Preface

Cremona violins occupy a unique and storied place in violin history. Andrea Amati and his descendents ushered in an extraordinary period of violin making, which peaked between 1650 and 1750. The most celebrated of the Cremona violin makers, Antonio Stradivari (1644c–1737), brought unsurpassed perfection to the instruments he built, instruments of a completely new quality, leaving behind the legacy of an instrument that possesses all the tonal characteristics of what is recognized today as a "classical Cremona instrument."

For the last three hundred years, well-known luthiers have attempted to replicate the Cremona violins. Although some of them (for instance, the renowned Frenchman, Jean Baptiste Vuillaume) have made excellent copies, the general consensus is that they do not come close to reproducing the distinct voices, carrying power, and responsiveness of the instruments of the old masters. This apparent lack of success has given rise to myths of unknown and unknowable secrets — the source of the wood, its treatment and the particulars of varnish. It has resulted in a vast amount of pseudo-historical and pseudo-scientific literature that is filled with incredible claims.

Likewise, in spite of an immense amount of scientific research along conventional methods, the goal of deriving credible, objectively measurable criteria for the evaluation of the Cremona instruments has remained elusive.

Although studies of the separate components or "mechanical subsystems," of the violin — the bridge, sound post, frequency modes, top and back plate resonances, action of the bow, radiation patterns, wood, varnish, and strings — have provided valuable knowledge regarding how the violins work, they have failed to give any clues about what makes a particular violin stand out among others, let alone the secrets of a Stradivari violin.

William F. "Jack" Fry, Professor Emeritus at the University of Wisconsin-Madison, well-known for his pioneering research in High Energy Physics and Astrophysics, has been pursuing violin research for several decades. He became involved in violin research in the 1960's, having accidentally had the chance to play on a couple of old Cremona violins, one by Allessandro Gagliano and the other by Antonio Stradivari. Amateur violin player that he was, playing

occasionally in friendly quartets, for Fry, it was a momentous revelation. "*For the first time in my life*," Fry says, "*I realized how a good violin can change one's ability to play. The two instruments were so different, and yet so much better than anything I had ever played on*." He became fascinated by the old instruments. How could they be so different from the violins he had played? Was there a scientific explanation for the phenomenon?

This book chronicles Fry's early researches and the gradual evolution in his ideas regarding violin acoustics. Initially, hoping to find some simple answers behind the "secrets" of Stradivari and other Cremona violins, Fry experimented extensively with varnish, frequency analysis, and asymmetries in the graduations of the plates. After numerous experiments, Fry became convinced that the traditional "reductionist" scientific approach was not the answer. Violin acoustics was a complex subject with too many variables. He said to himself, *Stradivari never had any of the modern electronic devices. Think of the great instruments he produced. Why can't we reproduce them with the techniques he used*?

I have known Jack Fry since 1955, when I attended the University of Wisconsin for my graduate studies. Fry had joined the physics faculty a few years earlier and had just founded the High Energy Experimental Group at Wisconsin, which blossomed out as one of the prominent research groups in the world. Fry and his collaborators became well known for their pioneering experiments in K-meson physics, which set the stage for subsequent discoveries of violation of certain fundamental laws in elementary particle interactions.

My own interest in violin research stems from my graduate physics courses in India on acoustics, particularly the work of C.V. Raman on the theory of bowed strings in connection with violin. This work, prior to his discovery of the celebrated Raman Effect that led to a Nobel Prize, had already brought him international recognition. Aesthetically, the violin played in South Indian tradition with its melodic rendering of ragas and its intimate association with the human voice was very dear to my heart. As I became exposed to western music, violins in string quartets and symphonic music stood out for me. During my early years in the United States, when music from India was not

easily available, the music of violinists such as David Oistrakh, Jascha Heifetz, and Yehudi Menuhin took over and filled the vacuum.

During my student days and subsequently, Fry and I, have maintained an endearing friendship. The exciting new discoveries in high energy physics had kept us in close contact through our research. I heard stories about his interest in violin research and his quest to uncover the secrets of Cremona violins. I happened to see Fry featured in a PBS sponsored NOVA program titled "The Great Violin Mystery," in which he described his early researches and where he was leading to in his quest for solving the great mystery. Science provided a tool, a way of understanding what the old Cremona masters had in mind when they were making their instruments. It was not beyond imagination that they could have known instinctively and through experiments the underlying physics principles Fry was discovering.

I felt that Fry's work was exciting and largely unknown. I started my own research, interviewing several violin players and violin makers. Over the years, in my conversations with several noted soloists playing in symphonic concerts or in chamber music ensembles, I found invariably their preference for old Cremona instruments, some very well-known, some lesser known. Joshua Bell, Midori and Jennifer Frautschi, all preferred to play instruments by Stradivari or Guarneri del Jesù. They spoke of the superiority of the Cremona violins over the modern instruments in their acoustical attributes. Modern instruments have the necessary power, but lack in dynamic range. They may have one or two good features, but for a player, Italian instruments have a response that makes it easy to play, whereas with modern instruments, one has to work hard to get the desired notes.

Violin makers also spoke of the superiority of the Cremona violins. For them a Stradivari or a Guarneri sound was a mystery. They made excellent copies, but were tradition bound in their instrument making. In the PBS Nova program, Fry described the complex acoustical system of a violin, the principal modes of vibrations and rotations of the plates and how they were affected by minute variations in the thickness graduations of the plates. But violin makers in general seemed unaware of these considerations. My research

and preliminary discussions with Fry led me to write an article for the Wisconsin Academy Review.* In the process of writing the article, I journeyed through the fascinating history of Cremona violins, the rise and decline in the art of violin making. I came across the book, *The Violin Hunter* and read the amazing story of Luigi Tarisio, but for whom, "the *Cremona violins created by master craftsmen, geniuses and gifted artists, so much in demand from dukes and emperors for nearly two centuries, would have been extinct*."

I visited Cremona a couple of times, once with Fry. There was the house on Via Garibaldi, where Stradivari lived from 1667 to 1680 before he moved to a house that overlooked the church of Saint Dominico and the courtyard in front around which the celebrated violin makers lived and worked side by side, building their homes and workshops. The church was destroyed in 1869 and a public garden, renamed the Piazza Roma, now occupies its place and the courtyard surrounded by shops and fast-food restaurants. One of the principal streets is dedicated to Stradivari's memory and a commemorative tablet has been placed on the wall of the home in which Stradivari lived and died. While these sights brought moving memories of what I had read in historical accounts, the highlight of the trip was the visit to the Stradivari museum. Among Stradivari tools, cuttings and wood pieces to be made into violins, Fry found what he calls "scrapers." For Fry it was another momentous discovery, a vindication of one of his most important ideas in his research.

It is a well known fact that the response of the completed instrument has little or no relation to the unassembled pitches of the plates. Whatever the frequencies to which the free plates may be tuned, varnish and gluing together would invariably alter the final response. Hence, for Fry, there had to be a method and a device to control and change the response of the instrument after it was completely assembled. For this purpose, Fry had invented simple homemade "scraping" devices that could be inserted through the f-holes and reach the interior parts of the plates and change the graduations. So Stradivari

*William F. Fry: *A Physicist' Quest for the "Secrets" of Stradivari*, Wisconsin Academy Review, Volume 46, Issue 2, Spring 2000.

could have used the same technique! Was it his secret? Fry wondered and was inspired and expressed his full confidence that he would be able to make changes and produce an instrument that had the desired acoustical properties of a Stradivari or a Guarneri del Jesù. That was the moment for me as well to continue my work beyond the article and write this book.

In the first two Chapters of the book, Fry's story is linked to the history, the rise and decline of the art of violin making in Cremona. The third Chapter discusses why the violin is made the way it is made, its components, its structure and its shape, varnish and how it affects the wood and the sound quality of the instrument. It also elucidates the physics of the violin, the mechanism of sound production. The fourth Chapter contains a brief history of violin acoustics research through centuries. The last four Chapters are devoted to Fry's work. From numerous experiments with what Fry calls "old junk violins" from the nineteenth century, which he finds in antique shops and violin stores, he has been able to make predictable changes in the tonal qualities of a given instrument. This is illustrated in the video accompanying the book. The decision to include an accompanying video came from the desire for the reader to hear and experience first hand, as Fry illuminates much of the fine tuning of his process and the predictable changes one can make in the tonal qualities.

Finally, we see in the video, a violin made by Fry, starting from a copy of Stradivari model with a label indicating that it was made in Germany in 1932. In the original form, the measured thicknesses of the central regions of the top and back plates were too thick. It lacked all the specific thickness graduations in the plates that Fry explains (and discussed in detail in the book). The sound we hear (played by Rosemary Harbison) clearly demonstrates Fry's success in duplicating the subtle tonal qualities generally attributed to a Stradivari instrument.

In writing this book, I straddled the difficult task of making Fry's work available to both scientists and to those who might find themselves intrigued on a more general level by the mysteries of the art and science of the Cremona violins. It is my hope that the book will be useful to both groups. However, it

has become clear to me this book covers just a tiny part of a subject that is huge in its scope, what it means to reproduce the sound of a Stradivari instrument and other aspects of sociology associated with violin makers and violin dealers. It is my hope this book will serve to keep alive the interest in this fascinating and complex subject.