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Keen eye in handcrafting violins

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David Ludwik Chrapkiewicz practices empirical science. As owner of Rapkievian Fine Violins in Washington Grove, the violin maker uses trial and error to try to make the perfect instrument. He handcrafts about three violins a year, which cost about $16,000 each.

"Most violin makers are not trained in science," he says. "They may make beautiful instruments, and one will turn out well in terms of sound, and they won't understand why. ... I don't think [Italian violin maker] Antonio Stradivari had any knowledge of acoustics... but he experimented."

The technological method of making violins hasn't changed much in 300 years. Although electrical equipment can be used to make mass-produced instruments, traditional violin makers carve their violins by hand, aware that the laws of science, especially involving acoustics, enable them to create their masterpieces. Most, however, don't completely understand the science at work in their creations.

Sometimes machines are used in the beginning stages of handcrafting a violin, but the final product must be finished by hand, Mr. Chrapkiewicz says. He works in dimmed light to better see where the wood needs additional carving. The shadows help him see details in the contours of the wood.

The arching of the wood on the top of the violin is one of the most important aspects of its design, he says. The curves should extend all the way to the edge of the top to carry the vibrating sound waves throughout the entire instrument.

The sound waves originate from the friction of the bow on the strings and are carried to the bridge, which supports the strings. The bridge pushes down on the top of the violin and sends the vibrations through the instrument.

"People think of the violin as a string instrument," Mr. Chrapkiewicz says. "It's really a wind instrument that uses strings to activate the air column."

Distribution of the stiffness and thickness of the wood on the top, back and bridge is what makes a great-sounding violin, he says. Thickness can be measured with a ruler, but the hand of a trained violin maker serves as the "stiffness" calibrator. The stiffness of the wood determines how the waves move in the air and travel throughout the violin, which affects the tone of the final sound.

"If the top is too thin, it will vibrate OK on the lower end and won't support the higher-pitched vibrations at the top of the violin," Mr. Chrapkiewicz says. "Everything ties into acoustics and stiffness. It all boils down to that."