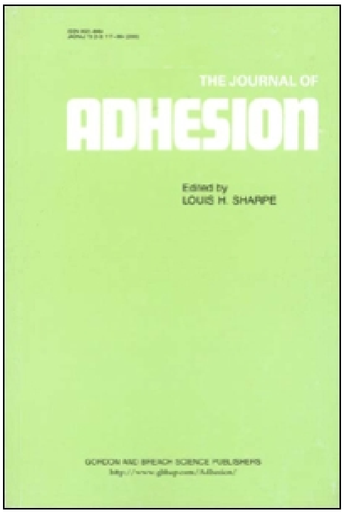

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Obituary: Pierre Gilles de Gennes

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OBITUARY

Pierre Gilles de Gennes

The whole scientific community was deeply affected by the death of Pierre Gilles de Gennes, on May 18th 2007, in Orsay, in his home, in the South suburb of Paris.

He was 74, and had been struggling against a cancer for several years. Despite the sometime exhausting treatments, he was still scientifically active and, a few days before his death, he was still present at Institut Curie, in Paris, where he had moved after he retired from College de France in 2004.

Pierre Gilles de Gennes' work was recognized by his selection for the Nobel Prize in physics in 1991. He was the recipient of The Adhesion Society Award for Excellence in Adhesion Science sponsored by 3 M in February of 2000, "for his contribution to the understanding of molecular mechanisms of adhesion, especially through the notion of connector molecules."

Pierre Gilles de Gennes was born in Paris in 1932 and he received his early education at home, due to the Second World War which obliged his mother to live away from Paris in the Alps for some time. He later attended Ecole Nomale Supérieure in Paris, where he received a cross disciplinary education in Physics and Life Sciences. He obtained his Ph.D. in physics in 1957, working on neutron scattering and heli-magnetism, at the French Atomic Energy Commission (CEA) in Saclay. In 1959, he performed a postdoctoral stay with Charles Kittel at the University of California, Berkeley, which he said was fully determining for the rest of his career, as he discovered there the excitement of being at the leading edge of science. He then joined the University of Paris Sud-Orsay in 1961 as a Professor, and started a research program in Solid State Physics, in the young and fast developing laboratory created by J. Friedel a few years before. He started to demonstrate his original way of managing research by creating and animating in the "Laboratoire de Physique des Solides", a research group mixing theoreticians and experimentalists all working together on superconductivity. In 1968, de Gennes changed the direction of his research toward Liquid Crystals, developing a new group (again mixing theoreticians and experimentalists) named "Orsay

Liquid Crystal Group”. I myself started my career with the beginning of the adventure of that Orsay Liquid Crystal Group, as an experimentalist, and started to experience the strength of working in close collaboration with young theoreticians like Françoise Brochard–Wyart, for example. Our collaboration has never stopped since those early days, and we can still experience the pleasure of discussing challenging questions raised by strange and provoking experimental results. In October 1971, de Gennes was nominated Professor at College de France, and he decided to build a new lab there, again mixing theoreticians and experimentalists, the “Laboratoire de Physique de la Matière Condensée”. He attracted there several scientists he had been working with in Orsay (I joined this lab myself in 1976). He soon started a collaborative research project in polymer physics with researchers at the University of Strasbourg and CEA Saclay. The joint project became known as STRASACOL and was illustrated by quick advances in the understanding of the behavior of concentrated polymer solutions, based on the development of the scaling approach of these systems. In 1976, while still running the lab in College de France, Pierre Gilles de Gennes was named director of the “Ecole Supérieure de Physique et de Chimie Industrielle de la ville de Paris”, a renowned engineering school in Paris, in which he initiated a full renewal of the content of the lectures, in order to prepare students to develop imagination and innovation. In 1984, de Gennes turned his attention to interfacial problems. His research group in College de France defined general laws of wetting and dewetting, explaining how liquid droplets behave on rough and smooth surfaces. In 1989, he began working in the physical chemistry of adhesives, which was a natural extension of the work he had developed on both interfacial phenomena and polymers.

In the late 1990s, de Gennes started working on granular materials and the glass transition. He retired from College de France in 2004, and moved to Institut Curie, where his scientific activity continued, more oriented towards biological questions, until his death.

Pierre Gilles de Gennes leaves an impressive life’s work, which covers wide and varied areas of Condensed Matter Physics. He has progressively contributed in the creation of the now well identified field of Soft Matter Physics, investigating complex systems not really considered as interesting by physicists before him (polymers, colloids, liquid crystals, surfactants, granular materials. . .). He totally renewed the vision of these fields. He was quite generous in disseminating his ideas. His lectures in College de France attracted scientists from all around the world, and a number of colleagues from the United States, from England, from Japan, expressed on the occasion of his death how deeply they had been influenced by their postdoctoral stay in the "Laboratoire de la Matière Condensée" in College de France.

Pierre Gilles de Gennes had an incredible curiosity for science, and he was always enthusiastic for new subjects and new ideas. I perfectly well remember him coming to my office on an evening in 1971. He was just back from a meeting of the American Physical Society where he had discovered the Wilson approach to phase transitions based on Renormalization Group Theory. He immediately had an intuition of the importance of that approach for solving the question of concentrated polymer solutions that he had started to investigate several years before but had left aside, not having at hand the tools to overcome the known limitations of the mean field approximation. In my office that evening he was excited, and needed to share this excitement with someone. I was a young PhD student, far from being able to understand the importance of what he was sharing with me, but I perfectly well remember the convincing strength he had, and my intuition that I should certainly change subjects, leave the field of phase transitions in Liquid Crystals, in which I was working at that time, to develop new experiments in polymers (what I did, indeed, a few years later, after having obtained my PhD under Pierre Gilles' supervision). Quite quickly following that evening (a few weeks), he produced his "$n = 0$" theorem, opening the path to the scaling approach of polymers solutions, one of his main contributions to polymer physics, which appeared first as a revolution in the field, and is now considered as classical, and taught at University. This discovery was one of the major points of his achievements mentioned in the quotation of his Nobel Prize.

Age and illness did not alter this enthusiasm and this curiosity: after retiring from College de France and joining Institut Curie, he started exploring new fields in neurosciences and in bio-adhesion. Several papers are presently in press on these questions.

Another characteristic of the style of research promoted by Pierre Gilles was relying on his conviction that, at least qualitatively, things could always be explained in simple terms, which could be understood by anyone, theoreticians, experimentalists, industrials, students, and even non-scientists. He had a certain genius in inventing images to make things easily understandable. The concept of Reptation, another of his big achievements in polymer physics, is a good illustration of that: the original paper of 1971 in which he first presented these ideas contains quite complicated calculations, but a number of scientists now using the concept of Reptation essentially rely on the image more than on the calculations. He was also particularly efficient in developing analogies between different fields of physics, and in transposing to a new field concepts well established in another one. A good example of this is the analogy he developed between superconductors and smectic liquid crystals. He was convinced that physics at the higher level has to be concerned with practical questions, and he often developed fundamental descriptions starting from industrial questions. The case of his work in adhesion and friction is a good example of that. Starting from practical questions, he developed a vision at the molecular scale of the mechanisms by which polymer molecules, strongly anchored to a surface, that he named "connector molecules," could promote adhesion and friction by being strongly stretched under the mechanical influences to which they were subjected. The enhancement of adhesion due to such molecules corresponds to the stretching energy which is lost after the opening of the fracture, and can be controlled by adjusting the length and the surface density of these connector molecules. A second seminal contribution of de Gennes in the field of adhesion was to describe the contribution of viscoelastic losses in enhancing adhesion, based on the remark that, as one moves from the fracture tip in the opened part of the fracture, the material has more and more time to relax and change from a high to low frequency modulus. This is reflected in the shape of the open part of the fracture, and was named by de Gennes the "viscoelastic trumpet". In many situations, the adhesive strength is dominated by the total energy dissipated in the whole volume of the sample in which the modulus relaxes from high to low. It is then possible to design the adhesive (both for its material properties and for its geometry) to reach a chosen level of adhesive strength at a given speed of the fracture opening.

Pierre Gilles de Genes was always highly reactive. I have in mind several examples of questions that we asked him on a Friday afternoon, after having turned and turned experimental results in all ways without being able to understand what was going on and, on Monday morning, he came to us with a paper almost written, quite often containing the essential lines of the explanation or of further investigations. When he could not find a coherent explanation, he loved to make conjectures, which sometime would be revealed as essentially correct, but it could take years to establish it. This was, for example, the case for the behavior of surface anchored polymer molecules in friction, for which he proposed a conjecture in 1979, and for which the behavior was elucidated experimentally and theoretically thirteen years later.

Pierre Gilles de Gennes was a member of the French Academy of Sciences, the French Academy of Technologies, the Dutch Academy of Arts & Sciences, the Royal Society, the American Academy of Arts & Sciences, and the U.S. National Academy of Sciences.

He was not only a unique and giant scientist, but also a rare personality from a human point of view. He was able to pay attention to people, not only for what they could bring in science, and he never refused a discussion, even with young students. His impact on the science of soft matter and especially polymers will certainly continue to be spread through the many people he has deeply influenced. We all miss him.

Thank you Pierre Gilles.

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