The Strange Relationship of Mathematics and Chemistry

Lecture 1  December 12
3:00 p.m.—4:00 p.m.

Lecture 2  December 13
3:00 p.m.—4:00 p.m.

Lecture 3  December 14
3:00 p.m.—4:00 p.m.

The Speaker’s Biography

Martin Feinberg is the Richard Morrow Professor of Chemical Engineering and Professor of Mathematics at the Ohio State University. Building on earlier work with F. J. M. Horn and Roy Jackson (formerly of the University of Houston), Feinberg and his students went on to prove penetrating and sometimes surprising theorems that led to chemical reaction network theory, a body of work that connects reaction network structure to qualitative properties of the corresponding differential equations. He has also done fundamental work on the mathematics of chemical processing and on foundations of classical thermodynamics. Before moving to Ohio State, Feinberg was a Professor of Chemical Engineering at the University of Rochester. He was educated at Cooper Union (B.Ch.E.), at Purdue University (M.S.), and at Princeton University (Ph.D.).

Like the economics department at the University of Chicago and the mathematics department at New York University, the chemical engineering department that Neal Amundson created at the University of Minnesota was a rare and singular academic entity whose influence remains profound and broadly felt. Although Neal’s department was generally known for bringing diverse streams of high-level science to the study of chemical engineering problems, it was the application and advocacy of modern mathematics that was the department’s signature.

At the time, this was not easy, nor is it entirely easy today, for the historic relationship between mathematics and chemistry has been a strangely distant one: In nature, there are thousands of distinct chemical reaction networks in which various molecules are created in certain reactions and simultaneously consumed by still others. These intricate chemical processes are ancient, ubiquitous, and almost impossible to understand without help from mathematics. One would think, then, that chemistry should have a deep and long-standing mathematical tradition, one resembling that of celestial mechanics or of electromagnetism. Yet, it is hard to argue that, until the advent of Neal’s department, there was a mathematical tradition in chemistry, at the reactor level, that had the depth or duration that one finds even in economics.

In this lecture, we’ll examine aspects of the often uneasy historical relationship between chemistry and mathematics, and, paradoxically, how clues about causes for the estrangement (or at least the mutual indifference) can actually be found in the elegant and remarkable mathematical structure that chemical reaction networks present. We’ll also examine why, especially in a century likely to be dominated by cell biology, there is much to be gained by both chemists and mathematicians from the more congenial relationship that Neal Amundson fostered.