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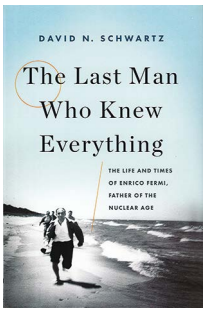

David N. Schwartz

The Last Man Who Knew Everything
The life and times of Enrico Fermi, father of the nuclear age

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This year marks the eightieth anniversary of the award to Enrico Fermi of the 1938 Nobel Prize in Physics. Fermi was appointed full professor of Theoretical Physics at the Royal University of Rome in 1927. In the following years, he was involved in a very intense scientific activity on a well-spread spectrum of research topics. These included the formulation of a statistical model for atoms, the study of spectroscopic questions, an original presentation of the general structure of quantum electrodynamics, the study of hyperfine structures of atoms. Starting from December 1933, there was an astonishing series of epochal results, starting with the formulation of the theory of beta decay (December 1933), which introduced a new kind of nuclear interaction then called weak interaction, and continuing with the discovery of the artificial radioactivity induced by neutron bombardment (March 1934), and the effects due to neutron slowdown (October 1934). The research on nuclear physics continued in the following years, with the study of the diffusion, absorption, and slowing down of neutrons in various substances. If we take into account that Fermi discovered what is now called Fermi-Dirac statistics, before the Rome period while he had a temporary position at the University of Florence, we can see that the Italian period, from graduation till his definitive departure to the United States, via Stockholm, in 1938, was extremely productive, with scientific results of long-lasting relevance.

Let us recall that the Nobel Prize in Physics 1938 was awarded to Enrico Fermi with the following motivation: "for his demonstrations of the existence of new radioactive elements produced by neutron irradiation, and for his related discovery of nuclear reactions brought about by slow neutrons".

It is astonishing to see that the scientific activity of Enrico Fermi in the United States, while he was in New York, Chicago, Los Alamos, and Chicago again, covers nuclear physics, cosmic rays, elementary particles, computers, and fully compares with the level of the activity in Rome. Fermi is a rare example of a Nobel laureate, who continues to reach exceptional results, outperforming himself. The peak reached in the United States is surely the establishment of the first self-sustaining controlled nuclear chain reaction, obtained on December 2, 1942, in the Chicago Pile 1, by exploiting natural uranium as fuel and pure graphite as moderator.

With the approach of the anniversary, the publication of this full-scale, monumental biography of Enrico Fermi is surely welcome.

The Author of the book, David N. Schwartz, is a political scientist, with a large experience in publishing and consulting activity on politico-military affairs, foreign policy, economics, development, governance and metropolitan policy. On the other hand, surely he absorbed a quite good deal of scientific sensitivity just in the family surrounding. In fact, his father, Melvin Schwartz, shared the 1988 Nobel Prize for Physics "for the neutrino beam method and the demonstration of the doublet structure of the leptons through the discovery of the muon neutrino".

The peculiar professional and cultural formation of the author is at the basis of a characteristic feature of the book: the continuous blending of the scientific aspects of Fermi activity with the political, cultural, human framework.

The book is based on original documents and a series of interviews. The whole matter is split into four parts. In the first part (Becoming Fermi) there is a complete account of Fermi formation and the first achievements, including the Pisa years at the Scuola Normale Superiore, the visits to Germany and Holland, the discovery of Fermi statistics. Part two (The Rome Years) deals with the family life, the work in spectroscopy in collaboration with the young "boys", and furthermore the establishment of the beta decay theory, the work with the neutrons culminating in the goldfish fountain apologue, related to the slow neutrons, the difficult relations with the Fascist regime, and finally the Nobel Prize. Part three (The Manhattan Project) describes the adjustment of Fermi, and his family, to the New World, the involvement with the exploitation of the newly discovered phenomenon of nuclear fission, the building of the nuclear reactors and of the bomb.

In part four (The Chicago Years) there is a description of the return to Chicago, and the research involvement there, including work on elementary particles on the new cyclotron, the remarkable teaching and mentoring activity, the travel aboard, in particular the double return to Italy, and finally the immature death. In this part there is also a quite complete account of the complex affair of the Italian Patent on slow neutron, which at the end resulted in a consistent compensation to the inventors, but largely inadequate with respect to the enormous relevance of slow neutrons in nuclear technology.

The treatment is systematic, well documented, and convincing. There are some parts where the reading is really fascinating, as for example the achievement of the criticality for the Chicago Pile, on December 2, 1942, and, for opposite reasons, the tragic development of the illness in 1954, leading to the premature death.

It is also very impressive how the peculiar human features of Enrico Fermi personality have been always put in the proper perspective. This is a very difficult subject, because we know a lot about the scientific activity of Fermi, but almost nothing really surfaces from the documents about his human personality. The net of considerations on this subject is everywhere dense in the book and is a real challenge and stimulation for further research.

We have also found it very stimulating how the treatment of a very controversial aspect of Fermi research is presented, *i.e.* about missing the phenomenon of fission, and the wrong interpretation of the hypothetical transuranic elements, ausonio (93) and esperio (94). Here further research is really necessary, in order to reach a complete explanation.

Certainly Fermi produced fission in Uranium in his experiments of May 1934, and in further research with slow neutrons,

without recognising it. Fission is very difficult to discover through radiochemical methods, as Otto Hahn and Fritz Strassmann achieved in December 1938. This analysis was overshadowed by the transuranic hypothesis, in all major nuclear laboratories, as Paris and Berlin. In December 1938 Hahn was almost "obliged" to admit that barium was the result of slow neutron irradiation of uranium. There is no way to argue that Rome missed the fission because there was no sufficient competence from the radiochemist of the group, Oscar D'Agostino. Surely, nobody in Rome could recognise fission by radiochemical methods, since it was not recognised at the time in the most well-developed laboratories of the world, as Paris with the Joliot-Curie and Berlin with Hahn and Lise Meitner.

On the other hand, fission is very easy to recognise through physical methods, because the two fission fragments have a very high ionisation power. The official version about missing the fission in Rome is that the revealing instruments were shielded against the alpha particles of uranium natural radioactivity through metallic foils, which absorbed the fission fragments also.

But Fermi was warned by Ida Noddack, to explore the possibility that nuclei with a low atomic number could be produced by the neutrons on uranium. It is incredible that Fermi did not take the chance to prove that Noddack was "wrong", by a simple experiment well within reach of the equipment of the laboratory in Rome.

So we come to another important point which is well emphasised in the book. Here the strict continuity is pointed out between the work done at Columbia and in Chicago, in 1939-1942, in order to establish the feasibility of the chain reaction, and the work done in Rome in 1935-1938, about the diffusion, absorption and slowing down of neutrons. Maybe it is true that Fermi missed the uranium fission in 1934, however he directed the research on neutrons along lines which allowed him to immediately enter the problem of the exploitation of nuclear fission, immediately after its discovery in Berlin.

In conclusion, we have found the book under review complete and exhaustive, well written, enjoyable to read, and very stimulating on very important still open historical problems.

We have also appreciated the decision of the author to include sensitive topics, as the discussion between Fermi and Robert Oppenheimer about the feasibility of radiological weapons for large-scale poisoning of food in Germany, and the revelations about Fermi stubborn, but finally hidden, opposition against the employment of the nuclear weapons on Japan.

Finally we remark that the book under review, and the authoritative recent biography "The Pope of Physics", by Gino Segrè and Bettina Hoerlin, are important contributions which complement each other in a very interesting way, by giving high-level tribute to the greatness of Enrico Fermi.

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