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**In memoriam Prof. Dr. Michel Perrut (March 29,
1947–July 7, 2018)**

Elisabeth Badens, Stéphane Sarrade, Jacques Fages, Gerd Brunner, Erdogan
Kiran

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In memoriam

Prof. Dr. Michel Perrut (March 29, 1947–July 7, 2018)



Professor Michel Perrut, passionate scientist and pioneer in the field of Supercritical Fluid Engineering, passed away on July 7th, 2018. It is with deep gratitude that we remember him here.

Prof. Perrut dedicated his professional life to promoting, disseminating and developing Supercritical Fluid (SCF) technology all over the world. He did this successfully, donning many different professional caps, not only as a scientist and researcher in industry and academia but also as the head of a renowned engineering school and as a shrewd businessman, supercritical equipment supplier and service provider for supercritical research and development projects. These different experiences led to a prolific scientific career, with a legacy of about 150 publications or communications and 50 patent applications. But above all, Michel Perrut was a leader. An entire generation of chemical engineers and Ph. D. students were inspired by his work, and by his advice and vision of a green economy driven by science.

Michel Perrut started out as a graduate of the Ecole Polytechnique (Paris, 1968) obtaining a doctorate in 1972 with a dissertation on *Hydrodynamics and mass transfer in liquid-liquid extraction*. From then onwards, he embarked upon an outstanding and varied professional career. Starting as an R&D scientist in the oil refining industry, he then became Professor in Chemical Engineering at the Ecole Nationale Supérieure des Industries Chimiques (ENSIC, Institut Polytechnique de Lorraine, Nancy) where he later served as Director from 1979 to 1983. It was during this time that he founded his Laboratory on Supercritical Fluid Applications, focusing his research activities on extraction, fractionation and chromatography. He left a lasting impression at ENSIC as

an exceptional teacher, remembered for his unwavering drive to share his knowledge. This character trait accompanied him throughout his life, giving rise to vocations among his students and inspiring many of his collaborators.

In 1985, a pivotal year in his career, he founded SEPAREX as a start-up company focusing originally on separation science. From that point onwards and for the next thirty years, Prof. Perrut consistently devoted his experience, energy and time to developing the use of supercritical fluid technology, designing and selling equipment dedicated to a wide range of SCF applications. SEPAREX has undergone various changes over the last thirty years but Michel Perrut's involvement remained constant and contributed to the expansion of SCF technology in industry and in the academic world.

In the early 1990's, in close cooperation with the CEA (French Atomic Energy Commission), he advanced the use of SCF at industrial scale with the development of platforms and industrial plants in Grasse (the leading place for perfume and aroma in France) and created the HITEX company.

Throughout his experience as a supplier, Michel Perrut remained convinced that there was a real need for industrialists to have access to experimental platforms with pilot and industrial scale facilities. Indeed, such platforms can be used to study scale-up effects, by producing initial batches, and subsequently even industrial batches, without requiring the need to invest in an industrial unit. In light of this, in 2010, Michel Perrut, together with his son Vincent, created the start-up Atelier Fluides Supercritiques (AFSC), still currently in activity.

In 1988, at about the same time as he embarked on his entrepreneurial activities, he founded the International Society for the Advancement of Supercritical Fluids (I.S.A.S.F.), a learned society dedicated to supercritical fluids. The main activity of the society consists in disseminating information and facilitating exchange between the different actors of SCF, both from public institutions and industrial companies, through the organization of scientific meetings. Michel Perrut organized the first International Symposium on Supercritical Fluids in 1988 which was held in Nice, France. With this meeting and the foundation of I.S.A.S.F., he provided a sustainable format for the presentation and discussion of all aspects of supercritical fluids.

Thanks to the involvement of Michel Perrut over the past three decades, there are now three series of successful scientific meetings focused on SCF fundamentals and applications:

- **The International Symposia Series** (Nice-France, 1988; Boston-USA, 1991; Strasbourg-France, 1994; Sendai-Japan, 1997; Atlanta-USA, 2000; Versailles-France, 2003; Orlando-USA, 2005; Kyoto-Japan, 2006; Arcachon-France, 2009; San Francisco-USA, 2012; Seoul-South Korea, 2015; Antibes-France, 2018).
- **The European Meeting Series** (Pont-à-Mousson-France, 1987;

Paris-France, 1991; Grasse-France, 1996; Villeurbanne-France, 1997; Nice-France, 1998; Nottingham-UK, 1999; Antibes-France, 2000; Bordeaux-France, 2002; Trieste-Italy, 2004; Colmar-France, 2005; Barcelona-Spain, 2008; Graz-Austria, 2010; The Hague-Netherlands, 2011; Marseilles-France; 2014; Essen-Germany, 2016; Lisbon-Portugal, 2017).

- **Seminar on Aerogels Series** (Hamburg-Germany, 2014 and 2018; Nice-France, 2016).

Prof. Perrut was deeply involved in the organization of most of these events. With the help of Mrs Françoise Brionne, he spent a lot of his time ensuring that the events would be a success. These meetings, which reflect his dedication to the field, have advanced our understanding and application of supercritical fluids and provided opportunities for strong networking among scientists and engineers. Michel Perrut was not only a strong proponent of this field of research, but also a great supporter of younger researchers, making them feel especially welcome at these meetings. He established a best PhD prize which is awarded during the ISASF. He chaired the latest International Symposium held in Antibes in April 2018, thirty years after the creation of ISASF and after the first International Symposium held in Nice. All the members of the “supercritical community” will forever remember Michel Perrut’s pleasure in bringing them together 30 years after the very first international event.

In 2006, Michel Perrut was also the co-founder of *Innovation Fluides Supercritiques (IFS)*, a French non-profit organization gathering scientists and industrial players in the field of supercritical fluids, promoting SCF technologies all over the world.

Throughout his career, Prof. Perrut produced a constant stream of rich scientific research. The impressive number of patents in his name demonstrates his inventiveness and creativity. His inventions brought valuable solutions for various fields of applications. They are linked to separation processes, and different innovative methods for particle generation and recovery, encapsulation, coating, impregnation as well as paper processing or viral inactivation that involve the use of sub- or supercritical fluids. Prof. Perrut’s dedicated research and development work has led to new applications and even to new fields of applications for SCF. He successfully transferred his ideas from laboratory to demonstration and industrial production scale, and the foundation of several companies was the outcome of these efforts. He tackled difficult problems occurring mainly within the scaling-up of processes. Besides

his numerous patent applications, Prof. Perrut authored or co-authored a large number of publications or communications, often linked to concrete examples of applications for SCF technology. He published comprehensive and impactful reviews, such as a review on particle generation using SCF (J. Jung & M. Perrut, *Particle design using supercritical fluids: Literature and patent survey*, Journal of Supercritical Fluids, 20 (2001) 179–219) and a recent review on sterilization (M. Perrut, *Sterilization and virus inactivation by supercritical fluids (a review)*, Journal of Supercritical Fluids, 66 (2012) 359–371). He was one of the first scientists to highlight that the biocidal effect of SC CO₂ can be advantageously exploited for a large number of applications.

This portrait would be incomplete if we were not to mention his exceptional oratory skills. Prof. Perrut gave oral presentations throughout his professional life, not only sharing his experience on industrial applications but also introducing less applied results and more fundamental thoughts. Even recently, he gave a presentation on a subject with very little data in the literature: the solubility of solutes in supercritical fluids above 100 MPa (11th International Symposium on Supercritical Fluids, Seoul, South-Korea, October 2015).

For all of these reasons, Prof. Perrut was a pathfinder and a guide for many scientists. He was a pioneer in the field of Supercritical Fluids and helped to organize and strengthen our community. He will be sadly missed.

Elisabeth Badens*

Aix Marseille Univ, CNRS, Centrale Marseille, M2P2 UMR 7340, 13451
Marseille, France

Stéphane Sarrade^{a,b}

^a CEA/DEN, Université Paris-Saclay, Gif-sur-Yvette, France

^b Innovation Fluides Supercritiques, Valence, France

Jacques Fages

Centre RAPSODEE, IMT Mines Albi, CNRS, Université de Toulouse, 81013
Albi, France

Gerd Brunner

Technische Universität Hamburg-Harburg (TUHH), Hamburg, Germany

Erdogan Kiran

Virginia Tech, Blacksburg, VA, USA

E-mail address: Elisabeth.badens@univ-amu.fr (E. Badens)

* Corresponding author.