OBITUARY

Pierre-Gilles de Gennes (1932–2007)

Pioneer of soft-matter physics.

"*Chacun en nous a son trésor d'images entrevues dans un instant mais jamais oubliées. Un exemple pour moi: Picasso peignant à grands traits blancs sur une vitre et filmé par Clouzot. Tout ce que j'ai essayé de dessiner laborieusement plus tard est né de ces moments là.*"

"Every one of us has a treasure of images caught in glimpses but never forgotten. A personal example: Picasso painting white lines on glass using large strokes, filmed behind the glass by Clouzot. Everything that I tried painting laboriously later was born from such glimpses." (Pierre-Gilles de Gennes, from *L'émerveillement* by Thibaut de Wurstemberger, Saint-Augustin, 1998.)

With his strikingly simple yet pioneering ideas, Pierre-Gilles de Gennes drew 'white lines in large strokes' that defined the physics of soft matter — liquid crystals, polymers, colloids and surfactants. He died on 18 May.

Educated at the École Normale Supérieure in Paris during 1951–55, de Gennes learned theoretical physics from the greatest masters of his time. He obtained his PhD in 1957 while at the French Atomic Energy Commission, specializing in magnetism and neutron scattering. During a stay at the University of California, Berkeley, in 1959 he studied with the solid-state physicist Charles Kittel, who taught him how to communicate ideas in physics using plain language, so avoiding the use of daunting equations.

After two years in the French navy, de Gennes founded a research group at the University of Paris, Orsay, in 1961. Working on superconductivity, he became a self-proclaimed "theoretician of the tangible" — a theoretical physicist who works closely with experimentalists. But it was in 1967 that he started on work in the area that made him famous, creating the Orsay Liquid Crystals Group. Assembling a group of specialists from the fields of optics, crystallography and magnetism, along with theoreticians, he formed a truly multidisciplinary team.

De Gennes fostered a collective research effort that is scarcely imaginable today. Papers were signed not with the names of individuals, but with the name of the group. Theoreticians would spend half their time contemplating liquid crystals under the microscope and discussing practical experiments. Researchers would often arrive in the morning to find a note from de Gennes that would launch them in yet another ground-breaking direction. Calling on his vast knowledge of physics, de Gennes drew analogies between different fields. For example, he realized that laws developed to describe superconductivity phenomena could be used to understand phase transitions in liquid crystals.

His nomination to the prestigious Collège de France in 1971 coincided with the end of his liquid-crystal research and the beginning of his work on polymers. Over the next three decades, de Gennes gave a series of public lectures on a different subject each year — colloids, granular matter and adhesion, to name just a few. While lecturing on phase transitions, de Gennes discovered the analogy between the conformations of polymer chains and the alignment of magnetic moments at a magnetic phase transition. This so-called '$n = 0$' theorem turned polymer physics upside-down, allowing theories of phase transitions to be applied to polymers and earning him the Nobel prize in 1991.

De Gennes was a proponent of the idea that diverse phenomena could be analysed with scaling arguments — that problems could be simplified by invoking a characteristic time and length scale. This approach helps get to the heart of a problem and guides experiments. During this period, he started to use images to explain his ideas, and found creative language to describe these images. Each theory based on scaling arguments became the subject of a drawing. For instance, he likened a polymer solution to a fishing-net and called the mesh a 'blob'. If our focus zooms in on a blob, we see the characteristic behaviour of an isolated polymer chain. But if the perspective zooms out sufficiently, we find another limit, that of the entangled polymer chains, which are composed of strings of independent blobs. The concept of blobs allows both the statics (equilibrium behaviour) and dynamics of polymer solutions to be calculated.

Another example is de Gennes' description of polymers adsorbed onto liquid–air or liquid–solid interfaces: he drew a fractal grid that allowed the theoretical concentration profile to be solved in a single line. Finally, his 'reptation' model describes how a polymer chain can snake through a tube formed by surrounding molecules. In this way, the viscoelastic properties of polymer melts can be described by a few simple equations.

In 1980, de Gennes turned his attention to the science of colloids and wetting, collaborating closely with industry. Intrigued by the process of assisted oil recovery — in which polymers or surfactants are injected into oilfields to aid the flow of oil — he plunged into the physics of wetting. By devising numerous "easy experiments"

(as he put it), de Gennes elucidated the spreading dynamics of drops on surfaces; the wetting behaviour of films; and the laws that govern aquaplaning by cars.

The final phase of de Gennes' career began in 2002, when he joined the Curie Institute in Paris. Here he studied two topics at the forefront of biology: cellular adhesion and memory formation. He took the same approach to biology as he had to industry — faced with problems of apparently insurmountable complexity, he isolated the few essential parameters to derive minimalist theories that could be used and tested.

De Gennes pursued his research with extraordinary imagination, insatiable curiosity and an ability to grasp facts rapidly. But he also gave his time to others and helped them develop their ideas. A keen ambassador of science to the public, he generated passionate debates on subjects as diverse as "Physics and Medicine", "Inventors" and "Primo Levi". He inspired generations of students to pursue careers in physics and played an active role in establishing the L'Oréal–UNESCO Awards for Women in Science.

Pierre-Gilles de Gennes leaves seven children, three born to Anne-Marie de Gennes and four born to me. His scientific legacy is the enduring stamp he has left on intellectual life in France and internationally on the study of the physics of so many diverse phenomena. Thanks, Pierre-Gilles, for sharing with us your insatiable love for science.

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