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Henri Edouard Audier (1940–2016)



Henri-Edouard Audier at la Ciotat (photo Florence Audier 2016).

Henri Edouard Audier was born on February 18, 1940 in La Ciotat, a city on the French Mediterranean coast where he later returned every summer. He obtained his first scientific degree at the Ecole Normale Supérieure in 1962. Henri began research as “attaché de recherches” in the team of Marcel Fétyzon at the Institut de Chimie des Substances Naturelles (ICSN) in the Centre National de la Recherche scientifique (CNRS) in Gif sur Yvette. In 1966, Henri presented his thesis on the use of mass spectrometry for the structural determination of natural products. In 1970, Marcel Fétyzon created the “Laboratoire de Synthèse Organique” at the University of Orsay, which later moved to the Ecole Polytechnique in Palaiseau in 1974. Henri-Edouard Audier directed the mass spectrometry group in this laboratory until 1985. During the reorganization of the chemistry laboratories at the Ecole Polytechnique, the “Laboratoire des Mécanismes Réactionnels” was created. Henri was first co-director of this new entity and was made full director in 1989, a position he held until his retirement in 2002 with the title of “Directeur de Recherches émérite”. Over the course of his forty yearlong scientific career, Henri directed ten Ph.D. students (Yannik Hoppilliard, Guy Bouchoux, Jean-Claude. Tabet, Chaid Moustapha, Dorothée Robin-Berthomieux, Candida Monteiro, Piétrick Hudhomme, Valérie Troude, Guillaume van der Rest, Hristo Nedev) and the same number of post-doctoral fellows. Henri published over 200 articles and established scientific collaborations and strong friendships with numerous foreign colleagues including: Steen Hammerum (University of Copenhagen), Robert Flammang and André Maquestiau (University of Mons), Thomas Morton (University of California, Riverside), and Terry McMahon (University of Waterloo).

During his time at the ICSN, Henri employed mass spectrometry to determine the structure of various natural products such as terpenes, steroids, flavonoids and alkaloids. Among his most prominent results was the demonstration of the influence of

stereochemistry on the fragmentation of ethylenic or polycyclic saturated ring systems. Henri also pioneered the introduction by microderivatization of appropriate functional groups, such as ethylene acetals, into molecules such as keto-steroids and keto-terpenes, in order to simplify their mass spectra. In 1969, Henri published a paper (*Organic Mass Spectrometry*, 2, 283–298) where he demonstrated the applicability of Stevenson’s rule to fragmentations leading to neutral and ionized molecular species. The corresponding fragmentations included McLafferty and retro-Diels-Alder rearrangements, cross-cleavage of four membered rings, and retro-ene fragmentation. This generalization of the Stevenson’s rule is now known as the “Stevenson-Audier” rule.

In 1977, Henri had the opportunity to use chemical ionization on one of the mass spectrometers at the ICSN where he performed a series of studies on simple molecules including aldehydes, ketones, esters, oxiranes, oxetanes, alcohols, ethers, and aromatics. Henri demonstrated the occurrence of several types of molecular rearrangements on the corresponding protonated species, in particular processes involving hydrogen, alkyl group and aryl group migrations.

The year 1980 saw the arrival of one of the first VG ZAB 2F mass spectrometers at the Ecole Polytechnique. This was for Henri the starting point of series of studies on metastable ions using MIKE and CID-MIKE techniques on ions coming from various classes of molecules such as amines, ethers, carboxylic acids, esters, aromatics, and furans. Most of these molecules, and their isotopically substituted variants, were prepared by close collaborators of Henri: Arielle Milliet, Jean-Pierre Denhez, and Georges Sozzi. From the important amount of results accumulated during this period, Henri was able to show that extensive skeletal rearrangements may occur in cations of low internal energy. He proposed isomerization mechanisms involving hydrogen migrations, reversible ring expansion-contraction, and reaction steps (substitutions, additions, exchanges) occurring inside isomeric forms such as ion-neutral complexes and distonic ions.

For several years, Henri championed a project to buy a Fourier transform ion cyclotron resonance mass spectrometer. This was accomplished in 1989, when a Bruker CMS 47X mass spectrometer equipped with an external EI/CI source and controlled gas inlets was installed at the Palaiseau laboratory. Until 2002, this new equipment was an opportunity for Henri to improve and complete previous studies and to examine new ion-molecule systems. Danielle Leblanc and Philippe Mourgues were key participants in these experiments as well as Julia Chamot-Rooke and Jacques Fossey who, in parallel, performed quantum chemical computations. Among the various ion-molecule reactions studied by Henri during this period one may cite alkene displacements, nucleophilic substitutions, hydrogen exchanges between oxonium, carbonium or carbene cations and small monofunctional molecules such as alkenes, alcohols, ethers, and benzene. Henri’s final work included studies on the chemistry occurring inside protonated adducts (for example water elimination from $(ROH)_2H^+$ complexes), or

on the strange reactivity of the $[\text{H}_2\text{O}, \text{NH}_3]^{++}$ complex, and selective preparation and examination of the reactivity of mono- and di-solvated ions (a typical example is the solvent catalyzed keto-enol tautomerisation).

To finalize this brief overview of Henri Edouard Audier's career, emphasis must be placed on his considerable involvement in promoting scientific research in France. In fact, Henri was both a researcher and an activist. As early as 1960, Henri was involved in UNEF and SNCS, the unions representing students and CNRS researchers, respectively. He was an active member of the national board of the SNCS up to his death. Henri was also co-founder of the movement "Sauvons la Recherche" created in 2003. Further, he was staff representative on the Ecole Polytechnique and CNRS administrative boards for more than ten years, and a member of the "Conseil Supérieur de la Recherche et de la Technologie" whose

mission was to give advice to governments regarding public research and technology. In 2010, Henri started a blog (<http://blog.educpros.fr/henriaudier/>) where he expressed his opinions, advice, and humor about research in France. Last, but not least, Henri's interest in social and cultural issues should be mentioned. Henri was a lover of art, particularly modern painting and architecture. Every scientific meeting was an occasion for him to visit a museum or church.

Henri Edouard Audier passed away October 9, 2016 after several years of battle with cancer. With Henri's passing, the mass spectrometry community has lost one of its most prominent historical members. And the scientific community as a whole has lost an ardent defender of fundamental research. Henri is survived by his wife Florence, partner of more than half a century, and their two children, Serge and Agnès-Corinne.

Guy Bouchoux.