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Even with our technology did Stradivarius and the old makers have an advantage over modern makers?

The modern violin was created almost 500 years ago and hasn't dramatically changed since. Though there have been some modifications since the earliest ones, the violin family of instruments (violin, viola, cello, double bass), and the classical music world and beyond, are indebted to one luthier for his legacy. (More about this later.)

A reader asked: Now knowing that Stradivari violins were made of extremely dense wood, will scientists invent a reverse-greenhouse to engineer such wood for musical instruments?

The short answer – it sounds like a great idea at first, but it's a bit unreal and not really unnecessary.

A lot of people would love to see some enterprising person or entity make a greenhouse for violin wood – it would create quite a sensation in the fine instrument world - but as Sitka Spruce has an average height of 150 ft., to make a greenhouse for even a micro forest hasn't been seen as viable - and actually its not really needed.

Stradivarius, Guarnerius, Amati, all the great old Italian boys used Sitka Spruce for the top of their instruments, and you find that used today in all professional violins, violas, cellos, as well as all pro pianos and other instruments like harps, mandolins, some guitars, etc.

Science has for long many years been analyzing the great old instruments to find the key to their greatness. When you ask if scientists “will invent a reverse-greenhouse to engineer such wood,” well, as the same forests of Sitka Spruce are there today as they were in the 1500-1700’s I suppose you’re referring to Europe's "little ice age" of the 15th-17th centuries, in which low summer temperatures led to slow but uniform growth in the Spruce trees, and that the wood's uniform density explains the instruments' high quality of sound. Wood density is one of several factors in excellent violin wood. I am synopsisizing the voluminous data and findings on this.

Spruce is less dense than the average tree (from balsa wood at 160 kg/m³ to Lignum Vitae at 1330, with Sitka Spruce at 450). The popularity of Sitka Spruce comes from its fine, even texture, consistently straight grain and an outstanding stiffness-to-weight ratio, which makes it light, stiff and resonant. It also happened to be growing in the Northern Italian forests, so it was fortunate indeed that the best wood and the best luthiers found themselves in the same place at the same time in history.

One might think it so, but resonance isn’t the total answer to good violin wood. The trick is not in finding one that is more resonant than another but in finding the material with the right primary resonant frequency and quality that we’ve grown to like. Generally speaking, the harder the wood the greater is the amplitude and higher power sound, but hardness also affects the tonal quality and other properties of sound. Softer and less dense woods generally emit softer, more resonant richness of tone. The Sitka’s fine, even, straight grain, along with the resonant qualities makes it the best for instruments.

Imagine sound vibrations passing through perfectly straight grain and what would happen if the smoothly running vibrations ran into a knothole in the wood. The vibrations would disperse, get erratic, and sound that way.

Researchers in The Netherlands and the U.S. used medical imaging technology to confirm that the great old violin wood came from slow-growing trees, and researchers in Sweden have argued that Swedish Spruce in the country's cold North are the closest specimens Europe now has to the wood of the Stradivari era. But a few years ago, Joseph Nagyvary, a violin maker who was also a professor of biochemistry and biophysics at Texas A&M University, spent years studying and analyzing Stradivari and Guarneri violins, and he doesn't believe the growing conditions of local forests to be an important factor. He said, "The problem with the Little Ice Age Theory, is that the same wood was available to French, German and other violin makers in Europe, but only instruments made in Cremona were any good. I believe that's because of the special, preservative varnish used there."

Varnish is another factor that has been extensively analyzed, but American concert violinist James Ehnes says that while varnish may be one of the keys to Stradivari greatness, it can't be the only one, for the simple reason that not all Strads sound the same. Now obviously, no two pieces of wood are going to sound exactly the same. Ehnes recently released a DVD, *Homage*, in which he performed on 12 instruments in the Fulton Collection in Seattle — probably the greatest collection of Stradivari and Guarneri violins in the world. Each Strad had its own voice, although there also existed a

"family resemblance" throughout the collection. "When I played these instruments I got the feeling that there were a thousand reasons why they were so great. There will never be one secret."

To climb a bit into the world of violin making I'll give personal experience. My father made violins as a hobby, producing about 25 instruments of medium professional quality (I play on one and really like it). He'd buy 100 year-old wood from a warehouse in New York, and spend dozens of hours replicating the Guarneri model specifications of size and shape. For the top of the violin, he'd use a micrometer to get the thickness' precise (unlike the guitar, the thickness of the violin top is graduated, being thinner in the raised middle and getting thicker as it comes down to the sides). Once he got the specs correct he'd hold it up to his ear and knock it with his knuckle to hear the resonance, do more scraping/sanding, knock again, scrap/sand, continuing this until it finally 'rang out,' indicating that for that piece of wood everything was just right. Violin making is still the highest level of woodworking.

When he finally finished one, a brand new violin, he'd have me play on it (he was an oboist), and when they're first played they sound horrible. It was fascinating though, that after even 10-15 minutes of playing you could hear the sound quality start to smooth out. People have used sound wave generators to 'mature' violins faster, and this is reported to be effective in some aspects.

What happens, and the primary reason the old instruments are so good, is found in what occurs with the wood on the molecular level. Sound vibrations shift the wood molecules around a bit, and they will gradually align themselves along the direction of the wood grain, so that the more they're played the more in alignment they are, therefore greater resonance.

In the case of the, they're getting so old that the wood degeneration factor is beginning to offset this other improvement factor. That's one reason the Guarneri, made later than the Strads and Amatis, are often considered these days to sound better.

Truth told, though, the *real* primary reason the old instruments are so great is found in "beauty is in the eye (and ear) of the beholder." Andrea Amati (1505-1577) could have been the one who crafted the very first violin. He is the one that is credited with popularizing it. Before him there was the Renaissance viol and rebec and other predecessors to the violin, with different shapes, sizes, number of strings, etc. Andrea had a great design with a wonderful sound, and began a dynasty of master luthiers when he founded a violin-making school in Cremona, Italy, which produced many of the great early makers (Stradivari, Guarneri, Guadagnini, etc.), who of course they made violins the way their teacher taught them (the school still exists in Cremona).

Nearly all old instruments were modified, including lengthening of the neck in response to the raising of pitch that occurred in the 19th century, the fingerboard was tilted a bit more to produce even more volume as larger and larger orchestras became popular, and the bass bar was made heavier to allow a greater string tension.

Back in the day, Europe was used to taking Renaissance ideas from the Italians, so this became the standard in Europe for the way to make violins. Therefore, that is the design and sound that became part of the entire classical music world.

If Andrea had made a different design, which had been proliferated across the Europe, and therefore the world, it would be that other sound that we would be using to gauge against in our considerations of what is the standard of beauty and a great violin.