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THE SCIENTIFIC LIFE OF MARIETA DA SILVEIRA

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Abstract

Marieta da Silveira (1917-2004) was born in the one of the Azores islands, and came to Lisbon where she graduated in physics and chemistry in the Faculty of Sciences.
She started research in the field of nuclear science in the Centre for Studies in Physics, where she studied the absorption of the Uranium X radiation. The hypothesis of the existence of natural radioactivity by spontaneous emission of neutrons was one of her results, published in Portugaliae Physica. *She obtained her PhD in 1945 and she continued working in the Centre until 1947, when senior researchers were expelled from the University for political reasons. The same political reasons led to a situation where she, although not expelled, was also segregated. Some years later she started working with geologists, studying radioactive minerals, doing research work where Portuguese uranium minerals, including those originated in the Portuguese colonies, are analysed. This work was more ambitious than the previous articles published in the first half of the century on the same theme –their authors were aware they were doing scientific research.*
Marieta da Siveira's research work was of great quality and some of her publications are mentioned in international documents of history of science (BAYER, R. T., Foundations of Nuclear Physics*, New York, Dover Publications Inc., 1949). Besides these research activities, she was also an outstanding teacher.*

Marieta da Silveira was born in the Azores islands in 1917. She did her secondary schooling in the Azores and, at the age of twenty, she went to Lisbon, where she started her higher education. She finished her degree in Physical and Chemical Sciences in 1941 at the Faculty of Sciences of Lisbon. At this time Marieta enrolled in a teacher training course which she abandoned because she was invited to teach at the Faculty of Sciences. Thus she started a new phase of her life in the Laboratory of Chemistry, later Department of Chemistry.

In those days faculty members were not requested to do research, and there were hardly any conditions to do so in the country. In the Faculty of Sciences there were two research centres: one in the Laboratory of Chemistry and the other in the Laboratory of Physics. Both of them dealt with radioactivity. Marieta, though she taught at the Laboratory of Chemistry, joined the Physics research centre, where she worked under the direction of Manuel Valadares and Marques da Silva, both with PhDs obtained at the Curie Laboratory, in Paris.

In 1938, Marguerite Perey had discovered the presence of the elements At and Fr in the radioactive families of Uranium and Actinium (see tables 1 and 2).

Table 1: The radioactive family of Uranium.

Nuclei	Disintegration mode	Semi disintegration period	Energy released (MeV)	Disintegration produce
U 238	α	$4.468 \cdot 10^9$ years	4.270	Th 234
Th 234	β-	24.10 days	0.273	Pa 234
Pa 234	β-	6.70 h	2.197	U 234
U 234	α	245500 years	4.859	Th 230
Th 230	α	75380 years	4.770	Ra 226
Ra 226	α	1602 years	4.871	Rn 222
Rn 222	α	3.8235 days	5.590	Po 218
Po 218	α 99.98 % β- 0.02 %	3.10 min	6.115 0.265	Pb 214 At 218
At 218	α 99.90 % β- 0.10 %	1.5 s	6.874 2.883	Bi 214 Rn 218
Rn 218	α	35 ms	7.263	Po 214
Pb 214	β-	26.8 min	1.024	Bi 214
Bi 214	β- 99.98 % α 0.02 %	19.9 min	3.272 5.617	Po 214 Tl 210
Po 214	α	0.1643 ms	7.883	Pb 210
Tl 210	β-	1.30 min	5.484	Pb 210
Pb 210	β-	22.3 years	0.064	Bi 210
Bi 210	β- 99.99987% α 0.00013%	5.013 days	1.426 5.982	Po 210 Tl 206
Po 210	α	138.376 days	5.407	Pb 206
Tl 206	β-	4.199 min	1.533	Pb 206
Pb 206	-	Stable	-	-

Table 2: The radioactive family of Actinium.

Nuclei	Disintegration mode	Semi disintegration period	Energy released (MeV)	Disintegration produce
Pu 241	*β-*	14.4 years	0.021	*Am* 241
Am 241	*α*	432.7 years	5.638	*Np* 237
Np 237	*α*	$2.14 \cdot 10^{6}$ years	4.959	*Pa* 233
Pa 233	*β-*	27.0 days	0.571	*U* 233
U 233	*α*	$1.592 \cdot 10^{5}$ years	4.909	*Th* 229
Th 229	*α*	$7.54 \cdot 10^{4}$ years	5.168	*Ra* 225
Ra 225	*β-*	14.9 days	0.36	*Ac* 225
Ac 225	*α*	10.0 days	5.935	*Fr* 221
Fr 221	*α*	4.8 m	6.3	*At* 217
At 217	*α*	32 ms	7.0	*Bi* 213
Bi 213	*α*	46.5 m	5.87	*Tl* 209
Tl 209	*β-*	2.2 min	3.99	*Pb* 209
Pb 209	*β-*	3.25 h	0.644	*Bi* 209
Bi 209	*α*	$1.9 \cdot 10^{19}$ years	3.14	*Tl* 205
Tl 205	.	Stable	.	.

Marieta was given the task of searching for these elements in the Thorium family. She worked in this project for one year but had to abandon because the Centre could not afford a strong source of thorium in order to acquire reliable results and be confident in the conclusions. Uranium was more available so she changed her subject and dedicated herself to the study of beta and gamma emissions of the first descendants of uranium.

Due to the financial shortage, Marieta had to build herself the Geiger counters she needed and she acquired an expertise in doing so. This is evident by the fact that in 1946, A. Vigon, a lecturer from a University of Madrid, came to Lisbon to learn with Marieta. She got some interesting results which led to several publications as well as her PhD thesis entitled "Contributions to the study of the radiations of the Uranium X complex". These publications were cited by R. Bayer in *Foundations of Nuclear Physics*, 1947:

- SILVEIRA, M. (1944) Absortion of gamma rays emitted by U I and its immediate descendants, *Portugaliae Physica*, I, 151.
- SILVEIRA, M. (1945) Natural Radioactivity by neutron emission, *Portugaliae Physica*, I, 167.
- SILVEIRA, M. (1945) On the absortion of the gamma radiation emitted by the UX complex, *Portugaliae Physica*, I, 175.

She did her PhD in 1946. While studying the beta and gamma emissions of the uranium descendants she discovered that there was also emission of neutrons. She attributed this emission to the isotope uranium Z.

In 1947, due to political reasons, the government sacked both Manuel Valadares and Marques da Silva, together with several other college professors.

Marieta continued using the measurement facilities she had helped to build to a different end: she started a collaboration with the Geology professor Torre da Assunção studying radioactive minerals, both from Portugal and from the colonies. She studied their structure using X-ray diffraction and their radiological properties. Some of this work was also published:

- MENDES, F. J.; SILVEIRA, Marieta da & VIEIRA, Glaphyra (1956). Estrutura fina dos Halos Pleocróicos observados em Rochas do Ultramar Português, *Actas do XII Congresso da Associação Portuguesa Para o Progresso das Ciências*,Tomo V, pp. 131-136 Coimbra.
- MENDES, F. J.; SILVEIRA, Marieta da & TORRE DE ASSUNÇÃO, C. F. (1957). O Zircão de Alter Pedroso (Alter do Chão) e o dofilão da Boa Esperança (Ribaué, Moçambique). Estudo Radiográfico. *Bol. M. e L. Min. e Geol*., nº25, 7ª série, pp. 209-219
- TORRE DE ASSUNÇÃO, C.F.; MENDES, F.J. & SILVEIRA, M. (1957). Contribuições para o conhecimento dos minerais de urânio portugueses – I, a malha das pechblendas da Metrópole Portuguesa e as suas possíveis relações com a composição química, *Rev. F.C.* Lisboa, 2ª série, C, vol. V, fasc. II, pp. 261-268.
- TORRE DE ASSUNÇÃO, C.F.; MENDES, F.J. & SILVEIRA, M. (1957). Contribuições para o conhecimento dos minerais de urânio portugueses – II, Sobre a identificação do uranófano no minério negro da Metrópole Portuguesa, *Rev. F.C*. Lisboa, 2ª série, C, vol. V, fasc. II, pp. 269-275.
- TORRE DE ASSUNÇÃO, C.F.; MENDES, F.J. & SILVEIRA, M. (1958). Contribuições para o conhecimento dos minerais de urânio portugueses –III,sobre a identificação metatorbenite, , *Rev. F.C.* Lisboa, 2ª série, C, vol. VI, fasc. I, pp. 51-68.

Marieta also did some work with the biochemistry professor Kurt Jacobsohn:

- JACOBSOHN K.; Silveira M. (1950). Action des neutrons sur l'activité fermentaire, *Comptes rendues des séances de la Societé Portugaise de Biologie*, novembre.
- JACOBSOHN K.; SILVEIRA M. (1950). Étude sur le mécanisme de l'inactivation fermentaire sous l'action des neutrons, *Comptes rendues des séances de la Societé Portugaise de Biologie*, décembre.
- JACOBSOHN K.; SILVEIRA M. (1951). Sur la protection d'un enzyme contre l'action détruisante des neutrons, , *Comptes rendues des séances de la Societé Portugaise de Biologie*, mai.
- JACOBSOHN K.; SILVEIRA M. (1951). Sur le mécanisme le mécanisme de l'inactivation fermentaire sous l'action des neutrons, *Bulletin de la Societé de Chimie Biologique*
- JACOBSOHN K.; SILVEIRA M. (1950). Actividade enzimática e radiações ionizantes, *Revista da Faculdade de Ciências*

After this busy period, and for reasons unknown, she had to interrupt her research work. But she did not stop: she published several notes about everyday chemistry and she translated a Russian scientific dictionary. In the late fifties, the Laboratory purchased a Perkin Elmer infrared and a Beckman V and UV spectrometer. She immediately thought of using them for research and went to Orsay where she studied these techniques. Some of the results she obtained in this field were published, in 1970, by the *J. Inorg. Nucl. Chem*. She started a study on the complexes of niobium and other group V metals, though there are no publications.

She ended her career at the age of seventy. She was an extraordinarily kind and gentle woman, an outstanding teacher, gifted to reach out to the students. All those who were lucky to know her, remember her.

She died in 2004.