

PAULING BIOGRAPHY HIGHLIGHTS CONTROVERSIES

Linus Pauling: A Man and His Science

Anthony Serafini

Paragon House, New York,
1989. 310 p.p. \$22.95 hc
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Reviewed by John S. Rigden

Linus Pauling is one of the greatest chemists of the 20th century; he is also one of this century's most controversial scientists. Taken together, these characteristics confront Pauling's biographer with an enormous challenge. In my judgment, the author of the present biography, Anthony Serafini, has not met the challenge.

Pauling received his doctorate in June 1925 from the California Institute of Technology, and in the spring of 1926 went to Munich, where he began his work under the guidance of Arnold Sommerfeld. Thus, Pauling was at the scene of the action when Schrödinger's quantum mechanics broke upon the world of physics—the wave-mechanical version of quantum mechanics that physicists and chemists where to apply with such success to the questions of molecular structure.

While Pauling played no part in the development of quantum mechanics itself, he, along with John Slater and Robert Mulliken, is credited with being a founder of quantum chemistry. Furthermore, his classic textbook *Introduction to Quantum Mechanics*, written with E. Bright Wilson Jr and published in 1935, educated generations of physicists and chemists in the subject. Pauling and Wilson's textbook enjoyed one of the longest lifetimes of any technical book ever published by McGraw Hill: It remained in print for 48 years.

Serafini's biography reveals nothing about the beginnings of quantum

chemistry and Pauling's role in it. (Pauling and Wilson's classic quantum mechanics textbook is not even mentioned.) There is no attempt to identify the steps that led to the quantum mechanical treatment of molecules; for example, the 1926 paper on helium by Heisenberg and the seminal paper in 1927 on the hydrogen molecule by Heitler and London are not mentioned. Hence no context is provided for examining Pauling's contribution to the creation and development of quantum chemistry: When did Pauling begin his quantum chemical work? How did he begin it? As a founder of quantum chemistry, what were his contributions? From any biography of Pauling, the reader deserves some insight to questions such as these. No such insight is forthcoming.

To respond to questions such as those posed above, a biographer would have to examine primary sources. The near total absence of any reference to the primary literature (out of a total of 202 references in the book, only three cite primary literature and they concern vitamin C) highlight the deficiency of this biography. Such an omission is particularly disheartening given the author's bent to underscore the controversies that accompanied Pauling's professional and political activities. In this book we learn of Maurice Huggins's claim that his ideas were taken by Pauling and published as his own; we learn that "many . . . believe that Pauling really did steal his famed principles from Bragg"; we learn of the Slater-Pauling duel and of "Slater's all-out attack on [Pauling's] methods." The primary literature might well have shed some light on serious charges such as these; however, the author provides only anecdotal commentaries. Further, the author chooses to cast the Pauling controversies in combative terms: "Pauling vs Dorothy Wrinch," "At War With Herman J. Muller," "Squaring off With William F. Buckley Jr.," "Pauling vs the Medi-

cal Establishment" and "In Defense of Vitamin C" are chapter titles. This approach succeeds in portraying Pauling as a feisty individual, but in the absence of thorough research, it fails as a means for understanding the essence of the differences that separated Pauling from his opponents.

Pauling's most famous book, *The Nature of the Chemical Bond*, was first published in 1939. In this book, he used the valence bond approach exclusively as the quantum mechanical means to understand molecular structure. Another quantum mechanical method for understanding molecular structure is the molecular orbital approach of Friedrich Hund and Mulliken. Pauling's personality was a significant asset for promoting the valence bond method. Mulliken has written, "As a master salesman and showman, Linus persuaded chemists all over the world to think of typical molecular structures in terms of the valence bond method."¹ This characterization of Pauling as showman is consistent with the image of Pauling that emerges from the biography under review. However, it would be nice to understand why Pauling eschewed the molecular orbital approach. A revision of *The Nature of the Chemical Bond* appeared in 1967 with the new title *The Chemical Bond*. In spite of the fact that between 1939 and 1967 it had become more common to discuss molecular structure in terms of molecular orbitals, Pauling again ignored it in his revised edition. Why? As one of the foremost quantum chemists, Pauling's rejection of the molecular orbital approach needs an explanation that is not found in this book.

Pauling's scientific style itself does come through in this book. His style is intuitive. He saw the structure of molecules in his mind's eye and his self-confidence allowed him to proceed even in the absence of supporting data. (In this regard, it is amazing how much future chemistry Pauling anticipated in *The Nature of the*

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Chemical Bond. Although this in itself should constitute a chapter in any biography of Pauling, it is not treated in Serafini's book.) Apparently, Pauling discovered the helical structure (the alpha helix) of the polypeptide chain by folding a piece of paper while sick in bed. (Ironically, the structural data as then known was misleading, and others who paid more attention to data, like Sir Lawrence Bragg, missed the opportunity to make this important discovery. Bragg later called this "the biggest mistake of my scientific career."²)

Likewise, Pauling intuited the molecular origin of sickle-cell anemia. While many criticized Pauling's style, Francis Crick credits Pauling with the correct theoretical approach to biological problems.³

After World War II Pauling became a political figure. In the climate of those times, his antinuclear stance, his campaigns for disarmament, his opposition to atmospheric nuclear testing and his generally liberal positions raised the suspicions of Senator Joseph McCarthy and others of his ilk. Although Pauling was accused of being a "fellow traveler," the accusation was never verified. Nonetheless, Pauling was repeatedly subpoenaed to appear before Congressional investigative committees, and his passport was denied because he was deemed a security risk. These were not proud years for Americans.

To the general public, Pauling is probably best known as the crusader for the therapeutic effects of Vitamin C. Pauling's activity in this arena is consistent with his highly intuitive style. Pauling has raised the ire of the medical community through both his methods and his claims. Here again, Serafini's book fails: No basis is provided for understanding how Pauling became devoted to the vitamin-C cause. Here is a case where direct contact with Pauling himself might have been helpful.

The issue of direct contact with the biography's subject raises another question about *Linus Pauling: A Man and His Science*. The author acknowledges Pauling "for making himself available to me." However, I did not read one quote identified as a statement made by Pauling directly to the author. It would have been nice if Pauling's voice had been heard in connection with his groundbreaking chemistry as well as the many controversies that swirl around his career.

References

1. Robert S. Mulliken, *Life of a Scientist*,

Springer-Verlag, New York (1989), p. 60.

2. Crick, *What Mad Pursuit: A Personal View of Scientific Discovery*, Basic Books, New York (1988), p.58
3. See ref 2 p.60.

From Quarks to the Cosmos: Tools of Discovery

Leon M. Lederman and David N. Schramm
W. H. Freeman, New York,
1989. 242 pp. \$32.95 hc
ISBN 0-7167-5052-X

The most important discovery made in elementary particle physics in 1989 was that there are only three families of quarks and leptons, or at least only three light neutrinos of the type associated with families. Ten years earlier, this situation had been anticipated by calculations of the production of helium in the early universe. The fraction of helium relative to hydrogen depends weakly on the number of light neutrinos, and three was the family number deemed most likely.

This is just one example of the close relationship between the smallest objects (elementary particles) and the largest (the universe) considered in science. During the last two decades, particle physics and early-universe cosmology have been steadily converging.

From Quarks to the Cosmos presents a description of both areas and their overlap, at a level typical of *Scientific American* and hence accessible to undergraduates and even to senior high school students. The two authors of this nicely produced book are superbly qualified for their task. Leon Lederman, the former director of Fermilab, is a particle experimentalist who played a leading role in discovering members of the second and third families of quarks and leptons. David Schramm is a theoretical astrophysicist at the University of Chicago and was a pioneer in the analysis of cosmological nucleosynthesis and its dependence on family number.

The book contains another beautiful example of the inner (subatomic) space and outer space linkage. In 1987 the neutrinos emitted in a supernova explosion over 100 000 light-years away were sensed on Earth in detectors constructed to find evidence for proton decay, which was predicted by ambitious unified particle theories. None of the detailed predictions of the unified theories has been confirmed by experiment, and yet the theories

initiated serendipitously the first neutrino astronomy.

The book includes two chapters on particle physics, followed by one on Big Bang theory, and one on their interrelationship. Finally, there is a chapter called "Tools for the 1990s." This chapter naturally encompasses the Superconducting Super Collider in Texas and the Hubble Space Telescope.

A shortcoming of the book is the lack of discussion of the relative accuracy of measurements in the two disciplines. The lifetime of, say, the muon particle in the microworld is known to better than 0.01% accuracy; the present age of the universe is not known even to 10% accuracy. The number of quark and lepton families could be estimated only roughly from cosmological theory but was measured precisely in particle experiments in 1989. That cosmology is generally the less quantitative of the two sciences does not clearly emerge from the text. I say "generally" because the recent Cosmic Background Explorer data (PHYSICS TODAY, March 1990, page 17) provide the first exception to this rule.

I liked this book both in style and substance and would unhesitatingly recommend it, especially to teachers, for an informed overview of the interrelationships between physics of the infinitesimally small and the almost infinitely large.

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Quantum Description of High-Resolution NMR in Liquids

Maurice Goldman
Clarendon (Oxford U. P.),
New York, 1988. 268 pp.
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Since its development in the late 1940s, nuclear magnetic resonance has grown into one of the most widely used spectroscopic techniques in modern molecular science. From crystalline materials at milli-kelvin temperatures to protein-DNA complexes in aqueous solution, nmr is capable of yielding a wealth of information on molecular structure and dynamics. To adequately describe such a broad field, nmr texts have, in the past, assumed encyclopedic proportions. Maurice Goldman's new book, *Quantum Description of High-Resolution NMR in Liquids*, departs from this traditional reference format and specializes in a particular, widespread application of nmr.