

Some Personal Reminiscences

JEAN JACQUES TRILLAT

There are moments in one's life when one should be able to stop and look back, just as an alpinist scaling a mountain looks back on the accomplished part of his way and gathers breath. The fiftieth anniversary of X-ray diffraction presents me with such a moment, and it is with a feeling of profound admiration that I look upon the immense work performed from the very first moments onwards by such pioneers as Max von Laue, W. H. and W. L. Bragg, and Maurice de Broglie. Without them, without their basic work, nothing much could have been achieved in the fields of Crystallography and of Applied X-rays.

The idea of having participated, even if to a very minor extent, in the building up of these fields gives one a feeling of elation. For is there a better reward for a researcher than to be aware of his having known the Great Masters, worked under their direction, and, sometimes, of having extended their work along new lines? To me, who belongs to this generation, this is an occasion for re-visiting the past and, in doing so, for giving expression to all my gratitude to those without whom my development undoubtedly would have been quite different.

It happened by pure chance that I was led to take an interest in X-rays. My father who was a departmental manager at the Institut Pasteur inculcated in me the love of research and of scientific rigour, and my entire development was determined by this starting point. This was the first piece of good luck, and, after my involvement in the First World War had come to an end, it made me enter, as a matter of course, the École de Physique et Chimie in Paris for a training in chemical engineering. My father, however, was of the opinion that an engineering diploma should be followed up with a doctoral thesis, and this is why in 1923, at the age of 24 years, I entered the Institut Pasteur with the object of starting research on the synthesis of ephedrine, under the direction of Jacques Trefouel who is the present director of this famous Institute.

I took a lively interest in organic chemistry, and I certainly obtained at the Institut Pasteur an excellent training as a chemist which stood me in good stead throughout my career. The difficulty of the chosen subject filled me, however, with some anxiety. It was at this point that the second piece of good luck occurred, namely my meeting Maurice de Broglie with whom, one day, I had a long conversation which was to decide my scientific orientation.

I became a member of his famous laboratory in 1924 and had the good fortune of remaining there until 1933. I had just got married and was confronted with many financial problems; my wife, to whom I owe so much, encouraged me to accept the assignment, in spite of her being worried by my having to work with these mysterious rays.

Maurice de Broglie, realizing my training was in chemistry, proposed from the start that I should study certain problems related to the structure of long-chain organic compounds (fatty acids, paraffins, soaps). After a few months with him, I had understood the basic notions regarding X-rays and was applying them to the study of fatty acids and their soaps, using the rotating crystal method. At that time very few papers had been published on this subject, mainly those of Alexander Müller and of Shearer, and these served as my starting point.

I worked at that time in a small maids-room in the attics of the private mansion of the Duc de Broglie in rue Châteaubriand. I did everything myself, even cleaning up the room, and if I needed a slightly more elaborate piece of apparatus, I asked Alexis, formerly the Duc's footman now turned mechanic. And all at once results accumulated, in quantity and quality so good that after two years, in 1926, I handed in my thèse de doctorat on the subject: 'X-rays and long-chain organic compounds; studies on their structures and orientations'.

What a wonderful group was at that time working in de Broglie's laboratory: A. Dauvillier, J. Thibaud, R. Lucas, L. Leprince-Ringuet, and later Magnan, Cartan and many more. Most illustrious of all was the Duc's very much younger brother, Prince Louis de Broglie. Every week a colloquium brought us together in the office of Maurice de Broglie where each of us presented his results and we discussed recently published papers. It is thus that I had the privilege of witnessing the emergence of wave mechanics, and this made me take great interest, later on, in electron diffraction and its applications, as well as in electron microscopy.

Never would I be able to describe appropriately the agreeable

atmosphere of trust in this laboratory, whose chief knew not only how to assist his pupils by his experience, but also to impart to them, what is perhaps even more important, the right attitude towards Science.

After having finished my degree work I continued working in de Broglie's laboratory. Some simple ideas made me invent new methods for special purposes, such as the method 'de la goutte tangente' where X-rays fall on a hanging liquid drop under varying glancing angles. I tried my hand at numerous subjects which, however, had it in common to stem from chemical problems. To me, X-rays were a means, not an end, a means for studying particularly chemical transformations and surface structures; I had a hunch that from these a great number of applications might result.

The presence of Louis de Broglie in this laboratory gave me the opportunity of learning electron diffraction which had just been shown experimentally to exist by G. P. Thomson in a form very closely resembling X-ray powder diffraction along the lines of Debye and Scherrer. Starting from the apparatus which Maurice Ponte had constructed, I built several more and more refined versions and used them, naturally, in the first instance for obtaining new insights into the long-chain organic compounds. I had the privilege of seeing von Laue take interest in some of this research, and had several very friendly discussions with him.

This entire first part of my career stood under the sign of Maurice and Louis de Broglie; it was essential for the time that followed. On the other hand, my training as a chemist and engineer gave me from the very start a bearing towards practical and even industrial applications of the new methods, and in that connection I have to say how grateful I am to certain industrial concerns (Kodak-Pathé, Péchiney, Michelin and many others) for having proposed to me, from the very beginning, research on industrial problems, which frequently became to me the starting point of new studies. I recall that in 1928 the Director of the Compagnie Péchinet, Raoul de Vitry, asked me to install X-ray equipment in one of his works (the 'Duralumin') 'for structural control and research'; he said, without fully anticipating the kind of result. After a few years the results were such that today there exists in France hardly a single industrial plant which does not use X-ray or electron diffraction and electron microscopy in its laboratory.

The third piece of good luck in my life was a lecture I gave in 1932 to the Society of Industrial Chemistry of Nancy. There I heard that at the Faculty of Science in Besançon a physics chair was vacant and that voting on the candidates was to take place in a few days. I had

never felt the urge to instruct; this, however, was a chance, and on the advice of my wife I presented myself as a candidate, and was chosen.

In 1933 I therefore left the de Broglie Laboratory, sad, it is true, but taking with me some of the instruments which the Duc de Broglie was good enough to give me for equipment. In Besançon, I found spacious rooms with nothing in them, and not even supplied with a.c. current.

In a year's time the laboratory began to function, and I spent happy years there up until the outbreak of the Second World War.

This Besançon laboratory of which I was now the director trained a large number of students, some of whom have become masters in their fields: Merigoux, Saulnier, Oketani, Fritz and others. It was there that, together with René Fritz, I built in 1935 the first French electron microscope. There again, I directed my research to problems of mineral and organic chemistry by applying jointly the diffraction of X-rays and electrons. Sometimes these methods proved yet insufficient, and in that case I had to devise novel means, as for instance the registering interfacial tensiometer which yielded many interesting results in the study of lubricants, or microradiography by photo-electrons.

After the Second World War I was appointed at the Sorbonne, first to a chair of P.C.B. (Physics-Chemistry-Biology), then to one of Physical Chemistry and finally to one of Electron Microscopy and Diffraction. I needed a laboratory, and the Sorbonne had none to give me. But thanks to the Centre National de la Recherche Scientifique (CNRS) I was enabled to install myself in Bellevue and to organize there the beginnings of what is today one of the best-equipped laboratories of this Institution.

It was here that I began a new and exciting period of my life; everything had to be built up from the ground in the difficult post-war period. From a researcher I was obliged to become, as it always happens beyond a certain age, a Director of Research, with all the loathsome but necessary duties such a job implies, such as administration, report writing, financing, social problems, etc. I have, however, always managed to save the maximum possible time for looking after the research that is going on in my laboratory, and to take a personal part in it. But very often I feel sad for having no longer the time for experimenting myself, for adjusting instruments, for waiting with anxious expectation in the red light of the dark-room for a diagram to come out in the developer. I consider it now as my primary task to help young people in gaining their full measure, to provide them with the necessary apparatus for their own research, and,

first and foremost, to give them subjects to study, to discuss their experiments with them, and to teach them in my turn what I myself learnt from Maurice de Broglie: the proper attitude towards Science.

In looking back over the path travelled, the large number of years spent in the laboratory, the friendship with which famous Scientists have honoured me, I say to myself that there is no finer life than that of a research man, for it implies the most beautiful social function and the greatest rewards one can hope for in this world.