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Editorial

Last February I wrote an editorial on my plan to teach a phase diagram course to engineering undergraduates without mentioning thermodynamics. The goal of the course was for students to learn how to read ternary and higher-order phase diagrams, and how to apply them to problems in physical metallurgy and ceramics. Here is a report on what I learned from that experience.

When I mentioned in the first class that thermodynamics would not be covered in the course, the class of more than 90 students cheered loudly and clapped their hands in approval. Although on occasion I did mention that thermodynamics provides a formalism for calculating phase diagrams, the ten-week course was focused on reading two-dimensional isotherms, isopleths, and liquidus projections.

The students were pleased with the textbook, *Phase Diagrams in Metallurgy* by Rhines. It was copied with permission from the publisher, McGraw-Hill. I added information on zero-phase-fraction lines and used Thermo-Calc predictions extensively. One student suggested a way of dealing with zero-phase-fraction lines at invariant reactions that improved on the method described in *Phase Equilibria in Multicomponent Systems* by Platnik and Landau. We called it the "Thompson half-moon construction," and it was a boon for a number of students.

After the course was over, I learned in a committee meeting that many faculty members in my department expected that thermodynamics, diffusion, and microstructural changes would be taught in the phase diagram course even though they were not mentioned in the course description. When asked how much time should be spent on ternaries, one faculty member suggested that one class period should be enough. Another offered that everything you really need to know can be found in binaries.

This winter I am teaching the course again and trying to better meet faculty expectations. For the first three weeks, a popular introductory materials science and engineering text that the students already own will be used to cover binary phase diagrams, diffusion, and microstructure. For the remaining seven weeks, we will use the textbook, *Ternary Phase Diagrams in Materials Science* by West and Saunders. One reason for selecting the latter book is the chapter on thermodynamics. The introductory text contains a fairly comprehensive survey of phase diagram terminology, although it informs students that the words "composition" and "concentration" are "interchangeable," and it also contains figures suggesting that solid phases can exist at the liquidus. Unfortunately, it is hard for a teacher to refute a textbook, even if backed by the dictionary and the lever rule. West and Saunders know better and may sway students' opinions with their text.

Truthfully, what I learned from this course was neither new nor profound. It was that courses should be designed to fit into the curriculum in which they appear, that some faculty, as well as students, need to be sold on the value of thermodynamics and phase diagrams, and that each year we teachers need to continue searching for better ways to teach our students because, as in research, "the truth lies just beyond."

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