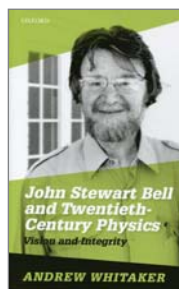


John Stewart Bell and Twentieth-Century Physics

Vision and Integrity

Andrew Whitaker

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John Stewart Bell, best known for his groundbreaking contributions to the foundations of quantum mechanics, was one of the most esteemed physicists of the 20th century. It was only a matter of time before he received a full biography, and historians and physicists interested in his life and work will welcome *John Stewart Bell and Twentieth-Century Physics: Vision and Integrity*.

After his undergraduate studies at Queen's University Belfast, Bell moved to Harwell National Laboratory and the University of Birmingham, where he worked with Rudolf Peierls and later earned his PhD. He went on to work in the theoretical division at CERN, where he stayed for the rest of his career and became known for his work on accelerator design and on particles and fields.

In the mid 1960s Bell brought a major innovation to another field, foundations of quantum mechanics. After exposing flaws in John von Neumann's proof against the possibility of modifying quantum mechanics via the introduction of additional "hidden" variables, Bell reexamined the famous Einstein-Podolsky-Rosen thought experiment suggested by Albert Einstein and his collaborators in 1935. Bell was able to prove that no theory complying with the assumptions of realism and locality could reproduce all quantum mechanics results—a proof that we now call Bell's theorem.

John Clauser and Abner Shimony were among the first to explore Bell's theorem experimentally, and experiments with the theorem continue to this day. The most recent ones involve massive particles, detectors separated by 140 km or so, and photons coming from distant stars in the galaxy. So far the experiments have confirmed quantum predictions, led to the establishment of entanglement as a quantum signature, and contributed to the blossoming of quantum information research.

Although Bell's current prominence

derives mostly from his work on quantum foundations, biographer Andrew Whitaker rightly notes that during his lifetime, Bell's reputation arose largely from his more conventional work on particles, fields, and accelerators. When Bell was elected as a Fellow of the Royal Society of London in 1972, the citation was almost entirely dedicated to nuclear and elementary-particle physics.

John Stewart Bell and Twentieth-Century Physics presents a vivid description of Bell's life and covers his diverse scientific accomplishments in detail. Occasionally, there is too much detail—certain passages risk overwhelming the reader. Despite that flaw, the book is invaluable for readers seeking a better understanding of quantum mechanics. It is also useful for readers interested in the history of 20th-century physics, particularly those who want to know more about particle physics and the history of CERN.

Whitaker was well placed to write this book. A physicist himself, he works on foundational issues of quantum mechanics, has interests in the history of science, and has already published books presenting the conceptual subtleties of quantum mechanics. He also currently teaches at Bell's alma mater, Queen's University Belfast. Thus he is very familiar with Bell's work and background.

Although thoroughly researched, the book would have benefitted from a deeper plunge into the literature about the stigma that haunted research in foundations of quantum mechanics throughout most of the second half of the 20th century. Bell was keenly aware of that professional bias, as Whitaker notes, and it could have been more thoroughly presented. Talented physicists such as Clauser, Heinz-Dieter Zeh, and Klaus Tausk found their careers obstructed because of their interest in foundations. For example, when Clauser was looking for a job in the summer of 1972, the chair of the physics department at San Jose

State University asked physicist Bernard d'Espagnat if Clauser's work was "real physics."

Bell himself received a letter from Léon Rosenfeld in December 1966 just after the publication of the paper deriving the theorem that now carries his name. Rosenfeld told Bell that he considered "hunting hidden parameters as a waste of your talent," adding: "I don't know, either, whether you should be glad or sorry for that." Nowadays the prejudice against foundational research is a thing of the past; quantum information theory is a blossoming field that draws directly from once-maligned work. However, for the sake of the current and future good health of physics, the full history should not be forgotten.

Bell's biography reminds us of the obstacles encountered in the making of physics. Whitaker's book, with its vivid biographical depiction and wealth of technical detail, fills a lacuna felt by many historians, philosophers, and physicists.

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Now

The Physics of Time

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Richard Muller's *Now: The Physics of Time* is an ambitious undertaking that begins much like a popular account of relativity and quantum physics, but culminates by proposing a new theory of time. As in his acclaimed *Physics for Future Presidents: The Science Behind the Headlines* (Norton, 2007), based on a course he offers for nonscience majors at the University of California, Berkeley, the writing is entertaining and at times refreshingly idiosyncratic. Muller has a way of keeping a reader's attention with provocative ideas or claims. Examples include sections entitled "Actually, There Are No Black Holes" and "Feynman Reverses Time" and an extended discussion on the entropic arrow of time. Skeptical

