

Preface

A number of years ago, I was on a university committee that was evaluating student life and how to change or improve it. After a couple of meetings, I stopped by a wise colleague's office and excitedly told him about all the great things that we were planning. He listened politely, and then, taking his pipe from his mouth, asked, "What exactly is the problem you are trying to solve?" After thinking for a moment, I said I didn't know. The committee had talked at length about what we wanted to do, but never asked the key question: Why do we want to do it? Since that time, I have always tried to have the answer to that question and the arguments for why something should be done close at hand.

So, I hope the reader is asking, "Why did he write this book? What was the problem he was trying to address? Why and how is this book part of the solution to this problem?"

In recent years, I have become increasingly concerned with the separation of the more quantitative and technological knowledge of the sciences and engineering and the more qualitative ways of knowing of the arts. Of course, this view is not new, as Snow's classic book,¹ and more recent works by Edward Wilson² and the reply to Wilson by Wendell Berry³ demonstrate. To my mind, it is clear that both ways of knowing are essential to our modern way of life, yet far too many people are turned off to science and mathematics at an early age, and they never really understand all but the simplest of ideas and concepts. Thus, an overriding goal of this book is to take at least a small step towards bringing these cultures together by discussing topics of common interest.

¹ *The Two Cultures: and a Second Look*, C. P. Snow, 1964.

² *Consilience: The Unity of Knowledge*, Edward O. Wilson, 1998.

³ *Life is a Miracle: An Essay Against Modern Superstition*, Wendell Berry, 2000.

Deep in the recesses of my mind, I have a memory of an idea attributed to St. Thomas Aquinas. The gist of the idea is that if you want someone to come over to your point of view, walk over to them, take their hand and lead them to your position. Thus, this work is first addressed to the non-scientist. The material was chosen to explain a most common everyday item, the laptop computer. The very same ideas are then used to help understand life and art. Certainly other examples abound, but these areas most closely associated with my personal interests.

My goal for these non-scientists is to write a book *of* science and technology as opposed to a book *about* science and technology. Far too often, when trying to reach non-scientists, we, the scientists, stop short of giving them hard science and focus on history or society or other less technical areas. I hope the readers who identify with non-scientists will find a clear, united presentation where ideas build on ideas and thereby lead them to better understand and appreciate the work of scientists and engineers, the intricacies of life, the interconnectedness of the sciences to themselves and to technology, and the basic workings of a computer.

I have tried to use simple models and explanations with a minimum of mathematics to reduce the non-scientist's discomfort. At the same time, mathematics is undeniably part of the language of science. I have long felt that part of being a well informed and active citizen is being scientifically and technologically literate, and mathematics must come along for the ride. On occasion, just as when a scientist studies Faulkner or Shakespeare, the reader will be required to "eat their spinach." I have also, possibly to the consternation of these individuals, used Greek letters to represent certain constants and quantities. I have used the same letters in the same manner as more advanced books. My hope is that the reader will consult such books and, because they already know the notation, they will not have the burden of connecting two different notations.

After writing the first draft, I discovered a second audience for this book – the scientific specialist who has not seen some of the material and the connections between the topics. In the time of William Bacon, a single person could know and understand literally *all* of science. This has certainly changed. Centuries ago chemistry, biology, and physics split and went their separate ways. In more recent decades, electronics and biochemistry split off from branches and combinations of these three "major" disciplines. Now interestingly, these "major" fields are starting to come back together. Certainly, this reunification is not total, nor does it encompass all of the areas of these disciplines. Nevertheless, an increasing number of scientists and

engineers are working in cross-disciplinary areas. We have, for example, a physicist that needs to know biology, or a biologist that needs to understand polymers. These individuals need to “get up to speed” rather quickly and they need to know and understand the language before they can proceed on to more advanced works.

Liquid crystal science and technology, life and the arts, and computers incorporate many different areas of science and technology and have been a breeding ground for this type of cross-discipline general science education for many decades. Thus, my goal for the scientist who knows some areas but not others is to provide a reasonable introduction to some of the essential ideas and how they connect to other ideas. This should provide an interesting course at the second year level for students in a variety of scientific disciplines. It is hoped that this book will serve as a readily accessible first step into areas which these readers are unfamiliar. The middle chapters, where this is most likely to be the case, have a large number of references for just this reason.

I have tried to convey my excitement, wonderment, and awe of nature in this book. The text is by no means self-contained. Nevertheless, I have tried to include sufficient background material so the reader will not have to consult other references except to obtain greater information and insight. I have started with the most basic ideas and then shown how they allow us to understand more complicated material. The level is deliberately uneven. Life is not “Science 101,” and all problems are not equally difficult. Most chapters end with two sections entitled Exercises and Research Questions. The purpose of the Exercises is to give the reader an opportunity to test their knowledge of the material in the chapter. This section also, on occasion, presents applications of the material and tries to illustrate how scientists apply these ideas. The Research Questions tend to be more difficult and, in many cases, are rather open ended. Their purpose is to provide the student the opportunity to extend themselves and the material.

No work is developed in a vacuum. This book has been the beneficiary of help from many people. Dr. John West, former director of the Liquid Crystal Institute at Kent State University first suggested I develop this material into a course and found the financial means to allow me to work on this project. Professor Oleg Lavrentovich, also of the Liquid Crystal Institute, suggested the title.

Several people read all or parts of the drafts and offered concise comments. I particularly wish to thank Dr. Mary Ann Simpson of the Lahey Clinic, my sister Judy Laston (a microbiologist), Mr. John Mishic of Analex

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A special thanks is reserved for Dr. Jonathan Ruth, also of the Liquid Crystal Institute. Jon served as my in-house editor and read and commented on *every* figure, word, and idea (sometimes in mind boggling detail!). He found unclear statements that others had missed, confusing aspects of figures, and made suggestions too numerous to mention. I have no doubt that this book is better for his voluntary efforts.

Joseph Collura, a former student and current friend, neighbor, and colleague read the “final version” and offered significant suggestions that made it the final version minus one.

Finally, I wish to thank my wife, Mary Alyce Mooney. She read every chapter multiple times and suggested far too many changes for me to count. She also kept me honest by asking those tough questions that forced me to clarify discussions, add footnotes, change figures, and read (and reread) just about every book listed in the footnotes and references.

Of course, all errors, unclear statements, and omissions are the author's.

M. R. Fisch