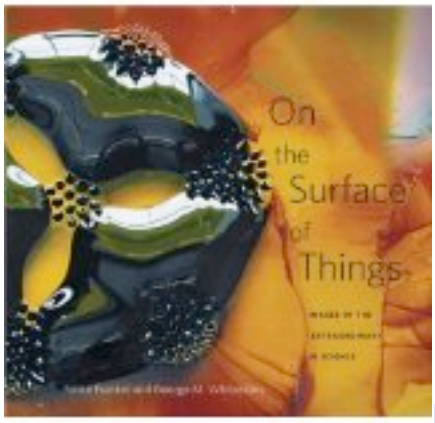

"On the Surface of Things: Images of the Extraordinary in Science"
by Felice Frankel and George M. Whitesides
Chronicle Books, 1997
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160 pages

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This project stems from a collaboration between an artist — MIT photographer Felice Frankel — and a scientist — Harvard chemist George Whitesides (Caltech Ph.D. 1964) — who agreed on two basic principles. First, visually striking images are an excellent way to draw attention to science. And second, left to their own devices, scientists do a generally lousy job of producing effective images. So they decided to see what might be done, and the result is this handsome and entertaining book.

The contents consist of about 65 entries, pairing Frankel's photographs with Whitesides' interpretations of the underlying science. Many of them are based on state-of-the-art research in surface science, carried out in Whitesides' group as well as those of colleagues. Some of the images would be extraordinary even without considering their connection to science. One of the most striking is a photograph of a drop of ferrofluid in a complex magnetic field. The combination of unusual symmetry and weird shapes obtained by deploying magnets, with the colors and composition that a skilled photographer knows how to produce, make this a stunning art object in any context.

Most of the photographs, though, derive their interest jointly from artistic and scientific aspects. A picture of alternating blue and green squares seems, at first glance, to be an array of abnormally colored Chiclets; but it is actually a dramatic demonstration of how surface properties can be tailored to produce square drops of water. A display of glass fibers wound with spiral metallic bands shows us the surface scientist's amazing ability to fabricate intricate patterns — and then the amazement is magnified many fold as the scale of the objects sinks in, and one realizes that each fiber is about as thick as a single hair. (The scale of each

photo is effectively communicated by apposing a circle that represents the size of a pinhead under the same magnification.) Other examples are photos of more commonplace objects, viewed in a new light: ice crystals forming on a window, backlit by the setting sun; lichen attacking old stone columns; brilliant patterns of color and light in an opal.

Whitesides' scientific explications are far from cold technical accounts. Written for the general reader, they are verbally picturesque, and make frequent use of analogy and metaphor to help the reader relate abstruse concepts to the more everyday world. Sometimes this may go a bit too far for some readers. The imagery of electrons or molecules as conscious beings is overused, for my taste. Examples: "Molecules — like ants, lemmings, herring, people — are happiest when surrounded by their own kind;" "...The quantum dots are boxes just small enough to give electrons claustrophobia;" and, perhaps the topper, "Then there are the adolescents [of molecular society] — liquid crystals."

Similarly, frequent reference to sound vibration is used to help convey the less familiar concept of electromagnetic vibrations in light. In one case — comparing the appearance of a red surface under white illumination with the resonant vibration of a tuning fork — the analogy may be more misleading than helpful, seemingly conflating reflection with adsorption/re-emission. Is this really necessary? For instance, the formation of "tears" on a glass of wine (illustrated by an unusual shadowgram) is explained with complete clarity and readibility, without any reliance on analogy.

Nonetheless, the majority of the explanations seem to be on the right level for the intended audience; and if some degree of rigor has been sacrificed in favor of a lyrical style, that's perhaps a justifiable choice. In any case, for those who want more detail, an appendix provides brief technical descriptions of both the photography and the science (and references, where appropriate) for each entry.

I hope it is clear from the above that I greatly enjoyed this book. And yet...from a scientist's point of view, I couldn't help feeling a small degree of unease. In the introduction, there is the statement: "A single image organizes a deluge of information in a form that is easy to understand. An image that is rich in composition and color always catches the eye. And what catches the eye, catches the mind." Is "catching the mind" being equated with making something "easy to understand?" I suppose the former must precede the latter (like the old joke about getting a mule to obey: first you hit it over the head with a two-by-four to get its attention); but few of the images seem to evince nearly as much concern with their potential ability to help explain as with their power to capture attention. Indeed, in some cases I had trouble figuring out just what I was looking at — a much more prosaic diagram, while unquestionably less visually attractive, might have made things much clearer — and all too often, the information content of an entry derives entirely from the explanation, and not at all from the photo.

Probably it is unfair to dwell much on this aspect, since it was not meant to be a focus of the book — the authors explicitly announce their intention to exhibit the beauty of science while suppressing some of the difficulties (more precisely,

comparing science to a rose bush, "we try to display some of the flowers and avoid the thorns.") Perhaps in their future collaborations, the authors will explore new ways to go beyond the generation of arresting images and exploit those images for probing more deeply into the science itself. *On the Surface of Things* is a significant accomplishment, which I recommend strongly to scientists and laymen alike; but in a certain sense, its title is just a little too appropriate.