Preface

Beyond its intrinsic beauty, the pursuit of physics, now into its fifth century, comes with a thrilling and compelling human story. From its earliest beginnings — think Galileo — this story has fascinated physicists and non-physicists alike. Over the years, I both heard and got to witness many such stories. They put a human face on the grand story, the evolution of our science. As a rule these stories are handed down by word of mouth. After finishing the proof of Emmy Noether's seminal theorem in my field theory course, I would let the students catch their breath, while telling them the moving story of this great mathematician. Invariably they were riveted; you could hear a pin drop. The idea of putting such stories down on paper for a change, was born, with the hope of conveying the excitement and flavor of the physicist's life, as well as the way physicists' lives are affected by the sometimes benign, at other times malignant, forces of history.

Though what follows is built out of many, many anecdotes, vignettes, and stories, they naturally cluster around certain clearly visible main themes, which give a degree of continuity to the whole. *What* all these scientists try to achieve, their deeper motivation, is obviously of

essence, and, rigorously foreswearing the use of any technical means, I have tried to give at least a general idea of the beautiful goal of the physicist's work. Above all, this book is about what happens at the human level when some extremely gifted individuals, living in the unavoidable historic reality, devote themselves to what can be called without hyperbole a transcendental goal.

By now I have twice referred to the beauty of physics and I ought to explain my use of this word. One normally associates beauty with works of art. It takes little to explain why Jean-Auguste-Dominique Ingres' *Grande Odalisque,* on view at the Louvre, is beautiful. The shapes are superb, the color scheme rich and sensual; the varnished texture intimates perfection. It all seems so inevitable, so elegant. It is these two ingredients, inevitability and elegance, or economy of means, which we find as well in a major scientific idea. In physics, the ultimate focus is on how many ideas previously thought of as unrelated now get connected into a meaningful whole and become much easier to comprehend, and then what entirely new perspectives open up before us.

Before Einstein's theory of general relativity, for example, the shape of space (or more generally, the shape of the four-dimensional space–time continuum) had to be postulated, or, more frankly, guessed. Then, in this guessed space one could study the problem of how gravity is generated by matter, and in turn affects the movement of matter. The shape of space had neither much to do with this problem, nor was it affected by this problem. But when the theory of general relativity was formulated and then experimentally confirmed, the interaction between matter and gravity was seen to also *determine* the shape of space, and guesswork was no longer needed. Two independent problems turned out to reflect different aspects of a larger whole. As a consequence, the evolution of space could be

studied and modern cosmology was born. How bold, how inevitable, how economic! How beautiful!

I have used a few criteria in selecting the stories in this book. I tried to exclude as much as possible anything having to do with my own work, lest some ulterior motives be read into my writing. I also steered away from stories that are widely known, such as Feynman's participation in the investigation of the Challenger disaster and Heisenberg's wartime meeting with Bohr, etc. I have tried to conscientiously check the stories I am telling. To a large extent I relied on my own good, though not infallible, memory. If there are some inaccuracies in this book, I am sorry and stand ready to be corrected. I hope, however, that my love and deep respect for the people I write about shines through these pages. There are some "heavies" in the book, at least as far as my narrative goes. But even these would not be worth writing about if they weren't as remarkable, great, and influential as they unquestionably are.

Quite often I try to understand the mindset of one or another of the people I write about. Some of my interpretations, I am sure, will give rise to controversy, but that is as it should be.

All verbatim quotations in these pages are my renderings of what I remember as having been said, or what I remember having been told was said. I sincerely hope that I have gotten the substance of these quotations right and that the words I place in peoples' mouths fit comfortably and deliciously, even if on occasion a bit painfully, there.

This book is about physics and about narratives. At first one might think the two have nothing in common. Yet, there is a close connection. To a large extent, to understand something is to be able to put it in narrative form. It should then come as no surprise if we find narrative

structures in physics. In fact there are three narrative structures running through physics.

First, each physics or mathematics paper has its own narrative structure: the proofs are not instantaneous, they develop in time. One can get as glued to a physics or mathematics paper as to a good mystery story. The heroes are the various *concepts*. Their adventures wring them through all those equations and at the end they emerge changed, or they even beget new concepts. Of course, such a narrative also involves minor characters, and we are often left wondering what happened to them. At the end of the paper, not surprisingly, we often find a throwaway remark like, "We hope to return to this elsewhere," and sometimes the paper is followed up by what in Hollywood would be called a sequel, or a spin-off.

On the second level, there is a narrative running through all of physics: the magnificent story of this science in its entirety. In this narrative the various *theories* are the heroes, as they change and ultimately evolve into better or altogether new ones. Each time an important new paper is written, all old papers implicitly get rewritten and we can explain to the young in a matter of years what took centuries to discover. Similar things happen in the arts. Before starting to write, a novelist does not have to read all the novels ever written, starting with Longus and Petronius, for at some level each new novel contains and also reacts to the wisdom of its ancestors. Once Tolstoy wrote *Anna Karenina,* Emma Bovary acquired company she would never be able to shake.

Finally, there is a third level at which physics has a narrative structure: the human level. Like all science or art, physics is a human enterprise, and its practitioners strongly interact with each other. Under the right circumstances these interactions result in brilliant work and beautiful friendships. But there is more to it. Physicists do

not live in an ivory tower; they are not spared the ravages of history. Very dramatic situations can be whipped up by the, often irrational, winds of history and politics. This drama, such as I have had the chance to observe it, is the focus of the stories I tell here.

In my life I have had ample occasion, more indeed than I could have wished for, to witness drama served up by history, which leaves its indelible stamp on all humans and in particular on scientists, be they physicists, mathematicians, biologists.... In Romania, where I grew up and got my undergraduate education, after the pleasures of a wartime fascist dictatorship, we were presented the glories of the dictatorship of the proletariat, in its purest Stalinist guise. The 1956 Hungarian uprising led to events in my hometown of Timişoara, during which I, an undergraduate at the Polytechnic Institute there, found myself lined up with other students between a wall and a line of tanks with their guns pointed at us. Obviously, for some rather bizarre — if for us happy — reasons, the communist authorities decided against mowing us down. But as far as I am concerned, my sensibility to political upheaval has forever been considerably heightened. I developed a keen interest in the way the physicists I came in contact with, managed to cope with the kind of crises that the twentieth century so copiously lavished on the supposedly civilized world.

During my graduate studies at the University of Vienna, my post-doctoral appointments at the University of Geneva and the Institute for Advanced Study in Princeton, and my many years as a professor of Physics at the University of Chicago, I got a chance to participate in and contribute to the development of the ideas that culminated in today's all-encompassing string theory. All through these years, I was in close contact with physicists whose own lives bore the distinct impact of the twentieth century's grand events, and who in turn had known others for

whom this was true. A picture, a narrative, started forming in my mind, which organized these remarkable human stories in a meaningful whole. Interestingly, this overarching human story is inextricably intertwined with the narrative of physics itself, lending a contrapuntal structure to this book.

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