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André Guinier (1911–2000)

André Guinier died on 3 July 2000, one month short of his 89th birthday. He had an exceptionally long and brilliant career as a solid-state physicist and crystallographer; passionately fond of scientific research, he still attended scientific meetings and laboratory seminars until a year before his death.

When a young man, he was a very gifted student and succeeded in entering the illustrious Ecole Normale Supérieure (ENS). He graduated in 1934 and became Agrégé Préparateur in the Physics Laboratory of the ENS in 1935. Such a privileged position gave him the opportunity to begin research work, with a free choice both of the scientific field and of his thesis supervisor. He chose the respected crystallographer Charles Mauguin. André Guinier presented his thesis in 1939 [*La Diffraction des Rayons X aux Très Faibles Angles: Applications à l'Etude des Phénomènes Ultra-microscopiques. Ann. Phys. (Paris)*, (1939), **12** 161–236] and obtained a position at the Conservatoire National des Arts et Métiers (CNAM), where he became deputy-director of the Testing Laboratory (Laboratoire d'Essais) in 1944. The CNAM is situated in a historic building in the centre of Paris; André Guinier nevertheless managed to create a Research Laboratory there where he received his first students. In 1949, he became a Professor at the University of Paris (the Sorbonne). He was then giving two types of course in parallel: basic physics at the University, and X-rays and the structure of metals at the CNAM. From very early on, his inventive and stimulating research work attracted foreign researchers and post-doctoral students to his group.

Ten years later, a University Scientific Centre was created at Orsay, outside Paris, as an extension of Paris University. André Guinier was the first Dean of Orsay and spent much energy and dynamism to successfully build up this new campus, which rapidly became one of the world's major scientific centres. He transferred his Research Laboratory to Orsay, and together with Jacques Friedel and Raimond Castaing founded the Solid State Physics Laboratory (Laboratoire de Physique des Solides, LPS). When this university laboratory later became associated to the CNRS (Centre National de la Recherche Scientifique), André Guinier was its first Director.

Professor at Orsay University and Member of the French Academy of Sciences, André Guinier was a very eminent scientist: his work is known and praised all over the world and he has been awarded numerous prizes from foreign as well as French institutions. Related to both his deep understanding of order and disorder phenomena in solids and his faculty to plan and carry out the vital experiment, his contributions were fundamental in a number of fields concerning condensed matter. Most of his work concerned the use of X-ray scattering to investigate and define the extent of order in solids: he pointed out the significance of diffuse scattering arising outside the Bragg selective diffraction spots and the importance of 'local order' to explain some physical properties of materials. A variety of experiments were used by him, particularly small-angle scattering and wide-angle diffuse scattering, which, together with their analysis, led to the development of what has come to be known as the 'Guinier school' of X-ray scattering.

In the case of small-angle scattering, the diffuse scattering is located close to the direct beam and is given by particles with an electron density different from that of the surrounding medium. André Guinier's very early observations made in 1938 on the Al–Cu alloy led to the discovery of the Guinier–Preston zones, which are specific to pre-precipitation phenomena in alloys, of major importance for hardening in alloys. The spatial extent of the diffuse scattering is directly connected to the size of the particles (the smaller the particles, the larger the extent) and the approximate relationship for the intensity variation is known as the Guinier law. Such kinds of studies were performed later on by André Guinier and his students for many different systems: metallurgical solid solutions, defects and radiation damage in crystals, biological solutions, polymers *etc*.

The study of wide-angle diffuse scattering corresponds to a more difficult situation since it involves, in principle, the whole reciprocal-space description. In the simplest cases, it is relatively easy to explain experimental observations by some particular distribution of atoms in the material: position correlation of atoms in disordered solid solutions, displacement correlations of atomic motions close to phase transitions. In fact, owing to the progress of instrumentation and analysis resources, more complex systems are now investigated: low-dimensional organic and inorganic conductors, fullerene compounds *etc*. The careful modeling of the intricate diffraction patterns gives information on the microscopic phenomena at play, the dimensionality and strength of local interactions. In most crystalline materials, the global intensity of diffuse scattering is much lower than that of the diffraction spots related to the mean lattice. This is not the case for liquid-crystalline materials: taking into account both kinds of scattering, the new investigative tools, built up for the description of structural fluctuations related to phase transitions, are basic for the understanding of these peculiar 'structures'.

A natural progression takes one from the study of metallic solid solutions to amorphous metals. At the beginning of the 70's, new metallic alloys were prepared at Caltech by very rapid quenching of the melt: this technique was then introduced in the Orsay laboratory, opening up new studies of metallic metastable phases. It was the beginning of a new field of structural investigations on glasses, liquids, and amorphous semiconductors, where André Guinier played a central role.

It always remained a great pleasure for André Guinier to learn about and discuss every novel result discovered in the laboratory. Many of us have benefited from his enlightening advice and he will be very much missed.

André Guinier was always closely concerned with instrumentation problems; most of the work described above would not have been achieved without specific devices involving a well defined monochromatic beam of high intensity. This developed into the well known Guinier camera, which is used at the present time in X-ray laboratories worldwide. In a slightly different field, he played an inciting role in the conception of the electron microprobe (EPM), which Raimond Castaing developed into an outstanding scientific instrument.

André Guinier's teaching was on a par with his research activity. He liked to be as simple as possible in his physics lectures for undergraduates as well as when developing new concepts for his research students. His perspicacity, associated with his wide range of competence, explains the worldwide interest aroused by the publication of his books, the best known of which is certainly *Théorie et Technique de la Radiocristallographie*, a major achievement with French editions in 1956 and 1965, which was translated into English, Japanese, Russian and Chinese. After his retirement, he also spent a considerable part of his time in writing scientific books for a wide audience.

During his exceptionally long scientific career, André Guinier assumed national and international responsibilities: he was President of the French Society of Mineralogy and Crystallography (1960), President of the French Society of Physics (1962), Member of the Executive Committee of the International Union of Crystallography (IUCr) (1954–1960), Chair of the Commission on Crystallographic Teaching of the IUCr (1966–1969), President of the IUCr (1969–1972) and Immediate Past President of the IUCr (1972–1975).

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