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OBITUARY

LARS ONSAGER—1903–1976

With the unexpected death of Lars Onsager on 5 October 1976, at the age of 72, the ice community lost its deepest and most profound theoretician. To many scientists outside ice research, the characterization of Onsager as an ice theoretician would be considered parochial at the very least. Solution chemists knew him for his work on electrolytes, thermodynamicists for his reciprocal relations, statistical mechanicians and critical phenomenologists for his solution of the two-dimensional Ising model, hydrodynamicists for his theory of turbulence, solid-state physicists for his interpretation of the de Hass–van Alphen effect, low-temperature physicists for his prediction of the quantum of magnetic flux in superconducting rings and a basic theory of strongly interacting superfluid helium and the prediction of quantized vortex lines, applied mathematicians for his work on special functions and applications to physical problems, and biologists for his interest in membrane problems and the origin of life. His work in many of these fields was so significant that many workers were quite surprised when the Nobel prize citation did not even mention the work that meant so much to them. It is also remarkable that he was widely acclaimed in so many different fields when his publications numbered only 71.

As a scientist and a teacher, Onsager was most valued by the ablest colleagues in the various fields in which he worked. Weaker scholars and many students found him difficult to understand because his communication style was so different from the conventional one. Rather than deliver polished lectures or give a continuous patter of monologue in conversations,

which require little effort from the listener, he preferred to give hints and suggestions with long pauses to let the listener work it out in his own mind, probably because he preferred to learn that way himself. However, when the listener asked a question, the reply was always carefully designed to fill the gap and never given in a way to humiliate the questioner. Repeated questioning resulted in very clear expositions tailored to the questioner. Such a pedagogical technique may teach less, but with the motivated listener it can result in more learning. His research papers are concisely written and require active effort on the part of the reader, but the effort is satisfying, like working out a well-constructed crossword puzzle (at which Onsager was also skilled).

When I first began to work with Onsager in 1962 I was interested in following up some work on superconductivity that he had done with earlier students. To a fledgling physics graduate student and to my contemporaries this seemed very exciting and fashionable. However, when I went to see Onsager he was always courteous but rather unenthusiastic and even dozed off on one occasion. (He also had the habit of nodding off in seminars, even when seated in the front row, much to the speaker's consternation. But he still asked the sharpest questions in the question period!) After about six months I was talking to Kelly Runnels who showed me the problem of the residual entropy of ice, which struck me as a neat mathematical game. When I mentioned to Onsager that I had found an upper bound, the response was so positive and the ensuing discussions so interesting that I continued working on the problem. However, the reaction of my contemporaries and even some faculty when I mentioned what I was working on was rather disconcerting. It usually began with the exclamation "Ice?!" and ended with questions about Onsager's age and mental acuity. Since my own interests at the time were purely in mathematical physics and I had little appreciation for ice, I once asked Onsager why research in ice was important. He smiled and paused for a while to formulate a careful answer. Finally, he said simply, "Well, there is a lot of it around".

The fact that Onsager spent a fair percentage of his last two decades working on ice problems is a tribute to their intrinsic fascination. The electrical conduction mechanism in ice was a natural field of inquiry for an electrolyte chemist and the combinatorial problems associated with the residual entropy and the dielectric constant appealed to his mathematical mind. However, I have seen Onsager become thoroughly engrossed in neat problems of high intrinsic interest and make great progress on them. But unless the problem had broader relevance he would drop it after a short time and put his results in a filing cabinet never to be published. There is another personal anecdote that illustrates some of the characteristics I have mentioned. I was trying to sneak out of a dull session in a biology conference in 1970 when Lars literally ran after me and began expostulating about bovulline. Many questions later it became clear that bovulline had nothing to do with the biology session but was an organic molecule which tautomerized in a way that generated a group of permutations on 10 elements whose graph was relevant to a question that had arisen in our work on ice. The diversity of the background prerequisite for this idea was staggering. But because the idea did not yield the highest dividends, it was relegated to the filing-cabinet drawer.

Onsager's long interest and sustained effort on ice suggests that he felt it has broader relevance, even beyond the fact that there is so much of it in the colder climates. One vision of this broader relevance, mentioned very briefly in several later publications, was that the electrical conduction mechanism in ice is likely to be relevant to biological systems and that ice-like conduction channels exist in biomembranes. Unfortunately, his death precluded the possibility that he himself could develop this vision into a successful theory. But he did inspire some of us in succeeding generations to value ice as a learning ground for the study of molecular mechanisms as well as for its own intrinsic interest. We shall sorely miss his great insights, his scientific enthusiasm, his courtesy and decency, and his analytical mind, which was razor sharp to the end.

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