

## DOES TIME EXIST

By John R. Cipolla, Copyright August 25, 2015

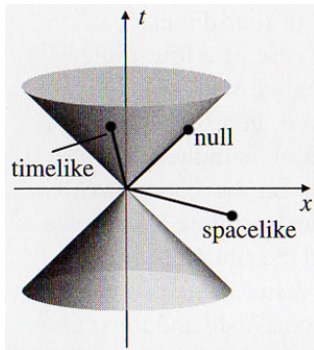
This discussion refers to the June 2015 Discover magazine article, "Tomorrow Never Was. A conscientious cosmologist rejects Einstein's notion that time is an illusion and the future is already written"<sup>1</sup>. This article concerns George Ellis's ideas about time and space and how time interacts with the quantum nature of the universe.

The classical notion of time according to Ellis is like taking successive photographs of a location where if the photographs are projected one after the other as a function of time makes a movie through which time appears to pass. This corresponds to our intuitive view of how time flows.

However, according to Ellis, "Einstein believed in the block universe view, where past, present and future all coexist simultaneously, and the passage of time has no meaning; all events coexist side by side" and "time is an illusion", it does not exist.

I believe Ellis is correct by saying time exists and the block view of the universe is not valid because the block theory violates causality, Minkowski flat space-time, Special Relativity and General Relativity and the concept of the light cone where there are separate regions for the past, present and future.

I do not believe the block universe is valid and I think Einstein did not either according to basic principals of Special Relativity. The following description of the light cone contradicts the statement by Ellis that Einstein believed in the block view



of the universe because the light cone as defined by Special Relativity<sup>2</sup> and General Relativity<sup>3</sup> recognizes the separate significance of time and space. Please see page 9 of reference-3, **SPACE TIME and GEOMETRY** where the light cone is described having **timelike** and **spacelike** regions depending on the speed of light. The text reads.

"A set of points that are all connected to a single event by straight lines moving at the speed of light is the **light cone**, since if we imagine including one more spatial coordinate, the two diagonal lines get completed into a cone. Light cones are naturally divided into *future and past*; the set of all points inside the future and past light cones of a point p are called **timelike separated** from p, while those outside the light cones are **spacelike separated** and those on the cones are **lightlike** or **null separated** from p."

Regardless of his misunderstanding about how time is defined in Relativity, I believe Ellis is correct by suggesting that General Relativity can be modified by saying, "the leading edge of space-time marks the "present" crawling outward, moment by moment, transforming tomorrow's maybes into yesterday's fixed happenings".

I believe Ellis is also correct by saying the mechanism “that causes the front edge of the universe to push forward” in time is due to quantum effects where the uncertainty of the future changes to the certainty of the past as the “uncertain future crystalizes into the past through a sequence of microscopic quantum events”. Therefore, the present is defined as the point on the leading edge of space-time where an infinite number of particles are being “observed” causing the leading edge of space-time to collapse into a single randomly determined identity, the present. The precise state of a particle, its position and energy, is determined on the leading edge of the universe where a particle transforms from the uncertain quantum state to the measured quantum state having a rigid identity, the present.

In conclusion, the time concept presented by Ellis may be a legitimate way to explain time and the way time is perceived. However, I believe it is incorrect to attribute the block view of the universe to Einstein. I do not know if Ellis is correct by attributing the limited block view to Einstein but the light cone concept from Special Relativity seems to contradict Ellis. It’s possible Ellis’s concept can unify General Relativity and quantum mechanics explaining the meaning of time and possibly allowing General Relativity to see within the singularity of black holes and the Big Bang. Also, this discussion verifies that 1) time exists; 2) its only possible to look into the past for example looking at a far away star; 3) it’s not possible to look into the future beyond the leading edge of space-time. Finally, Ellis’s hypothesis allows General Relativity to accommodate quantum mechanics in those regions or singularities where General Relativity is not valid like the event horizon of a black hole and at the singularity of the Big Bang.

## References

<sup>1</sup>Discover Magazine, “Tomorrow Never Was”, page 38, June 2015

<sup>2</sup>D. McMahon, *Relativity DeMystified* (McGraw-Hill, New York, 2006)

<sup>3</sup>S. M. Carroll, *SPACETIME AND GEOMETRY* (Addison Wesley, San Francisco, 2004)