Light and Video Microscopy

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and suggestions for future research. The book is interesting and well written, and I recommend it as a critical reference for anyone interested in the ecology, conservation, and management of snakes or other animals.

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LET THERE BE LIGHT

Light and Video Microscopy. Randy O. Wayne. Elsevier, 2009. 312 pp., illus. $99.95 (ISBN 9780123742346 cloth).

Light and Video Microscopy is a written version of the microscopy class Randy O. Wayne teaches at Cornell University. The class, offered in the biology department, is directed at biologists who have forgotten their freshman physics. As such, this book would be an excellent undergraduate-level text on optical microscopy for biologists. There are lab exercises for each chapter and even a final exam. The book has enough sophistication, however, to be appropriate in a physics department as well. As the manager of a confocal microscopy core facility, I deal with graduate students from a wide variety of fields, and very few have an understanding of the basic microscopy that this book successfully conveys.

But *Light and Video Microscopy* is not just a student textbook—it is also valuable to anyone using a light microscope. Because the field is explained carefully, any microscopist will be able to understand it (which is not the case for many books on microscopy). There are numerous excellent diagrams accompanying the descriptions of optical concepts, and in the back are color plates illustrating the different bright-field techniques. The book also lists Web resources for each topic. There are equations, but the author takes the reader through them step by step.

Wayne is, first and foremost, a teacher (I was once one of his students and am now a colleague at Cornell). His calling shows in his writing. In *Light and Video Microscopy,* he explains the complicated science of the subject methodically and patiently. From the nature of light, through geometric optics, and then into image formation and microscopy, he walks the reader through the field's key ideas. Wayne's informal and friendly approach makes the subject easy to learn. If you want to know basic geometric optics, or how phase contrast or differential interference contrast work, he describes them. All facets of transmitted-light microscopy are covered in thorough detail.

An ability to elucidate difficult concepts is not the only thing that makes Wayne an excellent teacher. He is also a historian of science and has thoroughly researched the topic in order to bring historical information to the reader. He quotes early scientists to illustrate their thought processes, bringing the history of microscopy to life. Just as the early microscopists learned how light behaves, the reader learns too. This weaving together of history and physics makes for a book that is both informative and enjoyable to read.

Light and Video Microscopy begins with a discussion of the nature of light and vision. Wayne challenges the reader to question images, beginning with examples of optical illusions. He follows this with a solid explanation of geometrical optics, covering reflection, refraction, and lenses, including that of the human eye. Principles of diffraction, resolution, and image formation in the microscope are covered next. These early chapters provide the foundation for the rest of the book.

Later, we learn how the wave theory and the particle theory of light were developed, and how one or the other predominated at different times until Einstein pulled them together. The emphasis here is on the wave nature of light, which held sway for many years. The book starts with simple contrast-enhancing techniques such as dark field, oblique illumination, and phase contrast, and then moves to polarization principles, which are used in the explanation of interference microscopy, differential interference contrast, Hoffman modulation contrast, and other amplitude-modulation contrast techniques. Finally, we arrive at fluorescence, which requires reconsideration of the particle nature of light. The author delves into the quantum mechanics behind fluorescence and the principles of confocal and two-photon microscopy. Throughout the book, he cautions the reader to remember the difference between object and image.

The book also includes very brief discussions of some unusual types of microscopy, such as centrifuge microscopy and acoustic microscopy, and some nonlight techniques, such as nuclear magnetic resonance imaging and scanning probe microscopy. A chapter on photomicrography covers film, which is useful from a historical perspective. There is also a chapter that describes the workings of video cameras, charge-coupled device cameras, and photomultiplier tubes, and Wayne includes a brief chapter on analog and digital image processing.

The only complaint I have about the book is its title. Because video is now obsolete technology, I worry that the book may appear out of date. In fact, video is only a very small part of the book, and I am surprised the term made it into the title. Light microscopy, especially transmitted-light microscopy, is a field that has fallen out of favor, overshadowed by the newer techniques of confocal, two-photon, stimulated emission depletion, photoactivated localization, and other types of microscopy. But the basic optics and principles of image formation, explained carefully here, are also relevant to these new techniques, making *Light and Video Microscopy* extremely useful for any light microscopist.

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