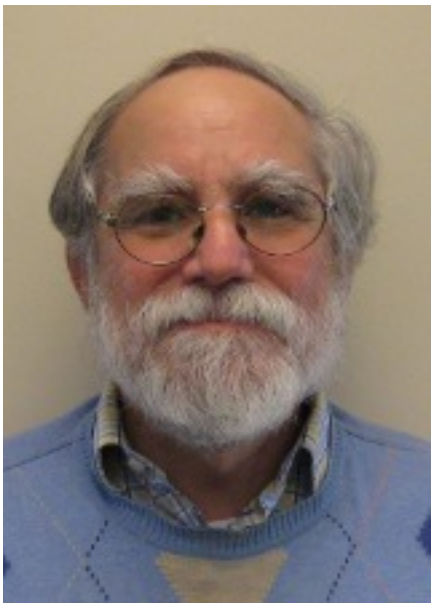
Sheldon Goldstein

Born: 24 August 1947 in Augusta, Georgia



Sheldon Goldstein was raised in a household of four consisting of his father: Moses Goldstein, his mother: Leah Goldstein, and older sister. Goldstein attended an Orthodox Jewish day school, the boys' prep school of Yeshiva University: Manhattan Talmudical Academy. He took full advantage of the numerous Advanced Placement courses and extracurricular opportunities offered at his school starting as early as his first year. His passion for physics from an early age would lead him to Yeshiva College in 1965 to study physics.

He studied mathematics, physics, and philosophy during his college years and graduated with a Bachelor of Arts in Physics in 1969. The same year he married philosopher, novelist, and public intellectual Rebecca Newberger Goldstein.

Together they had two daughters: poet Danielle Blau and novelist Yael Goldstein Love, who was also the co-founder and editorial director of the literary studio Plympton. He attended the California Institute of Technology for his first year of graduate school and obtained his Master of Arts and Doctor of Philosophy from Yeshiva University in 1973.

In the early years of his career he held various visiting positions such as a member of the Institute for Advanced Study at Princeton University in 1973/75. During the Summer of 1974 he was a Visiting Scholar at Battelle Seattle and in the Spring of 2016 he was a Visiting Assistance Professor at the Institute for Advanced Studies at Hebrew University. He had a recurring position as a Visiting Scientist at the Institut des Hautes Etudes Scientifiques in Paris for various semesters. He obtained his first full time job as an Assistance Professor at Cornell University in 1975. He would teach there for two years before going to Rutgers University, starting his long-term profession at Rutgers as a Visiting Assistant Professor. Over the years he climbed the ladder of positions from Visiting Assistant Professor to Assistant Professor, followed by Associate Professor, then Professor, and finally Distinguished Professor in 1989.

Saul Kripke, a philosopher and professor at Princeton played an immense influence in Goldstein's future work. After taking a course taught by him, Foundations of Quantum Mechanics, Goldstein pursued the study of quantum mechanics. In the 1980s, Goldstein with Professor Dr. Detlef Durr, University of Munich and Professor

Dr. Nino Zanghi, University of Genoa started Bohmian–Mechanics.net, international research collaboration on Bohmian Mechanics. Later he would publish an article with Detlef Durr, Roderich Tumulka, and Nino Zanghi titled *Bohmian Mechanics*. The overview starts with:-

> *Bohmian mechanics is a version of quantum mechanics for nonrelativistic particles in which the word "particle" is to be understood literally: In Bohmian mechanics quantum particles have positions, always, and follow trajectories. These trajectories differ, however, from the classical Newtonian trajectories. Indeed, the law of motion, see eq. (1) below, involves a wave function. As a consequence, the role of the wave function in Bohmian mechanics is to tell the matter how to move.*

$$\frac{dQ_i}{dt} = \frac{\hbar}{m_i} Im \frac{\Psi_t^* \nabla_i \Psi_t}{\Psi_t^* \Psi_t} (Q(t))$$

> *Bohmian mechanics constitutes a quantum theory without observers, i.e., a theory that is formulated not in terms of what observers see but in terms of objective events, regardless of whether or not they are observed. Bohmian mechanics provides a consistent resolution of all paradoxes of quantum mechanics, in particular of the so-called measurement problem. In particular, the collapse of the wave function can be derived from Bohmian mechanics.*

In 1992, Goldstein published his first article titled *On a Realistic Theory for Quantum Physics* alongside Detlef Durr and Nino Zanghi. He writes in the introduction:-

> *We discuss some ideas about quantum physics which we think are of relevance for the future evolution of the field. These ideas, though old, are either unknown or misunderstood. Our point here is that a strong realistic position has consequences: it offers a completely natural understanding of "standard quantum mechanics"; it fully reveals the nonlocal character of nature and it guides the search for a fundamental unified theory of the microscopic and macroscopic world.*

Peter R. Holland published *The Quantum Theory of Motion. An Account of the de Broglie-Bohm Casual Interpretation of Quantum Mechanics* in 1993. Goldstein first review begun with this book as follows:-

> *How can electrons behave sometimes like particles and sometimes like waves? How does an atom know, when it passes through one slit of a double-slit apparatus, that the other slit is also open, so that it should behave so as to contribute to an interference pattern? How does a radioactive atom know when to decay? How can electrons tunnel across classically forbidden regions? How can Schrodinger's cat be*

simultaneously dead and alive—but only until we look at it and find that it is one or the other?

Goldstein provided vast service to the Department and the University of Rutgers. He was a member of the Advisory Committee for Appointments and Promotions to Professor I, II, and III for various years. During the Spring of 1997 he was an Acting Member in the Personnel Planning Committee. His service to the profession was just as influential as he was on the Editorial Board of the Journal of Statistical Physics for numerous years. He was a referee for various articles such as Communications in Mathematical Physics, Foundations of Physics, American Journal of Physics, Proceedings of the Royal Society, and others. He was also the Coorganizer of the International Conference on Quantum Theory Without Observers at Bielefeld, Germany in the summer of 1995.

In 1997, Goldstein published a paper on how the concept of 'measurement' appears in physical theory at the most fundamental level: *Quantum Theory Without Observers*. He starts with the introduction:-

Despite its extraordinary predictive successes, quantum mechanics has, since its inception some seventy years ago, been plagued by conceptual difficulties. The basic problem, plainly put, is this: It is not at all clear what quantum mechanics is about. What, in fact, does quantum mechanics describe? It might seem, since it is widely agreed that the

state of any quantum mechanical system is completely specified by its wave function, that quantum mechanics is fundamentally about the behavior of wave functions. Quite naturally, no physicist wanted this to be true more than did Erwin Schrodinger, the father of the wave function. Nonetheless, Schrödinger ultimately found this impossible to believe. His difficulty was not so much with the novelty of the wave function: "That it is an abstract, unintuitive mathematical construct is a scruple that almost always surfaces against new aids to thought and that carries no great message." Rather, it was that the "blurring" suggested by the spread out character of the wave function "affects macroscopically tangible and visible things, for which the term "blurring" seems simply wrong."

In 1999, Goldstein gave a one-hour talk about "Boltzmann's Approach to Statistical Mechanics" at the Chance in Physics: Foundations and Perspectives Conference in Ischia, Italy. The purpose of this meeting was to address the importance of the fundamental and practical aspects of probability in physics.

In 2007, the "FQM Foundations of Quantum Mechanics – Quantum Reality: Ontology, Probability, Relativity was held at Rutgers University in honor of Sheldon Goldstein on the occasion of his 60th birthday. The conference was devoted to his scientific influence on mathematical physics and foundations of physics as well as to his interest in philosophy of natural sciences. Many participants such as Detlef Durr and

Barry Loewer dedicated their lectures: “The physicist Sheldon Goldstein” and “Goldstein on objective probability in deterministic theories” to Goldstein. In Durr’s lecture he discussed the impact of Goldstein’s scientific work and the lesson that everyone could learn from it.

In 2009, alongside Detlef Durr and Nino Zanghi, he served on the Organizing Committee for The Sexten Conferences that took place in Sexten, Italy. The purpose of it was to bring together scholars who share similar passions in the foundational issues of quantum theory. Goldstein spent his next six summers in Italy for the conferences: “Quantum Mechanics and the Nature of Physical Reality”, “What is Quantum Theory?”, and “Quantum Theory without Observers”. He spent his last summer of the Sexten Conferences running a Summer School alongside Detlef Durr, Nino Zanghi, Fay Dowker, and GianCarlo Ghiradrdi on the Foundations of Quantum Mechanics dedicated to John Bell.

In 2011, he was a participant at the Physics, Mathematics and Philosophy of Nature Conference in LMU Munich, Germany. This was an important conference for him because it dealt with all the main subjects that were important to him. There he gave a 45-minute lecture on Quantum Ontology.

On April 22-26, 2013, he was a participant at The Bielefeld Conferences: “Quantum Theory without Observers III” conference located in ZiF, Bielefeld, Germany. A conference centered on the theme: “Fundamental Problems of Quantum Physics”

with an importance on Quantum Theories without Observers. Main topics included Bohmian Mechanics, relativity and Bell non-locality, decoherence theories, physical status of the wave function, and more. When asked in the conference interview "What first stimulated your interest in the foundations of quantum mechanics" he responded:-

> *This is one of these foundation questions, foundations of quantum mechanics where actually understanding the foundations is really not understanding foundations its understanding the theory itself.*

Goldstein currently is working on many projects, his most important one he stated has to deal with:-

> *Much of what we think of as basic facts about the world we live in might turn out to be not basic at all at the fundamental level. Rather they might reflect our own prejudices and choices about how to describe the world. They might reflect more about us than about the world itself.*

Interviewed by: *Reuben Rios*

Date of interview: *4/25/17*

Final Essay for "History of Mathematics", Rutgers University, Spring 2017

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