NEW TECHNIQUES OF OPTICAL MICROSCOPY AND MICROSPECTROSCOPY

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NEW TECHNIQUES OF OPTICAL MICROSCOPY AND MICROSPECTROSCOPY

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Preface

Although the use of optical microscopy in biology has a long history, the last few years have seen a dramatic renewal of interest in its application. A whole new range of methodologies have been, or are being, developed, which add greatly to the power and scope of microscopy using visible light. The aim of this book is to provide an up-to-date account of the major developments.

The recent advances in optical microscopy subdivide into a number of interlocking areas. The early chapters of the book focus on developments which dramatically improve the quality of the image. Such methods have greatly benefited from the explosive growth of readily available computational power which has taken place over the past decade. In conjunction with scanning technologies, remarkable two-dimensional images and three-dimensional reconstructions are now obtainable with new standards of resolution and contrast. New lensless techniques of optical imaging are being devized which take spatial resolution beyond the fundamental physical limits imposed by lens-based systems.

In part associated with these improvements in image quality are methods for quantitatively investigating dynamic events in cells. An important advantage of optical microscopy over electron microscopy is that measurements can be made on living cells, thus permitting dynamic events to be observed. Techniques have been developed based on video-enhanced contrast microscopy which enable direct observation of the movements of cellular structures or of colloidal metal particles attached to specific molecules. Further methods for measuring molecular motion are based on fluorescence and quasi elastic light scattering. Interferometric microscopy in conjunction with image processing is particularly suitable for analysing cell growth and mobility.

Fluorescence is a versatile spectroscopic technique which has been employed in innumerable ways to study biological molecules in macroscopic samples. The high sensitivity of fluorescence has of course also long been

exploited in microscopy. However, in addition to visualization, new methodologies permit extension of fluorescence spectroscopic techniques, such as time-resolved fluorescence and monitoring of membrane potentials, to the single cell level. The development of fluorescence indicators for visualizing and measuring specific ion concentrations in cells is also finding widespread application.

It is apparent that modern optical microscopy is an interdisciplinary activity involving the combined efforts of biologists, biochemists, chemists, computer programmers and physicists. I hope that this book will succeed in conveying something of the excitement of current work in this area and encourage others to become involved in the further development of new techniques and their applications.

Colchester, 1990 R. J. C.

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