Alan G. MacDiarmid (1927–2007)

Alan MacDiarmid passed away at his home in Philadelphia on February 6, 2007, at the age of 79. His health had been failing over the last three years as a result of myeloplastic syndrome, a leukemia-like disease. Despite his poor health, he was about to depart on a long and arduous trip to New Zealand, his homeland, to see family and to visit the scientific institute created there in his name, The MacDiarmid Institute. Weakened from the disease, Alan fell down a flight of stairs in his home just moments before the planned departure.

Although an American citizen for many years, Alan always considered himself a New Zealander, a "Kiwi". I would argue that the term "Kiwi" was not appropriate for MacDiarmid. The Kiwi is a small bird that remains always and only in the shadows. Alan MacDiarmid was not a small bird; he was an outgoing and vigorous man, curious, demanding of excellence and yet caring about even the smallest details in the lives of his students, colleagues and, of course, family throughout his distinguished career as a scientist, teacher, and mentor.

Alan, Hideki Shirakawa, and I were awarded the Nobel Prize in Chemistry in 2000 for the discovery of conducting polymers. Polymer science began in the 20th century. Herman Staudinger was awarded the Nobel Prize in Chemistry in 1953 for his discoveries of the basic structure of polymers as macromolecules. Karl Zeigler and Gulio Natta independently discovered the class of catalysts known today as the Zeigler–Natta catalysts, and they were awarded the Nobel Prize in 1963. Their work enabled the large-scale industrial synthesis of polymers or "plastics". In 1934, Wallace Carothers, a research scientist at Dupont, discovered nylon, the first synthetic fiber. Paul Flory (Chemistry Nobel Prize 1974) was a giant in the field with a body of publications that combined both theoretical and experimental work, in particular related to thermoplastics. Each of these important discoveries is associated with three generations of polymers: The first generation consisted of natural polymers (e.g. leather, spider webs, and silk) that have been used by our ancestors for thousands of years; the discovery of synthetic fibers led to the second generation of polymers; and the third generation comprises the "plastics" that are so important to our society today.

However, none of these three generations of polymers is interesting from the point of view of electronic materials as they are insulators. The materials that MacDiarmid, Shirakawa, and I discovered, semiconducting and metallic polymers, brought electronic function into the area of polymer science. Conducting polymers are the fourth generation of polymeric materials. They are electronically active and display the properties of semiconductors and metals.

Now, three decades later, the discovery of conducting polymers is well known and often used as a highly successful example of the importance of interdisciplinary research. When we started this work, however, the basic concepts that define semiconducting and metallic polymers were not understood. In 1976, the creation of this interdisciplinary collaboration between an inorganic chemist (MacDiarmid), a physicist (Heeger), and a polymer scientist (Shirakawa) was bold and risky.

MacDiarmid was well aware of the risks. He had earned two PhD degrees in inorganic chemistry, one at the University of Wisconsin and a second at Cambridge University (UK), and had a successful career that focused on the chemistry of silicon. However, new directions in interdisciplinary science are where great discoveries can be found. Alan understood that opportunity and embraced our effort with enthusiasm, vigor, and true dedication.

There are many stories, often told, that I remember of those exciting early days. He pushed hard. His graduate students would come to me frequently and complain of having been subject to a "Big Mac Attack". When Alan had an idea, he was sometimes not patient in seeing that idea become experimental fact. On one occasion, he and I were having lunch at a cafe in the Children's Hospital on the University of Pennsylvania (PENN) campus. I complained that although we had spectacular results on doping polyacetylene with various acceptors, the changes in conductivity (by factors in excess of 10^9) occurred on a timescale that was too short to enable a detailed study of the insulator-to-metal transition. By the time we had finished lunch, Alan had suggested the use of electrochemistry to control the doping; that is, using the electrode in an electrochemical cell to oxidize or reduce the semiconducting polymer. We had it all sketched out on a napkin and hurried back to the lab for a "Big Mac Attack". Paul Nigrey, then a student in Alan's lab, provided the confirming data later that same day.

Alan was courageous as a scientist; willing to move into an entirely new area, willing to learn new ideas, and even willing to learn a little physics. We made a habit of getting together on Saturday mornings, sometimes to work together on a manuscript, sometimes to just discuss science and to learn from one another. On one such occasion, I decided to teach him the basic physics of the metal–insulator transition. To do so, I went to the black board, drew a chain of H-H-H-H-H, and said "let's consider a chain of hydrogen atoms". My motive was sound, for a chain of hydrogen atoms can be used as a model to explain the essential physics. Alan responded with a characteristically blunt phrase:

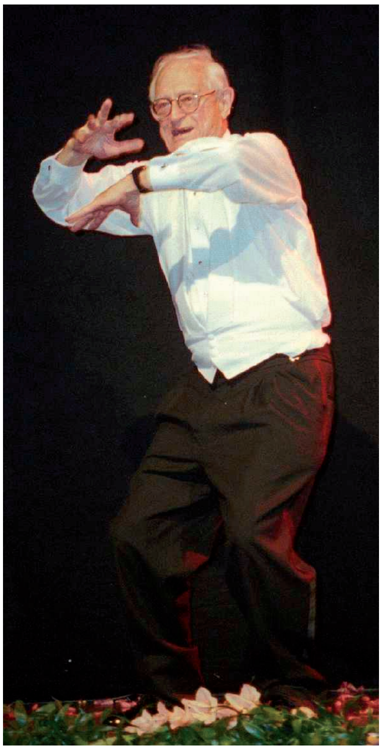

Figure 1. Alan MacDiarmid performing the Maori war dance.

"No!" he said. "A chain of hydrogen atoms does not exist." Fortunately, we came back together a week later and actually discussed and understood, together, the physics of the metal–insulator transition in terms of a chain of C-H atoms; that is, the fundamental repeat unit of polyacetylene.

Alan was courageous in other ways. The six years following the Nobel Prize were difficult. He fell and broke a foot causing him to require a cane for walking, he battled skin cancer with associated surgery, he fell again, broke his hip and had it replaced, and lived for more than three years with the myeloplastic syndrome that required blood transfusions every few weeks. Throughout these difficult times he "raged against the dying of the light" to paraphrase the poetry of Dylan Thomas; he traveled incessantly, he continued to do science with laboratories and ongoing projects at two universities (PENN and the University of Texas at Dallas), and he exerted his leadership in two institutes named in his honor, one in China and one in New Zealand.

MacDiarmid was renowned for his rendition of a Maori war dance. As he told the story, he and his sports teammates performed this fierce dance with associated shouting in the Maori language to frighten the opponents. He delighted in performing the Maori war dance at conference banquets. I will always remember his performance of the dance in the early hours of the morning following the Nobel Prize Ceremony and the banquet and ball. We had all moved to a new venue, where the university students put on a show full of fun and spiced with sarcasm. At just the right moment, Alan got up, walked onto the stage, and performed his Maori war dance, as shown in the accompanying photo.

Alan is survived by his wife, Gayle Gentile; he has three daughters and a son from his first marriage to Marian Mathieu, who died in 1990, a sister, two brothers, and nine grandchildren. He had a full life in every respect, and he made important contributions to chemistry. Those of us who knew him well will truly miss him.

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