

Obituary

## Louis Néel (1904–2000)

Louis Néel, who died on 14 November 2000 at the age of 95, was a dominant presence in French physics after the Second World War. By the time he retired in the mid-1970s, he had transformed Grenoble from a sleepy provincial backwater into a European centre for scientific research. Grenoble is now endowed with a huge nuclear centre, a first-rate technical university, a suite of specialized laboratories for the Centre Nationale de la Recherche Scientifique, a high-flux neutron reactor, and a European synchrotron radiation source. All of these, and more, Néel founded, directed or promoted.

Unusually for a Frenchman of his status, he made his entire career outside Paris, apart from four years at the Ecole Normale Supérieure, where he emerged top of the 1928 class in physical sciences.

The son of a government official, Néel spent a peripatetic childhood following his father's postings across the French provinces and North Africa, before being sent back to his native Lyons to prepare for entry to the Ecole Normale. Attracted to the study of magnetism, in 1928 he accepted an offer of an assistantship with Pierre Weiss in Strasbourg. Already present in Néel's doctoral thesis was the idea of extending his mentor's molecular field theory of ferromagnetism to understand the constant paramagnetism of certain metals whose magnetic properties were almost independent of temperature. This led him to predict the existence of antiferromagnetism — examples of which were discovered several years later — and thence to the theory of ferrimagnetism. Ferrimagnetic oxides with the Néel structure of two unequal and oppositely aligned magnetic sublattices are now used in most permanent magnets, recording media and high-frequency magnetic materials. They include the archetypal magnet, lodestone.

Néel's forte was phenomenological theory — understanding complex magnetic phenomena in terms of simple and solvable models that allowed 'back of the envelope' calculations. His work contained no profound insights into the origin of magnetism; the fundamental physics was already in place after the 1930 Solvay conference. Néel sought an understanding of the phenomena in broad physical terms rather than in mathematical detail, preferring to "explore virgin forests rather than to cultivate the vicarage garden".

At heart he was a craftsman and no follower of fashion. Once asked by Anatole



### Father of Grenoble's scientific fortune

Abraham why he had persisted with his theory of antiferromagnetism in the light of Lev Landau's prediction that only ferromagnetism was possible in nature, Néel thanked heaven he was not that smart. He enjoyed concentrating on practical issues: degaussing ships to protect them from destruction by magnetic mines; and explaining the natural magnetism of rocks in terms of the properties of oxide nanoparticles. The consequences were far-reaching. They included the establishment of the theory of global plate tectonics based on palaeomagnetic data, development of stealth bombers and the foundation of the modern magnetic-recording industry. His name is associated with a dozen concepts found in the toolkits of magnetic engineers from California to Kyoto — the Néel point, Néel structures, Néel walls, Néel's theory of superparamagnetism, induced anisotropy, exchange bias, orange-peel coupling... As a fellow Nobel laureate J. H. Van Vleck remarked in the preface to the English edition of *The Selected Works of Louis Néel* (Gordon & Breach, New York, 1988): "The name of the Place de l'Etoile may be changed, but Curie point and Néel point will forever belong in the terminology of physics."

Néel was the last of a generation of scientists who could afford to write almost entirely in French, in a sparse style with short numbered paragraphs and a disregard for units which belied a sure sense of the physical magnitudes involved.

Nevertheless, his ideas found their way first to Paris, where he was elected to the Academy of Sciences in 1952, and then to Stockholm — he shared the 1970 Nobel Prize in Physics with Hannes Alfvén.

Néel published a volume of memoirs *Un Siècle de Physique* (Odile Jacob, Paris, 1991), which offers a characteristically astute assessment of his own achievements, as well as of the foreign colleagues whom he encountered on his limited travels, and on the NATO Scientific Committee where he represented France for 20 years. Much of his book chronicles the transformation of the scientific environment in Grenoble, where he found a welcome after the Franco-German armistice in 1940. There he gathered and animated a circle of co-workers in the interpenetrating institutes with impenetrable acronyms that constitute the research and university scene in that city on the western edge of the Alps. When the Laboratoire d'Electrostatique et de Physique du Métal that Néel founded in 1945 was reconstituted as five separate laboratories in the Grenoble polygon in 1971, it was carrying out a range of work that could hardly have been divined from its original name. He foresaw the importance of large-scale facilities for condensed-matter research, not only for physics but also for biology, and ensured that Grenoble was endowed with world-class facilities for high magnetic fields, neutron scattering and synchrotron radiation. Franco-German collaboration was the key to realizing these ventures, which are a microcosm of the process of European integration. All of these institutes and the craze for winter sports have secured Grenoble's fortune.

Sensitive to the organic relation between applied science and technology, and the different perspectives of the researcher and the industrialist, there was less Néel could achieve in this area. He held patents on nanoparticulate permanent magnets and thin-film magnetic memory, but the spirit of the times frowned on the use of public resources for the benefit of private industry. Entrepreneurship was to arrive later.

Néel's success as a scientist rested on the simplicity and applicability of his ideas, and his physical insight. His success as a manager rested on a universal respect for his integrity and fairness. Never eloquent, he was thoroughly professional in all his dealings and a dogged champion of his vision for Grenoble, remaining admirably lucid and alert to the end of his long life.

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