Neil Ashcroft

November 27, 1938 – March 15, 2021

Neil Ashcroft was born in London, England on November 27, 1938. He remembered from his childhood the blackouts and bombings of World War II. Two years after the war, the Ashcroft family settled in New Zealand. Neil received Bachelor (1958) and Master (1960) of Science degrees from the University of New Zealand, today the Victoria University of Wellington, which awarded him an honorary doctorate in 1996.

He received his Ph.D. in physics from Cambridge (1964), working with the well-known solid state theorists John Ziman and Volker Heine. His thesis contained one of the earliest calculations of the structure of the Fermi surface of aluminium, the most fundamental determinant of any particular metal's electronic properties. When he lectured on his thesis in America, he enjoyed explaining that aluminium was a "transatlantic isotope" of aluminum.

In 1965, Neil came to Cornell as a postdoc. He joined our faculty in 1966 and remained a member of the Physics Department for the rest of his life. He became the Horace White Professor of Physics in 1990, and retired in 2006. After a long illness, he died in Ithaca on March 15, 2021.

Neil's wide-ranging research in the field of condensed matter physics included matter under extreme pressures, high-temperature superconductivity, metallic hydrogen and its alloys, metal–insulator transitions, and density functional theory. After his retirement he joined the research group of Roald Hoffmann in Cornell's Chemistry Department, collaborating on almost 50 joint papers. Roald said that "Neil was wise and perceptive, fascinated by the border between chemistry and physics. We valued his physical insight and remember his gentle wit."

In 1968, Neil proposed that at ultrahigh pressures hydrogen would become a metal, and a high-temperature superconductor. Three decades later experimentalists showed that hydrogen molecules did indeed turn metallic at enormous pressures.

When Neil's research group predicted in the 1990s that highly compressed lithium would change from a highly symmetric, close-packed structure to a form of lower symmetry, with more conduction electrons per atom, that unexpected transition was quickly confirmed.

Two decades ago Neil predicted that hydrogen-enriched metallic elements would become ultrahigh-temperature superconductors under extreme pressures. In the past six years, that, too, has been confirmed. Several research groups achieved record high temperatures—room temperature and above—with superconducting lanthanum decahydride and Sulfur trihydride. Room-temperature superconductivity has the potential to revolutionize technology

Neil was also a talented administrator. He was director of our Laboratory of Atomic and Solid State Physics (LASSP) 1979–84 and director of the Cornell Center for Materials Research (formerly the Materials Science Center --- Neil renamed it) 1997–2000. He played a vital role in launching the Cornell High Energy Synchrotron Source and served as its coprincipal investigator and associate director 1978–89 and its deputy director 1990–97.

I succeeded Neil as director of LASSP from 1984-90. I had an easy time of it, because of the superb administrators he had hunted down and hired during his own term.

The happiest years of my professional life were 1968–76 when Neil and I wrote, and saw into print, our book, *Solid State Physics*, which became one of the best-known advanced physics texts of the 20th (and 21st) century. Neil was fascinated with materials. Each was like a personal friend to him. I had little interest in or knowledge about particular materials. What fascinated me was the beautiful conceptual structure that encompassed all of them.

Neil wrote most of the first drafts. I would rarely understand what the overall issue was and would revise his text into something that made more general sense to me. Neil would then have to clarify my draft, correcting all the mistakes I had introduced. Back and forth we went, slowly converging on something that looked good to us both.

This was before the arrival of personal computers. I typed every page on a state-of-the-art IBM "bouncing-ball" typewriter, making revisions with a white "erasing ribbon" and retyping entire pages when revisions were major. It was a slow process. This gave us lots of time to think further and argue more about what we were writing. We were both having a wonderful time.

Neil had a fine sense of humor. He was a great mimic and did a superb Hans Bethe. We enjoyed dealing with each other's idiosyncrasies throughout our collaboration, and our fun permeates the book. That might explain why it's still thriving in its original edition, 45 years after it was published.

In 1990, I remarked to Bethe that Ashcroft and Mermin, as the book became known, was still in its first edition after 24 years. Hans said this showed "the stability of the subject." True enough. But I believe that those 24 years, and the two more decades since then, also reflect the fact that, unlike almost all other technical books, ours *entertains* the reader almost as much as Neil and I entertained each other during our six years of writing.

We even had fun reading pager proofs and making our enormous index. Putting together an index in 1975 was hard work. Every entry was written by hand on a “3-by-5 card.” If we stacked them, the pile would have been a couple of meters high. Neil’s favorite index entry is “Cart, before horse,92,” followed nine pages later by “Horse, after cart, 92.” My favorite, on page 808, is “Exclamation marks, 61, 185, 219, 224 (twice!), 291, 305, 403, 808.” This by itself indicates the difference in our styles. The book itself has nevertheless a uniform tone that is neither of ours, because we negotiated almost every word.

My only other collaboration with Neil was a short memorial article in 2006, “Hans Bethe’s Contributions to Solid-State Physics.” Our revisions, re-revisions, and re-re-revisions were unbelievably easier in the modern era, but just as extensive. Easy as it had become, this made us realize that we no longer had the energy to write a second edition of our book, even if we had thought one was needed.

Neil was a member of the U.S. National Academy of Sciences. More impressively, he was also a foreign member of the Russian Academy of Sciences. He was informed of this only by a letter, sent by ordinary (paper) mail. The day the letter arrived he called me into his office and showed it to me. “What do you make of this?”, he asked. I was bowled over. “Neil, congratulations, you’ve become an Academician!”

This memorial note about Neil would have been much better if I still had him with me to do our dance of multiple revisions. I have tried to imagine his ghost correcting and improving on me, but it’s not the same as the real thing.

I miss Neil enormously.

Written by N. David Mermin