year *1000 A.D* was in the future with respect to the universal moment of '*now*'. And that was true, when the year *1000 A.D* was in the present with respect to the universal moment of '*now*'. And it's still true, when the year *1000 A.D* is permanently in the past with respect to the universal moment of '*now*'. And as a general rule, if any moment of time is selected as a point of reference, that moment of time takes the attribute: Present, automatically. And the attribute: Future is, automatically, assigned to all other moments later than that moment. And the attribute: Past is, automatically, assigned to all other moments of time earlier than that particular moment of time.

Sinbadus:

McTaggart's basic conclusion, concerning the unreality of time, does not seem to be very different from that of Parmenides. So, why do you believe that the latter is okay; but the former is not?

Cynicus:

Parmenides made his argumentation with reference to eternity and the totality of existence. While McTaggart, by contrast, made the aforementioned argument with reference to finite intervals and durations of time. And therefore, Parmenides was definitely right. But McTaggart was definitely not.

Dingleus:

It seems clear, to me, that McTaggart has, somehow, given a privileged status to the universal and live moment of time labeled as '*now*', and implicitly has used it to distinguish the *A* series from the *B* series.

Cynicus:

He, also, appears to be affirming the existence of the present, in order to deny its reality. And consequently, his tautological argument for the unreality of time may well be labeled as '*self contradictory*' as well.

Sinbadus:

From the standpoint of the theory of relativity, McTaggart's argument, for the unreality of time, is basically semantic, with little or no mathematics or supporting experiments.

Dingleus:

Philosophical arguments, generally, are put forwards and expounded, verbally, the McTaggart's way. But let's, now, discuss in details and examine, closely, how Einstein's theory of relativity treats the continuum of time. So, Sinbadus, aside from his early statement, regarding the distinction between past, present, and future; did Albert Einstein write or say explicitly anything else interesting or important about the nature of time?

Relativistic Time Versus True and Mathematical Time:

Sinbadus:

In the *1924* revised edition of his book entitled "***Relativity: The Special and the General Theory***", Albert Einstein wrote: '*Since there exists in this four dimensional structure (space-time) no longer any sections which represent "now" objectively, the concepts of happening and becoming are indeed not completely suspended, but yet complicated. It appears therefore more natural to think of physical reality as a four dimensional existence, instead of, as hitherto, the evolution of a three dimensional existence*' [***Ref. #17***]. And so, it seems, to me, that Albert Einstein had, since the 1922 debate with H. Bergson, moved away from the ideas of Kant and Mach, concerning the notion of time, and closer to the ideas of Parmenides, about the totality of existence.

Cynicus:

That may, well, be due, in large part, to the '*Bergson effect*', Sinbadus! It appears, to me, that your adorable guru — Albert Einstein — had received a lot of hammering and scathing criticism, since the Paris debate; and so much so that his statements about the nature of time, no longer, seem to be coherent, slightly clear, or even a little bit meaningful in any way. And just for the sake of having a second opinion, let me ask you, Dingleus: What does the Einsteinian statement that '*the concepts of happening and becoming are indeed not completely suspended, but yet complicated*' say exactly to you?

Dingleus:

It doesn't appear to say much, to me, Cynicus! And in any case, Albert Einstein wasn't as good as Immanuel Kant and J. E. McTaggart at making verbal and philosophical arguments. So, let's just go ahead and examine the procedural and mathematical treatment of time, within the framework of his two theories of relativity. According to his special relativity, uniform motion changes all time durations from their values in a system at rest to their values in a moving system, as given by the following formula:

$$\Delta t' = \frac{\Delta t}{\sqrt{1 - \frac{v^2}{c^2}}}$$

in which Δt is the length of duration in a stationary system; and $\Delta t'$ is the length of duration in a moving system. Now, Sinbadus, would you, please, explain, to us, what this formula is, really, saying about the nature of time?

Sinbadus:

Well, it's saying that the duration of a physical event, with length equals Δt time units in the stationary system, becomes longer and equals $\Delta t'$ time units in the moving system. In other words, the length of

any interval of time in the moving system can be readily obtained mathematically by multiplying the corresponding interval of time in the stationary system by the relativistic gamma factor:

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

where v is the relative velocity between the two systems; and c is the speed of light in vacuum.

Dingleus:

Therefore, from the above relativistic formula, we can conclude that all time durations of events and physical interactions become longer and their rates of flow become slower, in every moving system. And we can easily calculate the results, by multiplying those durations, as measured in a stationary system, and dividing their running rates by the gamma factor. So, for the sake of argument, let's take, at face value, what the relativists say, about time slowdown in moving systems. And let's not argue, with them, about whether it's, physically, possible in nature, for motion and gravity, to slow the rates of time flow down. And let's focus, here, instead, on finding out whether or not, the relativistic slowdown of rates of durations and time intervals, in moving systems, have any potentially adverse effects, or otherwise, on the homogeneous continuum of Newton's true and mathematical time. Now, Cynicus; does uniform motion, according to Albert Einstein's theory of relativity, lead to multiple instances of your true and mathematical time as you defined it earlier?

Cynicus:

No, it does not, Dingleus! And although Einsteinianists used, in the past, to talk, too much and make a lot of useless noise, about the relativistic symmetry between the two systems, they actually admit, nowadays, that time durations are longer and their rates run slower, only, in one of the two systems in relative motion. Can uniform motion, according to Einstein's theory of relativity, lead to multiple instances of Newton's true and mathematical time? The answer is, definitely, in the negative.

Sinbadus:

The '*answer is in the negative*'! Do you borrow this form of expression from Albert Einstein, Cynicus? Now, it seems clear, to me, that if we multiply each one of the durations of the infinite number of hands, on the face of your universal clock, by the gamma factor, all durations will become longer and all rates of flow must slow down. And as a result, every moving system will have its own version of your so-called '*true and mathematical time*'.

Cynicus:

That form of expression was, most likely, written by the translator, an not by your mentor, Albert

Einstein, in the original version of his book! Even if uniform motion does what your guru, Albert Einstein claimed to do to time or for time, its net overall effect, on the universal clock of true and mathematical time, will be nil. And that is because, if the running rate of any hand slows down, the faster hand next to it, on the faster-rate side, will take its place. And since, the number of hands is infinite, the total time offset of this universal clock, due to Einstein's so-called '*time dilation*' can go no higher than zero; i.e., nothing will ever be noticed to happen, neither from inside the moving system, nor from outside the moving system.

Dingleus:

I suppose that the running rates of the two extremities – moment and eternity – will slow down, due to the relativistic time dilation, as computed within the theoretical framework of Einstein's special relativity, and on the basis of his his general relativity as well.

Cynicus:

There is not the slightest chance, for that, to happen; Dingleus! The moment hand of the universal clock has a duration equal to zero and running rate of infinity. Accordingly, if Einstein's so-called '*gamma*' factor is multiplied by the duration of the moment hand, the net numerical result ought to be equal to zero. And likewise, if the infinite running rate of the moment hand is divided by Einstein's so-called '*gamma*' factor, that running rate ought to remain infinite, as before, and as if nothing happens, at all. And the same applies to the eternity hand of this magnificent universal clock.

Dingleus:

That is, absolutely, incredible! Sinbadus; just look, very closely, at these fantastic results. Time dilation of Albert Einstein's special relativity has, absolutely, no effect, whatsoever, on eternity, or on this universal moment of time called '*now*'.

Sinbadus:

I agree, with you, Dingleus; it's incredible and fantastic! But I, really, think it's, mainly, due to Cynicus' peculiar choice of defining his universal clock, in terms of the infinite sequence of real numbers. Special relativity does not make, mathematically, any claim, at least, that time dilation can produce measurable effects, on intervals of time grouped, together, in the form of an infinite numerical series. Time dilation has real effects, only, on the very large, but limited number of durations and running rates, for any collection of true physical events, processes, and interactions, inside any relatively moving system.

Cynicus:

That is not the peculiar choice of mine, Sinbadus! The set of durations and the set of running rates of the universal continuum of true and mathematical time, each of which forms, naturally, an infinite series, in one-to-one correspondence with the infinite series of real numbers.

Dingleus:

Okay; Sinbadus, the following is the equation, for gravitational time dilation, as computed according to Albert Einstein's general theory of relativity:

$$T = \frac{T_0}{\sqrt{1 - \frac{2GM}{Rc^2}}}$$

What does it say, exactly, about the running rates of clocks, inside a gravitational field?

Sinbadus:

Obviously, the above relativistic equation is, simply, telling us that if an interval of time T_0 is measured by the slow-running clock at the location of mass M, then we can calculate the corresponding interval of time T, as measured by the fast-running clock located at infinity.

Cynicus:

Once again, this, supposedly, gravitational time dilation of Einstein's general theory of relativity can have no effect, to speak of — none whatsoever — on the universal and homogeneous continuum of true and mathematical time. It may or may not change durations and running rates of physical events. But this relativistic time dilation has no chance of changing or altering or affecting, in any conceivable or imaginable way, Newton's true and mathematical time and its universal and magnificent clock. By the way, gentlemen, pendulum clocks run faster near the mass M, and slower faraway from the mass M, as predicted by this well tested and far more meaningful and accurate mathematical formula of Newtonian mechanics:

$$T = 2\pi\sqrt{\frac{L}{g}}$$

where T is the time, for the pendulum to complete a single cycle; L is the length of the pendulum, between the center of mass of the bob and the pivot; and g is the acceleration of gravity. And it must follow, therefore, that it's, completely, untrue that the durations of all physical phenomena become longer and their rates run slower, near the central masses of gravitational fields.

Dingleus:

Thank you, Cynicus, very much for bringing this important exception, to our attention! It's, truly, a huge anomaly, indeed, at the very heart of Einstein's general theory of relativity.

Sinbadus:

The increasing number of osculations of a pendulum, near the central mass *M*, has nothing to do with the gravitational time dilation, as predicted by the general theory of relativity; Dingleus. The pendulum clock runs faster, in this particular case, not because the gravitational time dilation is absent or somehow suspended. But because the value of gravitational acceleration is much greater near the central mass. The same greater value of gravitational acceleration, also, makes freely falling bodies travel much faster, in the vicinity of the central mass *M*. And this, too, does not violate the predicted gravitational time dilation, by the theory of general relativity.

Dingleus:

So, Einstein's general theory of relativity does not make the sweeping claim that all physical things must run slower, near the central mass *M*. Do you confirm this general statement, Sinbadus?

Sinbadus:

Yes; I would maintain that the general theory of relativity does not claim that everything must go slower in the vicinity of mass *M*.

Dingleus:

That is good enough, for me; Sinbadus! And anyway, in the current discussion, we are not interested in investigating whether or not Einstein's two theories of relativity are true. Our main focus, here, is, only, on whether or not the relativistic treatment of time has any effects, on Newton's true and mathematical time.

Cynicus:

"*Einstein's general theory of relativity does not make the sweeping claim that all physical things must run slower, near the central mass M*"! Are you kidding? This declaration, means nothing less than the gracious admission, on your part, that the whole gravitational-time-dilation thing is bogus, baseless, and, entirely, worthless, from start to finish.

Dingleus:

It's good enough, for us; Cynicus! And in any case, in this discussion, we are not interested in investigating whether or not Einstein's two theories of relativity are correct. Our focus, here, is, only, on whether or not the relativistic treatment of time has any effects on Newton's true and mathematical

time. So, let me, now, pose, to both of you, this essential and crucial question: Is this moment we call '*now'* universal and the same everywhere in the universe, even if the relativistic time dilation, due to uniform motion and gravitation, is held to be physically real and true?

Sinbadus:

Although, according to the two theories of relativity, there can be no experimental or practical method available, for observers in relative motion, as well as for observers at rest in different locations, inside a gravitational field, to verify it, in any conceivable way, it's possible to take for granted, on purely metaphysical grounds, that the moment of '*now*', as defined in accordance with Newton's true and mathematical time, is the same everywhere in the universe, without, explicitly or implicitly, violating any rules or principles of Albert Einstein's two theories of relativity.

Cynicus:

On '*purely metaphysical grounds*'! Are you joking, Sinbadus? This very glorious moment named '*now*' is, actually, the present time and the ultimate guarantor of existence, itself, along with the persistent continuity of the physical world. It's, therefore, absolutely universal and the same everywhere in the universe, even if the self-contradictory time dilation of your mentor Albert Einstein's two theories of relativity is supposed to be, physically, meaningful or somehow true.

Dingleus:

Our next crucial question is this: Can two physical systems, in uniform motion relative to each other, share together and have the same moment we call '*now*', in spite of Albert Einstein's time dilation?

Sinbadus:

Even though, there can be, within the framework of the two theories of relativity, no experimental or practical method, at hand, for observers, in relative motion, to verify it in any imaginable way, it's possible to assume, on purely metaphysical grounds, that the moment of '*now*', as defined in accordance with Newton's true and mathematical time, is the same in this particular case of two relatively moving systems, without, explicitly or implicitly, violating any rule or principle of Albert Einstein's two physical theories of relativity.

Cynicus:

On '*purely metaphysical grounds*' again! Are you trying to pull Dingleus' leg, Sinbadus? Without assuming, right from the start, that the universal moment of '*now*' is the same in the case of two physical systems, in relative uniform motion, your good-for-nothing genius — Albert Hermann Einstein — could never be able to derive the equations of his so-called '*Lorentz transformation*'. And moreover, every duration of time, from the infinitely small to the infinitely large, must contain, inside the very guts of it, the moment of '*now*'; and hence, it must imply the existence of universal '*now*' as a necessary and basic condition for that duration of time to exist in the first place.

Dingleus:

Just a minute; Cynicus! Does the infinitely long duration we call '*eternity*' imply the existence of universal '*now*' as a necessary and basic condition, for it to exist, in the first place?

Cynicus:

Absolutely, Dingleus! Eternity would not make any sense, at all, in the absence of this universal moment of time named '*now*'. The only difference between present eternity and every other duration of true and mathematical time is that the passing of time, due to the continuous and eternal flow of '*now*' does not make any difference, with regard to the infinite amount of time of eternity, at all.

Dingleus:

Now, gentlemen; here's another important question: Does Einstein's relativistic time dilation imply or involve, somehow, any gain or loss, in the total amount of time, due to gravitation and uniform motion?

Sinbadus:

If a physical system changes its state of motion or its position in a gravitational field, the flow of time, within that physical system, changes its rate; and as a result, physical events, processes, and interactions may gain or lose certain amounts of time, in the length of their durations, due to changes in the state of motion, or in the gravitational position, or both. However, the elapsed amount of each duration, prior to those changes, remains the same. For example, if one third of the duration of an event or process elapsed, before the change in the state of motion or the gravitational position, then that third of the duration would remain the same, regardless of any changes, due to relativistic time dilation. And so, according to Albert Einstein's two theories of relativity, the past is conserved.

Cynicus:

Elapsed amounts of time are conserved, come hell or high water! And this obvious and self-evident fact, alone and by itself, demonstrates, very clearly, how erroneous, bogus, and baseless, the previous claim by your folk hero that '*the distinction between past, present, and future is only an illusion*', really, is!

Dingleus:

How many times, do I have to remind you, Cynicus? In the current discussion, we are not interested in investigating whether or not Albert Einstein's two theories of relativity are incorrect! Our primary focus, here, is, only, on whether or not the relativistic treatment of time has any effects, on Newton's true and mathematical time.

Cynicus:

You '*have to remind*' me? Hardy har har! You're the one who brought up that silly Einsteinian claim for investigation, at the start of this discussion. And we all should thank you, so much, for bringing up that bogus and outrageous claim, for discussion. Because that phony claim summarizes and symbolizes everything that went wrong with the relativistic treatment of time.

Dingleus:

I know, all along, that Einstein's statement is bogus, Cynicus! And I brought it up, at the start of this discussion, just to break the ice. As specified earlier, the running rates of all durations, for the infinite number of hands, on the face of the universal clock of true and mathematical time, are calculated by using the following algebraic formula:

$$\omega = \frac{2\pi}{P}$$

where P is the duration; ω is the rate at which that specific duration flows; and π is defined as the ratio of a circle's circumference to its diameter. Do Albert Einstein's two theories of relativity impose any upper limit on the numerical values of ω, in the above equation?

Sinbadus:

Cynicus' so-called '*universal clock*' is imaginary and impractical, anyway! However, even though the two theories of relativity impose severe limitations, on the radius of a rigidly rotating disk, we can, in principle, increase the numerical values of the angular velocity ω, indefinitely, by simply decreasing the values of the radius, indefinitely, in accordance with this simple equation:

$$\omega = \frac{v}{r}$$

where r is the radius; and v is the tangential velocity. And so, there is no problem, in this regard.

Cynicus:

Well, thank you, for your generous clarification, Sinbadus! However, durations and running rates of true and mathematical time exist and continue to exist, regardless of whether there are physical events and interactions of the same running rates and durations or not. In other words, true and mathematical time does not need matter; but matter needs true and mathematical time to interact with itself, to function properly; or to exist, any shape or form.

Dingleus:

So far so good! Now, gentlemen; do your have any reservations, with regard to this joint statement of ours, at the end of our current discussion: **There are no major conflicts between Albert Einstein's relativistic time dilation and Isaac Newton's true and mathematical time**?

Sinbadus:

I would like to reiterate the prevailing view, in modern physics, that the universal moment of '*now*' throughout the universe, as defined on the basis of Newton's true and mathematical time, is metaphysical in nature and impossible to verify through the use of experimental means.

Cynicus:

This great moment labeled as '*now*', which is the same, everywhere in the universe, is a lot more physical and less metaphysical than the so-called '*relativistic block universe*', which can have no experimental support, even in principle. And finally, I would like, here, to place more emphasis, at the end of this great discussion of ours, on the obvious fact that, even though it has been taken for granted, within the current context, for the sake of argument, Einstein's time dilation, due to uniform motion as well as gravitation, is highly unlikely to be realized in the physical world. And that it would be non-sublime, debasing, and extremely foolish, indeed, on the part of the glorious essence of matter, to try to realize or to substantiate, anywhere in the infinitely vast universe, even one small part of this totally unnatural and completely irrational and absurd relativistic fantasy, on the grounds of which even its inventor Albert Einstein, himself, could not distinguish between notions as clear and simple as the essential and very basic concepts of past, present, and future.

Dingleus:

Thank you very much, Cynicus & Sinbadus! And I do believe, now, that we have achieved our main objective of expounding and clarifying many aspects of this important subject. As you know, this discussion of ours was, originally, planned to be held, on the 10^{th} anniversary of our great *2005* discussion. But it's better late than never. As an honorary chairman of this meeting, I would like, now, to close our formal discussion, and to thank both of you, for your interesting insights and highly appreciated contributions and for your cooperation and respect for the procedural rules of this meeting.

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