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Perspectives on Fluorescence

A Tribute to Gregorio Weber

Volume Editor:
David M. Jameson

With contributions by

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Springer
Aims and Scope

Fluorescence spectroscopy, fluorescence imaging and fluorescent probes are indispensable tools in numerous fields of modern medicine and science, including molecular biology, biophysics, biochemistry, clinical diagnosis and analytical and environmental chemistry. Applications stretch from spectroscopy and sensor technology to microscopy and imaging, to single molecule detection, to the development of novel fluorescent probes, and to proteomics and genomics. The *Springer Series on Fluorescence* aims at publishing state-of-the-art articles that can serve as invaluable tools for both practitioners and researchers being active in this highly interdisciplinary field. The carefully edited collection of papers in each volume will give continuous inspiration for new research and will point to exciting new trends.
During the last few decades, fluorescence spectroscopy has evolved from a narrow, highly specialized technique into an important discipline widely utilized in the biological, chemical, and physical sciences. As in all scientific disciplines, the development of modern fluorescence spectroscopy has benefited from the contributions of many individuals from many countries. However, one individual, Gregorio Weber, can be singled out for his outstanding and far-reaching contributions to this field.

Gregorio Weber was born in Argentina on July 4, 1916. He died of leukemia on July 18, 1996. His death ended a remarkable and amazingly productive scientific career, which began in Buenos Aires, developed in England at Cambridge and Sheffield, and flourished at the University of Illinois at Urbana-Champaign. His contributions to the fields of fluorescence spectroscopy and protein chemistry are still evident and significant yet many young people entering these fields may not realize the debt they owe to his pioneering efforts. This book is intended to recognize the 100th anniversary of his birth. This project began several years ago when I was approached by Martin Hof and Otto Wolfbeis to organize this volume. To this end, I invited a number of distinguished researchers to take time away from their already busy schedules and write a chapter outlining a particular aspect of fluorescence spectroscopy, indicating how Gregorio Weber had influenced the field and their own approach to the work. Many of these authors had worked directly with Gregorio Weber, either as students, postdocs, or scientists visiting his lab. I believe that these collected chapters will not only offer the reader valuable and informative insights into the application of fluorescence methodologies to a wide variety of systems but will also serve to emphasize the debt that all of us working with fluorescence owe to Gregorio Weber.

The first four chapters (Jameson, Barrantes, Jovin, Visser) focus largely on the life and science of Gregorio Weber. Jameson summarizes and recounts Weber’s scientific career pointing out his contributions to fluorescence spectroscopy as well as to protein chemistry. Barrantes provides a marvelously detailed look into
Weber’s formative years in Argentina – before he left for England. Jovin follows Weber’s life from childhood to scientific eminence, discussing many of the major personalities and influences along the way. Visser gives a personal account of his time as a postdoc at UIUC in Weber’s lab and his work there on the application of high pressure to flavinyl tryptophan compounds and flavodoxin proteins.

Several chapters focus on spectroscopy, in particular the application of fluorescence spectroscopy to biophysical subjects. Gratton presents a compelling personal account of the development of frequency domain fluorometry and the pivotal influence Gregorio Weber had on his approach to this research. Visser and his co-authors discuss the ultrafast decay of fluorescence anisotropy of NATA, while Demchenko gives an extensive and detailed account of Weber’s red-edge effect and its significance to fluorescence spectroscopy in general and to protein dynamics in particular. Day discusses modern approaches to fluorescent lifetime imaging, while Xu and Knutson discuss the impact of laser developments on fluorescence spectroscopy.

Two chapters concern applications of fluorescence probes to study cell membranes as well as cellular interiors. Chong describes the use of fluorescence to elucidate membrane lateral organization, while Bagatolli and Stock apply 6-acyl-2-(dimethylamino)naphthalenes as relaxation probes of biological environments to elucidate aspects of water dynamics in cellular interiors.

Four chapters focus on proteins, in and out of cells. Reinhart presents an engaging discussion of his early connections to the Weber lab and how Weber’s work on the thermodynamics of protein interactions inspired his own studies on allosteric enzymes. Royer describes how fluorescence can be applied to characterize the molecular and energetic basis for the role of protein interactions in the regulation of gene expression. Brand provides a detailed examination of relaxation processes, such as time-dependent spectral shifts, exhibited by solvatochromic probes including tryptophan, and how these processes can illuminate aspects of protein dynamics. Marriott describes a new class of genetically encoded fluorescent proteins based on the lumazine-binding protein (LUMP) and then discusses the potential of using LUMP and related encoded proteins to advance the application of fluorescence polarization to analyze target proteins and protein interactions in living cells.

Several chapters describe the use of fluorescence methodologies to elucidate aspects of cellular dynamics. Cardarelli and Gratton discuss spatiotemporal fluorescence correlation spectroscopy to follow movement of single molecules inside cells, while Diaspro and colleagues describe the use of STED microscopy to elucidate pico-nanosecond temporal dynamics in cells. Jacobson and colleagues discuss plasma membrane DC-SIGN clusters and their significance.

I hope you enjoy this overview of modern applications of fluorescence, and I hope you gain a better appreciation not only of Gregorio Weber’s contributions to the field but also of his unique personality and character.

Kailua, HI, USA

David M. Jameson
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