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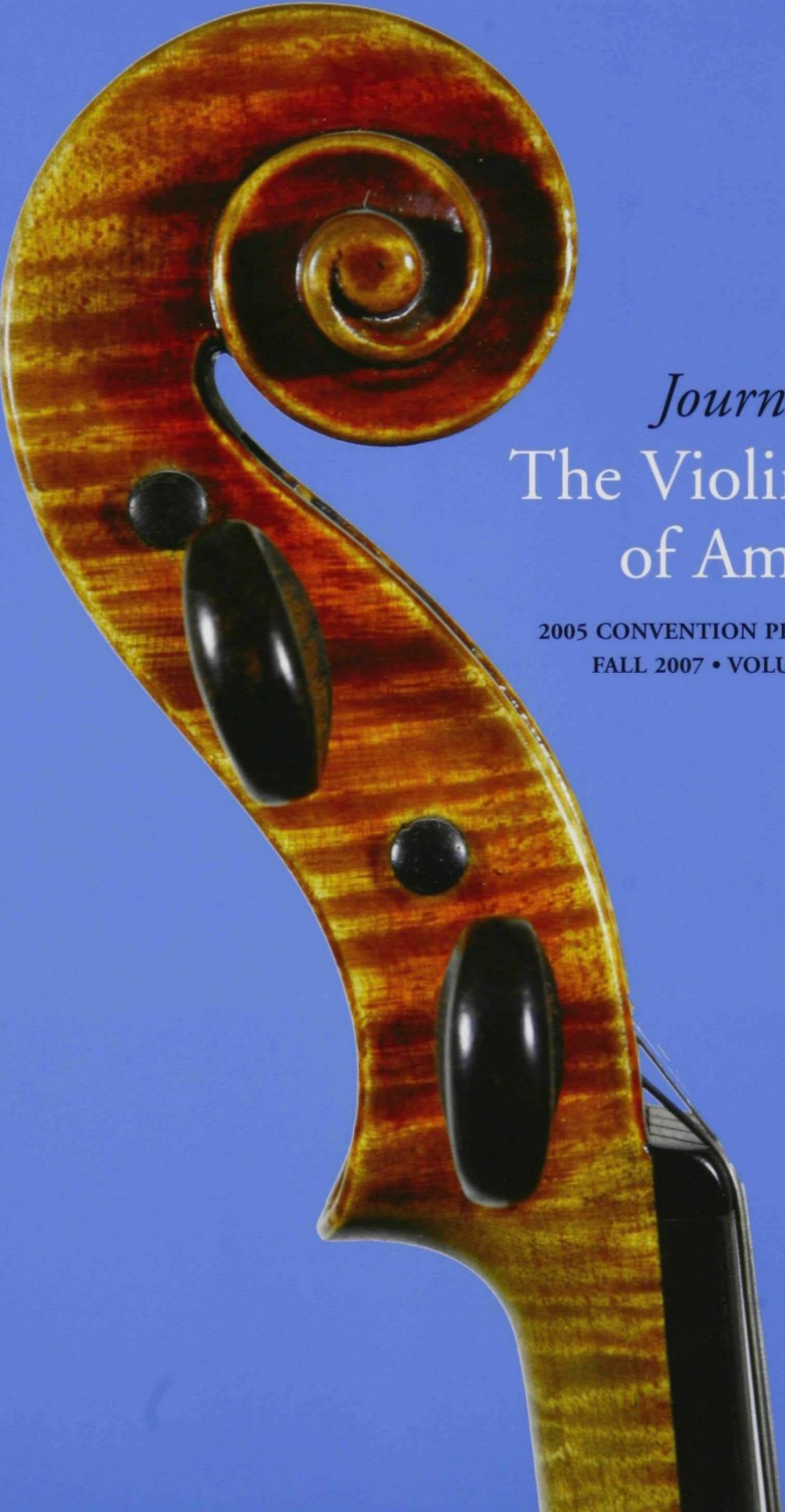

# Contents



Front cover: Scroll of a violin made by Ole H. Bryant, Boston, 1932 (photograph provided by Chris Germain). From the collection of David Bromberg, author of the article about American violinmakers that begins on page 13.

# Innovation and Shifting Paradigms: Innovation in Bow Making

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Saturday, November 12, 2005, 11:20 am

**Norman Pickering:** I would like to introduce Benoît Rolland, one of our greatest bow makers, who at the present time has an atelier in Boston. Benoît will give us the other side of the innovation equation: the bow. I keep reminding people that the violin or cello by itself is not much good. Aside from a movement of a Tchaikovsky symphony, there isn't much you can do with just pizzicato on an instrument. The bow is as much a part of the system as the instrument is, and Benoît will talk to us about that.

**Benoît Rolland:** I found it very encouraging that the Violin Society of America asked us to reflect about innovation and shifting paradigms in our craft. Indeed, things have been changing a lot, even though we are working on instruments that are considered to be close to perfection. I will propose a few approaches to the subject, touching practical matters and some prospective thinking about bows.

## FROM TRADITION TO INNOVATION

I always say that there is no tradition without innovation, and no innovation without tradition. Bow making shows throughout its history a strong tradition of innovation. After François Tourte, François Lupot improved the mechanical parts. He implemented the metallic end slide on the frog. Etienne Pajeot tried many novelties, such as a metallic plate on the throat to prevent wear on the frog, and a device that prevents oxidation inside the mortise of the handle. J.B. Vuillaume patented a hollow, metal bow. There have been a number of creative frog systems, such as the self-rehairing bow, which unfortunately required a great deal of precision as it is difficult to have two hairs of exactly the same length. The idea was fantastic, but it was quite impossible to produce in large numbers. Vuillaume also promoted the round ferrule and matching metal slide, which prevents the frog from moving laterally on the stick; the oblong ferrule, which was designed to vary the widths of the hair ribbon on the string; and, of course, the famous optical device in the eye on the side of the frog that displayed his own picture.

Such a tradition of innovation is partly due to the importance of the mechanical parts of the bow. However, restricting the concept of the bow to its mechanics is insufficient. I see innovation slowly moving to the core of the tool, at which point we may see a fundamental change in the body. I do not know what kind of stick may be created ultimately, but what's already changed is our attitude towards making. We want to understand better what we do.

The early innovations (Figs. 1 & 2) came about because of a need to find substitutes for materials that were too expensive or had become unavailable. For instance, Nacrolack™, a plastic material from the early 20th century, was developed as a substitute for mother of pearl. Likewise, Ivoirine™ imitates ivory, as Ebonite™ imitates ebony. Synthetic whalebone has also been manufactured (Fig. 3). By 1980, about 40 patents had already been filed for synthetic hair. None of them worked. Horsehair is very difficult to replace because of its particular elasticity.

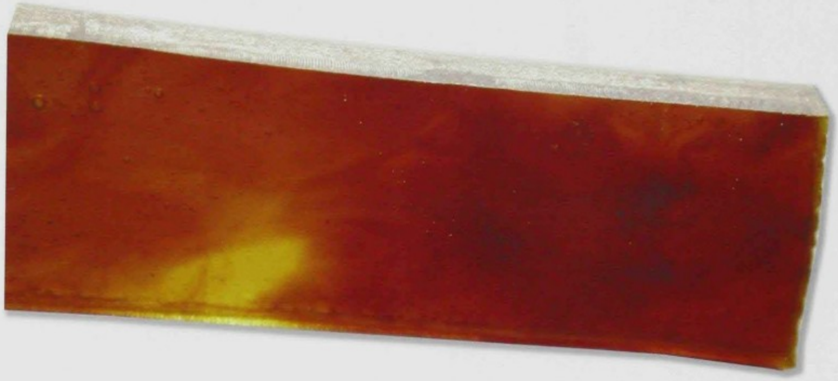

*Figure 1. Tortoise shell imitation, ca. 1950.*

*Figure 2. A plastic frog, ca. 1970.*

*Figure 3. Genuine whalebone next to imitation whalebone.*

## FROM TRADITIONAL MAKING TO SYNTHETIC MOLDING

Substitution and imitation reflect a strong attachment to continuity, rather than shifting gears. Such a mindset that technical, cultural, and market-related motivations can explain, influenced the research when it came time to find a substitute for pernambuco. People still wanted more of the same, and the first round of synthetic bows reproduced the shape and the aspect of wood bows. We may now be entering another phase.

Before going to new territory, let's reflect on what is implied by a major shift in the 20th century: molding synthetic bows. Although violins made of synthetic materials are still in the experimental stage, it's different for bows. Synthetic bows are widely distributed on the market. Progress has been rapid. When I designed a new bow 20 years ago, it started a virtual riot in France! Pernambuco was a familiar material, a material that was transformed by the maker from a tree to a log, from a log to a rough stick, and from a rough stick to a finished stick. This type of work is progressive, and both rational and sensitive (Fig. 4). At the opposite end, the bowmaker can now form a bow using several synthetic materials, e.g., carbon fibers (Fig. 5), glass fibers (Fig. 6), and Aramid fibers (Fig. 7), manufactured by various technologies. By themselves, these materials have no particular shape, as you can see in Fig. 8. This is a major switch.

Most synthetic materials used for molding bows are a mixture of liquid resin and raw fibers. First, one must create a mold, which is a negative image or imprint of a stick. Then you pour the mixture into the mold. No carving tool is used. Before molding, the maker must define the strength and flexibility he wants in the finished stick. This process is exactly opposite to traditional bow making, where the stick is progressively carved from the raw material with hand tools and skill and, hopefully, with feeling.

Moreover, the appearance of the carbon fiber stick out of the mold is completely different from that of a pernambuco stick. In order to hide this, manufacturers often apply a masking finish like a coat of paint or varnish. The present debate is between imitation and an affirmative creativity around the use of new materials. So far, the profile of most molded sticks is similar to a traditional bow. The mechanical characteristics of the materials used, be it wood or synthetic fibers, are similar even though their natures are completely different. We seem to be in a process of smooth substitution.

Now, what about the sound? The sound that the synthetic material produces is different and has not been studied in depth. Many questions are open that I find to be of great interest. To be adopted, a new technology should provide a better sound; we can probably expect this in the future.

One of the latest findings evidenced the notion of viscoelasticity. Charles Besnainou, an engineer at the Laboratoire d'Acoustique Musicale in Paris (within the French National Center for Scientific Research) and also a violinmaker, has molded several instruments using carbon fiber. He told me that he had at first been surprised by their lack of good sound quality. When musicians tried his instruments, the reaction was overwhelming. Comments included, "Yes, of course, it's light, it's very comfortable to play, it

*Figure 4. Carving a head into wood.*

*Figure 5. Carbon fibers.*

*Figure 6. Glass fibers.*

*Figure 7. Aramid fibers.*

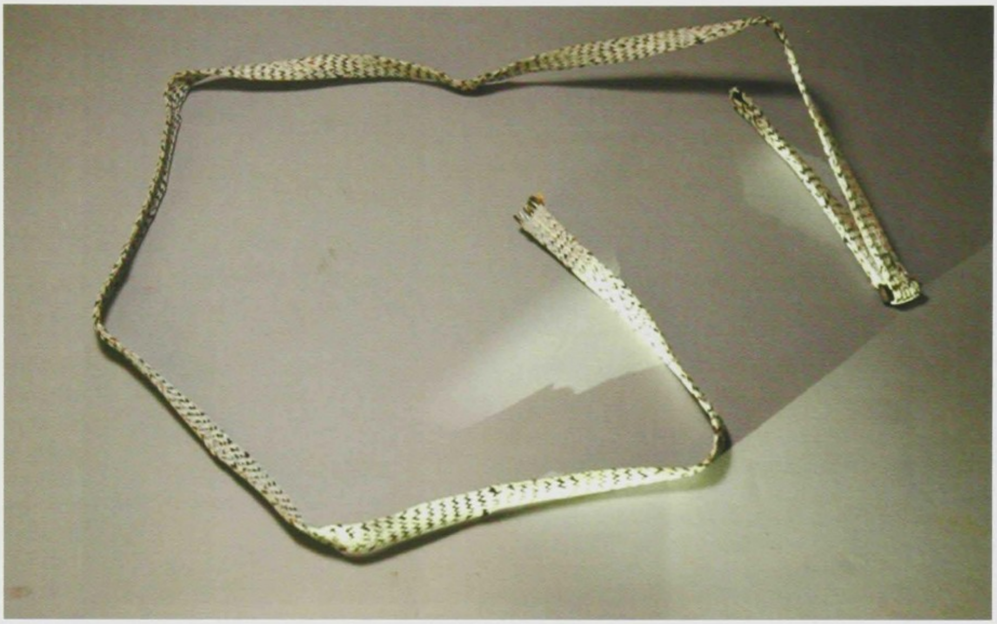

*Figure 8. Braided carbon fibers.*

should be unbreakable, but the sound is awful!" It was time for a new recipe. Dr. Besnainou found a new polymer that he mixed with the resin to absorb the vibration, which produced a better result. The sound, says he, went from awful—to boring—to interesting.

I'm confident about future progress. Technology is nothing without a good concept. Have we studied all the necessary parameters? I don't think so. There is more work to do in many different directions. Physics can help; analysis of perception has a role to play as well; and the maker's experience remains of major importance.

## FROM TYPICAL MAINTENANCE OF WOODEN BOWS TO REPAIRING SYNTHETIC BOWS

Instrument makers often ask, "How do we maintain and fix a synthetic bow?" Good question. The material is so different from wood that one needs some basic instruction before proceeding to repairs. For instance, how to straighten a synthetic stick that has warped? You may have seen warped carbon fiber or glass fiber sticks. You need heat to straighten them. This kind of heating device (Fig. 9) is good because it does not produce a flame. Before using it, be aware that resin weakens when it is heated. Don't overheat a carbon fiber stick. If you overheat a spot, you risk seeing a drop of resin fall on your bench. After you heat the stick, apply a little pressure to straighten it (Fig. 10).

Some precaution is also needed when hairing a bow or replacing a tip. A Spiccato bow with a coat of paint could create some problems when fixing the tip. In principle, the tip is so well attached to the head that it should never need replacement. If a tip breaks, and the bow does not have a complex coat of paint, you can revarnish with shellac or paint. Otherwise, you should return the bow to the manufacturer.

The low price range of synthetic bows means these are disposable bows. Everybody has in mind bows that are cheaper than a rehairing. The concept of disposable bows also reflects a change in paradigms, and I am curious to see how it will develop. Yet, it is amazing how François Tourte determined the right proportions of the very same bow that we still play two centuries later. Let's not be afraid to say that nobody

*Figure 9. Heating a synthetic stick.*

*Figure 10. Straightening a synthetic stick.*

has made a better bow than Tourte's best ones so far. From this exceptional artist's design to the least expensive bow today, the range is huge. The price range between hand-crafted contemporary bows costing $2000–$3000, and one made by François Tourte, reaching $100,000, is also huge. The market and consideration for bows keep oscillating between mythical and disposable.

## MAKING FROM TEMPLATES VS. SCIENTIFIC ELABORATION

Only 15 years ago, both in Mirecourt and in Germany, bows were systematically made after templates. Here are a few different templates that guide the maker, giving very precise indications and measurements (Fig. 11). One template shows the height of a head, a Vuillaume model. Others show the length of the head, the throat of a head for a cello bow and one for a violin bow, the inclination of the head for a violin and a cello, and the length of the frog. What we miss is a template that would control the thicknesses of the stick!

In Mirecourt it was common to taper all sticks the same way, whatever the wood was. That explains why bows produced in the factories there were so different from one another. When I studied bow making in Mirecourt in 1975, we were taught using templates. Back then, in the village, some craftsmen making bows had never even seen a classical violinist. The purpose of using templates is to maintain one strict way of working. Yet, making educates one's capacity for sensation, observation, and some rational analysis that derives from experience. This is how a tradition lasts. The repetitive gesture evolves under the combined influence of artistic talent, cultural evolution, music, playing styles, and, finally, odd circumstances like the availability of supplies.

The major revolution was to go from this ancestral logic, confined in the artisan's workshop, to a greater input from science and technology. More and more makers have a college education which, combined with the exploration of synthetic making, boosts their incentive to research. There is also a continuous small stream of interest from physicists regarding bows. [See the short reading list at the end of this article.]

There is now a three-way dialog between traditional making, new technologies, and the

*Figure 11. Traditional templates for making bows.*

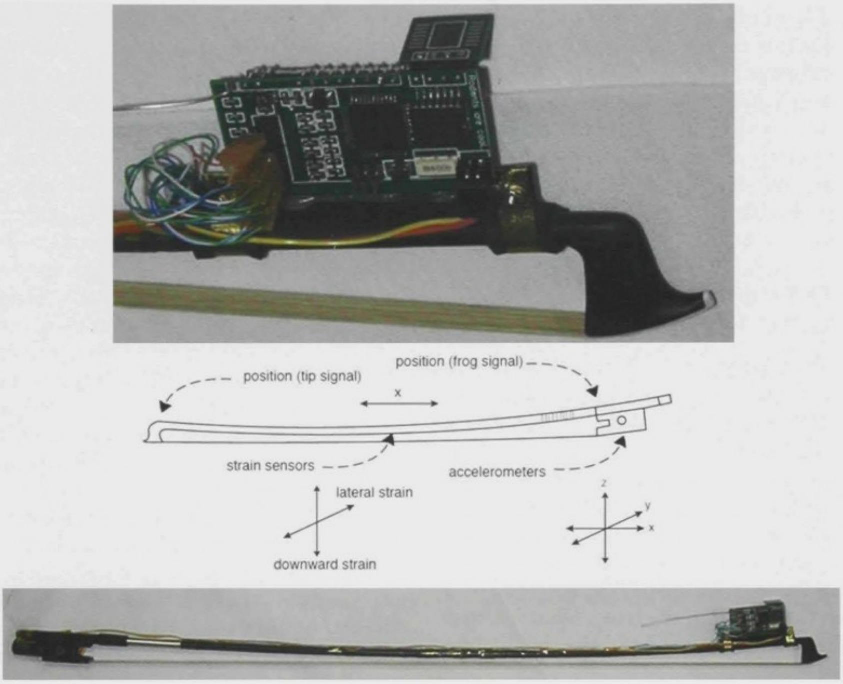


*Figure 12. Experimental setting for the Hyper-Bow Project. Photo provided by Diana Young, PhD, Medialab, MIT, Boston.*

physics of music. In other words, scientific research is gaining momentum. A symposium on the physics of music recently took place in Washington, D.C. One panel was titled "What the Knowledge of Instrument Makers Can Bring to Science." It showed how competencies indeed go both ways.

In Boston, the Medialab at MIT hosts the Hyper-Bow Project, whose objective is to analyze the movement of the player. To achieve this, sensors are plugged onto the bow, and radio-linked to accelerometers that analyze the downward and upward strokes and related movements (Fig. 12). Many different bowings are analyzed. It is very interesting, but difficult to interpret.

## FROM A MECHANICAL OBJECT TO AN ACOUSTICAL DEVICE

I would like to conclude by sharing my personal convictions. My use of the term "acoustical device" to describe a bow is a bit provocative, but it allows for a different point of view. So far, scientific researchers have tried to describe the mechanical properties of the stick, along with its interaction with the strings and the bridge. Strings benefited greatly from this research, more than bows. A second stream of research looked at the bow for studying the movement of the player—an analysis of the bowing phenomenon rather than of the bow, per se. It is interesting that no in-depth analysis has been made regarding the sound that the bow produces. Therefore, we still do not know why one kind of bow sounds better than another, although the matter is of great interest. Everybody knows that two different bows, played by the same performer, can bring two very different sounds out of the same instrument. Why?

I have studied this phenomenon for a while and obtained interesting results that prove that different kinds of sounds are not subjective. I would be very interested to investigate this phenomenon with scientists.

Let me finish by showing a musical instrument that belongs to the future. A few weeks ago Joseph Curtin and I were invited to share a great moment around physics and music. We met Serge de Laubier, an artist who developed and plays the Meta-Instrument™. This instrument—which is driven by computers—produces thousands of different sounds, along with images (Fig. 13). You see these small pads? They correspond to the fingers, the hands, and elbows. How one touches these pads affects the sound. Likewise, the musician can control video images while playing.

Just imagine a "bow" of this kind . . .

And now, ladies and gentlemen, go and innovate!

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*Figure 13. The Meta-Instrument. Concert by Serge de Laubier, Washington, D.C., October 26, 2005.*