

METHODS IN MOLECULAR BIOLOGY™

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Bioluminescence

Methods and Protocols

Second Edition

Edited by

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and

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 **Humana Press**

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Preface

Part I

I was raised in a redbrick Baltimore row house where summer was marked by the time-honored ritual of firefly-chasing – a backyard tradition that has endured the generations. Amid the excitement, my father often told the story of how, when he was a child, researchers at the Johns Hopkins University had appealed for the systematic capture of live fireflies en masse. Science had engaged the Baltimore youth in an entrepreneurial quest to jar as many lightning bugs as the dwindling light of dusk would permit. The very next morning, each 100-count glass jar of glowing crawling insects could be exchanged at the University for exactly one crisp dollar bill.

Unrecognized at the time by my father, his joyous endeavors had contributed in a profound way to the advanced molecular biological techniques that serve as the basis for this textbook. In 1947, William McElroy used extracts from those very fireflies to define the fundamental reaction underlying the mystical phenomenon of luminescence, and published “The energy source for bioluminescence in an isolated system” in the *Proceedings of the National Academy of Sciences*.

In the decades since that summer, the study and application of bioluminescence have allowed us to leverage the enduring power of nature’s elegance. We have painstakingly harnessed a powerful tool that enables us to seek a deeper understanding of the complex mechanisms underpinning so many vital biologic systems. This second edition of *Methods in Molecular Biology’s Bioluminescence: Methods and Protocols* serves as a readable and utilitarian compilation of the newest and most innovative techniques that have emerged in this rapidly expanding and progressively diverse field.

We are indebted to the authors for their thoughtful contributions, inspired by their rigorous dedication to the science of bioluminescence, humbled by the unyielding support of our colleagues, and grateful for the opportunity provided us by John and Jan Walker.

Chapel Hill, North Carolina

Preston B. Rich

Part II

My first encounter with bioluminescence happened while I was a child, during a family vacation at an Atlantic beach. One evening, we stayed near the water until night time, seeking some relief from the unusual heat. The magic happened when each walking and kicking step agitated the sand and water, lighting a soft blue glow. It evoked both poetic wonder and the foreign feeling suggested by a sci-fi movie. Later, I speculated which species was present that day. It is difficult to know, since so many marine organisms are bioluminescent.

Our personal anecdotes and countless others illustrate the widespread occurrence of bioluminescence in nature (bacteria, fungi, worms, fireflies, coral, jellyfish, fishes, etc.). Indeed, it appeared many times independently throughout evolution. Its purposes are also varied: it can be used for communication, predation (e.g., attraction to a lure in fish or aggressive flashing mimicry in fireflies), reproduction (attracting a mate), camouflage, repulsion, or other defensive strategies (e.g., dinoflagellates when endangered by a predator may use bioluminescence to attract a bigger predator who may prey on the smaller predator), and sometimes for illumination (night vision).

The extensive use of bioluminescence in nature is mirrored by its very wide use in scientific laboratories. Since the classical experiment by Raphael Dubois in 1885 describing for the first time the luciferin–luciferase reaction, the applications of bioengineered bioluminescence have continuously increased in number. In popular culture, the development of glowing pets, self-illuminating Christmas trees, and other wild endeavors appear amusing (light indeed). However, the applications in biotechnology and medicine are cutting-edge and far-reaching. Bioluminescence is used to study cellular and subcellular phenomenon, and we present in this second edition of *Methods in Molecular Biology's Bioluminescence: Methods and Protocols* some methods to assess cell trafficking, protein–protein interactions, intracellular signaling, and apoptosis.

One key feature of bioluminescence is the possibility to visualize and quantify biological mechanisms in real-time and in *in vivo* settings. This opens new avenues of knowledge, and we have included here some chapters that describe the *in vivo* study of bacterial or viral infections, transplanted cells, stem cells proliferation, vascular flow, and tumors.

The commercialization of reporter genes, assay kits, and imaging systems provide easy access to the materials needed for such studies. This book provides protocols that are detailed enough to be followed and adapted by scientific teams who have no previous expertise in bioluminescence. Hence, we believe that numerous breakthrough and new applications from basic to applied science and medicine will continue to be developed.

We thank the chapters' authors for sharing their rich expertise, and Jan and John Walker for helping us throughout the editorial process.

Chapel Hill, North Carolina

Christelle Douillet

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