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Book Review: *Fluid Interfacial Phenomena*

Fluid Interfacial Phenomena. Clive A. Croxton, ed., Wiley, New York, 1986.

The subject matter of this book belongs in the category of intrinsically difficult problems. The very dimensionality of surfaces often forbids taking the kind of limits that lead to the well-defined properties associated with a proper thermodynamic phase. Yet the same kinds of questions must be answered. Energy, entropy, density distributions, molecular orientations, structural fluctuations, and collective motions still need to be understood much as needed for bulk phases.

Several of the theoretical chapters give one a sense of vigorous frustration. One can nicely describe surfaces in the statistical way that has been successful in three-dimensional systems, but the language does not carry one far enough. The point is made clearly in the opening article by Percus and Williams, who are both elegant and honest in reviewing formalisms and asking the embarrassing question of how far they can go.

As in most fields of statistical physics, there is heavy use of computer methods—once probably thought of as an act of surrender by theoreticians. Nowadays, apparently, their use is conveniently either an important source of "experimental" data or a handy method of theoretical solution. Anastasiou's chapter on solid–liquid interfaces gives a rather detailed description of the salt/water interface based on Monte Carlo (MC) methods. Croxton's review of polymer configurations nicely develops the use of MC to combine molecular or model information with computation and comparison with other models for handling excluded-volume problems.

Other theoretical approaches are a good balance of concrete theory and experiment. Sullivan and Telo de Gama systematically develop wetting transitions and multilayer adsorption in a way that starts with macroscopic surface theory, works into the phenomenology of Landau theory, goes on to experiments demonstrating wetting transitions, and finally takes on multilayer adsorption and adsorptive fluctuations. Similar balance is achieved by Earnshaw in describing light scattering by the fluid interface. Rice, Gryko, and Mohanty, writing on a metal–vapor interfaces, have written a model minimonograph showing the peculiarities of forces at this particular interface with a development that is a progressive alternation of theoretical and experimental steps.

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The chapters by Sluckin and Poniewierski, on orientational wetting transitions nematics, and by Gubbins, on molecular orientation at the free interface, dwell mainly on theoretical models with some reference to experiment. Chapters by Desai and Grant on dynamics at the liquid–vapor interface, Blum on the electrostatic double layer, Henderson on spherical surfaces, and Stecki and Dudowicz on two-point correlation functions are presentations of formalism with little immediate connection to observation. One reads these chapters with the question of whether these approaches have already reached their limits.

It is clear in the Editor's Preface that he sees the next big steps coming from the experimental side. And he has ensured that this side be represented in four experimental chapters. The first, by Beaglehole, begins with a succinct description of the variables used to describe liquid interfaces and then provides a cursory summary of data from a few simple liquids. Cosgrove and Vincent cover the formalism, the methods, and some of the results used to describe absorbed polymers, a very brief review of a vast and important subject. Finally, Derjaguin, alone and with Churaev, has written two extensive chapters summarizing their decades of pioneering results in virtually all aspects of surface energies, stabilities, interactions, adsorption, and perturbation. In contrast to the theoretical chapters where experiments are sometimes forgotten, here there is a conscious effort to use such practical theory as exists even as the data collected pose theoretical problems in need of serious attention.

Frankly, I finished the book feeling disappointed. This was not the Editor's fault. In fact, I suspect he intentionally designed the book in this way to get people thinking differently. This is a highly qualified set of authors writing with authority about top-class work on a generously broad set of topics. In the end it is clear that the subject is very far from where it needs to be. Take-home lessons are still not so different from what one would have learned from back-of-the envelope theories or summaries of theory-free data.

The greatest real progress and hope for future results seems to be on the experimental side. If there were some way that the contents of this meaty book could be communicated to those outside the select fraternity of those presently concerned with the fluid interface, it would amplify its value manyfold. Even if not, it will serve as a good description of where we are.

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