

The Mysterious Disappearance of Ettore Majorana

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Ettore Majorana: 1906-?

Born: 5 August 1906 in Catania (Sicily)

Family of high status in Sicily: Majorana and Zichichi

Father: Fabio Majorana—1875-1934—was an engineer and later administrator in the telegraph and telephone industry. In 1928 he was appointed the General Inspector of the Italian Ministry of Communication in Rome.

Mother: Dorina Corso (overbearing)

Children: Rosina, Salvatore, Luciano, Ettore, Maria

Uncle: Quirino Majorana—1871-1957—was an experimental physicist at the University of Bologna

Shy as a child—hid under the table to do calculations—savant—Autistic?

Family "moved" to Rome in 1921.

Schooled in Rome in classical studies at the Institute "Massimiliano Massimo" run by Jesuit fathers, and earned final diploma "licenza Liceale" at the Royal Lyceum "Torquato Tasso" in 1923

November 3, 1923 enrolls in the two year preparatory course for engineers, held at the Faculty of Sciences at University of Rome and earned final diploma in Fall of 1925.

He then entered three year School of Applications for Engineers but did not graduate. Work was fine, *e.g.* he passed the hydraulics exam 7 December 1927 with mark of 75/100. However, influenced by his friend E. Segre, he was admitted to the Physics program, where he studied with the young E. Fermi, who obtained his professorship in a 1926 competition.

The board of examiners had met in November 1926 and chose (26 year old) Enrico Fermi, Enrico Persico, and Aldo Pontremoli and suitable for a professorship. Fermi went to Rome, Persico to Florence and Pontremoli to Milan.

Majorana was admitted to the physics program in November of 1928 and began his thesis work with Fermi on nuclear physics. He submitted his thesis July 7, 1929.

In January 1933 Majorana received a grant from the Italian National Research Council—12,000 Lire over six months—which allowed to him to to Leipzig to work with Heisenberg. His application was supported by Fermi. During his time away he also visited Bohr at the Institute in Copenhagen.

After return no publications until 1937. At this time a new competition was announced for professorship—the first since the time Fermi was appointed. Fermi was chair of the committee, consisting of himself, O. Lazzarino, E. Persico, G. Polvani, and A. Carelli, which met on October 25, 1937. They selected

- i) Gian Carlo Wick, who went to Palermo, then to Padova in 1938 and then to Rome in 1940
- ii) G. Racah, who went to Pisa but lost the chair in 1938 due to the fact he was Jewish, ended in

Jerusalem

- iii) G. Gentile, Jr. son of the politician G. Gentile, Sr., went to Milan, but died of a "minor" infection in 1942.

Majorana was considered above comparison with this group and was recommended for a position at Naples on the grounds of "alta fama di singolare perizia cui e pervenuto nel campo degli studi de Fisica teorica" (high fame of singular expertise reached in the field of theoretical physics). He began his career in January 1938 at an annual salary of 26,000 Lire.

In this regard, Fermi has been quoted as stating that "There are several categories of scientists in the world: those of second or third rank do their best but never get very far. then there is the first rank, whose who make important discoveries, fundamental to scientific progress. [Fermi considered himself to be in this category.] But then there are the geniuses, like Galileo and Newton. Majorana was one of these."

Also during the Manhattan project several times

crisis issues arose and Fermi turned to Wigner and said "If only Ettore were here." Another time he said "This calls for Ettore." After hearing this General Groves asked Fermi who this "Ettore" was and was told that it was Majorana. Groves said asked where he was so that they could bring him to work on the project. Wigner replied "Unfortunately he disappeared many years ago."

He submitted a publication list for this position and needed also a paper to support his application. This was Majorana neutrino paper, but was written by Fermi.

Majorana was a reluctant author. Once he discovered something he considered his own work to be banal. Once a problem was solved Majorana was very reluctant to write anything up on it. An example was the discovery of the neutron. Work by Joliot and Curie in France discovered a neutral particle that can enter matter and expel a proton. their conclusion was that it must be a photon, because at the time it was the only know particle with no charge. Majorana saw immediately that it must be a particle with a mass

near that of the proton, in order to move something as heavy as the proton. When he heard this, Fermi urged him to write it up immediately, but nothing happened and soon thereafter Chadwick was given the credit for discovery of the neutron for his work in beryllium.

Publications

Thomas-Fermi model:

G. Gentile and E. Majorana, "On the doubling of Röntgen and optical terms due to the rotating electron, and on the intensities of Cesium lines," *Rend. dell'Acc. dei Lincei* **8**, 229-33 (1928).

E. Majorana, "Search for a general expression of Rydberg corrections, valid for neutral atoms or positive ions," *Nuovo. Cim* **6**, 16-16 (1929).

Chemical bonds:

E. Majorana, "On the formation of the molecular helium ion," *Nuovo Cim.* **8**, 22-28 (1931)

E. Majorana, "Pseudopolar reaction between hydrogen atoms," *Rend. dell'Acc. dei Lincei* **13**, 58-61 (1931).

Spectroscopic lines:

E. Majorana, "The presumed anomalous terms of helium", *Nuovo Cim.* **8**, 78-83 (1931).

E. Majorana, "Theory of incomplete P'triplets," *Nuovo Cim.* **8**, 107-113 (1931).

Polarized atoms in changing magnetic field ("Majorana flip")

E. Majorana, "Oriented atoms in a variable magnetic field," *Nuovo Cim.* **9**, 43-50 (1932).

Relativistic wave equation for arbitrary spin (infinite dimensional unitary representations for the relativistic Lorentz group):

E. Majorana, "Relativistic theory of particles with arbitrary intrinsic momentum," *Nuovo Cim.* **9**, 335-344 (1932).

E. Majorana, "On the theory of nuclei," *Zeit. für Physik* **82**, 137-45 (1933).

Two component Dirac equation for particles which are their own antiparticle:

E. Majorana, "Symmetrical theory of the electron and the positron," *Nuovo Cim.* **5**, 171-184 (1937).

Found by his brother and published by G. Gentile,

E. Majorana, "The value of the statistical laws in physics and social sciences," *Scientia* **36**, 58-66 (1942) also published in English in *Quantitative Finance* 5, 133-140 (2005).

and his thesis, which extended the theory of alpha decay by Gamow and Houterman to the case of particles in excited states and with higher angular momentum:

E. Majorana, "On the quantum mechanics of radioactive nuclei," University of Rome, July 7, 1929.

Began his lectures on quantum mechanics in January 1938. Some notes are available and suggest he was on track to discover Feynman path integral methods, but ???

In late March of 1938, he took all his salary money (which up to that time he had not touched) out of the bank and went to Palermo.

On March 25, 1938 he write a note to the Director of the Naples Physics Institute, Antonio Carrelli, hinting at dramatic plans.

Naples, March 25 1938

Dear Carrelli, I made a decision that has become unavoidable. There isn't a bit of selfishness in it, but I realize what trouble my sudden disappearance will cause you and the students. For this as well, I beg your forgiveness, but especially for betraying the trust, the sincere friendship and the sympathy you gave me over the past months. I ask you to remind me to all those I learned to know and appreciate in your Institute, especially Sciuti: I will keep a fond memory of them all at least until 11 pm tonight, possibly later

too. E. Majorana

However, he promptly wrote again to Carrelli, saying that he had abandoned his earlier plans.

He bought a return ticket to Naples for March 26, 1938 and was never seen again.

On December 6, 1938 the minister issued a decree where Majorana was considered as having resigned from his public office, starting on March 25, 1938 because he "abandoned the duty of his office for more than ten days, without any justified reason."

Fermi wrote letter to Mussolini to undertake a search, saying "I have no hesitation to state to you, and I am not saying this as an hyperbolic statement, that of all Italian and foreign scholars that I have had the opportunity to meet, Majorana is among all of them the one that has most struck with for his deep brilliance."

What happened?

Most common theory is suicide, jumping into the Mediteranean on the boat trip from Palermo. But why

take money out of the bank? Also, his family said he was a very strong Catholic and would certainly not take this route.

Sicilian writer Leonardo Sciascia—convinced Majorana decided to disappear because he foresaw that nuclear forces would lead to nuclear weapons. In this regard, Laura Fermi said that her husband had said that "Ettore was too intelligent. If he has decided to disappear, no one will be able to find him."

Some (including his family) say he had a crisis of spiritual faith and retreated into a monastery. Monsignor Riccieri, who was Bishop of Trapani after serving in Catania, said that Majorana had experienced "mystical crises," and that again suicide was to be discounted. He cited the sanctity of the confessional to say no more.

Others say that he became a beggar in Naples and report such a person helping students with the mathematics.

Others say he went to South America and claim a Majorana checked into a hotel in Buenos Aires.

Detectives were dispatched but found page missing from hotel register.

Sicilian writer Salerno says "A theory of suicide has always been advanced, but the politics of the Fascist and Nazi years leading up to the Second World War suggest homicide. As some of Majorana's work might have facilitate development of an atomic bomb, a project with which Heisenberg was eventually involved for Nazi Germany, there exists a strong possibility that he was murdered, probably by Nazi agents."

What really happened?

We shall never know.