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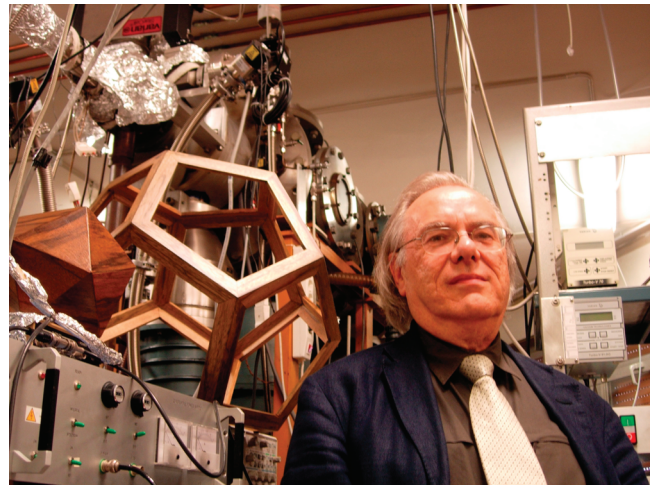

His Arrows and His Targets: A Tribute to Vincenzo Aquilanti

We and all of Vincenzo Aquilanti's colleagues and friends who have contributed to this special issue of *The Journal of Physical Chemistry A* are very pleased to dedicate it to recognize his long outstanding career of contributions in Chemistry, Physics, and Mathematics. Professor Aquilanti is known to many of us as Enzo, but the Latin community also knows him with the nickname Aquila which means "eagle" in Italian. This tribute comes from the following people: From one of his first collaborators from his days in Rome and in Perugia (Franco Vecchiocattivi), one of his scientific mates and life-long friend from his time at Harvard (Roger Anderson), one of his first students and current colleague at the University of Perugia (Piero Casavecchia), and a more recent collaborator and friend from Japan (Toshio Kasai), who together aim at highlighting some of Enzo's important scientific contributions that cover both experiments, molecular and ion beam studies of elementary chemical processes, and theory, ranging from the more mathematical aspects to those dealing with computational quantum and classical approaches to problems in chemistry and in atomic and molecular physics.

Enzo grew up in Rome living in an apartment that he still owns to this day. He attended a "classical" high school as opposed to a "scientific" one. His preference for a liberal arts education undoubtedly greatly influenced his future scientific work. He graduated from the University of Rome in 1963 with a degree in Chemistry. During his time at University he studied experimental methods for investigating the kinetics of gas phase reactions with gas chromatography and innovative high pressure mass spectrometry with G. G. Volpi. During a period at Harvard (1967−1968) with Dudley Herschbach, Enzo worked with a young Ph.D. student (Roger Anderson), and at that time met Yuan T. Lee who was also working on his postdoc. At Harvard, Enzo learned the basic tools of the molecular beam technique, and since his return to Italy in 1969 he collaborated on the introduction of this technique at the University of Perugia by building several productive molecular beam machines. Throughout his years in Perugia he has also developed well-recognized theoretical skills that have attracted not only physical chemists, but also atomic, molecular, and theoretical physicists and mathematicians, who come as regular visitors from all over the world in a common effort to tackle basic and unsolved problems in atomic and molecular physics.

In one of the first machines that Enzo constructed in Perugia (you can see a schematic of it in the Front Cover), use of the technique of crossed atomic and ion beams coupled with spectroscopic emission detection lead to the discovery of phenomena of polarization and interference in energy transfer collisions. In 1974 Piero Casavecchia had the luck and opportunity of being introduced as a student to the wonders of molecular beam research with Enzo working on this apparatus. In the 1980s, Enzo developed an original technique of magnetic analysis for the polarization states of spin and orbital angular momentum of atoms such as the halogens, oxygen, and sulfur. The characterization of their interactions provided valuable

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information on the initial phases of elementary chemical reactions. From the 1990s, after discovering features of rotational alignment in supersonic expansions, Enzo exploited them for scattering studies, characterizing intermolecular forces and their anisotropy in many systems. This work provides much understanding of the nature of weak chemical bonds and for the assessment of the role of clusters in important environments, such as atmosphere. The focus of his theoretical activity, motivated and developed in parallel to the experimental one, has been on the quantum treatment of those phenomena occurring in elementary chemical processes, where the behavior of the motion of nuclei is at the borderline between quantum and classical. Together with his collaborators, he dedicated a major effort to the exact treatment of a chemical reaction as a quantum mechanical problem by the technique of hyperspherical coordinates and harmonics, developing analytical tools and original algorithms.

His current experimental activity continues to exploit the established phenomenology of molecular alignment to study the nature of weak intermolecular forces and the transition to the effective chemical bond; the theoretical-interpretative search led him to the formulation of discrete representations, particularly efficient in the elaboration of programs for the calculation of elementary chemical processes, but also remarkably useful for the formulation of ortho-normal (Sturmian) orbitals as basis sets in quantum chemistry. Currently Enzo's other interests are on natural and electric hexapolar alignment techniques for chiral molecules; on classical many-body approaches as a novel perspective for nanoaggregate dynamics; and on the semiclassical formulation of angular momentum and spin network techniques of relevance beyond atomic and molecular physics for the fields of quantum computing and quantum gravity.

Enzo's major scientific achievements in the fields of radiation chemistry, of ionic reactions in the gas phase, of elastic, inelastic, and reactive collisions between atoms and simple molecules, and of quantum and semiclassical physical chemistry are represented by more than 350 articles in scientific journals and as chapters in various books.

In 2005, Enzo was elected to "The National Academy of Sciences" (also known as "Accademia dei XL"), which since 1782 has brought together many illustrious Italian scientists. Very recently (2009), Enzo's achievements have been recognized by his election as a member of the older and quite famous "Accademia dei Lincei". The dedication to him (together with Dieter Gerlich and Carl Lineberger) of the 2009 International Symposium on Molecular Beams, held in Dalian, China, was certainly most appropriate and deserved.

Enzo has educated more than 40 students to their master degree in chemistry and supervised more than 20 doctoral dissertations. He also hosted numerous postdocs from Italy, Europe, and extra-European countries. All of these scientists have benefited greatly and received deep inspiration working with Enzo. Many of his former associates now hold academic positions both in Italy and abroad. With boundless enthusiasm and dedication over the past 40 years, Enzo has played a central role in promoting high-level experimental and theoretical research on the dynamics of elementary processes in Italy. In particular, over several decades he has greatly inspired and guided the growth of the Perugia Molecular Beam group, something that has always been close to his heart.

Franco Vecchiocattivi. When I began studying chemistry at the University of Rome in 1963, I joined a group of about 20 students, which included as a tutor, freshly graduated Enzo Aquilanti. He taught us how to solve stoichiometry problems and lead us to our first contact with a real chemistry laboratory. A few years later, I started to work as undergraduate in the laboratory of Professor Volpi, where Enzo at that time was involved in studying ion−molecule reactions using high pressure mass spectrometry. I spent about two years in the laboratory of Professor Volpi but interacted with Enzo only during the first year, because the second year Enzo was at Harvard. When he came back to Italy, the laboratory was moving to Perugia because of the new appointment of Professor Volpi with the hope of beginning work with molecular beams. I had just graduated and accepted to join the Perugia group for this new adventure. Enzo came back from Harvard with great enthusiasm about reaction dynamics and was spending much time telling me about the many wonderful possibilities of the molecular beam technique. I remember that particular time as one of the most exciting times of my life. We were spending plenty of time thinking about possible experiments, drawing schemes of possible apparatuses on the blackboard. But finally we assembled real apparatuses and the even more exciting period of real experiments started. I will be always grateful to Enzo for all that he has taught me from the beginning of my interest in chemistry up to the present.

Piero Casavecchia. I am very grateful to Enzo for introducing me to the wonders of scientific research in molecular beam dynamics. In particular, I am especially grateful for suggesting in 1977 that I work with Yuan T. Lee in Berkeley as a postdoc. Certainly this proved to be a key step for my future scientific career. I acknowledge Enzo's (as well as G. G. Volpi's) strong and generous support in setting up my crossed molecular beams laboratory in Perugia in the early 1980s after my return from Berkeley and his continuous support and encouragement over the years. I truly believe that Enzo stands as a virtuous example to follow for his deep and sincere commitment to science, and I feel fortunate enough to have had him "next door" for the past 30 years. For sure, I learned to work hard from him - every time I went to the lab on weekends I found Enzo there (it was never clear who was checking on whom!).

Roger Anderson. I remember well when Enzo arrived at Harvard in 1966, and I was especially happy that he was willing to work with me on a new experiment to study collisional excitation of accelerated alkali atoms in collisions with rare gas atoms and diatomic molecules. Initially his English needed some work, and he knew little about molecular beams and nonadiabatic processes. However, I was greatly impressed by how rapidly Enzo learned all that was necessary to excel in his work. I especially noticed that he shared my interests in both experimental and theoretical chemistry. We worked well together, and we continue to have productive collaborations. For more than twenty years, we have worked together on discrete representations in quantum mechanics, and during this time I have been amazed at the insights that Enzo brings to theoretical chemistry. He first developed simple tools to interpret polarization effects in atom−atom or monatomic ion−atom collisions and then had a remarkable idea to classify atom−diatomic molecule collisions in an analogous way to Hund's cases. He went on to introduce discrete representations in quantum mechanical calculations and to exploit hyperspherical harmonics to advance our quantum mechanical understanding of three and four atom reactions. This latter work has now resulted in the "hyper-quantization" method that forms the basis for one of the most efficient computer codes to calculate quantum mechanical reaction dynamics. Enzo is a rare individual, and although he calls himself a chemist his work is equally recognized in mathematics and physics. If he had lived 500 years

ago, I have no doubt that he would be now remembered as one of the greats of the Renaissance. In addition to all of his accomplishments he is a wonderful friend!

Toshio Kasai. I am very grateful to be one of the guest editors for this special issue of *The Journal of Physical Chemistry A* honoring Vincenzo Aquilanti. We learn all the time about Enzo's unique insight into the essential role of "arrows" in chemical dynamics, which has been inspiring the intuition of a new generation of experimentalists as well as theoreticians. His arrows contain the concept of time, space, and spins. In Japan, Motonari Mori is well-known as one of the greatest warlords of the middle 16th century. He is best remembered among Japanese people for the famous event, namely when Motonari gave each of his three sons an arrow to break. He then gave them three arrows bundled together, and pointed out that while one arrow may be broken easily, not so in the case of the three united as one. This parable of the "lesson of the three arrows" is one of the most well-known parables among Japanese still today. In this context, Enzo is a chaser of "three" arrows in any meaning like the time propagation in chemical reaction, "past, present, and future" of reagent collision. Also the three for him may be "truth, faith, and beauty" in science. Besides these, Enzo's open mind, his concerns for other people, and his never-ending stimulation of new scientific ideas through international collaborations, all drive us forward to future promising science. I feel happiness and satisfaction at all times when I work with him, discuss with him, and drink wine with him, because Enzo is my most respectable teacher, most pleasant collaborator in science, and my best "amico" in life. Indeed, the "lesson of the three arrows" Enzo gives us must be a strong message of "meeting science is meeting scientists". We believe we share his arrows and his targets.

As guest editors, we again thank the many friends of Enzo who have come forward with contributions to this Festschrift on the occasion of his 70th birthday. We express our sincere gratitude to Enzo for his intellectual contributions, international leadership and service, and personal friendship. We wish him all the best for many years yet to come.

Piergiorgio Casavecchia

Università degli Studi di Perugia

Franco Vecchiocattivi

Università degli Studi di Perugia

Roger W. Anderson

University of California, Santa Cruz

Toshio Kasai

Osaka University

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