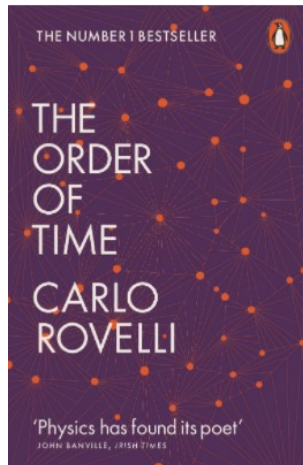




Title, Author: The Order of Time, Carlo Rovelli

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“People like us who believe in physics, know that the distinction between past, present, and future is only a stubbornly persistent illusion.”

- Albert Einstein

Over the last 150 years, our understanding about time and space has undergone a radical transformation. In ‘The Order of Time’, the Italian physicist Carlo Rovelli, explores the illusion of time, calling it the “greatest mystery”.

In the first section of the book, the author profoundly weaves together science, art, history and philosophy to confute the intuitive characteristics of time, such as singularity, uniformity, ubiquity and independence.

Time passes slower at sea level (closer to the centre of gravity) than at higher altitudes (away from the centre of gravity) – implying that time is neither independent nor singular. Through Einstein’s work on gravitation and its influence on space-time fabric, the author explains how time passes slowly closer to heavy bodies. The extent of slowing of time also depends upon the mass of the body exerting gravitational force; thus, time stops (or passes infinitesimally slowly) closer to a black hole.

The author explains that ‘now’ is highly localised and becomes redundant beyond our immediate surroundings. For example, it takes 499 seconds for the light from sun to reach our eyes; thus, whenever we see a sunrise, we are witnessing an event that happened ~8 minutes ago. Similarly, if you use a telescope to observe an alien lifeform on a hypothetical planet 10 light years away from Earth, you will see what the alien was doing 10 years ago. Theoretically, if that alien lifeform travels at a speed faster than the speed of light to reach Earth and knocks on your door, you will be able to see the alien on its planet (through telescope) as well as on Earth, simultaneously. Since light, sound and other waves require time to travel, there is an actual latency in our apparent environment. Hence, there is *no present*.

Drawing upon the works of physicists such as Ludwig Boltzman and Sadi Carnot, the author explains that the second law of thermodynamics (‘law of entropy’, $\Delta S \geq 0$), is the *only* law which can distinguish past from future. *“The difference between past and future, between cause and effect, between memory and hope, between regret and intention... in the elementary laws that describe the mechanisms of the world, there is no such difference.”*

To explain, entropy is a physical system’s natural tendency to drive new chains of events. Since it is impossible to reverse a system back to its original state at a microscopic level, entropy once increased, never decreases. For example, even though you make your bed in the same manner every morning, with a particular arrangement of pillows and duvet, there will be new creases and folds that did not exist before you went to bed the previous night. Or, when you put an egg in some water and add heat, you get a delicious snack. If you take the heat away you don’t go back to the original egg – an irreversible process.

As the total entropy of a system always increases, it differentiates past from future. Therefore, it is often called ‘time’s arrow’. For instance, the Roman Empire didn’t collapse due to the passage of time, but because the longer it existed, the greater the level of entropy – ballooning debt, balance of payments crises, rebellions, pandemics and barbarian attacks. The increase in entropy is the reason for evolution, for history and for the perception of the *passage of time*. Conclusively, the moment entropy ceases to increase – i.e. nothing changes – time stops.

The idea that change – as epitomized by entropy – is fundamentally more natural than time is a recurring theme throughout the book. *“The entire difference between past and future may be attributed solely to the fact that the entropy of the world was low in the past.”*

In the subsequent sections, the author delicately balances scientific realism, theoretical physics and philosophical romanticism, to elucidate how our perspectives have limited our understanding of time – time is convoluted and made of complex layers. The author explains that time is a logical outcome of events and processes and that viewing the world as a collection of interrelated events will enable us to comprehend it better.

‘The order of Time’ is highly engaging and grips the reader’s curiosity. Carlo Rovelli’s ability to simplify complex subject-matter through poetic writing is evident throughout the book. The author brings together numerous hypothetical and historical examples – such as the need for standardised time to facilitate scheduling of trains in the 19th century – to expound the nature of our relationship with time and the evolution thereof. The book successfully captures the reader’s imagination through the scientific expression of going beyond the obvious to seek answers, compelling them to read more on topics such as time, blackholes and relativity.

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