

PORTUGUESE CHEMISTS AND RADIOACTIVE MINERALS

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The first radioactivity studies conducted in Portugal concerned waters and radioactive minerals and were performed by chemists. During the first half of the 20th century, Portuguese chemistry was mainly developed in applied areas such as food and drug analysis. Radioactivity, which by that time was emerging in practical applications, became a strong incentive for Portuguese chemists. Since from a commercial standpoint, radioactive waters and minerals were interesting subjects, applied research in that field motivated a lot of Portuguese chemists.

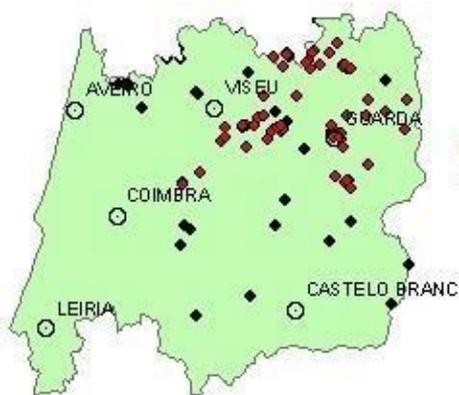
THE INDUSTRY OF RADIOACTIVE MINERALS

In Portugal there were a big amounts of uraniferous ore deposits. The minerals of greater economic value are localised in the provinces of Beira Baixa and Beira Alta.

The first mining work on Portuguese uraniferous ore deposits dates from 1907 and the extraction industry was started during 1908 by a French society which simply prepared uranium salts, shipping to France the radium bearing ore for further processing (Lepierre and Pio Leite, 1933). In 1910, plants for the processing of those minerals were founded.

This activity of the French society, for which several Portuguese

Location of mineral radioactive seams



◆ uranium mines
◆ another mines

chemists contributed (Charles Lepierre, A. Mourão, Pio Leite, Martins Rodrigues and C. Caldeira), lasted until 1927.

In 1926, nearly every plant was shut down, since the production price was no longer competitive after the discovery of radioactive ore deposits in the Belgium Congo, far richer than the Portuguese minerals. In spite



Quinta do Bispo Uranium mine

of that Charles Lepierre and Pio Leite, in *A Indústria do Rádio em Portugal*, (Lepierre and Pio Leite, 1933) conclude over the feasibility of the radium industry in our country.

Lepierre, one of the chemists working on radioactive minerals in Portugal, wrote the first article (Lepierre, 1913) where a reference can be found on the analysis of Portuguese radioactive minerals, excluding the previous article of Oliveira Belo (Oliveira Belo, 1911). (Este último é simplesmente um artigo descritivo dos minerais portugueses, em que são também referidos os radioactivos). Lepierre describes the methods of analysing minerals to determine the amount of uranium. Several procedures are presented for the chemical treatment of uranium separation in order to split it from phosphoric acid; the one that produced the best results is pointed out.

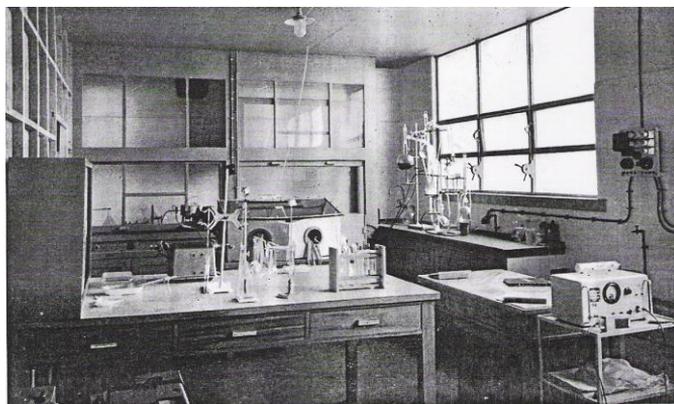
Pio Leite, another chemist working on radioactive minerals, discusses the procedure for the extraction of radium, and its applications: therapeutics, preparation of luminous products, experiments on the action of micro organisms, seeds and cultivations (Pio Leite, 1929, I, II).

In a later article by Lepierre and Pio Leite (Lepierre, C., Pio Leite, 1933), one can find quotes of reports on the treatment of minerals. From this article, we become acquainted with the history of the radioactive minerals extraction industry in Portugal. In that article not only the several Portuguese uranium minerals are characterized and their chemical composition given, but also the different manufacturing processes of radium salts are discussed. The article ends with the demonstration of the viability of a radium industry in Portugal.

Even though in the first decades of the XXth century the activity regarding radioactive minerals had a mainly economic purpose, scientific interests also conditioned the conducted studies. The most part of the authors of the papers published between 1913 and 1933 are professors at the university and they are interested in researching and learning radioactivity. Some of those scientists became interested by that new field of science and played a considerable role in their teaching and divulgation. One of them was Giovanni Costanzo, professor in *Instituto Superior Técnico*, an engineering school. He publishes some work concerning Portuguese minerals (Bensaude and Costanzo, 1921; Costanzo, 1928; Costanzo, 1929; Costanzo, 1931) but he writes a course too, the first one that is published about radioactivity, in Portugal (Costanzo, 1919; Costanzo, 1920 I; Costanzo, 1920, II).

RESEARCH ON RADIOACTIVE MINERALS

The Portuguese chemists were already researching on radioactive minerals but the field truly developed mainly in the fifties and mostly after the founding of the Committee of Nuclear Energy Studies (Comissão de Estudos de Energia Nuclear - CEEN).



Radiation chemistry laboratory (CEEN)

The CEEN was founded in 1952, and incorporated four groups (Maths, Physics, Chemistry, Geology and Mineralogy). The mineralogy and geology group contained the Geology and Mineralogy Centre of Coimbra and the

Geology and Mineralogy Centre of Lisbon. In the publication one can tell straight away that the founding of the CEEN initiated a large number of actions, with the support of I.A.C. (*Instituto de Alta Cultura*, an Institute that supports scientific research), in particular courses for the formation

of technicians, doctors, as well as post graduation. There were also conferences and courses conducted by foreign teachers, all reputed professionals in the nuclear area.

In the Centre of Lisbon studies resulted from the collaboration between chemists geologists and physicists. Marieta da Silveira, Torre de Assunção and Francisco Mendes, professors at *Faculdade de Ciências da Universidade de Lisboa* (Faculty of Sciences of Lisbon), worked together on radioactive minerals. Their papers published in these years (Mendes et al., 1957; Torre de Assunção et al., 1957 I; Torre de Assunção et al., 1957 II, Torre de Assunção et al., 1958) are essentially research works where Portuguese uranium minerals such as minerals of the Portuguese colonies are analysed. Those papers are much more ambitious than the previous articles published on the first half of the century on the same theme – theirs authors were aware they were doing scientific research. Francisco Mendes, says it explicitly: **“The purpose of our study was to research the mineral’s radioactive properties, hopping to find the elements responsible for certain alpha emissions that we had previously detected and which proved to be hard or even impossible, to interpret given our current state of knowledge.”** (Mendes, 1945, p. 71).

In 1943 Francisco Mendes published an article concerned even then the radioactive phenomena in Portuguese rocks – the pleochroic haloes (Mendes, 1943). That work was done in *Centro de Estudos de Física*, a research centre in radioactivity, where a strong program was being developed at the time, (Bragança Gil et al., 2005). Later, Mendes published another work in collaboration with chemists on the same topic (Mendes et al., 1956) and he goes on publishing about Portuguese uranium minerals too (Mendes and Furtado, 1960). In their works, clearly resulting of advanced research activity, Mendes made use of technology developed in *Centro de Estudos de Física* (Mendes, 1945, p. 72).

Branca Edmée Marques is another chemist working on the Uranium minerals in the fifties. She was a professor at Faculty of Science of Lisbon and she founded and co-ordinated a centre on radiochemistry (*Centro de Estudos de Radioquímica*) which was integrated in CEEN. In her work on Pechblenda of Urgeiriça (Marques, 1950) she applies radiochemistry methods to conclude about the constant value of the plutonium/uranium ratio in those minerals (Marques, 1950, p. 217).

The research on radioactive minerals had a relevant role in the modernization of the Portuguese science. In fact, the activity related with radioactive waters and minerals became a vehicle of reception and

transmission of the radioactive knowledge and an important training of scientists in the new science and in the new techniques of radioactivity.

PUBLIC UNDERSTANDING OF SCIENCE AND RADIOACTIVE MINERALS

Revista Portuguesa de Química is one of the first journals to publish results about radioactivity and radioactive mineral. In 1911, in *Instituto Superior Técnico*, Charles Lepierre, starts analyzing twenty five uranium minerals and his results are published in *Revista Portuguesa de Química* (Lepierre, 1913).

The interest for radioactivity began to manifest itself in 1906 in the magazine. Besides the specialized articles published, from the beginning, short notes



about relevant events and publications on radioactivity, as well as full texts of conferences related to the subject and also courses for Portuguese university students where radioactivity is the main subject (Maia et al., 2003).

In 1921, Cardoso Pereira's course notes about radium are published in *Revista Portuguesa de Química* (Pereira, 1921). This chemical engineering student describes the main results on radioactivity, as well as a discussion about Portuguese radioactive minerals.

Other journals and magazines contributed to the public understanding of radioactive phenomena, for instance *Gazeta de Física*, *Brotéria*, *O Instituto*, and *Seara Nova*. *Gazeta de Física* was a scientific journal addressed to a large public, but the other ones were literary or cultural magazines. The abundance of articles on radioactivity in the 40's and 50's can be explained by the importance assumed by this scientific area and their applications. In their articles, Portuguese scientists invoked those applications in order to claim the development of scientific research.

The minerals, being relevant in an economic point of view, were becoming interesting subjects to popularize radioactive science and technology. Besides publishing the results of their work on minerals, the

scientists Marieta da Silveira (chemist) and Torre de Assunção (geologist) contributed to that popularization. Between 1948 and 1951 they published three articles in *Gazeta de Física* (Silveira, 1948, Torre de Assunção, 1949, Torre de Assunção, 1951). *Elementos Transurânicos* was a basis for a seminar taking place at the *Centro de Estudos de Física*. Although with an emphasis on aiding the public knowledge, this article is full of information gathered in research articles from *Phys.Rev.*, *Nature*, etc.



In *Urânio em Portugal e no Mundo*, Torre de Assunção tries to draw attention to our rich natural resources in terms of uraniferous ore deposits.

One can conclude that radioactive minerals, as well as Portuguese chemists working in that subject, contribute in a significant way to develop scientific research and public understanding of science in Portugal.

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