

Optimizing Light Microscopy for Biological and Clinical Laboratories

by Barbara Foster

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Modern microscopy allows the life scientist to produce seductively beautiful images with powerful techniques developed by brilliant physical optical scientists, and yet be nearly completely confused with regard to the importance of the results. This is because modern microscopes are something like Lotus race cars: they have all the performance to fly in the hands of an experienced user, or crash and burn spectacularly in the hands of a novice. There is therefore great need for a comprehensive and accurate but accessible "drivers manual" for modern microscopical techniques.

Barbara Foster has provided such a text. In *Optimizing Light Microscopy*, she has found a way to take the novice user from a useful, very direct and non-intimidating introduction through polarized light microscopy, differential interference and fluorescence. Additional advanced techniques such as digital image processing and a comparison of atomic force and electron microscopical techniques are presented. Experienced users will also no doubt gain from this text, which assumes nothing about the reader's background, but nevertheless takes the reader to a fairly high level of competency.

This is an extraordinary book in that it very effectively bridges theory and practical application. A quick tour of the contents is very revealing: In Chapter 1, "Laying the Foundation", Foster discusses light/matter interactions and the basic physics underlying the behavior of light in different media and different materials. This is followed by a clear, understandable explanation of optical terminology and the relationship to the microscope. In Chapter 2, "Geometric Optics and Alignment (How does your microscope work?)", which ends with a discussion of the all-important Köhler illumination method and the use of the conjugate planes to adjust the microscope properly.

In Chapter 3, "Pushing the Limits of Resolution", she describes the theory of development of resolution and contrast in the microscope and the relationship to the image. "Some Practical Microscopy", Chapter 4, is critically important and full of practical advice for the recognition of different optics and their properties, and ends with a brief set of tips for the buyer to effectively match purchase with application. Chapter 5, "Bringing Out the Best", refers to different modes of obtaining improved contrast in the final image. Here, as elsewhere throughout the text, Foster encourages the reader to try little experiments to test the function of the microscope components and demonstrate how they can be adjusted. The proposed exercises here, however, are priceless, and it is here where *Optimizing Light Microscopy* is at its best. The next two chapters, 6 and 7 "Contrast II: Techniques Using Condenser plus Objective", (discussion of phase and Hoffmann modulation contrast) and "Contrast III: Advanced Techniques (Fluorescence, Polarized Light, and DIC)", are exactly what the professional user of any of these techniques will find at first very informative and then a useful reference as he or she goes about the daily effort. Foster might here have included an expanded version of her section on confocal microscopy, since it has become so very much more popular in recent years.

In subsequent chapters, Foster moves away from the more arcane aspects of microscopy and deals with the practical collection of data. "Basic Measurement", Chapter 8, deals with the simple problem of size measurement using first conventional calibration with optical and stage micrometers, and then reference to computerized collection techniques. Chapter 9 deals with "Archiving and Documentation" and discusses the advantages of conventional versus digital means of saving your images. Foster deals with "old-fashioned" photographic technique (not to say that silver-based photography is bad or outdated; just the opposite!) She deals effectively with such little-examined topics (at least for most modern biology students) as darkroom technique, reciprocity, and exposure calibration. She also discusses the characteristics of digital imaging with CCD cameras, and storage of large digital images. She quite correctly defers to local representatives for answers to digital printing and long-term archiving, since these technologies change significantly every few months.

In Chapter 10, "What's Next?", she discusses selected "power user" techniques such as digital image analysis, spectrophotometry, interferometry, confocal imaging, and scanning probe and electron microscopy.

In some ways my favorite parts of the book, however, are the very useful Appendices, which cover the history of microscopes, various optical aberrations and various microscopy troubleshooting issues, an all-in-one summary of contrast-enhancement, and an outstanding glossary. Foster ends the appendices with a table of filter sets for fluorescence, (quite possibly the most common type of questions I encounter). A list of equations (Appendix G) will probably be used by only the most dedicated microscopists, but the list of vendors in the back (Append. H) will be more than enough to get the new microscopist, or the experienced investigator setting up his/her lab for the first time, off to a strong start.

Foster's approach is excellent. She has a friendly style of writing and tries to directly engage the reader/user in mini-experiments. Each chapter contains quizzes designed to expand the users' skill, and she provides useful, succinct summaries of each of the chapters. The book needs an index and it would help to make the book even more useful.

This is an excellent manual for an upper level dedicated course for undergraduates, or a graduate/technical training level course. It should be on the bookshelf of every microscopist and every microscopy facility. It will be very useful for new graduate students and skilled users alike. ■

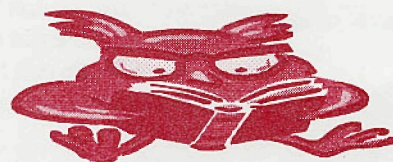
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