taking a course on liquid crystals.

Some minor shortcomings appear in the text. One concerns the presence of numerous grammatical mistakes and misspellings. Those never rise to the level of causing confusion, but they are noticeable. The second concerns a slight unevenness in how much background physics is supplied for the myriad topics covered in the book. In most cases, Blinov nicely relates his topic to basic physics before developing the ideas important to liquid crystals. But sometimes he makes a connection to a fairly sophisticated idea; in such cases readers unfamiliar with the concept will wish the author had offered a more fundamental discussion. But the weaknesses are fairly inconsequential; *Structure and Properties of Liquid Crystals* is a truly useful addition to the pedagogical literature on liquid crystals.

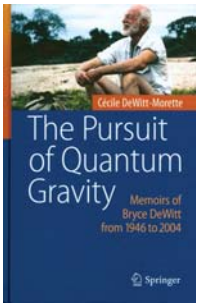
The Pursuit of Quantum Gravity

Memoirs of Bryce DeWitt from 1946 to 2004

Cécile DeWitt-Morette
Springer, New York, 2011. $49.95 (151 pp.). ISBN 978-3-642-14269-7

It took great courage for 24-year-old Bryce DeWitt, who in 1947 had just retired as a US Navy pilot in World War II, to choose a self-energy quantum gravity problem for his PhD thesis. When DeWitt entered graduate school that year at Harvard University where he studied under Julian Schwinger, quantum gravity was a peripheral field in physics and not a critical focus as it is now. In *The Pursuit of Quantum Gravity: Memoirs of Bryce DeWitt from 1946 to 2004*, DeWitt's wife Cécile DeWitt-Morette presents an honest and authoritative account of his remarkable contributions to the quantization and renormalization of the gravitational field and of non-abelian gauge fields, both of which are central today in particle physics.

DeWitt-Morette, a prominent physicist in her own right, is professor emerita at the University of Texas at Austin. *The Pursuit of Quantum Gravity* contains her well-chosen selection of DeWitt's original writings—their clarity highlights his extraordinary insight—and many personal recollections that capture his adventurous nature. Her own commentary on his writings is enlivening and sheds even greater light on his lifelong dedication to solving the problems of quantum gravity. She and DeWitt met in 1950 while both were conducting postdoctoral research at the Institute for Advanced Study in Princeton, New Jersey. They married in 1951 and moved to the University of North Carolina at Chapel Hill in 1956; there, encouraged by Freeman Dyson and John Wheeler, DeWitt would become the founding director of the Institute of Field Physics. (It was at the institute that Peter Higgs, then a postdoc, wrote his famous 1964 paper on the Higgs boson and its role in spontaneous symmetry breaking.) The DeWitts moved to the University of Texas at Austin in 1971 where he remained until his passing in 2004.



DeWitt was the first to find the perturbation rules to all orders for ghost fields, which are used to cancel infinities in internal loops but do not appear as external observable particles. In a 1988 letter reprinted on page 52, DeWitt wrote concerning his PhD thesis, "Since [an earlier work] was a photon self-energy calculation, rather than a graviton self-energy calculation, there was no need for ghosts. . . . They weren't invented until [Richard] Feynman pointed out the need for them in the early 1960s. Then the perturbation rules for the ghosts to all orders were obtained by me in 1966 and, in a slick, fast technique, by [Ludvig] Faddeev and [Victor] Popov in 1967." Indeed, I was with DeWitt in 1966 and 1967 at the Institute of Field Physics and I recall him explaining to me that he had found the rules for Feynman's ghosts to all orders.

In the early 1960s, Wheeler felt that the wave functional in quantum gravity should be a functional of three-geometries. He shared his theory with DeWitt, and that led to the famous Wheeler–DeWitt equation. On pages 58 and 59 DeWitt says, "It was not difficult to follow the path already blazed by [Erwin] Schrödinger and write down a corresponding wave equation. This I showed to Wheeler, as well as an inner product based on the Wronskian for the functional differential wave operator. . . . I wrote a paper on it in 1965, which didn't get published until 1967 because my Air Force grant was terminated, and the *Physical Review* in those days was holding up publication of papers whose authors couldn't pay the page charges." That held-up paper is the first of DeWitt's famous trilogy of *Physical Review* articles published in 1967, in which he took crucial steps toward a viable quantum theory of gravity and a renormalizable theory of non-abelian gauge fields.

Other gems in the book are the wonderful discussions by DeWitt and Wheeler about Hugh Everett III and his "relative state" or "many-worlds" interpretation of quantum mechanics (pages 91–100); an important biographical memoir (pages 123–131) by Steven Weinberg that he prepared in 2008 for the National Academy of Sciences; and an excellent introductory letter from DeWitt to his grandson, Ben, partly to explain why he chose physics (pages 1–4). DeWitt-Morette took great care in producing a well-documented and well-rounded memoir covering the many aspects of her husband's outstanding character and achievements. The only significant lacuna I noticed is that the book lacks an index of important terms.

I heartily recommend *The Pursuit of Quantum Gravity*. Beyond the physics, it delivers a uniquely personal record of what made DeWitt tick.

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Science in the Age of Computer Simulation

Eric Winsberg
University of Chicago Press, Chicago, 2010. $24.00 paper (168 pp.). ISBN 978-0-226-90204-3

About 20 years ago, while I was taking a midday stroll with colleagues, my mind wandered to a "large" molecular dynamics simulation I was working on. (That simulation could easily run on my laptop today.) After making some progress on a couple of problems that had been troubling me, I attempted to reenter my companions' conversation by uttering, "But why should the iteration $x\,(i+1) = (a^*x\,(i) + b)$ mod p have anything to do with the physics of aggregate formation?" My evident non sequitur was greeted with strange looks and "Huh? What are you talking about?" The publication of Eric Winsberg's *Science in the Age of Computer Simulation* is too late to rescue that old conversation, but its existence will help to validate interest in philosophical questions