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ECHOES

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Sonic Boom: From Bang to Puff

Kenneth J. Plotkin

A vehicle flying at supersonic speeds creates a system of shock waves that reach the ground as a sonic boom. Figure 1 is a sketch of the generation and propagation of sonic booms. Near the aircraft there is a pressure disturbance that closely follows the shape of the aircraft and its aerodynamic loads. The waves are near-acoustic, but strong enough that there is nonlinear distortion as they propagate to the ground. High pressure regions propagate faster than the ambient sound speed, and low pressure regions propagate slower. The complex detail in the near field tends to coalesce to something simpler in the mid-field and (usually) to a simple "N-wave" shape at the ground, with bow and tail shocks separated by a linear expansion. The shock waves are audible as a pair of "bangs" as the boom passes over a location on the ground. Sonic boom is a continuous effect as long as supersonic flight is maintained, and not (as once speculated) some type of explosion as the sound barrier is broken.

Shaped sonic boom demonstrator

Shock waves from an N-wave boom can be quite intrusive. The shocks from the first generation of supersonic transports (Concorde and Tu-144) at cruise exceed 2 pounds per square foot (2 psf = 134 dB peak) and are not acceptable over populated areas. For almost 40 years commercial supersonic flight over land has been prohibited because of the negative impact of sonic booms. At one time it was thought that N-wave sonic booms were inevitable, so the only path to reducing boom would be to increase its length, trading shock amplitude for N-wave duration. An interesting aspect of "long and low" N-wave analysis was that the optimum near-field signature would be a delta function. Bow and tail shocks would quickly evolve, and stretch the signature faster than other shapes.

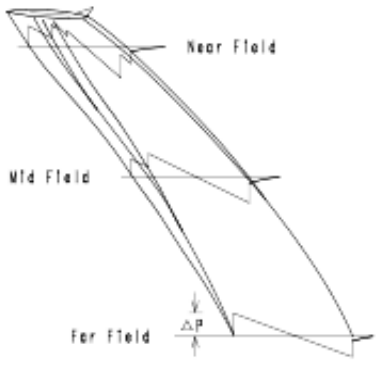

Figure 1 - Generation, propagation and evolution of an N-wave sonic boom

A major conceptual breakthrough for boom reduction came in 1965 when Ed McLean at the NASA Langley Research Center pointed out that the sonic boom from a large aircraft in the real atmosphere would not necessarily be a far field N-wave. This led to the possibility of "mid-field" signatures other than N-waves, potentially without shock waves. Figure 2 shows various types of potential booms. Figure 2a shows a conventional N-wave. Figure 2b shows an N-wave that is longer and has lower shock amplitude. Figure 2c shows a sine-like boom, where there are no shocks and, in fact, all of the high frequency energy has been eliminated. While shock formation may be avoidable, aging tends to generate signatures with linear segments, so a signature like the shockless boom, Figure 2d, may be more feasible to generate. If a shock is unavoidable, the minimum shock (Figure 2e) or flat top (Figure 2f) booms are expected to be favorable. Psychoacoustic listening experiments have shown that shaped booms, particularly ramp (shockless or minimum shock) and flat top booms are indeed quieter than N-wave booms. Some participants in listening tests have noted that shaped booms sounded more like "puffs" than "booms."

A method of systematically obtaining shaped booms was needed. In the late 1960s Professors Albert George and Richard Seebass at Cornell University developed such a theory, which identified optimal shapes. A key part of their solution is that the near field signature is defined analytically, via about half a dozen parameters, and that they provided a closed form relation to the equivalent vehicle cross-sec-

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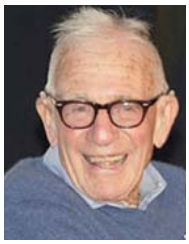
We hear that . . .

• **The National Institute on Deafness and Other Communication Disorders** (NIDCD) "It's a Noisy Planet. Protect Their Hearing" campaign recently received the Media Award from the National Hearing Conservation Association (NHCA). Since 1993, the NHCA Media Award has recognized the efforts of writers or producers of news features that serve to heighten public awareness of the hazards of noise.

• **USA Science & Engineering Festival**, a two-week celebration of science, centering on the National Mall in Washington, has a full program of exhibitions, lectures, and performances scheduled during October 10-24. Interactive exhibits and games are designed to capture the interest of youngsters and oldsters alike. Sponsors include a large number of science and engineering companies, societies, and magazines.

• **Walter Munk**, ASA Fellow, was awarded the 2010 Crafoord Prize by the Royal Swedish Academy of Sciences on May 11. The academy recognized Munk "for his pioneering and fundamental contributions to our understanding of ocean circulation, tides and waves, and their role in the Earth's dynamics." The prize, with a $550,000 award, comes 10 years after he won the Kyoto Prize, another major prize sometimes billed as a Nobel equivalent. Munk was named an Honorary Fellow of ASA in 2004.



Walter Munk

• **Patricia Kuhl**, the William P. and Ruth Gerberding University Professor at the University of Washington, has been elected to the National Academy of Sciences. Her research interests focus on the study of language and speech, particularly its development, and on how language information is processed by the brain. Pat is a Fellow and past-president of the ASA.

A letter from the editor: Biographies

Readers of "Scanning the Journals" will certainly know that *Nature* is one of my favorite scientific journals, covering, as it does, many different fields of science, including acoustics. Two items pertaining to scientific biography caught my eye in the February 25 issue. One was an interview with Geogina Ferry on writing biography. She sees scientific biography as providing a way of getting across to the public how scientists actually live, what doing science is really about. She cites the prize-winning biography of Paul Dirac, *The Strangest Man*, as a recent book with great public appeal.

In the same issue is a review of Robert Olby's biography *Francis Crick: Hunter of Life's Secrets*. Crick began his career as a physicist, worked on mine research during World War II, and studied biology after the war. Crick did his Nobel prizewinning work before he finished his PhD. His work with James Watson was essentially done in his spare time. The reviewer calls Olby's book a superb biography.

Why have so few biographies of acousticians been written? Rayleigh, Helmholtz, Tyndall, Stokes, Bell, and Sabine all had remarkably interesting careers. In more recent times are Morse, Lindsay, Knudsen, Ingard, Fletcher, Bolt, Hunt, Rudnick, Beranek, Schroeder, Apfel, and many others. We "insiders" know a lot of interesting things about these great acousticians, but the general public does not. I hope that one or more writers will take up the challenge to write about their fascinating lives.

ECHOES

Newsletter of the Acoustical Society of America

Provided as a benefit of membership to ASA members

The Acoustical Society of America was organized in 1929 to increase and diffuse the knowledge of acoustics and to promote its practical applications.

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Best Student Papers (Baltimore)

Acoustical Oceanography
First: Jorge Quijano, Portland State Univ.
Second: Jit Sarkar, Scripps Institution of Oceanography

Architectural Acoustics
First: Jeremy Manternach, Univ. of Kansas
Second: Matthew B. Zimmern, Univ. of Massachusetts-Lowell

Biomedical Acoustics
First: Kelley Garvin, Univ. of Rochester
Second: Christian Anderson, Washington Univ. in St. Louis

Engineering Acoustics
First: Joshua Krause, Tufts Univ.
Second: Alaa Abdeen, Dartmouth College

Musical Acoustics
First: Gang Ren, Univ of Rochester
Second: Chao-Yu J. Perng, Stanford Univ.

Speech Communication
First: Daniel Garcia Romero, Univ. of Maryland
Second: Marc Garellek, Univ. of California, Los Angeles

Structural Acoustics and Vibration
First: Sebastian Roa Prada, Rensselaer Polytechnic Inst.
Second: Micah Shepherd, Pennsylvania State Univ.

Underwater Acoustics
First: Adam Metzler, Rensselaer Polytechnic Inst.
Second: David Dall'Osto, Univ. of Washington

Best Young Presenters (Baltimore)

Noise
Colin Jemmott, Pennsylvania State Univ.
Julia Vernon, Brigham Young Univ.
Cole Duke, Brigham Young Univ.

Signal Processing in Acoustics
Na Zhu, Wayne State Univ.

continued from page 1

tional area and lift distribution. That relation is based on supersonic linearized flow theory. Modern aerodynamic design uses computational fluid dynamics methods, which account for detail not addressed in linear theory, but the George-Seebass theory defines a basic shape that can be refined by modern methods.

George and Seebass's theory yields the lowest possible shock amplitude for a given length and weight aircraft at particular flight conditions. Their papers present calculations of the length, weight and general shape for a given target shock strength. This includes limits such as the aircraft length needed to fully eliminate shocks: the "bangless boom."

Much of the effort toward a commercial supersonic transport through the early 1990s had been directed toward large airliners, with maximum gross takeoff weights from 400,000 pounds and upward. The concept of a large aircraft fit well with McLean's original analysis of aircraft size. None of the analyses, however, resulted in booms with peak shock overpressures significantly below 1 psf - a value that would not be acceptable for overland flight.

In the 1990s, the concept of a low boom supersonic business jet (SSBJ) was pursued by Gulfstream and Lockheed, who felt there was a strong market for this type of aircraft. This industry activity inspired the DARPA Quiet Supersonic Platform (QSP) program in 2000. The goal of QSP was a 100,000 pound class aircraft with a range of 6000 nautical miles and a bow shock overpressure of 0.3 psf or less. Both civil SSBJ and military applications were considered. Three airframe companies and a number of universities and individual experts were funded, with an intention of pushing all necessary areas of technology. The participants pursued both conventional shaping technology and also various unique concepts that may have lacked physical credibility but had a certain charm.

By the end of the QSP program, credible designs based on George-Seebass shaping were developed that would meet the sonic boom and performance goals. There was strong consensus that technology for a large airliner might be far in the future, but a 100,000 pound SSBJ was feasible within a decade, especially if technology continued to be pushed as it was in the QSP program.

An issue in the development of a low boom shaped aircraft was that there had never been flight demonstration of low boom shaped technology. Accordingly, the QSP program included flight demonstration. The demonstrator would have to be a modification of an existing flight vehicle. A manned aircraft was greatly preferred. Shaping did not have to be extensive enough to provide an audible change in the boom, but the measured shape of the boom would have to be definitively a flat top or ramp.

The demonstrator was built by Northrop Grumman Corporation based on modification of an F-5E. The F-5E/F was chosen for this project because it had a long slender nose, and there were variations of different length. By using a single seat F-5E and keeping within the length of the F-5F, stability characteristics would be within the F-5E/F's design envelope.

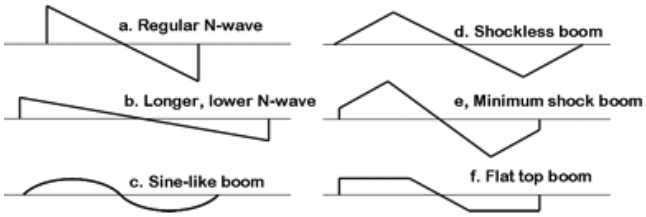

Figure 2 - N-wave boom and potential shaped booms

Some particular constraints requested by test pilot Roy Martin were that the engine inlet flow not be disturbed, and that the landing gear still had to work.

Design of the Shaped Sonic Boom Demonstrator (SSBD) proved challenging, and the design team led by Dave Graham worked through over two dozen configurations before obtaining an acceptable shape. The photo at the top of page 1 shows the SSBD before its first flight. Note the red and blue stripes on the side of the aircraft. The red stripe represents the 1.2 psf N-wave that a stock F-5E generates at the SSBD's design point of Mach 1.4, 30,000 feet. The blue stripe represents the 0.9 psf flat-top expected from the SSBD. It is always good practice to predict the result of an experiment before it is conducted. The SSBD team had the confidence to paint the expected results on the aircraft.

In August 2003 the SSBD flew its first on-condition supersonic run. It was followed half a minute later by a stock F-5E at the same condition. The results looked exactly like the stripes painted on the aircraft. SSBD program manager Joe Pawlowski commented "In 1947 Chuck Yeager broke the sound barrier. We just fixed it."

Hot summer weather closed in after that initial flight, but the team returned in January 2004 as the NASA/DARPA Shaped Sonic Boom Experiment (SSBE). Eight more back-to-back flights obtained the same positive results.

With the fundamental physics of low boom shaping validated by flight test, research has continued on practical aspects of low boom design. The George-Seebass theory has been extended to address full 3-D aircraft, not just simple undertrack booms. The design space for a low boom aircraft is very large, which has led to the development of multidisciplinary design and optimization tools. The Federal Aviation Administration has opened the US's sonic boom regulations for discussion, with four public meetings held to date. Continued development may indeed result in overland supersonic flight characterized by acceptable sonic puffs.

Kenneth J. Plotkin is Chief Scientist at Wyle, Arlington, Virginia. He is an ASA Fellow. This article is based on paper 1aNCa presented at the 2010 ASA/NOISE-CON meeting in Baltimore.

Echoes from Baltimore

New Fellows (l to r): ASA President Whitlow Au, Enrique Lopez-Poveda, Susan Nittrouer, David Knobles, Richard Freyman, Ruth Litovsky, Frank Brittain, Barbara Shinn-Cunningham, Paul Gammell, Mitchell Sommers, Peter Stein, Paul Nachtigall, Allard Jongman, Mark Sheplak, ASA Vice President Diane Kewley-Port, Karl Grosh

High school students demonstrate their homemade musical instruments following session 1pMU

Midshipmen from the U.S.Naval Academy assisted girl scouts working on acoustical merit badge projects

Jam session on Wednesday night was a big hit

Echoes from Baltimore

The Technical Council

Charles Schmid

The Technical Council is the hub for planning technical activities and forming technical policies of the ASA. The chairs of the technical committees (pictured below) preside over the 13 technical committee meetings held during the fall and spring meetings at which business and other newsworthy items are discussed and voted upon. The meetings often serve as a sounding board for Society proposals, with a recent example being whether or not to hold a joint meeting in Hong Kong. Discussions provide an important source for information about each specific technical field and general ASA operations, such as Society publications.

At each meeting Technical Committee chairs collect and coordinate the titles of special sessions for ASA meetings, and provide representatives for the Technical Program Organizing Meetings (TPOM) to organize technical sessions. Technical Committee meetings are open to all attendees, and the time and place for each of the 13 meetings can be found in the meeting programs.

Judges for best student paper awards are also handled by technical committees. Each Technical Committee can submit technical initiatives for funds for travel, student paper awards, satellite meetings, and other innovative projects. In addition to the 13 chairs of technical committees, members include a representative from Standards and the Meetings Committee. The Chair of the Technical Council is the Vice President.The Vice President-Elect and Immediate Past Vice President are also members of the Council. The Executive Director serves as secretary for the meetings of the Technical Council which typically are held on Monday afternoons and Friday mornings at Spring and Fall meetings, and are open to the public.

ASF Trustees (l to r): ASA President Whitlow Au, Richard Stern, Paul Ostergaard, Mahlon Burkhard, William Lang, Leo Beranek, Jiri Tichy, Louis Sutherland, Juliette Ioup, George Wilson, ASA Vice President Diane Kewley-Port, Gregory Tocci, Murray Strasberg

Grace Clark played the banjo at session 3aMU

Technical Council (l to r): Judy Dubno, Lee Culver, Michael Scanlon, Dean Capone, Ron Roy, Liza Zurk, Brandon Tinianov, Paul Wheeler, David Mellinger, Nancy Timmerman, Andrew Oxenham, Martin Siderius, Robert Hellweg, Diane Kewley-Port, Jeffrey Ketterin, Carol Espy-Wilson

Scanning the journals

Thomas D. Rossing

• Noisy humans may be **distracting hermit crabs to death** by diverting their attention from approaching predators, according to a paper in the February 23 issue of *Biology Letters*. When boat noise roared over a beach, the crabs were slower to hide inside their shells to avoid a predator. Apparently the boat noise masked the sound of an approaching predator. People have added all kinds of new roars and rumbles to nature's sounds, and research shows that the increasingly loud world affects animals.

• **Features of music** can influence the behavior of non-human species according to a paper in the February 23 issue of *Biology Letters*. Tamarins are generally indifferent to playbacks of human music, but respond with increased arousal to tamarin threat vocalization based music. Affective components in human music may have evolutionary origins in the structure of calls of non-human animals.

• The question of **how music conveys emotion** is a central theme in a review of a book on *The Music Instinct: How Music Works and Why We Can't Be Without It* in the 8 April issue of *Nature*. Modern cognitive neuroscientists ask how the brain interprets sensory events and imposes structure and meaning on them. Scientific research on music perception has increased exponentially in recent decades, as illustrated by a graph showing number of articles on Science of Music in the PubMed database over past decades. The secret to composing a likeable song, the author points out, is to balance predictability and surprise.

• **Phonon lasers** have been realized in two different ways, according to a Science Watch article in the May issue of *CERN Courier*. By coupling two optical resonators researchers at the California Institute of Technology have created the photonic analogue of a molecule with states differing in energy by an energy corresponding to that of a phonon. Coupling of the "whispering gallery" modes occurs through evanescent waves in the air gap between the cavities. Optical pumping of the system has produced coherent phonons at 21 and 41 MHz.

At the University of Nottingham, coherent sound amplification in the terahertz range has been demonstrated in a 50-layer n-doped superlattice of GaAs/AlAs to make the phononic analogue of a quantum-cascade laser in which electrons tunnel down a staircase of quantum wells emitting phonons by stimulated emission as they go. Interestingly, the same sort of phonon-electron coupling that normally gives rise to electrical resistance with incoherent phonon emission, here gives rise to a coherent beam of sound.

A phonon laser was reported in the Winter issue of *ECHOES*, and an article on "Lasers and Acoustics" appeared in the Spring issue.

• "**Directivities of Symphony Orchestra Instruments**" is the title of a paper in the Jan/Feb issue of *Acta Acustica/Acustica* which supplements a similar paper by Meyer some 30 years ago by providing details about the method of measurement. The paper presents directivities of 14 common instruments of a symphony orchestra recorded in an anechoic chamber with the same configuration of 22 microphones used for all instruments. The results for the brass instruments showed predictable and constant directivity in the direction of the bell, with the width of pattern decreasing with increasing frequency. The sound radiation from the woodwinds and the string instruments was more complex.

• A technology feature in the 18 February issue of *Nature* compares techniques for imaging whole animals to give an **integrated picture of biological functions** in living animals. Several of these, such as ultrasound and photoacoustic tomography use acoustics to extend the depth resolution in the images. In fact multimodality is a characteristic of many of the newer approaches to whole body imaging. Lasers transmit nanosecond pulses of light into tissue, causing it to expand and contact rapidly, and the resulting sound wave can be traced to a particular depth.

• In order to distinguish the echo of an initial pulse from a distant object from that of a later pulse from a closer object, **bats may produce pairs of sounds**, with the intervals between sounds alternating between short and long, according to a paper in the March 30 issue of *Proceedings of the National Academy of Sciences*. When the shorter pairs create interfering echoes, the bats can shift the first of the two sounds upwards in frequency by 3-6 kHz and the second downwards by the same amount.

• **Hearing a sound stop can be just as important as hearing it start**, but how the auditory system processes the end of a sound is not entirely clear. According to a paper in *Neuron* **65**, 412 (2010), when tones were played for rats, individual neurons responded to the end of tones at different frequencies, so one neuron could not register "on" and "off" for the same tone. The study suggests that the brain integrates activity in separate neurons to register the beginning and end of a sound.

• The 23 April issue of *Science* features a special section on **Science, Language and Literacy**. The issue includes a thoughtful editorial by Editor-in-Chief Bruce Alberts on "Prioritizing Science Education." In some schools, Alberts points out, students who struggle with reading or math are given double periods of reading or math drill, at the expense of the science activities that could excite them about school. A well-taught science class gives students a chance to excel in something. Those who are challenged with making progress in reading can gain the self-confidence needed to succeed by demonstrting skills in analyzing a problem that stumps the better readers or by mechanical manipulation of objects requried in a science lesson.

Six articles cover perspectives on science education and literacy and the challenge of reading for learning about science, as well as reviews of cognitive processes and knowledge representation, supporting students in developing literacy in science, and other aspects of the subject.

• In **echolocation**, a letter in the 18 February issue of *Nature* reminds us, animals such as bats emit sounds and then use reflected echoes to form images of their surroundings in their brains. But not all bats practice echolocation. Most echolocating bats produce sounds in the larynx, but a few species generate echolocating sounds by tongue clicks. In laryngeally

Scanning the journals

echolocating bats, the proximal end of the tympanic bone directly articulates with the tympanic bone, and is often fused with it. In bats that generate sounds with tongue clicks, there is no direct connection between the two bones. This suggests that echolocation may have evolved before flight.

• The March issue of *Acoustical Science and Technology* has an invited review of "**actuation at the micro-scale using electrostatics, electromagnetics and piezoelectric ultrasonics.**" All three actuator types have comparable force that is proportional to L^2. Piezoelectric transducers have short stroke lengths and high resonance frequencies that are commonly in the ultrasonic range. Mode conversion motors that use longitudinal vibrators held at particular angles and positions, are among the earliest designs of ultrasonic motors. Many centimeter-scale ultrasonic motors have very high torque and power densities, but they are somewhat difficult to miniaturize. The smallest ultrasonic motor reported to date has a diameter of 0.25 mm.

• The 29 January issue of *Science* has an editorial by Bruce Alberts, Editor, about the **Science Prize for Online Resources in Education (SPORE)** and also the first prize-winning essay in the 2009 competition ("Making Genetics Easy to Understand"). The initial 2009 prize competition attracted nearly 100 entries from many nations which spanned diverse subjects in science. Most sites targeted students, elementary through graduate school, while others focused on the general public. Alberts notes that there are many prizes for those who produce excellent scientific research but only a few awards for educators, and that is the reason that *Science* created the prize.

• "Quantum ground state and **single-phonon control of a mechanical resonator**" is an interesting article in the April 6 issue of *Nature* on the application of quantum mechanics together with novel cooling techniques to control mechanical systems that can be seen with the naked eye. A micromechanical resonator with a resonance frequency of 6 GHz, fabricated from a piezoelectric material, can be cooled to its ground state as well as excited with individual mechanical quanta.

• New software called NoteView is used to analyze single-line (monophonic) **musical performance**, according to a paper in the April issue of *Acoustics Australia*. As an example, two renditions of a familiar piece by a French horn player are compared. Pitch pairs across the two performances differed by a mean of 7 cents.

• A working group of the President's Council of Advisors on Science and Technology (PCAST) has been investigating **whether science education is broken** in the United States and how the country should fix it, according to a Comment in the 1 May issue of *Science News*. The U.S. performance comes out something like 24th or 25th in the world. The Obama administration has announced a number of science education initiatives, but the question is whether they will be enough. What is needed, perhaps, is something like a DARPA (Defense Advanced Research Projects Agency) for education.

Acoustics in the News

• When Drew Brees, winning quarterback in the Super Bowl, held aloft his 1-year old son after the game, he wisely placed earmuffs on his son's ears to protect his hearing from the roar in the stadium, according to a story in the March 2 issue of *The New York Times*. The noise in a football stadium full of people can easily reach 100 to 130 dB. Specialists say such safeguards are critical for young ears in a deafening world. Noise that is potentially dangerous to an adult is even more dangerous to a child, and Drew Brees's kids will be going to a lot of football games throughout their lives. An infant may perceive a sound as 20 dB louder than an older child or adult, and the shorter length of the ear canal increases dangerous noise levels in the higher frequencies which are crucial to language development.

• A seasoned skydiver plans a supersonic jump from 23 miles in the air, according to a story in the March 16 issue of *The New York Times*. Felix Baumgartner plans to jump from a helium balloon, reaching speeds well in excess of 600 mph in his descent. No one really knows what the shock wave will do to his body as it exceeds the speed of sound. More than three dozen veterans of NASA, the Air Force, and the aerospace industry have been working for years to plan the jump, build a balloon and pressurized capsule, and customize the astronaut's suit.

• Coral larvae, tiny hair-covered sacs of cells, can "hear" reefs and actually swim toward them, according to a story in the May 20 issue of the *Los Angeles Times*. Research findings suggest that sound is far more important in underwater ecosystem development than previously thought. Further, marine biologists say, human noise pollution has the potential to block the larvae's ability to seek out nearby reefs and settle there, ultimately harming other marine life. The researchers analyzed the movement of coral larvae inside tanks, setting up the tanks in the shallow waters. They used loudspeakers to broadcast coral reef sounds from different directions.

• The American Physical Society (APS) and the Optical Society of America (OSA) held a gala event at the Smithsonian Museum of American History to kick off LaserFest, the year's physics outreach program (see Spring issue of *ECHOES*), according to a story in the March issue of *APS News*. LaserFest is a yearlong series of events celebrating fifty years of the laser. Speaker for the gala event was Energy Secretary Stephen Chu, who won the Nobel Prize in 1997 for optically trapping and cooling atoms using lasers.

• Researchers have gained new insights into the brain by decoding the genome of the zebra finch, according to a story in the April 6 issue of *The New York Times*. The zebra finch is a type of songbird whose males learn a single love song from their fathers and repeat it throughout life (see Spring 2001 issue of *ECHOES*). Some 50 laboratories around the world are studying the zebra finch, many in the hope of gathering clues about how human language is learned. Like humans, the finch

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Acoustics in the News

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can imitate a sound it hears. The mechanisms of this vocal learning seem to be quite similar in birds and people, from the level of the brains's anatomy down to specific genes. People with mutations in a gene called FOXP2 have several kinds of speech defects, and songbirds cannot sing when their version of the gene is disrupted (see Winter 2010 issue of *ECHOES*).

• "Sound bullets" could one day allow doctors to destroy cancerous tumors, according to a story in the April 5 issue of *National Geographic News*. The technique is inspired by a common office toy called Newton's cradle in which several suspended balls of identical size touch each other, so that when an end ball is pulled back and released, the ball at the other end swings outward with the same speed. When a sound wave strikes an "acoustic lens" consisting of 0.95-centimeter stainless steel spheres in parallel chains, sound energy can be converted into a type of shock wave known as a solitary wave. The solitary wave exits the last sphere as a sound wave whose focal position can be controlled by a process called "static precompression." The emitted waves can be gentle enough to probe internal organs or powerful enough to serve as "sonic scalpels" for cleaving off tumors.

• The unique musical technology of Oceania will be highlighted in an exhibition at New York's Metropolitan Museum of Art, according to a review in the 18 February issue of *Nature*. The exhibition, which runs until September, includes instruments from Melanesia, Polynesia, Micronesia, Australia and Island Southeast Asia. The lunet, a wooden friction drum from Papua New Guinea, resembling a giant insect larva, was rubbed to honor the dead. A musician would run his moistened palm across the lunet's four carved tongues to create a rising series of tones similar to the cry of the local bird for which the instrument is named. Although many of the instruments are local, others such as didgeridoos, jaw harps, nose flutes, ukuleles and ocarinas are widely known and played.

• The April meeting of the American Physical Society (APS) included a plenary session, funded by the Kavli Foundation, on "Re-Energizing America's Focus in STEM Education," according to a story in the March issue of *APS News*. The session was organized jointly by APS, the American Association of Physics Teachers (AAPT), the National Society of Black Physicists, and the National Society of Hispanic Physicists. Linda Slakey, Acting Executive Officer of the Education and Human Resources Directorate at the National Science Foundation, was the opening speaker. She pointed out that at the high-school level, a key challenge is that we don't have physicists teaching physics.

• The March 18 issue of *The New York Times* has a review of the Jawbone Icon, claimed to be the "world's first intelligent headset."

• In a column in the 18 February issue of *Nature*. Colin Macilwain suggests that a "cozy" relationship between scientists and the media benefits neither group, and they should challenge each other more. The massive growth in public relations has led to inexpensive and safe content which masquerades as news. He recommends a more probing and intelligent approach to science journalism with more dedicated newspaper sections, radio and TV programs more akin to existing sports coverage.

• A paper in the July 1933 issue of *Journal of the American Chemical Society* reporting that intense sound could coagulate egg albumen apparently has been quoted as the scientific basis of bloggers claims that eggs could be cooked with intense musical sound. One blogger remembers that in the 70s teens would bring raw eggs to a rock concert and put them on the front of the stage. The eggs would be hard boiled by the music before the end of the concert and could be eaten.