

overview of significant advances in the field through 2014. They cover various topics from both theoretical and experimental points of view, including cavity systems with suspended mirrors, optomechanical crystal devices, LC circuits, ultracold ensembles of thousands of atoms, visible light, microwaves, and more. A final chapter on hybrid systems nicely complements the corresponding chapter in *Quantum Optomechanics*.

The chapters on hybrid systems are not the only point at which readers will find value in consulting both *Quantum Optomechanics* and *Cavity Optomechanics*. Together, the two books make for an authoritative introduction to optomechanics that will serve the needs of graduate students and more experienced researchers interested in moving into the fast-growing field. *Cavity Optomechanics* provides an introduction to many of the most interesting experimental systems, and *Quantum Optomechanics* brings readers up to speed on the state of the art of the theory. Students and researchers concentrating on experimental physics may find that *Cavity Optomechanics* is often sufficient. Theorists would be well advised to dig deep into *Quantum Optomechanics* as well.

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American Luthier

Carleen Hutchins—the Art and Science of the Violin

Quincy Whitney

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I became interested in the musical acoustics of string instruments late in my career and missed meeting Carleen Hutchins. As I got to know the field, however, it became clear that for most of the second half of the 20th century, she was a dominant force in violin acoustics. Hutchins's enormous effort, accompanying struggles, and eventual triumph is captured in great detail by journalist and biographer Quincy Whitney in her book *American Luthier: Carleen Hutchins—the Art and Science of the Violin*.

Hutchins's life was, by any

measure, remarkable. A Cornell-educated biology teacher and amateur violinist, she took up lutherie (the building and repairing of string instruments) in 1947 at age 36 to occupy herself while expecting her first child. She carved the scroll of her first attempt, a viola, in the maternity ward. Later, juggling motherhood and lutherie, she would use a three-hole poacher in which she cooked eggs for her toddlers in two holes and warmed her glue pot in the third. Anyone who has used animal glue will probably cringe at the thought.

While being treated for breast cancer in 1956, Hutchins met Virginia Apgar, the doctor who developed the famous Apgar test administered to all newborn babies, and struck up a lifelong friendship with the fellow amateur violinist. When the pair spotted a hospital telephone booth containing a piece of curly maple shelving that they fancied for a viola back, they planned and pulled off a now-famous heist to secure the desired wood. They replaced the shelf at dead of night with an equally attractive but acoustically useless piece of maple that Hutchins fashioned for the purpose and then cut to size on a toilet seat in the nearby ladies' room. Such was Hutchins's no-nonsense, get-on-with-it manner.

It was when Hutchins met retired Harvard physicist Frederick Saunders in 1949 that she set forth on her life's work. Saunders had been conducting acoustics experiments on whole violins. Hutchins suggested that to make any progress, Saunders would have to work with the individual plates, and that she could make those plates. In the absence of a useful mathematical model of the violin sound box (an absence that persists to this day, although fluid-structure coupled finite-element analysis is coming close), the only way to move forward was to build hundreds of instruments with variations in a dozen or so parameters. Needless to say, that was a Herculean task.

Over the next five decades, Hutchins built more than 300 musical instruments, mostly by herself, and concurrently learned their physics. Her aim was to bring the violin's power and clarity to the viola, cello, and bass, instruments whose lower strings are often hard to hear in ensemble playing. The

result was a new "violin octet," which consisted of eight newly designed instruments whose string tuning collectively covered five octaves and brought an even "violin tone" to the whole playing range.

Apgar and Saunders were just two of many talented people who bonded with Hutchins. She plainly had an ease with the accomplished, and after a while she no longer had to seek them out: They beat a path to her door—literally, as she operated out of her own house. She counted fellow luthiers, physicists, and world-renowned musicians such as Yo-Yo Ma and Leopold Stokowski among her friends and admirers.

While researching *American Luthier*, Whitney interviewed dozens of people in the US and Europe. She intersperses the story with vignettes on historical topics that set the scene for Hutchins's acoustics work. Whitney also peers into the world of luthiers and violin dealers—upon which Hutchins did so much to shine the light of day—and discusses the still-vexed issue of the relative quality of old Italian violins versus fine modern instruments, which can differ considerably in cost.

I have some quibbles with the book, mostly points that should have been caught by an editor. First, although the book is intended for a nonexpert audience, occasionally terms and phrases like "Helmholtz mode" or "JASA," the abbreviation for the *Journal of the Acoustical Society of America*, pop up out of nowhere unexplained. Second, some of the physics explanations would confuse a layperson. For example, Whitney says "the rush of air exiting through the f-holes amounts to a ten mile per hour wind." I know what she means, but a person expecting to place a hand over a violin f-hole and feel a draft would be disappointed.

Since her death, Hutchins's fame seems to have faded somewhat, at least in part because of the failure of the conservative musical community to embrace her new instruments. Hutchins's work, however, was always going to be a tough sell to traditionalists. Thus *American Luthier* is a timely work, and I recommend it to anyone interested in musical acoustics or in Hutchins's extraordinary life.

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