very useful to scientists in many fields, and certainly to physicists seeking an introduction to radiation health effects.

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Julian Schwinger: The Physicist, the Teacher and the Man

Edited by Y. Jack Ng
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Prodigies don't always pan out. Julian Schwinger did. He had fastened onto physics for his life's work while still in his early teens, when he got to the letter "P" in a systematic odyssey through the *Encyclopaedia Britannica*. Not much later, he was spotted reading (and understanding) Paul Dirac. Tales of the boy wonder began to circulate while he was still in high school. Schwinger's first two papers were published when he was seventeen, and a flood of others began to appear by his nineteenth year. Having transferred from the City College of New York to Columbia University, where he came under the tutelage of I. I. Rabi, Schwinger was off to a spectacular start. By age 20 Schwinger was, in Paul Martin's felicitous words, a recognized "impresario in a field for which the twentieth century has been a golden era."

Schwinger died on 16 July 1994 at the age of 76. Not long after, friends and colleagues organized several commemorative symposia, one held at Drexel University, another at the University of California, Los Angeles, and a third at a joint meeting in Washington, DC, of the American Physical Society and the American Association of Physics Teachers. *Julian Schwinger: The Physicist, the Teacher and the Man* is a collection of the talks given at those sessions, together with a brief preface by Y. Jack Ng. There are two valuable appendices as well: a list of Schwinger's doctoral students and his updated publication list.

Bryce DeWitt's article on curved spacetime propagators and Walter Kohn's article on density functionals are detailed, technical expositions. There are also two 1993 talks by Schwinger himself (read by Freeman Dyson at one of the symposia). One is Schwinger's response on receiving an honorary degree at The University of Nottingham in England. The other, "The Greening of Quantum Field Theory, George and I," was a talk, also given at Nottingham, that centered on—what else?—Green's functions. The remaining pieces in this volume are reminiscences and tributes contributed by former students and other colleagues: Abe Klein, Bryce DeWitt, Walter Kohn, David Saxon, Paul C. Martin, Kenneth Johnson, Stanley Deser, Robert Finkelstein, Ng, Herman Feshbach, Lowell Brown, Sheldon Glashow, Kimball A. Milton, C. N. Yang. They all describe the same man: shy, gentle, cultured, generous, elegant in his writings and lectures, scientifically conservative, stubbornly resistant to scientific domination by others, something of a loner and, also, somewhat unaccountably, a lover of big, expensive automobiles.

Schwinger supervised about 70 doctoral students, most of them during his years at Harvard, some few from his later period at UCLA. The total is awesome, yet the sum of one-on-one contact hours with the master was considerably more modest. Schwinger was much sought after as a doctoral adviser and apparently accepted all who persisted. Moreover, by all reports, time with him, when it could be had, was well spent. But that time was hard to come by, especially during the earlier years. Klein speaks of a total of three substantive sessions with Schwinger during his Harvard years, DeWitt of perhaps 20 minutes in the course of his thesis work! Much of Schwinger's influence was expressed through his lectures, which were masterpieces of exposition, clarity and originality and were widely attended by faculty and students alike. One did not interrupt with questions, just as one would not interrupt the performance of a Mozart sonata. Although private time with teacher was a scarce commodity, it was not uncommon for Schwinger's students to pick up his verbal and literary style. Even years later, one recognizes the marks of a Schwinger student.

The articles are varied in slant, but all are delightful. Inevitably, some focus more on the writer (and Schwinger), others more on Schwinger and his contributions, but almost all describe his singular work habits. His range was astonishing: nuclear, atomic, particle and condensed matter physics, statistical mechanics, classical electromagnetism, synchrotron radiation, waveguide theory (in the war years), general relativity, quantum field theory and, of course, quantum electrodynamics in particular, and the development of theoretical tools more generally. His work also contained important foreshadowings of the standard model and beyond. One picks up interesting and varying insights from the different contributions here, although the book is not at all a systematic scientific or personal biography of Schwinger. Such a biography is bound to come. It will be especially interesting to understand Schwinger's later years, as his methods came to be overtaken by Richard Feynman's and as the quark picture and then the standard model took hold, without Schwinger's direct participation and, to some extent, against his tastes. His source theory was not widely accepted and was, in any case, overtaken by events. Toward the end of his life, there was his seemingly inexplicable association with cold fusion, about which there is scarcely a word in these talks.

Concerning Feynman, Schwinger's famous comment is reproduced here in Yang's article: "Like the silicon chip of more recent years, the Feynman diagram was bringing computation to the masses." Yang offers a perceptive contrast between these two giants of theoretical physics: "Twenty percent impulsive clown, twenty percent professional nonconformist, sixty percent brilliant physicist, Feynman strived to be a great performer, almost as much as to be a great physicist. . . . Shy, erudite, speaking and writing in crafted and polished sentences, Schwinger epitomized the cultured perfectionist and the quiet inward-looking gentleman."

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Supernovae and Nucleosynthesis: An Investigation of the History of Matter, from the Big Bang to the Present

David Arnett
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A classic 1957 paper by Geoffrey Burbidge, Margaret Burbidge, William Fowler and Fred Hoyle convincingly showed that most of the heavy elements in the universe could be produced by nucleosynthesis in stars. In the past few decades, there has been a steady development in our understanding of the origin of nuclei and their ejection into interstellar gas. David Arnett has been a leading figure in that development, and his book covers many of the topics that he has investigated during his research career.

The main focus of his *Supernovae and Nucleosynthesis* is nucleosynthesis