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Women radio-chemists facing radioactive risks in France

(1) Introduction

This contribution represents a part of my PhD work which deals with the history of radiation protection in French laboratories from 1920 to 1960. My study addresses two main questions: first, how scientists became aware of the hazards of ionizing radiations and how they faced, on a collective level, those dangers. Secondly, I focus on daily practices in laboratories: that is, what were the scientists' perceptions of risk? To what extent did dangers, protections, rules and regulation impact the occupational organisation or the evolution of practices in the field of radioactivity? Concerning this question and the rather important number of women in radioactivity, especially in France (in the *Institut du radium* of Paris, there were about 30 percent of female workers in 1934), the issue of gender appears prominent to me.

Contrary to the United States, where there have been some studies concerning women's health in the workplace,¹ including some about the dangers of radioactivity,² the French case has been relatively unexplored by scholars. There are a number of studies concerning women in the workplace³ and some on women in science (which are, by the way, quite recent and rare),⁴ but hardly anyone has raised the question of women and occupational risk in the field of history of science.

Most of the usually works in history of science tend either to write a history of women in science or to consider gender issue as a topic in itself. My aim is slightly different. I want to explore the notion of gender within a wider topic, the perception of scientists facing risks. I wondered whether the relatively important presence of women in radioactivity, and specifically in radiochemistry, influenced practices and organisation of labour. On the flipside, did the idea of exercising a "risky" profession have any meaning for these women and had any consequences on their social lives? In other words, by considering gender in science and focusing on women, I would like to enrich my study on risk. So I use gender issues as a tool to analyse scientists' perception of risk in French laboratories.

To do so, I have followed three women's career in order to understand what being a woman in radioactivity in French laboratories meant in the period 1920–1960. The women I am focusing on are: Marie Skłodowska-Curie, Irène Joliot-Curie and Marguerite Perey. Those three radio-chemists belong to successive generations of French scientists and are a good entry to question perception of risk in experimental sciences. They all had to face radioactive hazards during their career and to deal with them, at different period of times, on a collective level, as head of laboratories and on a personal level, as they all were very affected by radiations.

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¹ Apple R. D. (ed.), *Women, health and medicine in America: a historical handbook* (New York and London: Garland Publi, 1990); Hunt V. R., "A brief history of women workers and hazards in the workplace", *Feminist Studies*, 1979, Vol. 5, No. 2, pp. 274–285.

² See for instance Claudia Clark's case study in: Clark Cl., *Radium Girls. Women and Industrial Health reform, 1910–1935* (Chapel Hill and London: The University of North Carolina Press, 1997).

³ Gardey D., *Un monde en mutation: les employés de bureau en France (1890–1930): féminisation, mécanisation, rationalisation*, Thèse d'histoire contemporaine, Paris VII, 1995; M. Maruani (dir.), *Les nouvelles frontières de l'inégalité. Hommes et femmes sur le marché du travail* (Paris: La Découverte, 1998).

⁴ Comité pour l'histoire du CNRS, *Les femmes dans l'histoire du CNRS*, Mission pour la place des femmes au CNRS, Paris, 2004; Boudia S., "Le donne nella ricerca scientifica in Francia: il caso della radioattività (1898–1934)", in: Simili R. (ed.), *Scienza a due voci* (Firenze: L. S. Olschki, 2006); Gardey D. and Löwy I. (eds.), *Les sciences et la fabrication du féminin et du masculin* (Paris: Editions des archives contemporaines, 2000).

Looking at radioactivity and notably at women radio-chemists in France leads unavoidably to Marie Sklodowska-Curie. Her leadership in French practices in radiochemistry was so important that she is pivotal to my study. It is interesting that, exploring Marie Curie's perception of radioactive danger, is not to put forward her devotion to science, which has been already the topic of numerous works,⁵ but is to understand the influence her behaviour, thoughts, discourses and actions may have had on the other women working in laboratories during her lifetime and on the next generations of radio-chemists. Marie Curie as a subject of study is also facilitated by the large number of documents and writing available.

Irène Joliot-Curie is perhaps less famous than her mother, even if she remains one of the most well-known women scientists. Marguerite Perey does not share the fame of the Curies: her story can teach us a lot and tells us much about women in radiochemistry. She is more representative than the Curies of women working in laboratories, as technicians, assistants or researchers. Younger than Marie Curie or Irène Joliot-Curie, she faced the hazards of radioactivity in a scientific context that was changing very quickly.

(2) Three examples of women facing risks in radiochemistry

When Marie Sklodowska-Curie discovered radium and polonium, she was working without any protection, as she obviously completely ignored the potential hazards of the substances she was manipulating. Even if she and her husband Pierre Curie rapidly noticed that radioactive substances were something different than those they were used to working with and could burn human tissues (it is quite well-known that they both got burns on their hands), they did not imagine that it could be dangerous and their enthusiasm concerning radiations led them to believe that it would be possible to use this powerful property for therapeutic purposes.

Nevertheless, the hazards of radioactive radiations were first identified at the beginning of the 20th century. Some people rapidly drew a parallel between the hazards observed in radiology and the burning property of radioactivity. As these hazards had already caused lots of problems for radiologists, they were observed in detail and studied a lot at that time. Still, it was more complicated for scientists to admit that radioactive substances could be dangerous and the recognition of the hazards of radioactivity took longer, as it concerned only a small community of workers. Around 1910, the English were the first to make the connection and they tried to find solutions to protect themselves. In Paris, at the *Institut du radium*, it seems that hardly any protection was used before the 1920s, when several articles dealing with English studies on radium services staff sounded the alarm of a real danger.⁶

A number of accounts given by radio-chemists who worked at some point at the *Institut du radium* between 1910 and 1930 suggest that some elementary rules of protection were gradually put in place and followed but that it was not habitual to use them. For instance, in 1911, May Sybil Leslie, who was trained by Professor Smithalls in Leeds and who worked in Paris for two years wrote to the latter: "my electroscope is disgraceably sensitive to the influence of anyone entering from the sale active so that I spend half my time in keeping dangerous people out and in airing the room."⁷ According to her, the fact that a new Institute was about to be built made a lot of workers abandon necessary precautions. Almost twenty years later, Elizabeth Rona had also been struck by the lack of concern for occupational hazards compared to the Kaiser Institute of Berlin.⁸

⁵ Pycior H., "Marie Curie: Time Only for Science and Family", in: Rayner-Canham M. F. and Rayner-Canham G. W. (eds.), *A Devotion to Their Science, Pioneer Women of Radioactivity*, McGill-Queen's University, 1997, pp. 31–50; Quinn S., *Marie Curie, A Life* (New York: Simon & Schuster, 1995).

⁶ Boudia S., "Dangers des rayonnements ionisants: les premiers pas de la radioprotection", in: Bordry M. and Boudia S. (eds.), *Les rayons de la vie, une histoire des applications médicales des rayons X et de la radioactivité en France*, (Paris: Institut Curie, 1998), pp. 132–136.

⁷ Letter from May Sybil Leslie to Professor Smithalls, 8 June 1911, quoted by Rayner-Canham M. F. and Rayner-Canham G. W. in "May Sybil Leslie, from Radioactivity to Industrial Chemistry", in: Rayner-Canham M. F. and Rayner-Canham G. W. (eds.), *op. cit.*, 1997, pp. 76–81.

⁸ Rona E., "Laboratory contamination in the early period of radiation research", *Health Physics*, 1979, Vol. 37, pp. 723–727.

And yet Marie Curie could not ignore the hazards of radiations, even if she denied them longer than other pioneers of radioactivity. She was herself deeply affected by radiations: her hands were harmed, her cataract made her almost blind in the 1920s and she felt often very weak. Some of her collaborators were very ill, like Sonia Cotelle, who suffered from sudden loss of hair and stomach troubles in 1927⁹ or two engineers of the radium industry who died in 1925. Most of the time she tried to avoid talking about the dangers of radiations or to minimize them in front of her collaborators, claiming that holidays and the fresh air of the mountain for a few days were enough to recuperate. She was nevertheless one of the authors of a report on the hazards of radiation written for the French *Académie des sciences* in 1925.¹⁰ Apparently, she considered that it was important to set rules for workers in the industry, but that scientists were able to protect themselves without any official recommendation. In 1934, she died of a pernicious anemia due to radiations which was clearly recognized as such by her doctor.

Irène Joliot-Curie followed her mother's example.¹¹ She started to work with her during World War I as a radiologist at the front and was, already at that time, very exposed to radiations (in fact we can also assume that she had been exposed very young, as radioactive substances had often been brought back home by Marie or Pierre Curie when she was a little girl.) After the war, she worked with her mother at the *Institut du radium* and seemed to have adopted more or less the same position as her mother on the hazards of radiations. After Marie Curie's death, radium and its derivative substances, including the gas radon, whose inhalation had been for a long time available as an over the counter predication, were classified by the French authorities as poisonous substances which required specific rules for trade, use and transport.¹² The aim was to fight against the abuses in the use of radioactive substances in numerous beauty and pharmaceutical products. But Irène Joliot-Curie strongly reacted to this decision, arguing that radon was not at all dangerous:¹³

[radon] is completely harmless and at the same time a very powerful analgesic, bracing and curative medicine. [...] it is a mistake from the Académie de médecine or from advisers who suggested this law [...]. Not any medical opinion have ever been against emanation (*my translation*).¹⁴

Even if this is true that radon was used to cure cancer, at the same period of time, some physicians showed that emanation of radon could cause some lung cancers and warned against it.¹⁵

Without ignoring the dangers of radiations, Irène Joliot-Curie seemed to hesitate admitting them publicly. She continued to take a lot of risks for a long time: even after World War II, some pictures show her sucking polonium with a pipette in her mouth.¹⁶ This could be partly explained by the fact that she knew that had been much irradiated when she was younger. She tried to protect her collaborators more than herself. She is the one who assigned Paul Bonet-Maury, a biophysicist, the responsibility of creating a protection unit at the *Institut du radium* in 1950. She died in 1956 of leukaemia due to her exposure to radiations. During her life she was continuously ill and weak, but this was usually put down to tuberculosis. Even after her death, her husband Frédéric Joliot-Curie thought that her leukaemia

⁹ Letter from Irène Joliot-Curie to Marie Curie, 3 August 1927, in: Curie M. and I., *Marie et Irène Curie, correspondance: choix de lettres (1905–1934)* (Paris: Les éditeurs français réunis, 1974).

¹⁰ Cl. Régaut (eds.), "Sur le contrôle et la réglementation des établissements industriels qui s'occupent de la préparation des corps radioactifs", *Bulletin de l'Académie nationale de médecine*, n°93, 1925, pp. 161–166.

¹¹ On Irène Joliot-Curie, see for instance Crossfield E. T., "Irène Joliot-Curie: Following in Her Mother's Footsteps", in: M. F. Rayner-Canham and G. W. Rayner-Canham (eds.), *op. cit.*, 1997, pp. 97–123.

¹² Conseil supérieur d'hygiène publique de France, *Inscription des substances radioactives aux tableaux annexes au décret du 14 septembre 1916*, Archives Curie.

¹³ Letter from Irène Joliot-Curie, Archives Curie.

¹⁴ Letter from Irène Joliot Cuire, Archives Curie : "[le radon] est d'une innocuité absolue en même temps qu'un très puissant remède analgésique, stimulant et curatif. [...] c'est une erreur de l'Académie de médecine ou des conseillers compétents qui ont suggéré cette loi [...]. Aucune opinion médicale n'a jamais été contre l'émanation."

¹⁵ Laborde S. and Leclerq J. "Les maladies professionnelles causées par les rayons X et par les substances radioactives", *Journal Belge de radiologie*, n°148, mai-juin 1937.

¹⁶ Such pictures can be found in the Archives Curie, Institut Curie, Paris.

was only due to the radiations she was exposed to during World War I and claimed that they manipulated radioactive substances with precautions.

Let me briefly introduce Marguerite Perey: after education in a school for female technician workers, she started her career as Marie Curie's personal assistant at the *Institut du radium* of Paris in 1929. She learnt there all the techniques concerning the preparation of pure radioactive sources. In 1938, manipulating a pure source of actinium, she discovered one isotope of the last natural radio-active element, which had not yet been observed, which she called Francium. This discovery enabled her to carry on with studies in physics and chemistry at the University of Paris and to prepare a PhD thesis during World War II. After the war, she was assigned a chair in nuclear chemistry at the University of Strasbourg and founded a laboratory of radiochemistry there.

Marguerite Perey was one of the most important female French scientists of her time. In Strasbourg she built a laboratory and started new research, mostly on the biological application of francium, in collaboration with other local Professors. But after a few years, she started to have some health problems. Indeed, she had been deeply contaminated by radiations during the years she worked at the *Institut du radium* and suffered among others from bone troubles, with pains in her hands and her shoulders. Her disease was not identified immediately by physicians, but she always suspected that this was due to radiations. This was confirmed by Doctor Shields Warren, an American medical specialist of radiations, in 1958.¹⁷ She endured several surgical operations in Strasbourg and Paris and finally had to retire to a health clinic in the south of France in 1961, where she stayed almost until her death in 1975 of a generalized cancer.

Marguerite Perey was definitely aware of a certain danger of radiations when she arrived in Strasbourg, even before she knew that she was ill. She always encouraged her students and collaborators to take all possible precautions when manipulating radioactive substances. She struggled during years to get a well-equipped laboratory, even if her request was not always taken seriously by her colleagues, notably by the physicists she worked with. Paradoxically enough, in spite of this obvious awareness of risk and a real physical and moral suffering, she seemed to accept her condition as the price to pay for the advancement of science, a similar frame of mind as this of her predecessors and mentors.

(3) Scientists facing radioactive risks and gender issues

The attitude of these three women radio-chemists when faced with the hazards of radiation is particularly interesting, as it helps us to understand the way scientists dealt with risks. But one question emerges: is the issue of gender actually relevant when it comes to such a topic? Indeed, the reaction of these three women has to be explained through an analytical framework based on the ideas of local scientific practices, cultures and traditions, specificities of disciplines, subjectivities of actors and the importance of the chronology and of the historical context. For instance, the concern for occupational hazards in 1920 was obviously much more important for scientists working in radioactivity in England than in France. Men working at the *Institut du radium* in Paris took at least as much risk as women and were also very affected by radiation during the interwar period. So, what place can be attributed to gender issues?

First, I want to emphasize that women working in radioactivity were usually radio-chemists, either laboratory assistants or doctors, and physics was more often a masculine task. This tendency, which can be explained by several factors at the beginning of the 20th century seemed to be still stronger when the division between nuclear physics and nuclear chemistry appeared at the end of the 1930s. If one risk clearly existed in both professions, it is not exactly of the same nature. In radiochemistry, workers faced a direct risk by continuously manipulating dangerous substances and could be contaminated or could contaminate the environment on an individual level very quickly. In nuclear physics, using accelerators, the danger was concentrated in the beam and sources. The risk was different, as the technical safety regulation of the accelerators indirectly led to the protection in part from other risks.

If the fact that women worked as chemical assistants seems natural in the interwar period, as women had been for some time exercising this kind of profession in other fields of chemistry, the fact that they managed to get positions with high responsibility is more unusual. Of course, Marie Curie

¹⁷ Letter from Miss Perey to Mr. Dupouy, 17 février 1959, Perey's Archives, MP 95/1, University Louis Pasteur, Strasbourg.

played a large role as a model for the young women who came to work in her laboratory and encouraged them to work in the new field that represent radioactivity. But even if some had interesting careers, very few of them actually reproduced the social scheme that Marie Curie or her daughter Irène followed, with a standard marital and family life. Following the example of Marguerite Perey, most women working in radioactivity remained single, without children, or stopped working when they got married.¹⁸

This is true that During World War I, women had gained their place in the working world. After the war, the situation of a woman in French society was changing little by little, but in the middle-class, from which most of those women came, a woman's role was still to get married and become a mother,¹⁹ Marguerite Perey, for instance, started to work because of a difficult financial situation in her family in spite of the fact that she belonged to a middle-class protestant family. She happened to work in a scientific field where fascination with radiations and devotion to science and medicine were easily putting forward by the pioneers. Her admiration for Marie Curie quickly appeared and remained strong during her whole life. So, there is nothing surprising about a woman feeling attracted by such a destiny, in a time of women's liberation, but she seemed to have to make some choice — consciously or unconsciously — concerning marital life and maternity. Marie and Irène Curie apparently managed to get through this social aspect and lived the exceptional lives everybody has heard about, partly because of the condition of their childhood.

Perhaps the fact that this profession was a "risky" profession can be one factor that unconsciously pushed so many women in this direction. At this point, the notion of heroism in science has to be explored in detail in order to understand the link that may exist between the social status of these women and their profession. Concerning men, heroism is well-tolerated by the society. Men go to war, are accustomed to exposing themselves to different dangers at work and furthermore risk was viewed to be a personal issue. As far as women are concerned, their exposure to risk could have been experienced and perceived as a much more important social transgression, and all the more so if it could affect potential descendants.

Indeed, biological effects of radiations had been studied and observed since the very beginning of the 20th century. In the interwar period, the danger of radiations was well-identified, even if a lot of issues remained unsolved. And, important point, the question of the effects on fertility of men and women and on a potential foetus had already been raised.²⁰ If workers didn't seem particularly preoccupied by this problem, it could nevertheless have influenced the way women acted or the way they were perceived on a social level.

The question of the effects of radiation on fertility remained outstanding after World War II. The main preoccupation at that time was the genetic effects of radiations. Indeed, with the generalisation of the use of atomic energy, this problem could have touched the global human class. So a lot of studies touched on the subject.

So, the question of social transgression was not the same than in the interwar period, because women working in laboratories were getting married more frequently,²¹ but this problem may have affected the division of labour in nuclear sciences. Less women of that period of time are known for their scientific work and it seems that responsibilities were assigned to men. A notable thing is for instance the legislation that was elaborated to protect workers of nuclear fields that mentions that the most risky situations had to be prohibited for all women of childbearing age.²² Society so decided to protect women as mothers and this might in some way have influenced the role that was devoted to them in nuclear sciences.

¹⁸ Boudia S., *op. cit.* 2006.

¹⁹ Omnès C., *Marchés du travail et trajectoires professionnelles : les ouvrières parisiennes de l'entre-deux-guerres*, Thèse d'histoire, Université Paris X, 1993; Battagliola Fr., *Histoire du travail des femmes* (Paris: Edition la Découverte, 2004, nouvelle édition).

²⁰ See for instance Laborde S. and Leclercq J.*op. cit.* , 1937, p. 25.

²¹ According to what I could find about Perey's collaborators in Strasbourg in her personal and professional archives, almost all the women working in the 1950s married another scientist, usually continuing to work and having children.

²² *Journal officiel de la République française*, 11 juillet 1957, p. 6825, and 30 juin 1966, p. 5490.

These few remarks illustrate that it is important to look into the question of a connection between occupational risk, the place devoted to women through this period of time in society and in the workplace and the evolution of a labour division in radioactivity. In this respect, gender issues can help to obtain a better understanding of scientist's perception of radioactive risk.