

Chapter 1

To My Readers

Poets say science takes away from the beauty of the stars — mere globs of gas atoms. I, too, can see the stars on a desert night, and feel them. But do I see less or more? – Richard Feynman

There is poetry in physics and physics in poetry. This book is the product of a course I taught at the University of Toronto starting in 1971 and which I am still teaching at the date of this publication. The course was entitled the Poetry of Physics and the Physics of Poetry. The course was first taught at University College of the University of Toronto and then switched to New College where I also organized a series of seminars on future studies known as the Club of Gnu. After a short recess the course then became a Department of Physics course and was offered as a seminar course for first year students. The purpose of the course that I have now taught for the past 38 years was to introduce the ideas of physics to humanities and arts student who would not otherwise be exposed to these ideas and to try to address the alienation to science that so many of the lay public feel, which is a characteristic of our times. By studying physics without math you, the reader, will encounter the poetry of physics. We will also examine some of the impacts of physics on the humanities and the arts. This is the physics of poetry.

The alienation represented by the gap between the sciences and the humanities is frequently referred to as the two cultures. There are two factors contributing to this alienation; one is the basic lack of understanding of the actual subject matter of science and the other a misunderstanding of the role science plays in our society. Although the fear of science is quite pervasive I believe there are many people interested in leaning about physics. The word “physics” is derived from the Greek word phusis, which means nature. Those that are curious about

the “nature” of the world in which they live should, therefore, want to study physics.

This unfortunately, is not always the case, due in part to the fact that historically physics has been taught in a manner, which alienates most students. This has been accomplished by teaching physics mathematically, which has resulted in more confusion than elucidation for many. Also because the easiest way to examine students and assign grades is to ask quantitative questions, there has been a tendency to teach the formulae of physics rather than the concepts.

This book attempts to remedy this classical situation by communicating the ideas of physics to the reader without relying on mathematics. Mathematical formulae are used, but only after the concepts have been carefully explained. The math will be purely supplementary and none of the material developed later in the book will depend on these formulae. The role of a mathematical equation in physics is also described. To repeat the mathematics is purely supplementary. This book is written explicitly for the people who have difficulty with the mathematics but wish to understand their physical universe. Although all fields of physics are covered the reader will find a bit more emphasis on the modern physics that emerged in the beginning of the 20th century with quantum mechanics and Einstein’s theory of relativity. The reason for this is that this physics is less intuitive than classical physics and hence requires more of an explanation.

A second aim of the book is to understand the nature of science and the role it plays in shaping both our thinking and the structure of our society. We live in times when many of the decisions in our society are made by professionals claiming scientific expertise. Science is the password today with those who study social and political problems. They label themselves social scientists and political scientists. It is, therefore, vital to the survival of our society that there exists a general understanding of what science is, what it can do and perhaps most importantly what it cannot do. I have therefore, made an attempt to shed as much light on the scientific process as possible. We will demonstrate that science unlike mathematics cannot prove the truth of its propositions but that it must constantly test its hypotheses.

To restore the perspective of what science is really about we will examine science as a language, a way of describing the world we live in. To this end we will briefly examine the origin and the evolution of language to reveal how the language of science emerged. We will show

that the spirit of trying to describe the physical world we live in is universal and can be traced back to preliterate societies and their oral creation myths. It was with writing that the first signs of scientific thinking began to emerge. We will also explain how alphabetic writing influenced the development of abstract science in the West despite the fact that most of technology emerged in China. We will also document the contributions to science by other non-European cultures once again demonstrating the universality of scientific thinking. Hindu mathematicians invented zero and Arab mathematicians transmitted it to Europe providing the mathematical tools for modern science. Arab scientists and scholars contributed to the scientific revolution in Renaissance Europe through their accomplishments in algebra, chemistry and medicine.

Finally, I hope that through this book I will be able to share with the reader the mystical feelings that once characterized our response to our physical environment. Unfortunately, there has arisen in many people's minds a division between the mystical and the scientific. For those in tune with their universe there is no division. In fact quite the opposite is true as these words of Albert Einstein reveal:

The most beautiful and most profound emotion we can experience is the sensation of the mystical. It is the power of all true science. He to whom this emotion is a stranger, who can no longer stand, rapt in awe, is as good as dead. That deeply emotional conviction of the presence of a superior reasoning power, which is revealed in the incomprehensible universe, forms my idea of God.

Hopefully, the beauty of the concepts of physics will be conveyed so that the reader will come to appreciate the poetry of physics.

In addition to the poetry of physics we will also examine in this book the physics of poetry by which we mean the ways in which physics has influenced the development of poetry and all of the humanities including painting, music, literature and all of the fine arts. Interspersed within our description of the evolution of science we will examine how the arts were influenced by science and vice-versa how the arts and humanities influenced science. There will be more of a focus on poetry because like science it is pithy and it will be easy to demonstrate how science impacted on this art form by quoting from poets ranging from the poetry of creation myths to the poetry of modern times.

This book was written for first year students at the University of Toronto and as such it can be used as a textbook for an introductory non-mathematical two-term physics or science course. It is also written in such a way as to appeal to the general reader. For instructors wishing to use this book as a textbook I have provided some suggestions in Chapter 29 on topics for essay assignments or for classroom discussions.

I would welcome comments or questions from my readers via email at logan@physics.utoronto.ca.