

PIERRE CURIE

Marie Curie

With Autobiographical Notes by Marie Curie

Translated by Charlotte and Vernon Kellogg
with an Introduction by Mrs. William Brown Meloney



Hellog Dujardin

PIERRE CURIE IN 1906

Imp. Ch. Willmann

Dover Publications, Inc.
Mineola, New York



Copyright International
Mme. Curie and President Harding at the White House, May 20, 1921,
when a gram of radium was presented to its discoverer by the women
of America

CHAPTER I

I have been asked by my American friends to write the story of my life. At first, the idea seemed alien to me, but I yielded to persuasion. However, I could not conceive my biography as a complete expression of personal feelings or a detailed description of all incidents I would remember. Many of our feelings change with the years, and, when faded away, may seem altogether strange; incidents lose their momentary interest and may be remembered as if they have occurred to some other person. But there may be in a life some general direction, some continuous thread, due to a few dominant ideas and a few strong feelings, that explain the life and are characteristic of a human personality. Of my life, which has not been easy on the whole, I have described the general course and the essential features, and I trust that my story gives an understanding of the state of mind in which I have lived and worked.

My family is of Polish origin, and my name is Marie Sklodowska. My father and my mother both came from among the small Polish landed proprietors. In my country this class is composed of a large number of families, owners of small and medium-sized estates, frequently interrelated. It has been, until recently, chiefly from this group that Poland has drawn her intellectual recruits.

While my paternal grandfather had divided his time between agriculture and directing a provincial college, my father, more strongly drawn to study, followed the course of the University of Petrograd, and later definitely established himself at Warsaw as Professor of Physics and Mathematics in one of the lyciums of that city. He married a young woman whose mode of life was congenial to his; for, although very young, she had, what was, for that time, a very serious education, and was the director of one of the best Warsaw schools for young girls.

My father and mother worshiped their profession in the highest

degree and have left, all over their country, a lasting remembrance with their pupils. I cannot, even to-day, go into Polish society without meeting persons who have tender memories of my parents.

Although my parents adopted a university career, they continued to keep in close touch with their numerous family in the country. It was with their relatives that I frequently spent my vacation, living in all freedom and finding opportunities to know the field life by which I was deeply attracted. To these conditions, so different from the usual villegature, I believe, I owe my love for the country and nature.

Born at Warsaw, on the 7th of November, 1867, I was the last of five children, but my oldest sister died at the early age of fourteen, and we were left, three sisters and a brother. Cruelly struck by the loss of her daughter and worn away by a grave illness, my mother died at forty-two, leaving her husband in the deepest sorrow with his children. I was then only nine years old, and my eldest brother was hardly thirteen.

This catastrophe was the first great sorrow of my life and threw me into a profound depression. My mother had an exceptional personality. With all her intellectuality she had a big heart and a very high sense of duty. And, though possessing infinite indulgence and good nature, she still held in the family a remarkable moral authority. She had an ardent piety (my parents were both Catholics), but she was never intolerant; differences in religious belief did not trouble her; she was equally kind to any one not sharing her opinions. Her influence over me was extraordinary, for in me the natural love of the little girl for her mother was united with a passionate admiration.

Very much affected by the death of my mother, my father devoted himself entirely to his work and to the care of our education. His professional obligations were heavy and left him little leisure time. For many years we all felt weighing on us the loss of the one who had been the soul of the house.

We all started our studies very young. I was only six years old, and, because I was the youngest and smallest in the class, was frequently brought forward to recite when there were visitors. This was a great trial to me, because of my timidity; I wanted always to run away and hide. My father, an excellent educator, was interested in our work and knew how to direct it, but the conditions of our education were difficult. We began our studies in private schools and finished them in those of the government.

Warsaw was then under Russian domination, and one of the worst aspects of this control was the oppression exerted on the

school and the child. The private schools directed by Poles were closely watched by the police and overburdened with the necessity of teaching the Russian language even to children so young that they could scarcely speak their native Polish. Nevertheless, since the teachers were nearly all of Polish nationality, they endeavored in every possible way to mitigate the difficulties resulting from the national persecution. These schools, however, could not legally give diplomas, which were obtainable only in those of the government.

The latter, entirely Russian, were directly opposed to the Polish national spirit. All instruction was given in Russian, by Russian professors, who, being hostile to the Polish nation, treated their pupils as enemies. Men of moral and intellectual distinction could scarcely agree to teach in schools where an alien attitude was forced upon them. So what the pupils were taught was of questionable value, and the moral atmosphere was altogether unbearable. Constantly held in suspicion and spied upon, the children knew that a single conversation in Polish, or an imprudent word, might seriously harm, not only themselves, but also their families. Amidst these hostilities, they lost all the joy of life, and precocious feelings of distrust and indignation weighed upon their childhood. On the other side, this abnormal situation resulted in exciting the patriotic feeling of Polish youths to the highest degree.

Yet of this period of my early youth, darkened though it was by mourning and the sorrow of oppression, I still keep more than one pleasant remembrance. In our quiet but occupied life, reunions of relatives and friends of our family brought some joy. My father was very interested in literature and well acquainted with Polish and foreign poetry; he even composed poetry himself and was able to translate it from foreign languages into Polish in a very successful way. His little poems on family events were our delight. On Saturday evenings he used to recite or read to us the masterpieces of Polish prose and poetry. These evenings were for us a great pleasure and a source of renewed patriotic feelings.

Since my childhood I have had a strong taste for poetry, and I willingly learned by heart long passages from our great poets, the favorite ones being Mickiewicz, Krasiński and Slowacki. This taste was even more developed when I became acquainted with foreign literatures; my early studies included the knowledge of French, German, and Russian, and I soon became familiar with the fine works written in these languages. Later I felt the need of knowing English and succeeded in acquiring the knowledge of that language and its literature.

My musical studies have been very scarce. My mother was a musician and had a beautiful voice. She wanted us to have musical training. After her death, having no more encouragement from her, I soon abandoned this effort, which I often regretted afterwards.

I learned easily mathematics and physics, as far as these sciences were taken in consideration in the school. I found in this ready help from my father, who loved science and had to teach it himself. He enjoyed any explanation he could give us about Nature and her ways. Unhappily, he had no laboratory and could not perform experiments.

The periods of vacations were particularly comforting, when, escaping the strict watch of the police in the city, we took refuge with relatives or friends in the country. There we found the free life of the old-fashioned family estate; races in the woods and joyous participation in work in the far-stretching, level grain-fields. At other times we passed the border of our Russian-ruled division (Congress Poland) and went southwards into the mountain country of Galicia, where the Austrian political control was less oppressive than that which we suffered. There we could speak Polish in all freedom and sing patriotic songs without going to prison.

My first impression of the mountains was very vivid, because I had been brought up in the plains. So I enjoyed immensely our life in the Carpathian villages, the view of the pikes, the excursions to the valleys and to the high mountain lakes with picturesque names such as: "The Eye of the Sea." However, I never lost my attachment to the open horizon and the gentle views of a plain hill country.

Later I had the opportunity to spend a vacation with my father far more south in Podolia, and to have the first view of the sea at Odessa, and afterwards at the Baltic shore. This was a thrilling experience. But it was in France that I became acquainted with the big waves of the ocean and the ever-changing tide. All my life through, the new sights of Nature made me rejoice like a child.

Thus passed the period of our school life. We all had much facility for intellectual work. My brother, Doctor Sklodowski, having finished his medical studies, became later the chief physician in one of the principal Warsaw hospitals. My sisters and I intended to take up teaching as our parents had done. However, my elder sister, when grown up, changed her mind and decided to study medicine. She took the degree of doctor at the Paris University, married Doctor Dluski, a Polish physician, and together they established an important sanatorium in a wonderfully beautiful

Carpathian mountain place of Austrian Poland. My second sister, married in Warsaw, Mrs. Szalay, was for many years a teacher in the schools, where she rendered great service. Later she was appointed in one of the lycéums of free Poland.

I was but fifteen when I finished my high-school studies, always having held first rank in my class. The fatigue of growth and study compelled me to take almost a year's rest in the country. I then returned to my father in Warsaw, hoping to teach in the free schools. But family circumstances obliged me to change my decision. My father, now aged and tired, needed rest; his fortune was very modest. So I resolved to accept a position as governess for several children. Thus, when scarcely seventeen, I left my father's house to begin an independent life.

That going away remains one of the most vivid memories of my youth. My heart was heavy as I climbed into the railway car. It was to carry me for several hours, away from those I loved. And after the railway journey I must drive for five hours longer. What experience was awaiting me? So I questioned as I sat close to the car window looking out across the wide plains.

The father of the family to which I went was an agriculturist. His oldest daughter was about my age, and although working with me, was my companion rather than my pupil. There were two younger children, a boy and a girl. My relations with my pupils were friendly; after our lessons we went together for daily walks. Loving the country, I did not feel lonesome, and although this particular country was not especially picturesque, I was satisfied with it in all seasons. I took the greatest interest in the agricultural development of the estate where the methods were considered as models for the region. I knew the progressive details of the work, the distribution of crops in the fields; I eagerly followed the growth of the plants, and in the stables of the farm I knew the horses.

In winter the vast plains, covered with snow, were not lacking in charm, and we went for long sleigh rides. Sometimes we could hardly see the road. "Look out for the ditch!" I would call to the driver. "You are going straight into it," and "Never fear!" he would answer, as over we went! But these tumbles only added to the gaiety of our excursions.

I remember the marvelous snow house we made one winter when the snow was very high in the fields; we could sit in it and look out across the rose-tinted snow plains. We also used to skate on the ice of the river and to watch the weather anxiously, to make sure that the ice was not going to give way, depriving us of our pleasure.

Since my duties with my pupils did not take up all my time, I organized a small class for the children of the village who could not be educated under the Russian government. In this the oldest daughter of the house aided me. We taught the little children and the girls who wished to come how to read and write, and we put in circulation Polish books which were appreciated, too, by the parents. Even this innocent work presented danger, as all initiative of this kind was forbidden by the government and might bring imprisonment or deportation to Siberia.

My evenings I generally devoted to study. I had heard that a few women had succeeded in following certain courses in Petrograd or in foreign countries, and I was determined to prepare myself by preliminary work to follow their example.

I had not yet decided what path I would choose. I was as much interested in literature and sociology as in science. However, during these years of isolated work, trying little by little to find my real preferences, I finally turned towards mathematics and physics, and resolutely undertook a serious preparation for future work. This work I proposed doing in Paris, and I hoped to save enough money to be able to live and work in that city for some time.

My solitary study was beset with difficulties. The scientific education I had received at the Lyceum was very incomplete; it was well under the bachelorship program of a French lyceum; I tried to add to it in my own way, with the help of books picked up at random. This method could not be greatly productive, yet it was not without results. I acquired the habit of independent work, and learned a few things which were to be of use later on.

I had to modify my plans for the future when my eldest sister decided to go to Paris to study medicine. We had promised each other mutual aid, but our means did not permit of our leaving together. So I kept my position for three and a half years, and, having finished my work with my pupils, I returned to Warsaw, where a position, similar to the one I had left, was awaiting me.

I kept this new place for only a year and then went back to my father, who had retired some time before and was living alone. Together we passed an excellent year, he occupying himself with some literary work, while I increased our funds by giving private lessons. Meantime I continued my efforts to educate myself. This was no easy task under the Russian government of Warsaw; yet I found more opportunities than in the country. To my great joy, I was able, for the first time in my life, to find access to a laboratory: a small municipal physical laboratory directed by one of my cousins. I found little time to work there, except in the evenings and on Sundays, and was generally left to myself. I tried out vari-

ous experiments described in treatises on physics and chemistry, and the results were sometimes unexpected. At times I would be encouraged by a little unhopèd-for success, at others I would be in the deepest despair because of accidents and failures resulting from my inexperience. But on the whole, though I was taught that the way of progress is neither swift nor easy, this first trial confirmed in me the taste for experimental research in the fields of physics and chemistry.

Other means of instruction came to me through my being one of an enthusiastic group of young men and women of Warsaw, who united in a common desire to study, and whose activities were at the same time social and patriotic. It was one of those groups of Polish youths who believed that the hope of their country lay in a great effort to develop the intellectual and moral strength of the nation, and that such an effort would lead to a better national situation. The nearest purpose was to work at one's own instruction and to provide means of instruction for workmen and peasants. In accordance with this program we agreed among ourselves to give evening courses, each one teaching what he knew best. There is no need to say that this was a secret organization, which made everything extremely difficult. There were in our group very devoted young people who, as I still believe to-day, could do truly useful work.

I have a bright remembrance of the sympathetic intellectual and social companionship which I enjoyed at that time. Truly the means of action were poor and the results obtained could not be considerable; yet I still believe that the ideas which inspired us then are the only way to real social progress. You cannot hope to build a better world without improving the individuals. To that end each of us must work for his own improvement, and at the same time share a general responsibility for all humanity, our particular duty being to aid those to whom we think we can be most useful.

All the experiences of this period intensified my longing for further study. And, in his affection for me, my father, in spite of limited resources, helped me to hasten the execution of my early project. My sister had just married at Paris, and it was decided that I should go there to live with her. My father and I hoped that, once my studies were finished, we would again live happily together. Fate was to decide otherwise, since my marriage was to hold me in France. My father, who in his own youth had wished to do scientific work, was consoled in our separation by the progressive success of my work. I keep a tender memory of his kind-

ness and disinterestedness. He lived with the family of my married brother, and, like an excellent grandfather, brought up the children. We had the sorrow of losing him in 1902, when he had just passed seventy.

So it was in November, 1891, at the age of twenty-four, that I was able to realize the dream that had been always present in my mind for several years.

When I arrived in Paris I was affectionately welcomed by my sister and brother-in-law, but I stayed with them only for a few months, for they lived in one of the outside quarters of Paris where my brother-in-law was beginning a medical practice, and I needed to get nearer to the schools. I was finally installed, like many other students of my country, in a modest little room for which I gathered some furniture. I kept to this way of living during the four years of my student life.

It would be impossible to tell of all the good these years brought to me. Undistracted by any outside occupation, I was entirely absorbed in the joy of learning and understanding. Yet, all the while, my living conditions were far from easy, my own funds being small and my family not having the means to aid me as they would have liked to do. However, my situation was not exceptional; it was the familiar experience of many of the Polish students whom I knew.

The room I lived in was in a garret, very cold in winter, for it was insufficiently heated by a small stove which often lacked coal. During a particularly rigorous winter, it was not unusual for the water to freeze in the basin in the night; to be able to sleep I was obliged to pile all my clothes on the bedcovers. In the same room I prepared my meals with the aid of an alcohol lamp and a few kitchen utensils. These meals were often reduced to bread with a cup of chocolate, eggs or fruit. I had no help in housekeeping and I myself carried the little coal I used up the six flights.

This life, painful from certain points of view, had, for all that, a real charm for me. It gave me a very precious sense of liberty and independence. Unknown in Paris, I was lost in the great city, but the feeling of living there alone, taking care of myself without any aid, did not at all depress me. If sometimes I felt lonesome, my usual state of mind was one of calm and great moral satisfaction.

All my mind was centered on my studies, which, especially at the beginning, were difficult. In fact, I was insufficiently prepared to follow the physical science course at the Sorbonne, for, despite all my efforts, I had not succeeded in acquiring in Poland a preparation as complete as that of the French students following the same course. So I was obliged to supply this deficiency, especially

in mathematics. I divided my time between courses, experimental work, and study in the library. In the evening I worked in my room, sometimes very late into the night. All that I saw and learned that was new delighted me. It was like a new world opened to me, the world of science, which I was at last permitted to know in all liberty.

I have pleasant memories of my relations with my student companions. Reserved and shy at the beginning, it was not long before I noticed that the students, nearly all of whom worked seriously, were disposed to be friendly. Our conversations about our studies deepened our interest in the problems we discussed.

Among the Polish students I did not have any companions in my studies. Nevertheless, my relations with their small colony had a certain intimacy. From time to time we would gather in one another's bare rooms, where we could talk over national questions and feel less isolated. We would also go for walks together, or attend public reunions, for we were all interested in politics. By the end of the first year, however, I was forced to give up these relationships, for I found that all my energy had to be concentrated on my studies, in order to achieve them as soon as possible. I was even obliged to devote most of my vacation time to mathematics.

My persistent efforts were not in vain. I was able to make up for the deficiency of my training and to pass examinations at the same time with the other students. I even had the satisfaction of graduating in first rank as "*licencié es sciences physiques*" in 1893, and in second rank as "*licencié es sciences mathématiques*" in 1894.

My brother-in-law, recalling later these years of work under the conditions I have just described, jokingly referred to them as "the heroic period of my sister-in-law's life." For myself, I shall always consider one of the best memories of my life that period of solitary years exclusively devoted to the studies, finally within my reach, for which I had waited so long.

It was in 1894 that I first met Pierre Curie. One of my companions, a professor at the University of Fribourg, having called upon me, invited me to his home, with a young physicist of Paris, whom he knew and esteemed highly. Upon entering the room I perceived, standing framed by the French window opening on the balcony, a tall young man with auburn hair and large, limpid eyes. I noticed the grave and gentle expression of his face, as well as a certain abandon in his attitude, suggesting the dreamer absorbed in his reflections. He showed me a simple cordiality and seemed to me very sympathetic. After that first interview he expressed the desire to see me again and to continue our conversa-

tion of that evening on scientific and social subjects in which he and I were both interested, and on which we seemed to have similar opinions.

Some time later, he came to me in my student room and we became good friends. He described to me his days, filled with work, and his dream of an existence entirely devoted to science. He was not long in asking me to share that existence, but I could not decide at once; I hesitated before a decision that meant abandoning my country and my family.

I went back to Poland for my vacation, without knowing whether or not I was to return to Paris. But circumstances permitted me again to take up my work there in the autumn of that year. I entered one of the physics laboratories at the Sorbonne, to begin experimental research in preparation for my doctor's thesis. Again I saw Pierre Curie. Our work drew us closer and closer, until we were both convinced that neither of us could find a better life companion. So our marriage was decided upon and took place a little later, in July, 1895.

Pierre Curie had just received his doctor's degree and had been made professor in the School of Physics and Chemistry of the City of Paris. He was thirty-six years old, and already a physicist known and appreciated in France and abroad. Solely preoccupied with scientific investigation, he had paid little attention to his career, and his material resources were very modest. He lived at Sceaux, in the suburbs of Paris, with his old parents, whom he loved tenderly, and whom he described as "exquisite" the first time he spoke to me about them. In fact, they were so: the father was an elderly physician of high intellect and strong character, and the mother the most excellent of women, entirely devoted to her husband and her sons. Pierre's elder brother, who was then professor at the University of Montpellier, was always his best friend. So I had the privilege of entering into a family worthy of affection and esteem, and where I found the warmest welcome.

We were married in the simplest way. I wore no unusual dress on my marriage day, and only a few friends were present at the ceremony, but I had the joy of having my father and my second sister come from Poland.

We did not care for more than a quiet place in which to live and to work, and were happy to find a little apartment of three rooms with a beautiful view of a garden. A few pieces of furniture came to us from our parents. With a money gift from a relative we acquired two bicycles to take us out into the country.

CHAPTER II

With my marriage there began for me a new existence entirely different from the solitary life that I had known during the preceding years. My husband and I were so closely united by our affection and our common work that we passed nearly all of our time together. I have only a few letters from him, for we were so little apart. My husband spent all the time he could spare from his teaching at his research work in the laboratory of the school in which he was professor and I obtained authorization to work with him.

Our living apartment was near the school, so we lost little time in going and coming. As our material resources were limited, I was obliged to attend to most of the housekeeping myself, particularly the preparation of meals. It was not easy to reconcile these household duties with my scientific work, yet, with good will, I managed it. The great thing was that we were alone together in the little home which gave us a peace and intimacy that were very enjoyable for us.

At the same time that I was working in the laboratory, I still had to take a few study courses, for I had decided to take part in the examination for a certificate that would allow me to teach young girls. If I succeeded in this, I would be entitled to be named professor. In August, 1896, after having devoted several months to preparation, I came out first in the examination.

Our principal distraction from the close work of the laboratory consisted in walks or bicycle rides in the country. My husband greatly enjoyed the out-of-doors and took great interest in the plants and animals of woods and meadows. Hardly a corner in the vicinity of Paris was unknown to him. I also loved the country and these excursions were a great joy for me as well as to him, relieving our mind from the tension of the scientific work. We used to bring home bunches of flowers. Sometimes we forgot all about the time and got back late at night. We visited regularly my husband's parents where our room was always ready.

In the vacation we went on longer outings by means of our bicycles. In this way we covered much ground in Auvergne and in the Cévennes and visited several regions at the seashore. We took

a great delight in these long all-day excursions, arriving at night always in a new place. If we stayed in one place too long, my husband began to wish to get back to the laboratory. It is also in vacation time that we visited once my family in the Carpathian mountains. My husband learned some Polish in view of this journey to Poland.

But first of all in our life was our scientific work. My husband gave much care to the preparation of his courses, and I gave him some assistance in this, which, at the time, helped me in my education. However, most of our time was devoted to our laboratory researches.

My husband did not then have a private laboratory. He could, to some extent, use the laboratory of the school for his own work, but found more freedom by installing himself in some unused corner of the Physics School building. I thus learned from his example that one could work happily even in very insufficient quarters. At this time my husband was occupied with researches on crystals, while I undertook an investigation of the magnetic properties of steel. This work was completed and published in 1897.

In that same year the birth of our first daughter brought a great change in our life. A few weeks later my husband's mother died and his father came to live with us. We took a small house with a garden at the border of Paris and continued to occupy this house as long as my husband lived.

It became a serious problem how to take care of our little Irene and of our home without giving up my scientific work. Such a renunciation would have been very painful to me, and my husband would not even think of it; he used to say that he had got a wife made expressly for him to share all his preoccupations. Neither of us would contemplate abandoning what was so precious to both.

Of course we had to have a servant, but I personally saw to all the details of the child's care. While I was in the laboratory, she was in the care of her grandfather, who loved her tenderly and whose own life was made brighter by her. So the close union of our family enabled me to meet my obligations. Things were particularly difficult only in case of more exceptional events, such as a child's illness, when sleepless nights interrupted the normal course of life.

It can be easily understood that there was no place in our life for worldly relations. We saw but a few friends, scientific workers, like ourselves, with whom we talked in our home or in our garden, while I did some sewing for my little girl. We also maintained

affectionate relations with my husband's brother and his family. But I was separated from all my relatives, as my sister had left Paris with her husband to live in Poland.

It was under this mode of quiet living, organized according to our desires, that we achieved the great work of our lives, work begun about the end of 1897 and lasting for many years.

I had decided on a theme for my doctorate. My attention had been drawn to the interesting experiments of Henri Becquerel on the salts of the rare metal uranium. Becquerel had shown that by placing some uranium salt on a photographic plate, covered with black paper, the plate would be affected as if light had fallen on it. The effect is produced by special rays which are emitted by the uranium salt and are different from ordinary luminous rays as they can pass through black paper. Becquerel also showed that these rays can discharge an electroscope. He at first thought that the uranium rays were produced as a result of exposing the uranium salt to light, but experiment showed that salts kept for several months in the dark continued the peculiar rays.

My husband and I were much excited by this new phenomenon, and I resolved to undertake the special study of it. It seemed to me that the first thing to do was to measure the phenomenon with precision. In this I decided to use that property of the rays which enabled them to discharge an electroscope. However, instead of the usual electroscope, I used a more perfect apparatus. One of the models of the apparatus used by me for these first measurements is now in the College of Physicians and Surgeons in Philadelphia.

I was not long in obtaining interesting results. My determinations showed that the emission of the rays is an atomic property of the uranium, whatever the physical or chemical conditions of the salt were. Any substance containing uranium is as much more active in emitting rays, as it contains more of this element.

I then thought to find out if there were other substances possessing this remarkable property of uranium, and soon found that substances containing thorium behaved in a similar way, and that this behavior depended similarly on an atomic property of thorium. I was now about to undertake a detailed study of the uranium and thorium rays when I discovered a new interesting fact.

I had occasion to examine a certain number of minerals. A few of them showed activity; they were those containing either uranium or thorium. The activity of these minerals would have had nothing astonishing about it, if it had been in proportion to the quantities of uranium or thorium contained in them. But it was not so. Some of these minerals revealed an activity three or four

times greater than that of uranium. I verified this surprising fact carefully, and could not doubt its truth. Speculating about the reason for this, there seemed to be but one explanation. There must be, I thought, some unknown substance, very active, in these minerals. My husband agreed with me and I urged that we search at once for this hypothetical substance, thinking that, with joined efforts, a result would be quickly obtained. Neither of us could foresee that in beginning this work we were to enter the path of a new science which we should follow for all our future.

Of course, I did not expect, even at the beginning, to find a new element in any large quantity, as the minerals had already been analyzed with some precision. At least, I thought there might be as much as one per cent of the unknown substance in the minerals. But the more we worked, the clearer we realized that the new radioactive element could exist only in quite minute proportion and that, in consequence, its activity must be very great. Would we have insisted, despite the scarcity of our means of research, if we had known the true proportion of what we were searching for, no one can tell; all that can be said now is that the constant progress of our work held us absorbed in a passionate research, while the difficulties were ever increasing. As a matter of fact, it was only after several years of most arduous labor that we finally succeeded in completely separating the new substance, now known to everybody as radium. Here is, briefly, the story of the search and discovery.

As we did not know, at the beginning, any of the chemical properties of the unknown substance, but only that it emits rays, it was by these rays that we had to search. We first undertook the analysis of a pitchblende from St. Joachimsthal. Analyzing this ore by the usual chemical methods, we added an examination of its different parts for radioactivity, by the use of our delicate electrical apparatus. This was the foundation of a new method of chemical analysis which, following our work, has been extended, with the result that a large number of radioactive elements have been discovered.

In a few weeks we could be convinced that our prevision had been right, for the activity was concentrated in a regular way. And, in a few months, we could separate from the pitchblende a substance accompanying the bismuth, much more active than uranium, and having well defined chemical properties. In July, 1898, we announced the existence of this new substance, to which I gave the name of polonium, in memory of my native country.

While engaged in this work on polonium, we had also discovered that, accompanying the barium separated from the pitch-

blende, there was another new element. After several months more of close work we were able to separate this second new substance, which was afterwards shown to be much more important than polonium. In December, 1898, we could announce the discovery of this new and now famous element, to which we gave the name of radium.

However, the greatest part of the material work had yet to be done. We had, to be sure, discovered the existence of the remarkable new elements, but it was chiefly by their radiant properties that these new substances were distinguished from the bismuth and barium with which they were mixed in minute quantities. We had still to separate them as pure elements. On this work we now started.

We were very poorly equipped with facilities for this purpose. It was necessary to subject large quantities of ore to careful chemical treatment. We had no money, no suitable laboratory, no personal help for our great and difficult undertaking. It was like creating something out of nothing, and if my earlier studying years had once been called by my brother-in-law the heroic period of my life, I can say without exaggeration that the period on which my husband and I now entered was truly the heroic one of our common life.

We knew by our experiments that in the treatment of pitchblende at the uranium plant of St. Joachimsthal, radium must have been left in the residues, and, with the permission of the Austrian government, which owned the plant, we succeeded in securing a certain quantity of these residues, then quite valueless,—and used them for extraction of radium. How glad I was when the sacks arrived, with the brown dust mixed with pine needles, and when the activity proved even greater than that of the primitive ore! It was a stroke of luck that the residues had not been thrown far away or disposed of in some way, but left in a heap in the pine wood near the plant. Some time later, the Austrian government, on the proposition of the Academy of Science of Vienna, let us have several tons of similar residues at a low price. With this material was prepared all the radium I had in my laboratory up to the date when I received the precious gift from the American women.

The School of Physics could give us no suitable premises, but for lack of anything better, the Director permitted us to use an abandoned shed which had been in service as a dissecting room of the School of Medicine. Its glass roof did not afford complete shelter against rain; the heat was suffocating in summer, and the bit-

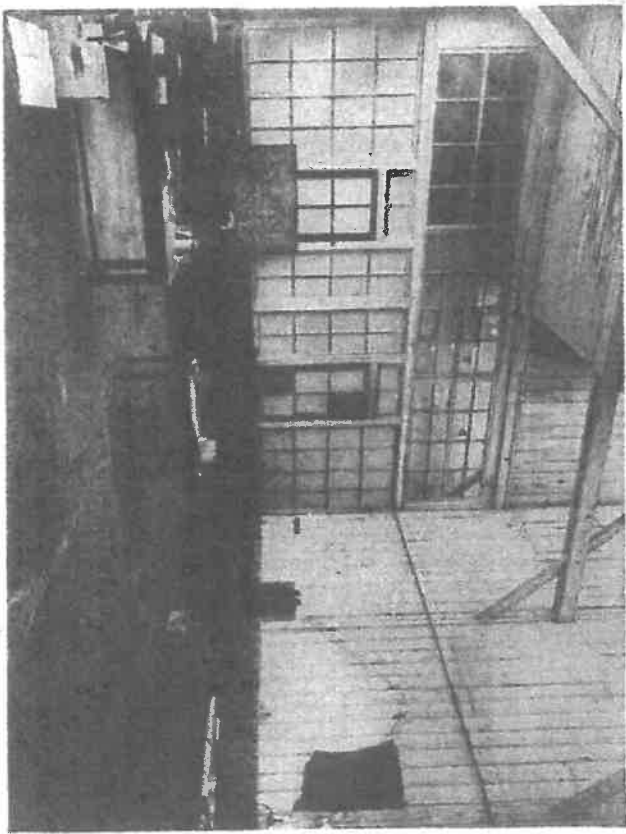
ter cold of winter was only a little lessened by the iron stove, except in its immediate vicinity. There was no question of obtaining the needed proper apparatus in common use by chemists. We simply had some old pine-wood tables with furnaces and gas burners. We had to use the adjoining yard for those of our chemical operations that involved producing irritating gases; even then the gas often filled our shed. With this equipment we entered on our exhausting work.

Yet it was in this miserable old shed that we passed the best and happiest years of our life, devoting our entire days to our work. Often I had to prepare our lunch in the shed, so as not to interrupt some particularly important operation. Sometimes I had to spend a whole day mixing a boiling mass with a heavy iron rod nearly as large as myself. I would be broken with fatigue at the day's end. Other days, on the contrary, the work would be a most minute and delicate fractional crystallization, in the effort to concentrate the radium. I was then annoyed by the floating dust of iron and coal from which I could not protect my precious products. But I shall never be able to express the joy of the untroubled quietness of this atmosphere of research and the excitement of actual progress with the confident hope of still better results. The feeling of discouragement that sometimes came after some unsuccessful toil did not last long and gave way to renewed activity. We had happy moments devoted to a quiet discussion of our work, walking around our shed.

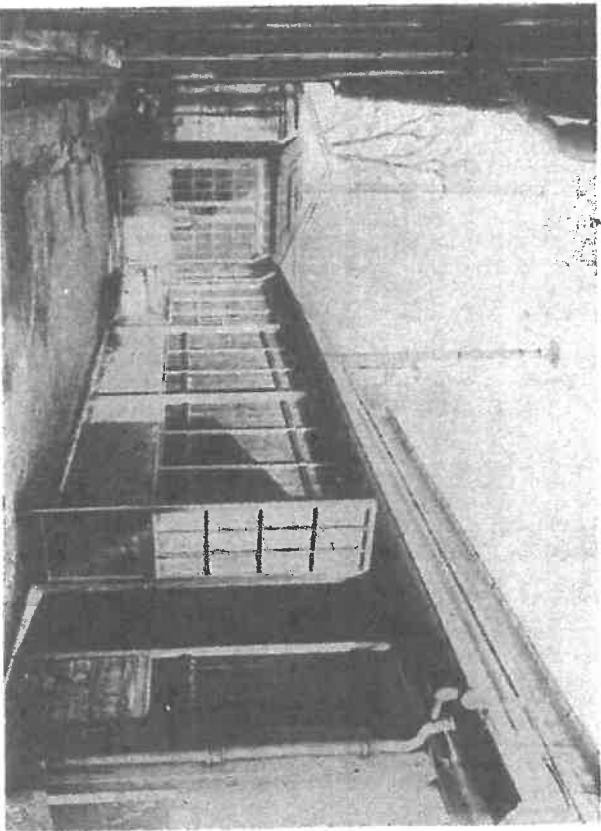
One of our joys was to go into our workroom at night; we then perceived on all sides the feebly luminous silhouettes of the bottles or capsules containing our products. It was really a lovely sight and one always new to us. The glowing tubes looked like faint, fairy lights.

Thus the months passed, and our efforts, hardly interrupted by short vacations, brought forth more and more complete evidence. Our faith grew ever stronger, and our work being more and more known, we found means to get new quantities of raw material and to carry on some of our crude processes in a factory, allowing me to give more time to delicate finishing treatment.

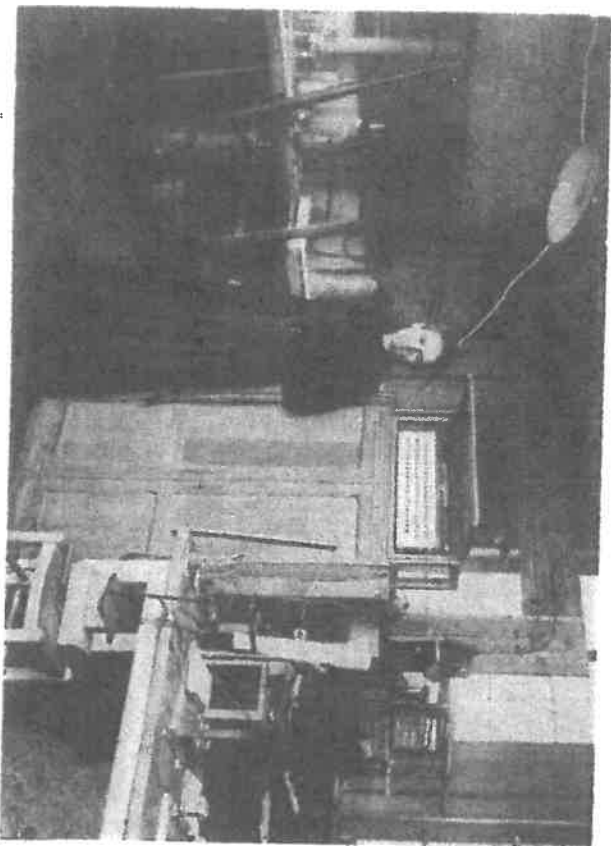
At this stage I devoted myself especially to the purification of the radium, my husband being absorbed by the study of the physical properties of the rays emitted by the new substances. It was only after treating one ton of pitchblende residues that I could get definite results. Indeed we know to-day that even in the best minerals there are not more than a few decigrammes of radium in a ton of raw material.



View of the laboratory in which Mme. Curie made her radium discoveries



Outside view of the laboratory in which Mme. Curie discovered radium



Henri Manuel, Paris
Mme. Curie in her laboratory at the Institut Curie, Paris



Photo by U. S. Signal Corps
Mme. Curie instructing American soldiers in her Paris laboratory

At last the time came when the isolated substances showed all the characters of a pure chemical body. This body, the radium, gives a characteristic spectrum, and I was able to determine for it an atomic weight much higher than that of the barium. This was achieved in 1902. I then possessed one decigramme of very pure radium chloride. It had taken me almost four years to produce the kind of evidence which chemical science demands, that radium is truly a new element. One year would probably have been enough for the same purpose, if reasonable means had been at my disposal. The demonstration that cost so much effort was the basis of the new science of radioactivity.

In later years, I was able to prepare several decigrammes of pure radium salt, to make a more accurate determination of the atomic weight and even to isolate the pure radium metal. However, 1902 was the year in which the existence and character of radium were definitely established.

We had been able to live for several years entirely engrossed in the work of research, but gradually circumstances changed. In 1900 my husband was offered a professorship in the University of Geneva, but almost simultaneously he obtained a position of assistant professor at the Sorbonne, and I was made professor at the Normal Superior School for young girls at Sèvres. So we remained in Paris.

I became much interested in my work in the Normal School, and endeavored to develop more fully the practical laboratory exercises of the pupils. These pupils were girls of about twenty years who had entered the school after severe examination and had still to work very seriously to meet the requirements that would enable them to be named professors in the lycées. All these young women worked with great eagerness, and it was a pleasure for me to direct their studies in physics.

But a growing notoriety, because of the announcement of our discoveries, began to trouble our quiet work in the laboratory, and, little by little, life became more difficult. In 1903 I finished my doctor's thesis and obtained the degree. At the end of the same year the Nobel prize was awarded jointly to Becquerel, my husband and me for the discovery of radioactivity and new radioactive elements.

This event greatly increased the publicity of our work. For some time there was no more peace. Visitors and demands for lectures and articles interrupted every day.

The award of the Nobel prize was a great honor. It is also known that the material means provided by this prize was much greater

than is usual in prizes for science. This was a great help in the continuation of our researches. Unhappily, we were overtired and had a succession of failures of health for the one or the other of us, so that it was not until 1905 that we were able to go to Stockholm, where my husband gave his Nobel lecture and where we were well received.

The fatigue resulting from the effort exceeding our forces, imposed by the unsatisfactory conditions of our labor, was augmented by the invasion of publicity. The overturn of our voluntary isolation was a cause of real suffering for us and had all the effect of disaster. It was serious trouble brought into the organization of our life, and I have already explained how indispensable was our freedom from external distraction, in order to maintain our family life and our scientific activity. Of course, people who contribute to that kind of trouble generally mean it kindly. It is only that they do not realize the conditions of the problem.

In 1904 our second daughter, Eve Denise, came to us. I had, of course, to interrupt my work in the laboratory for a while. In the same year, because of the awarding of the Nobel prize and the general public recognition, a new chair of physics was created in the Sorbonne, and my husband was named as its occupant. At the same time I was named chief of work in the laboratory that was to be created for him. But in reality the laboratory was not constructed then, and only a few rooms taken from other uses were available to us.

In 1906 just as we were definitely giving up the old shed laboratory where we had been so happy, there came the dreadful catastrophe which took my husband away from me and left me alone to bring up our children and, at the same time, to continue our work of research.

It is impossible for me to express the profoundness and importance of the crisis brought into my life by the loss of the one who had been my closest companion and best friend. Crushed by the blow, I did not feel able to face the future. I could not forget, however, what my husband used sometimes to say, that, even deprived of him, I ought to continue my work.

The death of my husband, coming immediately after the general knowledge of the discoveries with which his name is associated, was felt by the public, and especially by the scientific circles, to be a national misfortune. It was largely under the influence of this emotion that the Faculty of Sciences of Paris decided to offer me the chair, as professor, which my husband had occupied only one year and a half in the Sorbonne. It was an exceptional deci-

sion, as up to then no woman had held such a position. The University by doing this offered me a precious mark of esteem and gave me opportunity to pursue the researches which otherwise might have had to be abandoned. I had not expected a gift of this kind, I never had any other ambition than to be able to work freely for science. The honor that now came to me was deeply painful under the cruel circumstances of its coming. Besides I wondered whether I would be able to face such a grave responsibility. After much hesitation, I decided that I ought at least to try to meet the task, and so I began in 1906 my teaching in the Sorbonne, as assistant professor, and two years later I was named titular professor.

In my new situation the difficulties of my life were considerably augmented, as I alone had now to carry the burden formerly weighing on my husband and me together. The cares of my young children required close vigilance; in this, my husband's father, who continued to live with us, willingly took his share. He was happy to be occupied with the little girls, whose company was his chief consolation after his son's death. By his effort and mine, the children had a bright home, even if we lived with our inner grief, which they were too young to realize. The strong desire of my father-in-law being to live in the country, we took a house with a garden in Sceaux, a suburb of Paris, from which I could reach the city in half an hour.

This country life had great advantages, not only for my father-in-law, who enjoyed his new surroundings, and especially his garden, but also for my girls, who had the benefit of walks in the open country. But they were more separated from me, and it became necessary to have a governess for them. This position was filled first by one of my cousins, and then by a devoted woman who had already brought up the daughter of one of my sisters. Both of them were Polish, and in this way my daughters learned my native tongue. From time to time, some one of my Polish family came to see me in my grief, and we managed to meet in vacation time, at the seashore in France, and once in the mountains of Poland.

In 1910 we suffered the loss of my very dear father-in-law, after a long illness, which brought me many sorrowful days. I used to spend at his bedside as much time as I could, listening to his remembrances of passed years. His death affected deeply my elder daughter, who, at twelve, knew the value of the cheerful hours spent in his company.

There were few resources for the education of my daughters in Sceaux. The youngest one, a small child, needed principally a