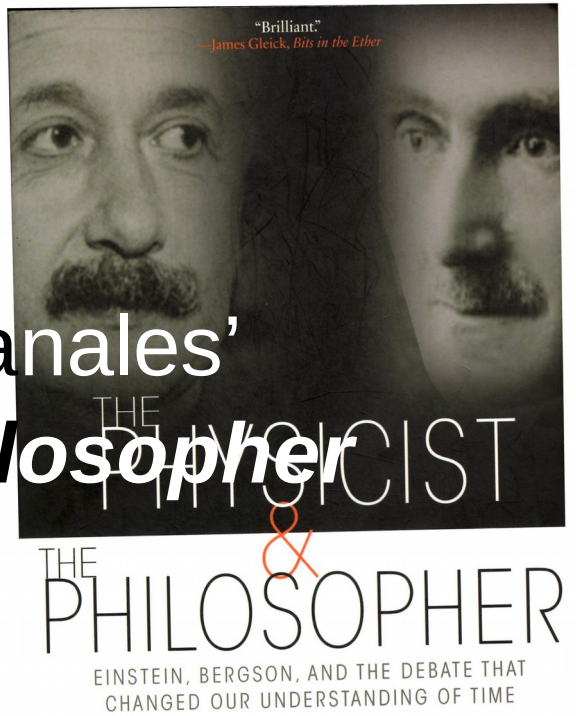
# *IT WAS ABOUT TIME*

~~A review of~~
~~An overview of~~
~~An introduction to~~
~~Comments on~~
A book report of Jimena Canales'
***The Physicist & the Philosopher***




*Leo Michelotti*

*December 7, 2018*

# Structure and content

- Part One: The Debate  (three chapters)
  - Starts from the 1922 meeting featuring Einstein and Bergson and proceeds to preliminary introductions of material to follow.
- Part Two: The Men  (sixteen chapters)
  - Most of the major players in the subsequent discussions, with their repercussions for science and philosophy.
- Part Three: The Things  (eight chapters)
  - Inventions, discoveries, and technologies that influenced the arguments: e.g. clocks, telecommunication, movies, recordings, trains, planes and automobiles, and atoms.
- Part Four: The Words  (two chapters)
  - A few final (recorded) thoughts of Einstein and Bergson about each other and the argument they initiated.

# Bergson’s position

- **Time is not space**; it is ontologically different from space.
  - “[Bergson] associated [time] with ***elan vital***, a concept translated worldwide as 'vital impluse.' This impulse...was **interwoven throughout the universe giving life an unstoppable...surge**....”
  - **“ 'Time is...the necessary condition of action: What am I saying? It is action itself.' “**
- Time exists in ***duration***; there is no time "point."
  - “ 'The pure present is an ungraspable advance of the past devouring the future. In truth, all sensation is already memory.' ”
- Einstein’s time is static, reversible; Bergson's Time is dynamic and irreversible. **Einstein destroyed the “flow” of time.**
  - *Time is **not homogeneous**!*
  - *“Any physical measurement of time, [Bergson] argued, contained an irreducible psychological [ i.e. human ] element.”*
- **Physical time of clocks is real but not complete**. Philosopher’s Time exists too.
  - Deeper questions: What is a measurement? Why make clocks?
- Logical inconsistency in definition of simultaneity between near and far.
  - In the end, Einstein accepted this criticism.
- (Later) claimed that quantum mechanics proved him right.

# Einstein’s position

- Synchronization at large distances should be done with light.
- Speed of light is the same in all inertial frames.
  - Eliminate "ether" as explanation of Lorentz contraction
- **Simultaneity** of distantly separated events was **not an absolute** predicate, and the **temporal order** of events outside each other’s light cones was **ambiguous**.
- There is **no preferred reference frame for <u>any</u> physical effect**.
  - All physics to be invariant under Lorentz transformations.
  - This was a true revolution. (man in a box thought experiments)
- **Time is what you measure with a clock!**
- Fitzgerald-Lorentz-Minkowski transformations are ***not just mathematics*** but express something real about the true nature of space-time.

# Einstein’s position

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*“[During] those years, [Einstein] believed that time was either what clocks measured or it was nothing at all. ...”*

*Bruno Latour: “ 'Bergson had carefully studied Einstein's theory of relativity and wrote a thick book about it, but Einstein had only a few dismissive comments about Bergson's argument. After Bergson spoke for thirty minutes, Einstein made a terse two-minute remark, ending with this damning sentence: "Hence **there is no philosopher's time**; there is only a psychological time different from the time of the physicist." ' ”*

*"Einstein's reply [ during the 1922 debate ] – stating that the time of the philosophers did not exist – was incendiary."*

# Twin paradox

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"When did Bergson first learn of Einstein's work? In the spring of 1911 ... scientists and philosophers ... met in Bologna during the Fourth International Congress of Philosophy.... **Paul Langevin asked members of the audience if 'anyone among us' would want to 'dedicate two years of his life to find out what Earth would look like in two hundred years.'** ... Langevin delivered this question not as a peddler of dreams and fantasies, but rather as a pure and honest physicist. ... Bergson, we are told, was seething in the audience, already getting ready for a fight. ... Langevin's presentation stole the show. ... [ It ] was simply brilliant. ... Einstein [ though absent ] was thrilled."

# Part Two: The Men

- Principals: Albert Einstein and Henri Bergson
- Seconds: Paul Langevin, Paul Painlevé and Edouard Le Roy
- Others: Hendrick Lorentz, Albert Michelson, Henri Poincaré, Alfred North Whitehead, Bertrand Russell, Arthur Eddington, Martin Heidegger, Hermann Minkowski, Ernst Mach, Edmund Husserl, Hermann Weyl, Norbert Wiener, (Parmenides), (Heraclitus), …
- Not in the book: Ludwig Wittgenstein, Georges Lemaître, Michael Polanyi, (Teilhard de Chardin), ...

# Part Two: The Men

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“The philosopher Brunschvicg ... reminded the attendees [ of yet another conference, this time in Paris ] that for Langevin's hypothesis to be correct, scientists still need to prove that biological processes underwent the same temporal transformations as physical ones [i.e. clocks] ... [Others criticiz**Edouard Le Roy**ibed clocks as 'aging' and 'growing old.' ... The physicist Jean Perrin ... added with irony: 'When physicists say "aging," that is one word I especially like' ”

“[ Edouard Le Roy suggested: ] Why not simply use different terms...? Why not use 'hour' for the time of physics and 'time' for that of philosophy? In this way, Le Roy aimed to set boundaries.... **After listening attentively ... Langevin retreated. ... [He] admitted that he did 'not have the pretension of speaking from the point of view of a philosopher.'** ”

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# Organizations

- International Committee on Intellectual Cooperation (CIC)
  - formed under League of Nations
  - forerunner of UNESCO
- International Congress for the Unity of Science
- International Congress on Philosophy
- Academie de sciences
  - not to be confused with the Academie des science morales et politiques
- International Time Bureau (ITB) (France)
- International Research Council (IRC)
  - International Astronomical Union (IAU)
  - Committee on Standard of Wavelength
  - National Physical Laboratory
- Congres international pour la reforme du calendrier
- French Bureau des Longitudes
- Solvay Conference(s)

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*The CIC was founded so scientists and intellectuals "could lead nations by showing them how cooperation and agreement across borders could be forged, peacefully and civically [sic], so that senseless wars and conflicts would be avoided. ..."*

*"[The] League of Nations spearheaded initiatives to standardize the calendar and to set and coordinate world time."*

# Organizations

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*“Michelson's experiments about the speed and behavior of light... were undertaken in efforts to find* ***better measurement systems*** *than science could offer at the end of the century. They were part of broader efforts to find better ways of measuring time and length. Einstein was profoundly aware of initiatives to find absolute standards of measurement. His knowledge of current measurement techniques and limitations was so thorough that in 1901, when looking for a job, he described himself as 'a mathematical physicist familiar with absolute measurements.' ”*

# Organizations

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*This is also a tale primarily of two nations: France and Germany, with a little sidebar attention given to England, Italy and Norway.*

*Einstein felt that the CIC was biassed toward France.*

*“[Einstein] described himself as 'rarely enthusiastic about what the League of Nations has done or has not done.' [He] explained to Paul Painleve that 'I have always regretted the fact that the institute [CIC] was established in Paris and financed exclusively by French funds.' He advocated instead 'to move the institute in toto to Geneva and have all countries contribute to its financial support under a quota system.' “*

# Paul Painlevé

- Mathematician: studied differential equations and their singularities; noted for the "Painlevé transcendents."
- Research on general relativity: discovered coordinate transformation that removed Schwarzschild singularity from the metric.
- Yet, he agreed with Bergson that "experimental results did not lead directly to Einstein's conclusions."
  - “[Other] influential physicists who worked on relativity theory [also] agreed, including ... Henri Poincare, Hendrik Lorentz and Albert A. Michelson.”
  - This essentially correct statement could be considered less a criticism than an indication of Einstein's creative genius.
  - Deeper question: How should physics be done? Driven only by experiment and observation?
- French Minister of War in the 1920s. Crucial to design and construction of the Maginot Line.

# Alfred North Whitehead

- Alfred North Whitehead sided with Bergson. “[The] admiration between Bergson and Whitehead was thorough and mutual.” “[Whitehead] shared with Bergson a desire to think of time as something different from space.”
  - Whitehead explaining Bergson: "All the paradoxes of relativity ... consisted in maintaining a strict difference between the local and the distant.”
  - “Whitehead...considered Einstein’s theory ‘adequate from the scientific standpoint and equally inadequate from the epistemological standpoint.’ “
  - “What did Whitehead dislike about Einstein's approach? His answer was simple. 'The concept of the passage of time has been lost,' he lamented.”
    - Elsewhere he “would use the phrase 'passage of nature' ... to prevent [confusion] with 'the measureable time of science and of civilized life generally.' ”
- Lord Haldane: “ 'Professor Whitehead [has] brought out [the character of space and time] in his treatment of relativity more thoroughly than Einstein or even Minkowski himself has done. ' ”
- “What did Einstein think of Whitehead? Not much ... Einstein once confessed: ‘I simply do not understand Whitehead.’ ”

# Alfred North Whitehead

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Whitehead taught at Harvard, starting in 1924, and brought his affinity for Bergson with him. He established "process philosophy," also called the "ontology of becoming," which identifies change - "becoming rather than "being" - as the cornerstone of reality.

At Harvard, Whitehead advised William Van Orman Quine, whose work in logic and axiomatic set theory went on to supersede his own and Russell's.

Quine too favored Bergson's philosophy, challenging the logical empiricism associated with Einstein's.

# Bertrand Russell

- “Russell admired Einstein with the same fervor with which he hated Bergson.”
  - His criticism of Bergson was personal and bordered on vicious. “Russell described Bergson as anti-intellectual, claiming ... that, for Bergson, 'intellect is the misfortune of man.' ”
  - “[In his] bestseller *A History of Modern Philosophy* [Russell] claimed that Bergson's philosophy 'harmonized easily with the movement which culminated with Vichy.' Bergson [had, in fact,] openly warned against the 'formidable wave of anti-Semitism ...' ... When others fled, he chose 'to remain among those who tomorrow will be the persecuted ones.' In protest to the government, he resigned from all of his official positions.”
  - Also “attacked” Poincare – and other French philosophers – accusing him of being a ‘nominalist.
- “[An] important difference between Russell and Bergson centered on the spatial qualities of time. Bergson had violently fought against treating time as a kind of space, insisting that they were entirely different. Russell, on the contrary, took them as so similar that he introduced the concept of 'time corpuscles' as an exact counterpart to 'space corpuscles.' ”

# Bertrand Russell

- “Russell admired Einstein with the same fervor with which he hated Bergson.”

“The label of nominalist charged Poincaré with the claim that scientific truth was so particular and so dependent on individual cases and practical situations that absolutely no general, let alone universal, lessons could be drawn from it. Poincaré resisted this characterization of his own work and distanced himself from any form of nominalism.”

a ‘nominalist.

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# Henri Poincaré

- Opposed reducing mathematics to symbolic logic or set theory.
  - More interested in what could be *understood* rather than what could be formalized.
  - Gödel's incompleteness theorems (1931) vindicated his stand.
- His work on relativity preceded Einstein's.
  - Some claimed he should have been given credit for the theory of relativity, because …(see overlay) … but
    - *"He did not think the concepts of time and space should be overhauled." "Einstein's genius centered on his reinterpretation of the notion of time, a contribution … essential and novel to his work."*
- A conventionalist, Poincare's (normal) view was that *math is a tool* for understanding physical phenomena. Equations do not express the universe itself. *" 'Geometrical axioms are conventions.' "*
  - *"At stake … stood one of the pithiest questions pertaining to the nature of mathematical knowledge and the shape of the universe."*

# Henri Poincaré

Poincaré's work on relativity preceded Einstein's and included:

- the principle of relativity
- a conjecture: violation of relativity could not be detected
- "philosophical assessments" on the relativity of space, time, and simultaneity
- nullification of the ether hypothesis
- using light signals to synchronize clocks
- conjecture: "no velocity could surpass that of light"
- "inertia [ i.e. mass ] increasing with velocity"
- thoughts on non-Euclidean geometry (mostly wrong)

But it was Einstein who demanded that (a) the Lorentz transformation be extended to all physical phenomena, and (b) the metric truly described the nature of space-time.

# Henri Poincaré

- Opposed reducing mathematics to symbolic logic or set theory.

> "Poincare's famous Science and Hypothesis (1902) opened with a clear attack against Le Roy, one of Bergson's closest allies. He associated Le Roy's philosophical position with nominalism.... In The Value of Science (1905) Poincare wrote that the worst aspects of Le Roy's philosophy were due to Bergson's influence on him. 'Le Roy's doctrine,' he explained, 'has another characteristic that it doubtless owes to M. Bergson, it is anti-intellectualistic.' But with time, his initial animosity against Le Roy and Bergson attenuated. Poincare became a supporter of Le Roy."

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understanding physical phenomena. Equations do not express the universe itself. *" 'Geometrical axioms are conventions.' "*
  - *"At stake … stood one of the pithiest questions pertaining to the nature of mathematical knowledge and the shape of the universe."*

# Ernst Cassirer

- “By far the most important endorsement of relativity by a philosopher came from one of the most talented men in the profession: Ernst Cassirer. … [Unlike other Kantians, he] was a real ally.”
- “In the spring of 1920 Cassirer sent Einstein the manuscript of a book on the theory of relativity.... [His] purpose was to 'bring about agreement' between physicists and philosophers and to 'avoid misunderstandings' among them. That summer Einstein responded approvingly ...: 'I think your treatise is very well suited to clarify philosophers' ideals and knowledge of the physical problems of relativity.' Their disagreements were minor, but nonetheless existed. ... [He urged] Cassirer to place more emphasis on experiment and measurement: 'The theory of relativity stands and falls as a physical theory,' he underlined.”

# Ernst Cassirer

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"Cassirer endorsed Lorentz's view of relativity as much as Einstein's. What is more, he repeated the claim, made initially by Lorentz, that Einstein simply postulated what he had earlier deduced. …"

“What most separated Cassirer from Bergson was the legacy of Kant. ... Cassirer was a neo-Kantian....”

“Cassirer had initially operated under the assumption that the nature of our thought processes and the thinking apparatuses shaped what was known – but retreated from this position after being chastised by Einstein.”

# Martin Heidegger

- "The act of measuring time, according to both [Heidegger and Bergson] destroyed much of it. ‘We...make a cut in the time scale, thereby destroying authentic time in its flow and allowing it to harden. The flow freezes, becomes a flat surface, and only as a flat surface can it be measured’ ”
  - “ ‘...relativity is concerned with...measuring time, not with time itself.’ ”
- "Neither Bergson, Whitehead, Martin Heidegger, or Walter Benjamin thought that a sharp distinction could be drawn between the assessment of an event taking place 'here' rather than 'there,' or 'now' rather than 'later.' Heidegger argued that scientists obtained accurate measurements only by first assuming that a certain moment (the moment of measurement) could be separated from the rest of time."
- “For Heidegger, the two conceptions of time -- clock time and lived time -- ... were symptomatic of the broader divisions of rationality and irrationality...[science vs. experience].”

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> “[In 1928] Heidegger confronted Cassirer. Cassirer a defender of Einstein and enemy of Bergson, was now pitted against a man ready to leave both Einstein and Bergson behind. By then, Heidegger was not only ready to confront Cassirer; he was also poised to abandon his teacher, Husserl.”

# George Mead: American Pragmatism

- Bergson was intellectually close to William James and John Dewey, who in turn tutored George Herbert Mead at Harvard, a founder of American Pragmatism.
- “Although Mead concluded, with Einstein, that ‘Our grasp of the innermost structure of things is experimental.’ ” he “associated [Einstein] with the belief in a universal, predetermined reality, and Bergson with its near opposite – a belief in 'the emergence of the novel.’ ”
- He sided with Bergson “‘in retaining the centrality of duration or process as the crucial element' "

# George Mead: American Pragmatism

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"Mead disagreed intensely with the block, or four-dimensional, view of the universe, in which the past, the present and the future were already laid out, predetermined, and in which our sense of time was a mere illusion." He denied the human experience was just an epiphenomenon: "[The] physical investigation of time should not have to be done at the expense of our experience of time."

"Whitehead conceived of 'events' as 'eternal objects,' rendering them unnecessarily abstract. Mead 'on the contrary' chose to 'recognize what becomes as the event which in its relation to other events gives structure to time' "

# Percy Bridgman: Operationalism

- Percy Bridgman: a physicist but critical of the general theory of relativity, writing his first critique in 1936.
- “Bridgman adored Einstein's early work, particularly because of how it was attentive to the actual operations of measurement, because it was modest about drawing any broader implications, and because it was simple and procedural.  Einstein's methodology in 1905, he claims, was perfectly consonant with the 'operational point of view.'  His later work was not. 'Einstein did not carry over into his general relativity theory the lessons and insight which he himself has taught us in his special theory,' Bridgman lamented.”
- Founded another philosophical school: "operationalism."
- "A number of scientists and philosophers followed Bridgman in thinking about these questions in terms of the communicative structures that allowed for the transfer of meaning."

# Logical positivism

- “Sitting in front of him in his classroom in Berlin, Einstein found two men ... [who] would join the fight against Bergson and against Henri Poincare's conventionalist approach to science. ... One of them, Hans Reichenbach, would become one of the most prominent defenders of logical positivism.... He found an ally and friend in Rudolf Carnap, an active and prominent member of the Vienna Circle. … Bergson was synonymous with a dangerous new enemy: metaphysics.”
- “Logical positivism was a heterogeneous movement …. Yet one of its defining principles maintained that science emerged from a strictly sensorial basis and was then built upward with clear logical principles. … Part of the movement was shaped by a particular hatred for the work of one man – Bergson – and an intense appreciation of the work of another: Einstein.”

# Hans Reichenbach

- “According to Reichenbach, Einstein had completely revolutionized the relation between physics and philosophy: ‘There is no separate entrance to truth for philosophers: the path of the philosopher is indicated by that of the scientist.’ Einstein, Reichenbach would repeat for the rest of his life, had finally pushed traditional philosophy aside...”
- Reichenbach's views on the foundations of science were even more extreme than Einstein's. … (see overlay) ...
- Very deep question: “[Reichenbach] attacked [Poincare's] claims about the relation of mathematics to physics -- that mathematics was a tool and not a reflection [i.e. a model] of how the world actually was. He chastised him for espousing the view that scientists could chose [sic] between different geometries.... From then to the end of his career, he would consistently claim that only one of them ... described the actual 'geometry of the physical world.'”

# Hans Reichenbach

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"Reichenbach's notion of scientific experiment ... did not include a role for technology.... In 1949 Reichenbach published an essay ... representative of logical empiricism. He explained how Einstein's work emerged from 'an empiricism which recognizes only sense perception and the analytic principles of logic as sources of knowledge.' Intermediate material between sense perception and the final results of science were unaccounted for."

# Rudolf Carnap

- “Carnap introduced a division of labor in which each (mathematicians, philosophers, physicists) would be limited to studying distinct notions of space (formal, intuitive, and physical, respectively). ... ‘All parties were correct and could have been easily reconciled if clarity had prevailed concerning the three different meanings of space.’ ... Carnap tried hard to show how physics did not need to engage with these other disciplines and could fare better if purified from them. … By using clear, uncontested data as starting points, attaching them to numerical values, and combining them with clear mathematical rules, Carnap believed he could put science on firm, uncontestable footing.”

# A few others

- Albert Michelson
  - Surprised by the revolution his experiments began.
- Hendrick Lorentz
  - Praised by Einstein: *“ ‘I revere you beyond measure.’ ”*
- Arthur Eddington
  - His bent light experiment confirmed Einstein’s theory, yet he eventually sided with Bergson.
- Herbert George Wells and Charles Percy Snow
  - Temporal bookends. Wrote “The Time Machine” (1895), on time travel, and “The Two Cultures” (1959), on the rupture between science (esp. physics) and “the humanities.”

# A few others

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**Albert Michelson**

“ ‘In 1880 I conceived for the first time the idea that it should be possible to measure optically the velocity of the Earth through the solar system.’ ”

“What did Michelson find from his work with Morley? Nothing. ... [In] disbelief he did not find any effect of the ether or of the velocity of the Earth on light waves. The result of his experiment was simply null.”

# A few others

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**Hendrik Lorentz**

*“Lorentz … [once] claimed that ‘Einstein simply postulates what we have deduced, with some difficulty and not altogether satisfactorily.’ ”*

*“Einstein himself had initially described his contribution as one that 'raised' a 'conjecture ... to the status of a postulate.' ”*

*And yet Lorentz admitted " ‘the theory of relativity is really solely Einstein's work.' "*

# A few others

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**Arthur Eddington**

*“Eddington had avoided the draft by asking the government instead for permission to embark on an eclipse expedition to test relativity theory.”*

*“[On] November 6, 1919 [Eddington] presented the results of two expeditions....  The next day, Einstein became world news. ... [He] was crowned as the man who forever changed our conception of the universe.”*

# A few others

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**Arthur Eddington**

*“[In 1927, Eddington said] that he no longer believed with Einstein that the illusion of time passing by was simply our mental construct. … Our minds did much more than simply register stimuli in a mechanical and automatic way; they faithfully registered an aspect of time connected to a legitimate and irregular sense of 'becoming.' ”*

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**Arthur Eddington**

*“[A]spects of time...connected to life, had been forever lost. 'The more perfect the instrument as a measurer of time, the more completely does it conceal time's arrow,' lamented Eddington.”*

# A few others

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**Arthur Eddington**

*“In 1928 he wrote, “ '[R]esults of physical investigation have been woven into a scheme which has ... proved wonderfully successful.' But this success had come at a loss. Science was 'only imperfectly representative of the time familiar to our consciousness.' Victory had come at a price. ... 'Your protest in the name of common sense against a mixing of time and space is a feeling which I desire to encourage,' he told his readers. 'Time and space ought to be separated.' ”*

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**1895: H.G.Wells publishes "The Time Machine"**

"A mathematical line, a line of thickness *nil*, has no real existence. ... Nor having only length, breadth and thickness can a cube have a real existence. ... Can an instantaneous cube exist? ... Can a cube that does not last for any time at all have a real existence? ... Clearly, any real body must have extension in four directions: it must have Length, Breadth, Thickness, and -- ***Duration***. ... There really are four dimensions, three of which we call the three Planes of Space, and a fourth, Time. There is, however, a tendency to draw an unreal distinction between the former three dimensions and the latter, because it happens that our consciousness moves intermittently along the latter.... ***There is no difference between Time and any of the three dimensions of Space except that our consciousness moves along it.***"

# TO BE CONTINUED

“People assume that time is a strict progression of cause to effect, but actually, from a nonlinear, non-subjective viewpoint, it's more like a big ball of wibbley-wobbley, timey-wimey stuff.”

– Doctor Who