



World Enough and Space-Time

by John Earman

A Review by Dr. Sergei Bobrovskiy *

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We live in space, we think in spatial terms, we send probes and humans into space and so the notion of space and time is something natural and primitive to us, even if we perform computations using our most sophisticated theories like Einstein's General Theory of Relativity. However, the nature of space was a topic of discussion for the likes of Newton, Leibnitz and Einstein and is still of interest for many philosophers.

John Earman's *World Enough and Space-Time* is a classic work in the philosophy of physics examining the various positions on the nature of space-time by illuminating the historical developments and the current status of the *absolute* versus *relational* debate. The absolute view holds in simple terms that the space-time is something that has an independent existence on its own playing a "container" • for physical objects like particles and fields (substantivalism). The relationists claim on the other hand that only physical objects and relations between them truly exist, whereas space-time is a notion derived from the underlying relations, a book-keeping device - "Spatiotemporal relations among bodies and events are direct; that is, they are not parasitic on relations among a substratum of space points that underlie bodies or space-time points that underlie events."(P.12)

Major historical proponents of both views were respectively Newton and Leibniz, whereas Newton was also holding a stronger now refuted view, that space is absolute in a sense that it is meaningful to ask of a single particle, whether it is moving.

Earman manages to clarify the central points of the debate employing not only transparent wording and analysis but also carefully dosed differential geometry.

Starting with Newton's *Principia* the book traces the Leibniz Clarke (Newton's proxy) correspondence, rewrites the historical space-time ideas in mathematical terms and discusses philosophical arguments for each model. One chapter of the book deals exclusively with rotation which was considered by Newton and still is one of the main arguments for absolute space, as it is still meaningful to ask whether a single body is rotating. Next chapters deal with modern relational theories, Kant's contributions to the debate and impact of relativity and field theory. From a physicist viewpoint especially the last chapter on the contribution of the General Theory of Relativity to the question whether space time is a substance is an illuminating read leading to a conclusion that a new conception of space-time not fitting the classical dichotomy is needed. I really enjoyed this book and recommend it to everybody interested in these topics. As a final thought, these rather fancy discussions may have an impact on our understanding of the basic ingredients of nature - the quantum fields, their relation with the space-time and the quantisation of General Relativity.

John Earman - *World Enough and Space-Time*, MIT Press, 1989, 234 pp

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Abstract: We consider various curious features of general relativity, and relativistic field theory, in two spacetime dimensions. In particular, we discuss: the vanishing of the Einstein tensor; the failure of an initial-value formulation for vacuum spacetimes; the status of singularity theorems; the non-existence of a Newtonian limit; the status of the cosmological constant; and the character of matter fields, including perfect fluids and electromagnetic fields. When a Romulan weapons test goes wrong, the Enterprise is trapped between dimensions and Lt. Commander Sulu finds himself 30 years out of place and the key to saving the crew of the Enterprise as the precarious grasp on their own dimension begins to slip. Guest starring George Takei, who returns to the role of Hikaru Sulu, which he played on television in (Star Trek: The Original Series) and in (Star Trek: Voyager), as well as in the six feature Star Trek films. In physics, spacetime is any mathematical model which fuses the three dimensions of space and the one dimension of time into a single four-dimensional manifold. Spacetime diagrams can be used to visualize relativistic effects, such as why different observers perceive differently where and when events occur. Until the 20th century, it was assumed that the 3-dimensional geometry of the universe (its spatial expression in terms of coordinates, distances, and directions) was independent of one-dimensional Newton's Principia introduced conceptions of space and time that launched one of the most famous and sustained debates in the history of physics, a controversy that involves fundamental concerns in the foundations of physics, metaphysics, and scientific epistemology. This book introduces and clarifies the historical and philosophical development of the clash between Newton's absolute conception of space and Leibniz's relational one. It separates the issues and provides new perspectives on absolute relational accounts of motion and relational-substantial accounts of the ontology...Â Library of Congress Cataloging-in-Publication Data Earman, John. World enough and space-time. "Bradford book." Includes index.