

was motivated by the Ritz Combination Law of spectroscopy. Similarly the author of the time-energy uncertainty relation – so most of us have been taught – was Bohr and not Heisenberg. The discussion on the various alternative ways to understand the uncertainty principle is well motivated but finally leaves one uncertain. And Wick's confident assertion about Wigner – 'unlike most physicists, Wigner did not think the Copenhagen interpretation had settled the matter' – seems somewhat at variance with Wigner's own statement: 'The orthodox view is very specific in its epistemological implications. . . . A large group of physicists finds it difficult to accept these conclusions and, *even though this does not apply to the present writer*, he admits that the far-reaching nature of the epistemological conclusions makes one uneasy'.

In conclusion, the book is well worth reading to learn interesting points of history, to see the pressure of philosophical prejudices in every position or point of view, and to appreciate the utter nontriviality of the problems involved. One also understands that just as Bohr and Heisenberg were pioneers, so were Bohm and Bell in a later day. And in each case the courage and persistence shown by the pioneers made the way for those who followed deceptively easy.

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Yakov Ilich Frenkel: His Work, Life and Letters. Alexander S. Gilbergleit, ed. Birkhäuser Verlag, Postfach 133, CH-4010, Basel. 1996. Price: DM 198, SFr 168. 323pp.

Victor Frenkel's *Yakov Ilich Frenkel: His Work, Life and Letters* is a thoughtfully compiled biography of the great Soviet theoretical physicist, J. I. Frenkel (1894–1952) who lived and worked through what has come to be known as the golden age of the twentieth century physics. This biography is, however, not just about the many scientific achievements of J. I. Frenkel, the physicist, but also about Frenkel, the man (or J. I., as he is

affectionately referred to throughout the book) – about his worldview and the civic convictions upheld by him through the tumultuous decades that followed the October revolution when the scientific ideas of Quantum Mechanics and the Relativity Theory were held suspect by the State.

In this book we are re-told of Frenkel's well-known contributions to theoretical physics which are deep and, indeed, far too many for any one individual. This fact stands acknowledged in terms of the diverse physical phenomena and effects that now bear his name. Thus, we have the Frenkel defects in crystalline lattices; the Frenkel excitons in semiconductors; the Frenkel-Kontorova equation for the plastic deformation giving Frenkel solitons; the Frenkel Saw, or the Double-Saw model for the elastic limit of crystals and for dry friction; the Frenkel-fields of quantum electrodynamics; and, of course, the Frenkel theory of the liquid state, the last mentioned being closest to his heart, and considered by many his abiding contribution to theoretical physics. Some others, however, viewed his idea of the exciton (the photo-excited mobile electron-hole pairs *sans* photoconductivity) as 'the pearl of his creative legacy'. Then there are the less known works traceable to Frenkel for which he did not quite get the credit that was rightly his. This includes his work on the superdense stars – the White Dwarfs – which, he had argued, were stabilized against gravitational collapse by the electronic degeneracy pressure, rather than by a high temperature as the great Eddington would have it. And similarly for his work on the theory of metals with 'collectivized' electrons obeying Pauli's 'residence law'; his theory of the superdense nuclear matter; or his dynamo theory of Earth's magnetic field. Even the electron-paramagnetic resonance (EPR) was in fact one of his sound theoretical guesses. So was his idea of the lattice-polaron. He had, perhaps, expressed these seminal ideas just in passing. Some of his ideas were simply ahead of his time, e.g., the Ioffe-Frenkel idea of tunneling was realized in Tunnel Diodes, long after his death.

The biographer has provided insight into the working of Frenkel's mind, his method, and his style of pursuing scientific enquiry. Frenkel belonged to 'the theoreticians of the experimentalist type'. His method was, we are told, 'to come forward with a kind of "catch" and then with its help to approach the truth'. He

was known to have bemoaned the 'unhealthy passion for formal mathematical apparatus, a formal approach to physics that brings more damage than profit by tempting physicists to be satisfied with cheap mathematical trophies and to forget about the true essence of the problem considered'. The biographer hastens to clarify, however, that Frenkel was merely objecting to 'shooting guns at sparrows'. To him, introduction of new ideas remained the single greatest service one can render to science. It has been said of him that 'sometimes not even a model, but a precise, clear imaginative (if anthropomorphic, or terramorphic) expression by J. I. Frenkel, actually provided the formulation of some problem, later solved by other theoreticians'. This is well illustrated by his remark that '. . . the surface layer of every solid may be considered even in the absence of any alien adsorbed particles, as itself having been adsorbed with respect to the substrating mass'. One has only to read through his arguments as to why a liquid is kinetically closer to a solid than to the gas, that it naively resembles most, to be left in no doubt about its truth. The biography is, however, quite candid about some of Frenkel's intuitive remarks that may now seem untenable. Thus, for instance, Frenkel felt the gravitational field to be too 'macroscopic' to be quantized. But, precisely this and such otherwise inaccessible asides have added great value to this book for a discerning reader.

Last but not the least, this is a biography of an illustrious father by an affectionate son, not just filed from some archives but compiled with care from personal recollections and letters and familial anecdotes that go far beyond the usual public domain. Through reading these, a curious reader may even deconstruct the mind and the personality of J. I. Frenkel. From this record, J. I. emerges as a creative first-principle scientist, an encyclopaedic thinker, a kindly warm hearted professor with friends all over the world, and an artist. Some of the paintings/portraits by him reproduced in the book are simply disarming in their appeal. His students loved him, and there was no 'theoretical minimum' at his Physical-Technical Institute, that Landau, for one, would have insisted upon. For all his varied interests he was no great reader, or collector of books. But, he had read Jim Corbett's *Man-eaters of Kumaon* and *Leopard Man-eater from Rudraprayag*.

He was a prolific writer – with more than 200 papers published during 1916–1951 (some posthumously) and some 25 books, multi-printed since then. He considered his writing of books a commitment to science, even though, on his own admission, it did affect his research output adversely.

Finally, this book clearly belongs in any science library attached to a university/ research institution. It belongs equally well in the personal collection of those with a sense for the history of science and the scientific ideas. Condensed matter physicists should love it. Personally,

however, I would have liked the book to be somewhat shortened by selective deletion of some of the rather discursive letters.

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