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OBITUARY

For Love of Eisner

Thomas Eisner (1929–2011)

Robert A. Raguso

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On March 25, 2011, Chemical Ecology lost one of its original guiding lights, Thomas Eisner, after a long and courageous battle with Parkinson's Disease. By now, numerous obituaries have detailed his prolific career as a research scientist, photographer, musician and champion of environmental and human rights. Equally well documented is his intriguing personal odyssey, beginning as a child refugee from fascist Europe and ending as a beloved professor emeritus at Cornell University. Others have profiled his numerous awards in recognition of his excellence in research (National Medal of Science, Carty Award of the National Academy of Sciences), his ability to communicate the joy of scientific discovery (Lewis Thomas Prize, New York Film Festival Grand Prize) and his tireless dedication to conservation (Tyler Prize for Environmental Achievement). Instead, in this brief essay I celebrate Tom's unusual scientific vision, rooted in the synergism between natural history and the experimental study of mechanism, and nurtured through collaborations across the physical sciences. The Eisner Vision figured prominently in the establishment of Chemical Ecology as a field, as well as the founding of my home department (Neurobiology and Behavior) at Cornell. It is carried forward today by his former students and remains a unifying philosophy among the new generation of chemical ecologists at Cornell, with whom I have the privilege of working.

Tom Eisner's keen interest in natural history was kindled during his childhood in Uruguay, described glowingly in his autobiographical "For Love of Insects". Aside from Niko Tinbergen's "Curious Naturalists", I find this book unrivaled in its humble and joyous account of a life spent pondering nature. Its passages resonate with anyone whose scientific career was sparked by early encounters with the natural world and was sustained by a desire to understand its inner workings. As an adult, Tom continued to seek inspiration through critical observations of natural history, accompanied by his wife and lifelong collaborator Maria (Loebell) Eisner, the naturalist Mark Deyrup, and their students. These observations invariably were followed by bioassays in which hapless frogs, birds, spiders, ants or fish were duped into approaching a would-be prey item, only to get splattered with some noxious defensive secretion. Although Tom's explorations required increasingly more sophisticated tools, these only enhanced, rather than diminished, the Eisnerian sense of wonder so familiar to generations of Cornell students.

Tom was a great aficionado of analytical equipment, especially anything that pushed the limits of optics, microscopy and high speed/resolution photography. So many of his group's seminal contributions, including the mechanisms of benzoquinone emission by bombardier beetles, the adhesion of the palmetto beetle's tarsal bristles to leaf surfaces, and the "hidden" patterns of UV reflectance in flower petals, were communicated through stunning photographic images. As accomplished a photographer as Tom was, he benefited from (and lovingly acknowledged) Maria's mastery of SEM, and frequently recounted in lectures his awestruck encounter with Harold "Doc" Edgerton, MIT's pioneer of strobe photography, whose high speed wizardry revealed the cooling mechanism for the abdominal emission chambers of bombardier beetles. Tom also enjoyed a long and fruitful collaboration with Dan Aneshansley, an engineer who devised elegant methods for measuring the physical properties (e.g. heat evolution, force transduction) by which beetles defend

R. A. Raguso (✉)
Department of Neurobiology and Behavior, Cornell University, Ithaca, NY 14305, USA
e-mail: rar229@cornell.edu

themselves against predators. Of course, it was Tom's career-long partnership with Jerry Meinwald, whose group provided critical expertise in analytical chemistry, which had the greatest impact on our field. Tom and Jerry's decades of identifying strange compounds from even stranger glands led them through a forest of natural products, from the C10 cyclopentanoid constituents of catnip (nepetalactone) and walking stick defensive sprays (anisomorphal), to carminic acid, lucibufagin steroids and pyrrolizidine alkaloids that protect cochineal bugs, fireflies and tiger moths, respectively, from a grisly death. In the quality and quantity of their collaborative output, Eisner and Meinwald were the "Lennon and McCartney" of Chemical Ecology, and their "greatest hits" continue to inspire students of chemical defense, counter-defense and mimicry. As interest (and expertise) in natural product elucidation continues to wane among university chemistry departments, we are reminded of how crucial such collaborations are to the continued growth of our field. During his last years, this remained one of Tom's greatest concerns.

Tom sometimes lamented that his research had been criticized for its "lack of conceptual framework", but this criticism was shortsighted. In his foreword to "For Love of Insects", Tom's friend and intellectual gadfly E.O. Wilson likened him to a pointillist painter, from whose body of focused, detailed case studies emerges a canvas rich with patterns "of evolutionary adaptation, molecular evolution, behavior and life cycles that likely would not have been revealed by other means". As a group, chemical ecologists have been slow to grasp evolutionary theory and slower to embrace conditionality in the interactions whose mechanisms they dissect with such care. Not so with Tom and his students, whose studies of butterfly courtship, tiger moth alkaloid acquisition, spider web construction or herbivore-induced nicotine mobilization were rife with fitness tradeoffs, cost-benefit analyses and contingency. The students responsible for these studies are among today's most conceptually sophisticated interpreters of animal (and plant) behavior. Like Tom, their current research builds upon the foundation of natural history with sophisticated experimental manipulations of visual and acoustic as well as chemical and metabolic signals, in studies designed to explicitly measure fitness consequences.

Finally, Tom felt that by combining aesthetically appealing patterns with rigorous experimental elucidation of their underlying processes, he could more effectively communicate the splendor and importance of the natural world to a broader public, and educate them on the dire need to conserve nature's pharmacopoeia for future generations. In the final passage of "For Love of Insects", Tom described the mutual dependence between the role of nature in sustaining human curiosity and the increasingly urgent role of human curiosity (and its valuation) in preserving the world's remaining wild places. "Will the collective urge to discover keep natural history alive?" he asked. "Without [human] curiosity, without a passion for discovery, nature cannot endure. And without nature, curiosity will fade…It is so fundamentally human to thirst for knowledge and to turn to nature for visions of the unknown".

Thomas Eisner inspired generations of chemical ecologists to turn to nature for chemical visions of the unknown, visions that have given form and structure to the increasingly complex interaction webs that we now study in terrestrial, aquatic and marine environments across the globe, as communicated in this journal. He will be sorely missed by those who were inspired by his vision and his unquenchable sense of wonder about the natural world. I will remember him fondly, along with his tales of toxic steroids and *femmes fatales*, whenever fireflies light up the humid summer evenings of Ithaca.

RETROSPECTIVE

Thomas Eisner (1929–2011)

A biologist who marveled at insects and their arsenal of compounds sparked the field of chemical ecology.

Jerrold Meinwald

With the passing of Thomas Eisner on 25 March 2011, at the age of 81, the world has lost one of its most original and influential scientists. We owe the development of the contemporary discipline of chemical ecology largely to him. Eisner was fascinated by insects throughout his childhood. Wherever he found himself, he would observe in meticulous detail the behaviors of his favorite "bugs," carefully noticing how these marvelously diverse creatures managed their interactions with one another and with their environment. He maintained a lifelong curiosity and regard for insects and their chemical treasures.

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Born on 25 June 1929 in Berlin, Eisner moved with his parents to Barcelona, Spain at the age of 4, and after a brief stay in Paris, moved to Montevideo, Uruguay. In 1947, the family moved to the United States, and Tom attended Champlain College before transferring to Harvard University. By the time he completed his undergraduate and graduate studies at Harvard (where he earned a Ph.D. in biology), he had developed into one of the greatest naturalists of his generation. Stimulated by Harvard faculty members, and perhaps even more by extensive contact with fellow students—among them Edward O. Wilson, Julius Adler, and Eric Kandell—Eisner's love and knowledge of nature continued to grow throughout his more than half-century career in science.

Tom Eisner joined the Cornell University faculty in 1957 as an assistant professor in the Department of Entomology. Howard Schneiderman, a mutual friend in Cornell's Department of Zoology, introduced us to one another shortly after Tom's arrival, saying something like "This is my good friend, Thomas Eisner, who has just come to Cornell. He is interested in all sorts of insect-related projects, and some of them might benefit from chemical collaboration." It was the beginning of our eating lunches together in the Faculty Club, where he would pour forth a string of stories about defensive techniques practiced by a wide variety of arthropod species, including whip scorpions, daddy longlegs, millipedes, centipedes, ants, beetles, and caterpillars of all sorts. It turned out that many of these stories did indeed involve unexplored chemistry. Our joint endeavors to understand the lives of arthropods at the molecular level occupied not only the two of us but also our research students for the next five decades. What was unique about Tom was his ability to bring his subjects into the laboratory, to develop quantitative bioassays, and, when the problem at hand required, recruit the appropriate chemical, physical, or engineering collaborators to gain a deep understanding of his initial field observations. Tom's work did not go unnoticed: Just a dozen years after joining the Cornell faculty, at age 40, he was elected to membership in both the American Academy of Arts and Sciences and the National Academy of Sciences.

Tom Eisner took the greatest care in writing his scientific papers. We wrote many of these together, and he could be counted on to think of a clearer and more elegant way of stating our case than I had been able to do alone. His command of spoken languages was also remarkable. He was fluent in German, Spanish, and French, and although he was 17 when he came to the United States from Uruguay, he soon spoke absolutely accent-free English. His lectures were packed full of intriguing information and insights. They were fast-paced, witty, and beautifully organized. They transmitted his unmistakable enthusiasm for his subject perfectly, and it is no wonder that he inspired so many of his audience members.

Eisner's skill as a photographer made his lectures particularly interesting and added substantially to the impact of his publications as well. In this context, his extensive collaboration with his wife, Maria, who became an expert in electron microscopy, is especially noteworthy. Many of his papers in *Science* appeared in issues whose cover pictures he provided.

No account of Tom Eisner's life should omit mention of his love of music. He was an outstanding pianist and had the remarkable ability to sight-read just about anything placed before him as if it were something he had been playing for years. He especially enjoyed inviting old and new friends and visitors to his home for musical evenings, which might be spent reading through anything from baroque flute sonatas and Beethoven chamber works to Schubert Lieder, Bach arias, or even complete Mozart operas. He also enjoyed conducting and took great pleasure in leading an amateur orchestra composed of friends and colleagues from the Cornell community. Interestingly, although his love of music was a very important part of his life, he was reluctant to play for an audience. It was the act of making music that gave him the deepest pleasure.

Beyond biology, photography, and music, Tom was engaged passionately in many other activities. He played a very active role in promoting conservation and in defending human rights worldwide. Among his services in these endeavors, he was on the Board of Directors of the National Audubon Society, on the National Scientific Council of the Nature Conservancy, on the World Resources Institute Council, and served as president of the American Society of Naturalists.

Tom Eisner was an exemplary son, a devoted husband, and a proud parent and grandparent. Everything that he undertook, he pursued with intensity and style. His autobiographical volume, *For the Love of Insects*, provides an intriguing account of his remarkable career. He spent his entire independent academic life at one university, never chaired a department, never started a company, and almost never boarded an airplane. He had much to teach us.

Chemistry and Chemical Biology, Cornell University, Ithaca, NY 14853–1301, USA. E-mail: circe@cornell.edu

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