Yves COUDER
1941 - 2019

Yves Couder passed away at age 78 on April 2, 2019 in Paris, surrounded by his wife Lorna and their two children Jeanne and Julien. Many of his friends and colleagues attended the memorial and burial ceremonies held on April 8.

He was Professor of Physics at the Denis Diderot University in Paris and a member of the French *Académie des Sciences*.

Upon completing his doctorate in Physics at the University of Paris in 1965, Yves moved to *Ecole Normale Supérieure* where he created and fostered the growth of a talented and thriving research team until 2006. In 1985, he also became Professor of Physics at the Paris-Denis Diderot University. As of 2006, his research activities moved there within the *Matière et Systèmes Complexes (Matter and Complex Systems)* laboratory. He played a pivotal role in the foundation and establishment of this new lab.

Yves Couder's research achievements in Fluid Dynamics are simply stellar: he has made pace-setting and truly seminal contributions in several important areas of the field by conceiving extremely elegant and deceptively simple experiments. Here are some of his most striking accomplishments in Fluid Physics and in closely connected areas.

Soap films, dynamics of vortices and two-dimensional turbulence: Yves Couder and colleagues (Couder & Basdevant, 1986; Couder, Chomaz & Rabaud, 1989) were the first to introduce soap films as an original setting to study the dynamics of vortices and the properties of two-dimensional turbulence. In particular he was able to observe and characterize the inverse energy cascade predicted by the theory of two-dimensional turbulence. This very productive analogy subsequently led to the development of other soap film experiments in several groups in the USA and Europe.

Three-dimensional turbulence and vortex filaments: Yves Couder and colleagues (Douady, Couder & Brachet, 1991) were also the first to detect and characterize intense vortex filaments in three-dimensional turbulence. They showed that such filaments, referred to as the *sinews of turbulence* by Keith Moffatt, are responsible for the production of low-pressure bursts in the so-called *French washing machine* experiment.

Saffman-Taylor fingering: This phenomenon refers to the formation of fingers at the interface between two fluids when a more viscous fluid is displaced by another less viscous fluid. Yves (Couder, Gérard & Rabaud, 1986) demonstrated that the application of singular perturbations at the tip of the finger is sufficient to influence the selection process that determines the finger configuration.

Ferromagnetic drops, morphogenesis and the growth of plants: The spiral patterns displayed by plants may be explained by appealing to the properties of Fibonacci sequences and the Golden Mean. Yves has confirmed these features by studying in detail the spiral patterns formed by the arrangement of seeds in the central bud of sunflowers (Douady & Couder, 1992; 1996). Here again he proposed a striking analogy between this process and pattern formation in a collection of ferromagnetic drops. This fluid experiment led to a global interpretation of the observed patterns: the system of drops tends to a configuration based on irrational numbers since, during the pattern formation process, it is observed to avoid rational numbers.

Particle-wave duality in drop dynamics: In his last years, Yves Couder was engaged in a comprehensive investigation of the dynamics of drops that bounce on a liquid interface subjected to periodic vertical oscillations (Faraday experiment). This set-up revealed the existence of a dynamic coupling between the vertical motion of the bouncing drop and the gravity wave field which it generates (Couder, Protière, Fort & Boudaoud, 2005; Protière, Boudaoud & Couder, 2006). The study of this phenomenon has led to fascinating macroscopic analogs of G.I. Taylor's single-photon experiment and de Broglie's electron diffraction experiment (Couder & Fort 2006). Chaotic régimes were more recently identified (Perrard, Labousse, Fort & Couder, 2014) and Yves' pioneering studies have triggered further important research by John Bush at MIT.

Yves' creativity was exceptional and he had a special talent for detecting profound analogies between seemingly very distinct fields. He has had a profound impact on colleagues and young brilliant researchers both in the US and in Europe, and they constitute what may rightfully be called an informal Couder school of macroscopic physics.

Yves received many distinctions. Among them the 2012 Fluid Mechanics Prize of the European Mechanics Society. The prize citation read: *For experiments in fluid mechanics which are novel, elegant, deep and provocative*.

Yves Couder is sorely missed in our community but for years to come, he will remain a vibrant source of inspiration…

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