

BOOKS

Forty Years after his Death, Finally a Life of Fritz London

Fritz London: A Scientific Biography

Kostas Gavroglu
Cambridge U. P., New York, 1995.
299 pp. \$69.95 hc
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Reviewed by Anthony J. Leggett

Fritz London was arguably the cofounder of not one but two major disciplines in condensed matter: His 1926 paper with Walter Heitler lies at the very roots of modern quantum chemistry, while his 1935 work, with his brother, Heinz, was the theoretical breakthrough that later, in the hands of John Bardeen, Leon Cooper and J. Robert Schrieffer, led to the unlocking of the mystery of superconductivity. In addition, London made seminal contributions to the theory of superfluidity, and his 1938 monograph, with Edmond Bauer, on the problem of measurement in quantum mechanics, is still standard reading among aficionados of that subject. Yet the only major prize that London ever received was the Lorentz Medal of the Royal Netherlands Academy of Sciences, presented to him in 1954, the last year of his life. (Ironically, the prize named for him posthumously has become one of the two major international awards in low-temperature physics.) And 40 years after his death there was still no scientific biography of him.

This major gap has now been filled by Kostas Gavroglu, professor of the history of science at the University of Athens, Greece. In a book that intertwines personal and scientific history, Gavroglu follows London's career from his early essays in philosophy through his work on quantum chemistry in Zurich and Berlin, his nomadic years in Oxford and Paris and his final settlement as a professor of theoretical chemistry at Duke University, where he spent the last 15 years of his life. The work is well written and readable, and the comparatively small amount of formal theoretical

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FRITZ LONDON (right) and his brother, Heinz, in 1953 at the Mond Laboratory in Cambridge, England. (Photograph courtesy of Edith London.)

physics and chemistry in it should be accessible to, say, senior undergraduates in these subjects.

In his introduction, Gavroglu tells us that ever since reading Thomas Kuhn's influential *Structure of Scientific Revolutions*, he had "become impressed with what appeared to be the easy part: normal science" and had determined, in effect, to see whether it really was that "easy." London's work is indeed "normal" science by Kuhn's classification, in that London did not overthrow any of the existing paradigms but rather built on them. But a point of major interest that emerges from Gavroglu's book is that, nevertheless, neither the history of quantum chemistry nor that of the theory of superconductivity and superfluidity developed in the calm, logical progression that hindsight makes it easy to infer. For example, while modern students of superfluidity may find it natural to view the contributions of London, Laszlo Tisza and Lev Landau as harmoniously fitting elements in what is now the accepted picture, that was not at all how it looked to the protagonists at the time. Indeed, neither London nor Landau, temperamentally diamet-

ric opposites but perhaps closer in their intuitive approaches to physics than either would admit, ever really fully appreciated the other's point of view.

This book does belated justice to a towering figure of 20th-century condensed matter physics. It is fitting that its publication should coincide, almost to the month, with the first direct experimental verification—in June 1995—of London's prediction of Bose condensation in a real-life interacting system of atoms.

The Myth of Scientific Literacy

Morris H. Shamos
Rutgers U. P., New Brunswick,
N. J., 1995. 261 pp. \$27.95 hc
ISBN 0-8135-2196-3

In *The Myth of Scientific Literacy* Morris Shamos examines the public's understanding of and interest in science. He finds no improvement since World War II despite enormous and expensive educational efforts promoting science literacy. He argues convincingly that previous reforms in science education

have failed and that current efforts are doomed because they lack clear goals. Science literacy in its cultural sense of mere recognition of terms or knowledge of a few major facts leads to little appreciation of the process of science. More sophisticated science training that allows people to discuss science articles in the popular press still fails to enable them to apply that training to new situations.

Shamos concludes that most students cannot achieve sufficient understanding of science to judge the quality of scientific work in fields that are new to them. He therefore advocates redefining the goals of science education to promote "science awareness" rather than traditional science literacy tied to individual disciplines. He argues that science awareness includes an understanding and appreciation of science and technology as an enterprise and need not rest upon much specific scientific knowledge. The public needs both to understand what science can reasonably be expected to produce and to recognize that science is a technique for acquiring knowledge rather than a body of facts and organizing theories.

To support this contention, Shamos, a physicist who has served as president both of the National Science Teachers Association and the New York Academy of Sciences, analyzes the reasons science has become an accepted part of the curriculum. He discusses science education from Plato through Thomas Dewey to the American Association for the Advancement of Science's Project 2061, the National Science Teachers' Association's Scope, Sequence and Coordination Project, the science, technology and society movement and the current "antiscience" movement. In particular, he stresses the difficulties of evaluating curriculum reform and the very long time needed to produce meaningful change. The analysis, which is clear, elegant and well documented, should be required reading for those interested in science education. It justifies the purchase of the volume.

It is probably too much to expect so insightful an analysis of such an extremely complex problem as science education to be followed by equally brilliant and specific proposals for solving it. Nonetheless it is disappointing to seek answers in *The Myth of Scientific Literacy* and find only broad goals outlining the process of science and its relationship to technology. These goals define science awareness; taught in their present form, they would quickly amount to a sophisticated version of memorizing without understanding steps of the scientific method. Abstract philosophy seems unlikely to interest high school students: Shamos admits

that developing curricula to advance these ideals is not simple, and he suggests that tying science to technology will improve students' interest and understanding.

Disappointingly, Shamos does not discuss the current attempts at systemic reform of science education—namely the National Science Foundation's effort to address many of the problems that he eloquently describes. Issues of equality of access and opportunity appear as brief afterthoughts. The discussion is limited to gender issues and does not address ethnic or economic disparities in access to science. And the discussion of professional training of scientists fails to acknowledge the current glut of PhDs in the job market.

Nevertheless, this volume contributes significantly to the debate on reforming science education. Shamos's ideas are worth careful consideration.

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The Force of Symmetry

▶ Vincent Icke
Cambridge U. P., New York, 1995.
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Imagine setting out to write a book about modern elementary particle theory that avoids advanced mathematics yet attempts to describe in detail ideas ranging from relativity and quantum mechanics to representations of the rotation group, gauge invariance, renormalization, Feynman diagrams, isospin, Yang-Mills theory, quantum chromodynamics, asymptotic freedom, grand unification and string theory. Well, Vincent Icke has grabbed this bull by the horns in his book, *The Force of Symmetry*. Let me state right away that I think this is a bold and well-written effort. Nevertheless, I have no idea whatsoever who the audience might be.

The book jacket suggests that it is suitable for first-year undergraduates in the physical sciences or mathematics or as an accompaniment to more advanced texts. Yet the attempt seems to be to reach an even broader audience. For example, the precession of a gyroscope, which can succinctly be explained at this level using vector multiplication, is instead presented purely in words. The effort is laudable, but I think it may be misplaced.

Only a motivated reader can be expected to puzzle through many of the discussions in this book. My suspicion is that those readers willing to work

through the verbal arguments presented by Icke are those who might also be able to handle some, if not all, of the necessary mathematics. In addition, with no problems in the book to guide students, many of them may not be able to separate the wheat from the chaff.

Part of the problem is that the reader is given little inducement to tackle the subject beyond a short introduction about the beauty and wonder of the natural world. Within a few pages, the reader is thrust headlong into the details. In addition, there is a certain unevenness about the presentation, so that the reader who is seduced into a nice discussion of Feynman diagrams, by the standard heavy-beanball-throwing analogy of exchange forces, is at the same time confronted with the mention of vector and tensor fields in space-time, products of group representations for $U(1)$ and $SU(3)$, spherical harmonics, Lorentz transformations, infinite sums and so on. Those with any fear of mathematical notation may feel daunted, even though a detailed appreciation of these concepts is not essential to read the book. The author is from the University of Leiden; perhaps a European audience can cope with this better than would an American audience.

The book may be useful to physicists looking for ways to explain to their students, in layman's language, various concepts in modern physics. There are various such gems sprinkled throughout this volume. I found the discussion of local-versus-global gauge invariance involving a tablecloth and a Dutch glue called Velpon amusing. I also might recommend parts of this book to the better introductory students or advanced undergraduates who are searching for something additional to read on various topics—although again they might prefer something with concrete mathematics and examples, such as *The Feynman Lectures on Physics* (Addison-Wesley, 1963, 1989).

I do have two quibbles with views expressed by the author in his introduction. He claims that theory has gotten short shrift in modern popular writing. I don't know what books Icke was reading, but I think that the opposite is true and that this perhaps reinforces the misplaced but popular notion that modern physics is somehow based on pure speculation and is not connected to the real world. He argues further that mathematics is suppressed in this volume in part because it is often ugly—that the "nitty-gritty" of relativistic quantum field theory is singularly repulsive (the cognoscenti who have seen, for example, the full expression of the electroweak La-