



Revealing the Secrets of Stradivari

By Gary Sturm

Antonio Stradivari (who labeled his instruments in the Latin--"Antonius Stradivarius") is universally acknowledged as the most famous and influential of violinmakers. The Stradivari workmanship and the qualities of tone associated with his instruments are generally thought to be unsurpassed.

Born in the northern Italian town of Cremona around 1644, Stradivari lived to age 92, having produced some 1,100 musical instruments. Around 650 instruments have survived and are played and treasured by collectors and musicians alike. What makes the Stradivari instrument unique?

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Image: CT-scan image of the "Greffuhle" violin by Antonio Stradivari, about 1700. Photo by Bruno Frohlich, National Museum of Natural History, Smithsonian Institution.



Notes from the Director

This month we are exploring the symbiosis between music and invention. Our ever-amazing digital revolution is transforming culture in myriad ways, not least through music. Electronically synthesized sound, which virtually anyone can now generate on a laptop computer, has become a staple of the music and dance scene. It has spun off a range of electronic musical genres and a revolution in music "mash ups" and remixes, and prompted debates about quality control and barriers to music production among bloggers. Rivaling even the electric guitar as a pop culture icon, the ubiquitous iPod now inhabits not only our cell phones and PDAs but almost every corner of our lives. The universal availability of music through downloads has in turn spawned countless other societal changes and conundrums. Such dazzling examples of our digital and internet age make us think that we belong to a unique era of technological and cultural change. We all tend to be "period chauvinists" in this respect.

However, a technological revolution at least as transformative as our own occurred a century ago, and it, too, called forth characteristic forms of musical expression. The so-called Second Industrial Revolution of the late 19th and early 20th centuries ushered in automated machinery, the radio, the car, the airplane, and new synthetic materials. It also launched a fascinating musical avant-garde associated with the surrealists, Dadaists, and futurists, among other cultural shock troops.

To give just one example, F. T. Marinetti, the spiritual father of the Italian futurist movement, called in 1909 for radical new art forms that expressed the speed, power, and, as he saw it, the violence of the Machine Age. Futurist followers F. B. Pratella and Luigi Russolo in turn published radical music manifestos celebrating the machine and invented new instruments that were ancestors to today's synthesizers. The latter's "[*intonarumori*](#)" contained acoustic generators that produced odd noises--screeches, hisses, whispers, whistles, and thunder--all designed as a

deliberate insult to what futurists saw as the mediocrity of the musical status quo. Concerts using such instruments were not everyone's cup of tea, of course, but Russolo's *intonarumori* influenced such famed compositions as George Antheil's *Ballet mécanique*. The electronic music pioneer Edgard Varèse also owed a musical debt to the futurists. So inspired by science and technology that he once even wrote to Bell Laboratories for a grant, Varèse was known for his use of innovative instruments and for compositions like *Hyperprism* and *Ionisation*, the latter a non-electronic piece that used novel percussive sounds.

Russolo's synthesized noise opened the door to a panoply of 20th-century sounds, including those produced by German composer and electronic music pioneer Oskar Sala. A student of Friedrich Trautwein, inventor of the trautonium, Sala developed his own "[Mixtur-Trautonium](#)" in 1952. Though you may not have heard of Sala, you have probably heard his "music." He synthesized the chilling screeches of the avian invaders in Alfred Hitchcock's film *The Birds*. Technological revolutions find mysterious ways to infiltrate culture.

Best regards till next month,
Arthur Molella
 Jerome and Dorothy Lemelson Director



Have You Seen?

Coming into work one Monday morning in November 1996, I strolled past a small exhibit case and noticed that something wasn't quite right. The case was familiar to me because it was part of the Lemelson Center's exhibition *From Frying Pan to Flying V: The Rise of the Electric Guitar*, and I was the co-curator of the show. On closer inspection I discovered that indeed something had been added, or I should say some *things*--specifically, seven guitar picks littered the floor of the case. With eyes only half open before my morning cup of coffee, I scratched my head and wondered: How did those get there?

Eventually, I realized that visitors had slipped them through the miniscule cracks between the case's glass doors, apparently leaving them as offerings to honor iconic instruments (including a loaned first-edition 1954 Fender Stratocaster) and beloved musicians such as Prince, represented by his 1989 "Yellow Cloud" guitar from our Museum's collection. This wasn't an isolated incident; we found more guitar pick offerings throughout the show's run. I also stumbled on a man literally on his knees in front of a case featuring early instruments including the 1931 prototype of the Rickenbacker "Frying Pan," the first commercially successful electric guitar. Reverently, the man turned to me and proclaimed: "This, to me, is the Holy Grail of electric guitars."

Although the exhibition closed in 1997, [the virtual version of From Frying Pan to Flying V](#) lives on, and I continue to receive emails that attest to the personal meaning and educational impact of the research we share with the public.

--Monica Smith, Exhibition Program Manager, Lemelson Center

Image: This case from the Lemelson Center's 1996-97 exhibition, From Frying Pan to Flying V, featured iconic electric guitars. Photo by Rick Vargas, Smithsonian Institution.



Trivia Challenge



In each edition of *Prototype*, we offer a question about an invention or inventor that you and your friends and family can try to answer. Sometimes the answer can be found on the Lemelson Center's website, where you can also learn a little more about the subject. Email your answer to us at prototype@si.edu along with your name and mailing address. Each month we'll select winners randomly to receive a small prize from the Center.

Thank you to everyone who entered the June challenge and congratulations to Virginia V. of Washington, D.C., and Kevin Q. of Syracuse, New York, who, among others, knew that the forerunner to the disposable diaper was invented by Marion O'Brien Donovan. Determined to find a way to prevent leaks, Donovan first experimented with a shower curtain to create a reusable diaper cover. She eventually earned four patents for her invention, which she dubbed the "Boater," and sold the manufacturing rights for \$1 million. [To learn more about Marion O'Brien Donovan and the Boater](#), visit our website.

This month's question: Jon Hendricks pioneered a new musical style that replaces the sounds of instruments with a vocal chorus by using multitrack recording methods. What was the new style named? Bonus: Who pioneered multitrack recording?

Image: Marion O'Brien Donovan demonstrating the "Boater," June 19, 1949. Archives Center, National Museum of American History, Smithsonian Institution, AC #02072101.



From the Archives

If you like electronically generated sounds and want to learn more about their history, then the Analogue Music Synthesizer Oral History Project, 1996-1998, and the Electric Guitar Video Documentation Project, 1996, will have something for you. Housed at the Archives Center, National Museum of American History, both of these oral history collections document the pioneers and inventors associated with creating and producing electronic sounds and their related instruments.

The Analogue Music Synthesizer Oral History Project contains approximately thirty hours of oral histories with the pioneering engineers and musicians of the electronic music synthesizer. This project was spearheaded by Trevor Pinch and Frank Trocco of Cornell University to study the invention and development of the first commercial analog electronic music synthesizer. Pinch and Trocco compared the goals, designs, and achievements of two important inventors--Robert Moog and Don Buchla--and discovered how this new instrument came into being and took form. Additional interviews in the collection include: Jonathan Chowning, Herbert Deutsch, Bill Hemsath, Bernie Krause, Tom Oberheim, Jay Pollock, Don Preston, Jim Scott, Walter Sear, and Reynold Weidenaar. For more information about the electronic music synthesizer, see *Analog Days: The Invention and Impact of the Moog Synthesizer* (Harvard University Press, 2002) by Trevor Pinch and Frank Trocco.

The Electric Guitar Video Documentation Project contains oral history interviews, with some of the best-known electric guitar manufacturers, luthiers, and accessory makers discussing major 20th-century technological and cultural trends. The interviews were conducted by Reuben Jackson, Marge Ostroushko, Robert Santelli, and Matt Watson. The interviewees include: Junior Brown, John Ingram, Duke Kramer, Ted McCarty, Pat Metheny, Les Paul, G. E. Smith, Paul Reed Smith, Joe Louis Walker, and Tom Wheeler. The oral histories were created in 1996 during the Lemelson

Center’s symposium, [Electrified, Amplified, and Deified: The Electric Guitar, Its Makers, and Its Players](#). This week-long event explored the intersection of technology and music in the 20th century through oral and video histories, exhibitions, concerts, a session discussing the cultural significance of the electric guitar as instrument, technology, and symbol, and an electronic fieldtrip for school-age children, all spotlighting those inventors and players who plugged in and forever changed the sound of American music. For more information on this collection, see the [Electric Guitar Video Documentation Project finding aid](#).

For access to the Analogue Music Synthesizer Oral History Project or the Electric Guitar Video Documentation Project, [email the Archives Center](#) or call 202-633-3270.

--Alison Oswald, Archivist, Lemelson Center

Image: Junior Brown playing his guit-steel at one of the Electrified, Amplified, and Deified concerts, 1996. Photo by Eric Long, Smithsonian Institution.



Inventive Ideas for Schools and Families

Since antiquity, people have used their imagination and common materials to invent toys--many of them active, kid-powered, and noise-making--like the whirligig. While we will probably never know who invented the first whirligig, such simple whirling toys are described in European literature as early as the 18th century. Additionally, numerous Native American whirligigs made of bone and clay have been found throughout the western United States, indicating the toy’s lineage in North America.

You can continue that history of innovation by inventing your own musical whirligig. [Download the experiment](#).

Image: Spark!Lab intern Ethel Villafranca with her own whirligig. Photo by Steven Madewell.



Enter the *Inventors Digest* Essay Contest for Students

In honor of National Inventors’ Month in August, the Lemelson Center partners with *Inventors Digest* magazine and others to sponsor the 2059 Essay Contest for middle-school and high school students.

The assignment: In 500 words or less, describe what technology, tool, or product will shape our lives in 2059, and why. Entries will be judged on clarity and vision of how new technology or products will be used in the year 2059. Winning essays will demonstrate imagination rooted in science and engineering principles. The prizes include a laptop computer, publication in *Inventors Digest*, a year’s subscription to the magazine, and more. [For entry rules and more information](#), visit the *Inventors Digest* website.

Image: Poster for "Imagine Your World in 2059" essay contest, courtesy of Inventors Digest.



Our Podcast—Prototype Online: Inventive Voices

Andy Bozanic talks about his research, supported by a fellowship from the Lemelson Center, on the history of the acoustic guitar. In this podcast, he



explains how the unique qualities of the acoustic guitar--its portability, affordability, and adaptability to different styles of music--brought it into the mainstream of American music in the 20th century. [Tune in!](#)

Image: Andy Bozanic, reflected in the back of an acoustic guitar in the Museum's collections. Photo courtesy of Andy Bozanic.



Upcoming Lemelson Center Events

From Spark to Click: Celebrating National Inventors' Month

Saturday, August 1, 11 a.m. to 5 p.m.

Sunday, August 2, 11 a.m. to 3 p.m.

First floor center, National Museum of American History

Join us in kicking off National Inventors' Month in August by helping the Lemelson Center and LEGO build a record-breaking eight-foot-tall lightbulb--the universal icon of a big idea. The lightbulb will be made entirely of LEGO brick, constructed by visitors with the help of LEGO master builders. Spark!Lab will feature special building- and engineering-related activities throughout the weekend.

Innovative Lives with Ralph Baer

Saturday, August 15, 11:30 a.m.

Carmichael Auditorium, first floor, National Museum of American History

In honor of National Inventors' Month the Center welcomes Ralph Baer--inventor of the home video game--as the latest participant in our Innovative Lives series. Baer will reenact the first time he played Odyssey with his partner Bill Harrison, and then answer questions from the audience. You can visit our [Facebook page](#) to submit your questions online.

After the program, visitors will be able to play classic and contemporary video games on the first floor of the Museum, including Baer's Odyssey and Simon.

Image: Two-foot-tall model of LEGO lightbulb. Courtesy of LEGO Group.

Prototype, July 2009

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Contact us at prototype@si.edu.

General Smithsonian Visitor Information: 202-633-1000

or see more online:

[Lemelson Center website](#)

[National Museum of American History Frequently Asked Questions](#)