

A major—and lively—contribution to Einstein scholarship

Subtle Is the Lord: The Science and the Life of Albert Einstein

A. Pais

552 pp. Oxford U.P., New York, 1982. \$25.00

Reviewed by Banesh Hoffmann

Here is an outstanding biography of Albert Einstein that one finds oneself reading with sheer pleasure. It is concerned mainly with Einstein's scientific ideas, which it presents in depth with ample use of equations and physical concepts. But Abraham Pais is solicitous of the reader. He breaks the chapters into well-labeled sections that he keeps comfortably short and maintains a running commentary telling the reader, for example, where the background of such and such an idea of Einstein's is dealt with, where the idea itself appears, and where subsequent developments are discussed.

Pais devotes certain chapters or sections to nonscientific matters. These parts, which amount to about 20% of the total—their titles are printed in italics in the table of contents—together constitute a charming nonscientific biography of Einstein that can be read independently of the scientific part, though not without loss.

Pais is well qualified for the task he has set himself. In addition to being a distinguished physicist, he was long associated with both Niels Bohr and Einstein. He has also had access to the Einstein Archives and the invaluable aid of Helen Dukas. Building on an extensive study of sources and recalling his conversations with Einstein, Pais has produced a lively book that is, at the same time, a major contribution to Einstein scholarship.

Here, with all eight reference symbols omitted, is an excerpt that shows Pais's ability to present a striking vignette:

Toward the end of the [wartime year 1971 in Berlin, Einstein's] health worsened. It turned out that he was suffering from a stomach ulcer. For the next several months he had to stay in bed. His feelings were at a low ebb. "The spirit turns lame, the strength diminishes." While bedridden, he derived the quadrupole formula

for gravitational radiation. In April 1918 he was permitted to go out, but still had to be careful. "Recently I had a nasty attack, which was obviously caused only because I played the violin for an hour." In May he was in bed again, this time with jaundice, but completed a fundamental paper on the pseudotensor of energy-momentum. His dream (in August) that he had cut his throat with a shaving knife may or may not have been a reaction to his state of health. In November he published an article on the twin paradox. In December he wrote to Paul Ehrenfest that he would never quite regain his full health.

The degree of scientific sophistication that Pais expects of the reader can be gathered from the following preliminary remarks about Einstein's work on Brownian motion. Note with what perception Pais goes to the heart of the matter and with what vividness he

presents it:

[Einstein's paper] bristles with new ideas: particles in suspension behave like molecules in solution; there is a relation between diffusion and viscosity, the first fluctuation-dissipation theorem ever noted; the mean square displacement of the particles can be related to the diffusion coefficient. The final conclusion, that Avogadro's number can essentially be determined from observations with an ordinary microscope, never fails to cause a moment of astonishment even if one has read the paper before and therefore knows the punch line.

There are some strange omissions. For example, Pais well recognizes the central role of aesthetic considerations in Einstein's research, yet in telling about the 1916-17 work on spontaneous emission, which led Einstein to an important new derivation of Planck's radiation formula, Pais does not men-



Einstein in Pasadena, California, 1932, in a photo courtesy the AIP Niels Bohr Library.

tion Einstein's revealing remarks in the published papers that the derivation is "amazingly simple" and that the argument "commends itself by its simplicity and generality."

In telling of Einstein's journey from the special theory to his masterpiece, the general theory of relativity, Pais speaks of some of the errors that led Einstein astray. He does not, however, mention the difficulties caused by a confusion of active and passive transformations or Einstein's long-held erro-

neous belief that if one went from Minkowski coordinates to more general coordinates, one would no longer be dealing with the special theory of relativity. However, Pais makes ample amends by quoting the following from a letter that Einstein wrote to Hendrik Lorentz in January 1916 about the general theory: "The series of my papers about gravitation is a chain of false steps which nevertheless by and by led to the goal. Thus the basic equations are finally all right but the

derivations are atrocious...." One could hardly want a clearer indication of the extraordinary power of Einstein's intuition. As Pais says:

The portrait of Einstein the scientist in 1913 is altogether remarkable. He has no compelling results to show for his efforts. He sees the limitations of what he has done so far. He is supremely confident of his vision. And he stands all alone. It seems to me that Einstein's intellectual strength, courage and tenacity to continue under such circumstances and then to be supremely vindicated a few years later do much to explain how during his later years he would fearlessly occupy once again a similar position, in his solitary quest for an interpretation of quantum mechanics which was totally at variance with commonly held views.

In telling about the long quantum debate between Bohr and Einstein, Pais sides completely with Bohr. Nevertheless, in telling of Einstein's tenacious search for a unified field theory, Pais stresses that behind the search was Einstein's hope that an overdetermined set of field equations would limit the singularity-free solutions to discrete sets, thereby leading in an unforced way to the presence of quantum effects.

In an appendix Pais tells the intriguing inside story of how Einstein came to be awarded the Nobel Prize. In another he presents Einstein's recommendations to the Prize committee. The final entry in a summarizing chronology makes a charming unexpected ending for this warmly recommended book.

Banesh Hoffmann, professor emeritus at Queens College, collaborated with Einstein and wrote with Helen Dukas Albert Einstein, Creator and Rebel and Albert Einstein, the Human Side.

Atomic Many-Body Theory

I. Lindgren, J. Morrison

469 pp. Springer, New York, 1982. \$55.00

The stationary properties of atoms can, in principle, be computed by diagonalizing an effective Hamiltonian in a space spanned by a large number of (configuration) basis vectors. For most systems this procedure is not feasible, and it has become customary to resort to many-body theory, which is based on perturbative expansions of Green's functions and on coupled-cluster expansions. These expansions can be represented with diagrams that increase understanding and simplify computation. A special feature of atomic physics is the "goodness" of a

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