Roberto Piazza: “Soft matter, the stuff that dreams are made of”

(Springer, 2011, ISBN: 978-94-007-0584-5, EUR/USD: 24.95)

R. Podgornik

Received: 27 February 2012 / Accepted: 28 February 2012 /

Published online: 25 March 2012

© Springer Science+Business Media B.V. 2012

Roberto Piazza wrote a beautiful book on soft matter. That is the bottom line. “Simple enough to be amusing, but not so trivial as to spoil the fun”, as he himself puts it. The gentleness of the subject matter promotes a gentle method of exposition, helped thoroughly by the fact that we face many domains of soft matter in our everyday endeavors and chores.

The book is divided into “five easy pieces”, plus a glossary of more unusual scientific terms that might baffle the general audience. The overall style of the book is very clear, peppered with interesting anecdotes, historical vignettes, and obscure facts of everyday life, in one way or another connected with soft matter, which make its reading a delight. My only wish would be that the author would use the “folksy style” less often as it does not contribute to the readability of the book. The historical anecdotes, the beautifully crafted explanations of complicated phenomena, the sheer breadth of the author’s knowledge and his masterful way of wielding it without overpowering us with technical clutter, all these already make this book superbly readable. No more is needed.

Who is the book for? No specific audience is intended and the book is completely self-contained. There is no doubt that it can be handled by an interested layman of any background. There are a few equations, but they are not essential, either for explanations or the general flow of the narrative. But there’s more. Academic courses on soft matter, be it at the undergrad or higher levels, are usually hampered by the fact that apart from providing consistent explanations and methodology for understanding of phenomena related to soft matter, they also have to give a sometimes impromptu introduction to the phenomenology of the systems comprising the soft state of Nature. This endeavor is usually very time-consuming and is not given enough time in the standard curricula. The present book could, in my opinion, very appropriately fulfill the role of an introductory treatise for the phenomenology of soft matter, even in a graduate level course. Maybe the author did not envision this type of academic audience when he set himself to writing this book, but I believe that it has the required potential. The audience can thus be much broader than

R. Podgornik (✉)

Department of Theoretical Physics, J. Stefan Institute and Department of Physics,
Faculty of Mathematics and Physics, University of Ljubljana, 1000 Ljubljana, Slovenia
e-mail: rudolf.podgornik@fmf.uni-lj.si

perhaps intended and certainly I would recommend this book to both my undergrad as well as my graduate students who are taking the soft matter course on either level.

The “five easy pieces” of Piazza’s book are in broad strokes dedicated to colloidal science, polymer physics, amphiphiles, order and packing and—in the final chapter—to structural biophysics. Each chapter is introduced by interesting examples and/or historical anecdotes. For instance, in the chapter on colloid physics, with the title “A life in suspense”, Piazza hides a whole little separate treatise on the physics of concrete, dear to my own heart, too, as it brings fourth so many fundamental and to a large extent only partially understood unusual features of electrostatic interactions in colloidal systems. It is a nice tapestry of history and physical principles, woven together by simple and clear language, opening up the eyes of the reader to the underlying profound questions of colloid science that underpin the hardening of concrete that we can observe practically anywhere in the modern world but is very nontrivial to fathom. All expositions in the book are in general phenomena-driven and concepts are added “on the fly” when needed or when convenient for the story line, which is certainly the style I prefer, too.

In the chapter on polymer physics entitled “Freedom in chains”, Piazza effortlessly introduces many of the basic as well as some more advanced concepts of polymer physics in a clear and understandable way. There is again a wealth of data, observations from everyday life and historical details worth reading about. In particular, the forte of this chapter is the introduction of some of the main polymer players in our everyday lives, providing plasticity, elasticity and viscoelasticity to everyday contraptions and materials. The explanation of the entropic elasticity and reptation are definitely the high points of this chapter, providing a nice and intuitive explanation for the two salient but non-trivial phenomena of polymer physics. There is an occasional mathematical formula here and there, and I wonder if it would not be better to relegate it to a footnote as it might present a put-off for a mathematically naive reader. Some of these formulas I even find thoroughly unnecessary, like the Einstein formula for the viscosity of a suspension, and they seem to serve no obvious purpose.

The chapter on amphiphiles and their exotic properties in aqueous solutions entitled “Double-faced Janus molecules” appears to me to be the most solid and well-written part of the book. It introduces most of the main amphiphilic players, from soaps, phospholipids all the way to block copolymers, together with the principles of hydrophobicity and hydrophilicity that lead to complicated macroscopic phenomena from a humble microscopic beginning. The discussion of the overall geometry observed in surfactant phases seems to stand out, and the exposition of the Israelachvili–Ninham arguments connecting the shape of individual molecules and the global geometry of their thermodynamically stable aggregates is explained very nicely. Again, historical vignettes abound, and when possible, a potent connection is always established with the world of everyday phenomena.

Order and packing is introduced and discussed in the chapter entitled “Nanoarchitecture”. Piazza deals with packing problems in general and in colloidal systems in particular, together with related phenomena such as packing in granular matter. I find this bringing together of the two types of packing phenomena, finite and zero temperature ordering, very appropriate, though many times they are being discussed in completely separate contexts. Physics of glasses and liquid crystals naturally enters the discussion of order and its characterization. There are many fascinating examples here that could be used also in more advanced courses on soft matter as they are bound to catch the attention of the students, the M&M packing problem studied extensively by P. Chaikin certainly being one of them.

The last and longest chapter of Piazza’s book is dedicated to structural biophysics with the title “Dreamtime”. It revolves wholly around biological macromolecules—lipids, proteins, and nucleic acids. It is a good introduction to structural biophysics in a nutshell, from the standpoint of molecular architecture. The path from phenomenology to general principles is less straightforward here, if it exists at all, but that is just the way things are in biophysics, or anything related to biology for that matter. DNA and the relationship between structure and function is not a typical example in this case, but rather an exception within structural biophysics. Again, this chapter alone could be a good self-contained introduction to a more advanced course in structural biophysics for physics students.

At the end, let me also state that I find Piazza’s point of view, expressed in an interview for *Physics Today* in December 2011, rather important in general for writers of popular science books and maybe describes his own book best. He says, “In my view, good books in popular science should not seriously pretend to teach anything. Rather, my goal was just arousing curiosity and a little excitement for this fascinating ‘middle earth’ lying between the atoms and ourselves.” Indeed, he aroused just this kind of excitement in this commendable and illuminating book. It is certainly very far away from popular science books on esoteric topics such as multiverses, strings, black holes, and dark matter, which, more than arousing genuine interest for the world around us, rather convey the idea of science as impenetrable black magic.

Overall, my impression of Piazza’s book is excellent, and I wholeheartedly recommend it to an interested lay audience as well as to physics students, or natural scientists in general, who are about to embark on a more detailed course on soft matter and biophysics. Well-written, overflowing with historical vignettes and concise, simplified, but always correct explanations, it is, I believe, a fascinating read even for a working scientist, whose perception of his own field is many times bogged down by the unavoidable forces of specialization and knowledge fragmentation. In my assessment of the book, I thoroughly share the opinion of H. Lekkerkerker expressed in the foreword—“enjoy and profit”.