PREFACE

Both of us are so excited about the combination of optical and molecular tools that are now available that we wish we were just starting our research careers! We feel that this excitement *must* be conveyed to both young and "seasoned" researchers who are looking for ways to analyze and solve problems that, perhaps, the more conventional methods alone are unable to do.

With the above in mind, we undertook an assembly of chapters that deal with the long history of the "microbeam" approach (see Chapters 1, 2, and 7), and the rest of the book which is a group of chapters that primarily focus on the use of light as (1) a microablation tool (scissors), Chapters 4, 5, and 7–15; (2) a noninvasive force-generator (tweezers), Chapters 6 and 16–22; and (3) a mechanism to catapult molecules and fragments of cells into other devices for molecular analysis (catapulting and capture), Chapters 23–26.

But before embarking on an exploration of this book, we would like to recount for the reader/browser some of the key people and our own *moments* in a field that both of us have devoted our careers to.

One of us (M.W.B.) was introduced to the "microbeam" by one of my Ph.D. committee professors, Adrian Srb, a geneticist at Cornell University, who took me aside one day in 1965 and said, "There's a new thing called a laser. We have one down in the basement of Stimson Hall [now an historical building at Cornell University in Ithaca New York] that is coupled to a microscope. No one knows quite what to do with it, so why don't you see if it will be useful in your experiments to 'micro-dissect' the *proliferation zone* in the anal segment of the millipedes that you are studying." My Ph.D. project was to try to understand how the millipede regulates the number of body segments and legs that it makes during its postembryonic development. Ironically, the system did not work for my application because the ruby laser wavelength 694.3 nm [see diagram and photo, Figures 2–7 and 2–8 in Berns (1974)] would not pass though the hard pigmented exoskeleton of the millipedes. However in doing my background research for these experiments, I learned that lasers were not the first radiation sources attached to microscopes.

In fact, we both discovered that there was a long history of "microbeams" going all the way back to 1912 when Sergei Tschachotin (also spelled *Tschakotine* and *Chakhotin*) published his first description of an ultraviolet light source attached to a microscope for the purpose of partial irradiation of biological objects (Tschachotin, 1912). In fact, the trials and tribulations of Sergei Tschachotin throughout his prolific scientific and sociopolitical life is an intriguing story in its own right. In many ways, Tschachotin was a scientific and political "nomad" (see his biography in Chapter 27). He was an outspoken critic of both the Nazi and

Stalin regimes, and he literally roamed throughout Europe as a "man without a country" at times being a scientist and at times being an author and political critic. This made him persona non grata in many countries from the 1920s until his return to the Soviet Union in the 1950s. He went to Germany for his graduate studies ultimately attaining the Ph.D. from the University of Heidelberg in 1908. His scientific tradition was continued in the 1970s and 1980s by the brothers Drs. Christoph and Thomas Cremer. They introduced one of us (K.O.G.) into the field, who had his scientific cradle in Heidelberg until he changed, after the reunification of Germany, to Jena in the former German Democratic Republic. This revelation now explains the long successful tradition of microbeam irradiation at the University of Heidelberg (see References in Chapter 1 to the 1970s work of Christoph and Thomas Cremer, and Jurgen Bereiter-Hahn).

Certainly, Sergei Tschachotin must be considered one of the twentieth century pioneers of experimental cytology and embryology. Without his seminal work, this book simply would not have been written. He also was a brave man who was not afraid to express his political views against totalitarian and immoral political regimes. For that we are all in his debt.

When the laser came on the scene in the early 1960s, it was immediately recognized as a potential, powerful, and revolutionizing force for the field of microbeam irradiation. Through the work of Frenchmen, Marcel Bessis and G. Nomarski in 1963, and subsequent studies by the French "School" of microbeams (see Chapter 1) the laser was shown to have unique advantages attributable to its monochromaticity and intensity. By 1967, when the first NATO Advanced Study Institute on "Microbeam and Partial Cell Irradiation" was held in Cannes, France (September 20–29), it was clear that the laser was the "light wave" of the future for microbeams. When the second NATO Advanced Study Institute on the same subject was held in June of 1970, in Stresa, Italy, it was recognized that the laser was, indeed, the radiation of choice for selective cell manipulation through the microscope. With the invention of optical tweezers and its adaptation for nondestructive cell manipulation by Arthur Ashkin in 1987, the laser microbeam "toolbox" became complete in such a way as could never be imagined by the two true generally unsung pioneers, Sergei Tchakhotine and Marcel Bessis.

Now as we gaze over the past and present landscape of a field that started almost 100 years ago by a man who was a scientist and political critic (at a time when political critics somehow disappeared), *microbeams* are no longer a technology primarily of the wealthier countries such as the United States, Japan, and Europe. This field is now "global" as evidenced by the list of contributors from all over the World.

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References

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