The newsletter of
The Acoustical Society of America

ECHOES

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Spring 2007

ASA returns to Salt Lake City

"This is the place!" exclaimed Brigham Young when he led 148 pioneers over mountains and deserts in covered wagons to finally gaze on the beautiful Salt Lake Valley. ASA will meet in Salt Lake City for the third time, and although most of us would prefer to arrive by airplane rather than oxcart, the valley remains one of the most scenic in the United States. The meeting will feature 683 papers and 43 special sessions. There will be a short course on Architectural Acoustics given by K. Anthony Hoover on Sunday afternoon and Monday morning. On Monday evening, Uwe Hansen will present a tutorial lecture on "Musical Acoustics: Science and Performance," assisted by the Salt Lake City Jazz Orchestra. There will be a Gallery of Acoustics, featuring images, videos, audio clips, and sounds generated by signal and image processing of acoustic data. The Acoustics Education Prize Lecture will be given by William J. Strong, and the Acoustical Oceanography Prize Lecture will be given by Brian D. Dushaw.

"This is the Place"

Other special events include technical tours of the acoustics research facilities and carillon at Brigham Young University (Monday) and the 21,000-seat LDS Conference Center and newly-refurbished Mormon Tabernacle in Temple Square (Wednesday). At the conclusion of the tour (Wednesday noon), there will be an organ recital in the Tabernacle. Session 2aAA on Tuesday morning will be a walking and traveling tour of three concert halls in the Salt Lake Valley. Buffet socials will be held on Tuesday and Thursday evenings preceding the technical committee meetings. The Tuesday social will be held on the plaza (weather permitting), while the Thursday social will be in the Grand Ballroom of the Hilton.

The ASA Plenary session, where Society awards are presented and newly-elected Fellows are recognized, will be held on Wednesday afternoon. The Fellows luncheon on Thursday will be at the Rose-Wagner Hall, a short 2-3 minute walk from the Hilton. Richard T. Kouzes from the Department of Energy's Pacific Northwest National Laboratory will speak on "Detection of Nuclear Threats at Borders." The Women in Acoustics luncheon will be on Wednesday.

The Technical Committee on Architectural Acoustics and the National Council of Acoustical Consultants are sponsoring a Student Design Competition with prizes of more than $4000. The 2007 competition involves the design of a performance hall primarily for opera performances.

Since the attractive and full program will monopolize our attention during the week, many of us will want to arrive early or stay late to enjoy the spectacular Utah scenery. Nevertheless, sightseeing and social activities are planned during the meeting for participants and accompanying persons. In addition to the buildings and museums in Temple Square, popular attractions include the Utah State Capitol Building, the Salt Lake Art Center, the Utah Museum of Natural History, the University of Utah, "This is the Place" State Park, Abravanel Hall, and the Olympic Oval. Trolley Square is a major shopping and dining center near downtown. Tours for accompanying persons include a city tour (Tuesday) and the "Alps of Utah" (Thursday). Utah has five outstanding national parks.


Mormon Tabernacle Organ


The Hilton Hotel

We hear that . . .

• An **acoustics workshop** will be held June 11-14 at the Rose-Hulman Institute of Technology in Terre Haute, Indiana. This workshop will include simple experiments on ultrasonics, resonance, and dispersive wave behavior and Vernier software will be used. The workshop, led by Michael Maloney, is dedicated to the memory of Wilkison W. Meeks, Professor of Physics. Participants should bring their own laptop computers. See http://www.rose-hulman.edu/~moloney/Meeks_Workshop.htm.

• (The following item was printed in the Winter issue of *ECHOES* with the wrong photo, for which the editor apologizes. We reprint it now with the correct photo): **John J. Ohala**, Professor Emeritus of Linguistics at the University of California, Berkeley, received the 2006 International Speech Communication Association (ISCA) Medal for Scientific Achievement. John is a Fellow of the ASA and served as president of the International Phonetic Association. His work was also recognized by an honorary degree from the University of Copenhagen.

• The National Recording Preservation Board is accepting nominations of sound recordings to be included in the ***National Recording Registry***. Criteria and nomination procedures plus a nomination form can be found at http://www.loc.gov/rr/record/nrpb/nrpb-form.html. Although the board accepts nominations year round, they will only consider those submitted by *July 1, 2007* for inclusion on the 2007 registry list.

Message from the President

Anthony Atchley

As you read this column, I am nearing the end of my term as ASA president. I approach this event with mixed emotions. Our Society keeps its presidents busy, and in all honesty, some days the thought of a less active telephone and email inbox is appealing. However, I must confess that I will miss being involved in making decisions that shape the future of the Society. One of the great characteristics of the ASA is that there is no shortage of talented members who agree to stand for election to leadership positions. I leave the Society in the capable hands of Gilles Daigle. Gilles is an accomplished researcher and has previously served as vice president of the Society.

Being president affords the opportunity to observe the inner workings of the Society from a unique perspective. By design, ASA presidents come and go. Also by design, the continuity and corporate memory reside with the Executive Director, the managers, the non-elected officers (Editor in Chief, Treasurer and Standards Director) and staff. Without a doubt, one of the most pleasant aspects of serving as President is working closely with these individuals. I can personally attest to the fact that they are all dedicated to the well being of the Society. For the majority of members, Society publications (*JASA, Acoustics Today, ECHOES* and *standards*) and ASA meetings are the most visible activities of the Society, as it should be. However, an amazing amount of work goes on behind the scenes, invisible to the most of us, to keep things running smoothly. And they do run smoothly, solely because of the quality of the people at "headquarters."

Shortly after taking office, I wrote a column for *Acoustics Today* in which I said that a year is not much time to get things done. Looking back over the past year, I am struck by two things–that a year is indeed a very short time, and that a lot can be accomplished in a year. Often it appears that things change slowly within the ASA. While this is not necessarily bad, there are times when we need to respond rapidly. I will mention three examples. One is the challenge presented by the increasing public sentiment that publications should be freely accessible to all. *JASA* is the ASA's only revenue generating cost center. Therefore, we cannot make it free any time soon. We are however looking at avenues for getting research results out to the public in a rapid and open way that does not compromise the reputation of *JASA* or our long term financially stability. Another example needing rapid attention is our role in shaping public opinion and policy. It is sometimes difficult for scientists and engineers to grasp the importance of these non-technical issues which affect the advancement of acoustics and science in general. Nevertheless, it is an area in which we need to become more actively engaged. The last example is the role that fund raising and development plays within the ASA. There is little doubt that, as a society, we can do more to benefit our members and educate the general public, but we have to find a way to support these activities. Space does not permit me to provide the details of how we are addressing these issues. I will only say that over the coming months you can expect to see real progress for the betterment of the ASA.

Finally, I want to express my gratitude for the opportunity to serve as your president. It is an experience and an honor that will be with be with me for the rest of my life. Thank you.

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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Nobel Laureate goes to the Oscars

Elizabeth Cohen

After volunteering in schools for over a quarter of a century I bear witness to the persistence of the archetype of the scientist or engineer as nerd. I was discussing this topic last January with George Smoot, physics professor at the University of California Berkeley and 2006 Nobel laureate. We discussed how important it is for young people to connect the math and science that they study to creativity and the arts. Furthermore that mastery of these core subjects can lead to great adventures and that core life experience: FUN. This line of thinking encouraged some brainstorming on how we could grow the scope of ongoing programs as well as create new materials to help students and K-12 teachers build these connections. It was sheer serendipity that the Oscars were almost upon us and we had a great venue to kick-start some of our ideas.

Elizabeth Cohen and George Smoot at the Oscars (photo courtesy of the Academy of Motion Picture Arts and Sciences).

Most people do not realize that the OSCARS™ refer to merit awards for the Academy of Motion Picture Arts and Sciences. The Academy has engaged in technical activities since its founding in 1927. Details on the science and technical programs may be found at the Academy's website http://www.oscars.org/council/index.html

Therefore at February's Oscar ceremonies in Hollywood, Nobelist Smoot accompanied me to the Academy Awards. He met with Sid Ganis, President of the Academy of Motion Picture Arts and Sciences, and with the members of the Academy's Technical Council to discuss ways of encouraging further contributions of science and engineering to the arts. Smoot also found time to meet with a wide range of artists and advocates including Spike Lee and Al and Tipper Gore. Smoot has been invited by Technical Council Director, Andy Maltz, to address the council this spring and discuss ways for further collaboration.

Elizabeth Cohen, President of Cohen Acoustical, former Consulting Professor of Electrical Engineering at Stanford and Visiting Professor of Film, Television and Digital Media at UCLA, is a past president of the Audio Engineering Society (AES) and a member of the Academy of Motion Picture Arts and Sciences. An active member of ASA as well as AES, she is now working in the areas of advanced network computing for acoustics and audio, music information processing, and sound recording archiving, preservation, and restoration activities.

ASA Returns to Salt Lake City

Technical Program Committee:Tracianne Nielsen, Bruce Smith, Matthew Dzieciuch, Rachel Hayes-Harb, Tim Leishman, George Ioup, Sean Lehman, Bruce Olson, Richard Raspet, Kent Gee, Scott Sommerfeldt, Bill Strong, Gary Rose, Donal Sinex, Michael Bailey.

LDS Conference Center

Utah state capitol

Novel Biologically-Inspired Directional Microphones

R. N. Miles

A common complaint of hearing aid users is that they have great difficulty understanding speech in noisy environments. The use of directional microphones has shown considerable promise for addressing this problem. Clinical studies of the hearing impaired have demonstrated improvements in speech intelligibility in noise from the use of directional microphones. While advances in directional microphone technology are of great interest, the most recent revolutionary change in microphone construction was the commercially viable electret over thirty years ago; the sensor still consists of a metalized pressure-sensitive membrane placed near an electrode. In contrast to the modest advances in microphone technology, our ability to process signals has exploded through the advent of low-power digital signal processors and Sigma-Delta analog-to-digital conversion. Processing technology has outpaced acoustic transducer technology. The development of improved directional microphone technologies coupled with improved signal processing algorithms will result in a demonstrable improvement in the lives of the hearing impaired.

Conventional microphones often consist of a thin diaphragm along with a backplate electrode positioned in parallel at a small distance away. This permits the detection of the motion of the diaphragm through the capacitance change between the diaphragm and the backplate. There are a few limitations of this configuration. First, the viscous damping caused by the air between the diaphragm and the backplate can have a significant negative impact on the response. Secondly, the signal to noise ratio is negatively influenced by the electronic noise associated with the capacitive sensing and the thermal noise associated with the passive damping. Thirdly, while the electrical sensitivity is proportional to the bias voltage, if the voltage exceeds a critical value the attractive force associated with this bias voltage will cause the diaphragm to collapse against the backplate.

The novel biomimetic differential microphone diaphragm developed in this study, shown in Fig. 1, is based on a mechanical model of the ears of the parasitoid fly, *Ormia ochracea*.

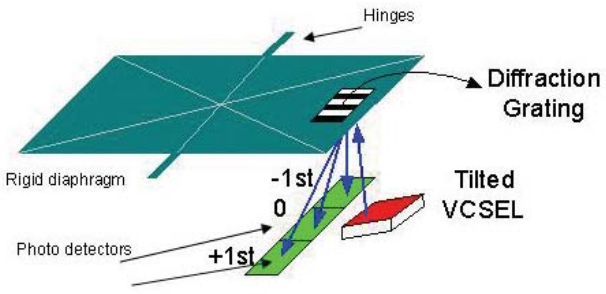
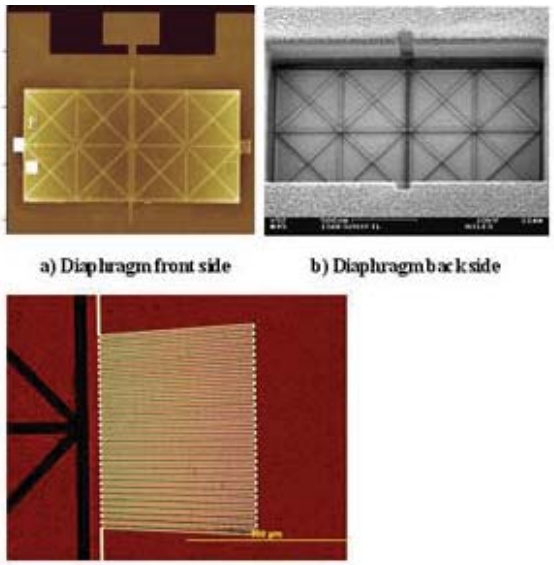


Figure 1. Schematic of directional microphone with integrated optical readout



a) Diaphragm front side b) Diaphragm back side

c) Inter-digited fingers at end of diaphragm

Figure 2. Fabricated differential microphone diaphragm with inter-digited fingers a) Front side optical view. b) Backside view using an SEM. c) Inter-digitated fingers at the end of the diaphragm with backside illumination.

The diaphragm is combined with an optical sensing scheme to provide electronic readout of the diaphragm deflection with a minimum of electrical and thermal noise. The 1 mm by 2 mm diaphragm is supported at only two pivot points at the middle and reinforced with stiffening ribs. The thickness of the diaphragm is 2 μm. Inter-digitated fingers, shown in Fig. 2, are incorporated at the two ends of the diaphragm, the locations with maximum deflection as the diaphragm rocks about the hinges in response to sound. The dimensions of this structure have been determined by a detailed finite element-based optimization. This structure provides a highly compliant differential microphone that responds to the differences in pressure on the two sides of the diaphragm that are separated by the hinges at the center.

The optical detection method is based on a phase-sensitive grating structure, where the intensity of reflected diffraction orders is monitored as the displacement signal. Using vertical cavity surface emitting lasers (VCSELs) as the light source and integrating photodetection electronics as shown in Fig. 1, the overall volume of the interferometer can be reduced to the cubic millimeter level.

The measured acoustic directionality of the microphone diaphragm is shown in Fig. 3. This figure shows a polar plot of the amplitude of the output of the microphone for various angles of incidence of the sound. The microphone is most sensitive to sound incident from either zero or 180 degrees least

Echoes from Honolulu

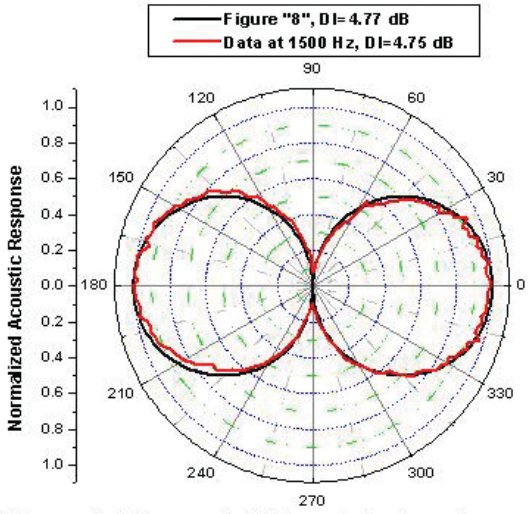


Figure 3. Measured differential microphone directivity pattern compared to "ideal" figure 8 pattern

sensitive to sounds incident from angles of either 90 or 270 degrees. The figure shows that the microphone diaphragm's response is extremely close to the expected figure eight directivity pattern of an "ideal" differential microphone.

Acknowledgments: This work is supported by NIU grant 1R01DC005762-02A1 and is the result of the efforts of the following: W. Cui, Q. Su, R. Wu, L. Tan, Y. Liu, S. Jones, V. Mohnankrishnaswamy, T. Strait, W. Butler, and D. Dibernardo at SUNY Binghamton; and F. L. Degertekin, B. Bicen, K. Jeelani, W. Lee, and S. Qureshi at Georgia Institute of Technology.

Ronald N. Miles is professor of mechanical engineering at the State University of New York in Binghamton. He has served as department chair and as director of graduate studies. His primary research is on the development of biologically-inspired acoustic sensors. This paper is based on the lay-language version of paper 3aEA7 presented at the joint ASA/ASJ meeting in Honolulu.

Acoustics in the News

• Bubble fusion or sonofusion is back in the news. According to a story in the February 9 issue of the *Chicago Tribune*, a panel at Purdue University has rejected allegations that a nuclear engineer interfered with efforts to verify his claims of tabletop fusion. The internal university committee investigating the work of professor Rusi Taleyarkhan determined that the evidence does not support the allegation of research misconduct and that no further investigation is needed. *Nature* reported last March that several of his Purdue colleagues accused him of attempting to thwart their efforts to test his claims, and this led to appointment of a committee to investigate.

• Other alternative approaches to fusion, including bubble fusion using sound waves, are described in the February 27 issue of *The New York Times*. Seth Putterman and his graduate students at UCLA have shown that sonofusion or bubble fusion is possible in principle (see Summer 2006 issue of *ECHOES*), but they have not yet succeeded in demonstrating it. Furthermore they have not been able to duplicate experiments of Taleyarkhan and others who claim success. Another approach, called inertial confinement fusion, makes use of accelerated charged ions. Yet another approach, known as dense plasma focus, uses an electric spark to generate strong, unstable magnetic fields to compress and heat a gas to fusion temperatures.

• Bubbles of an entirely different type have been used to perform logical functions of the type handled by computers, according to a report in the 9 February issue of *Science*. Scientists at MIT have shown that the direction of flow of air bubbles in a microfluidic system can be switched according the presence or absence of other bubbles. The researchers used this property to create a very simple logical "and/or" gate, and also have succeeded in creating more complicated "inverter-and" gates in which a smaller bubble can switch the direction of larger bubble.

• The February 23 issue of the *Natick Bulletin & Tab* carried a nice article on Bill Cavanaugh and the Wallace Clement Sabine Medal that he received at the ASA meeting in Honolulu. As an acoustical consultant his work involves the control of unwanted sounds (noise) as well as the enhancement of desired sounds (speech and music) for listening spaces of all types–indoors and out. As an acoustical consultant for the Tweeter Center in Mansfield, Massachusetts, his job was to assure orchestras such as the Pittsburgh Symphony that their sound would carry in the expansive outdoor space. But when rock bands began performing in the same theater, his job description changed. He made measurements to understand what level would not be disturbing to the neighbors. The sound system includes green, amber, and red lights to indicate when the levels are OK or too loud.

• An article in the April 8 issue of the *Washington Post* described the experiences of Joshua Bell playing his Stradivarius violin at the L'Enfant Plaza metro station in Washington, DC. According to the reporter, "The acoustics proved surprisingly kind," but the response of passersby was understandably mixed. Bell began with Bach's "Chaconne" from the Partita No. 2 in d-minor, a piece written for solo violin. Three minutes went by before anyone stopped to listen; he received his first donation about a half-minute later. A postal supervisor, who plays the violin, was the first serious listener; he listened for nine minutes and tossed in $5. Only one person recognized Bell: a demographer at the Commerce Department who had heard Bell's concert at the Library of Congress three weeks earlier, and she appropriately rewarded him with $20. A video of Bell's "pearls before breakfast" performance can be viewed at the Washington Post's website.

• Classroom acoustics was the subject of the March 22 pro-

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Scanning the Journals

Thomas D. Rossing

• The November/December issue of *Acustica/Acta Acustica* is a special issue on **Soundscapes** edited by Brigitte Schulte-Fortkamp and Danièle Dubois. Soundscape considers the conditions and purposes of noise production, perception, and evaluation from a human point of view. The issue includes articles on the history of soundscape research in Japan, psychoacoustics and its benefit for the soundscape approach and many others.

• The **Earth's "hum"** is driven by ocean waves over the continental shelves, according to a Letter in the 15 February issue of *Nature*. Seismic normal modes of the Earth at frequencies near 10 mHz are excited at a nearly constant level in the absence of large earthquakes. This background level of excitation is equivalent to the maximum excitation from a magnitude 5.75 earthquake. Most studies have attributed the forcing to atmospheric turbulence, analogous to the forcing of solar oscillations by solar turbulence, but recent observations suggest that the predominant excitation source lies under the oceans. Ocean waves couple into seismic waves through the quadratic nonlinearity of the surface boundary condition, which couples pairs of slowly propagating ocean waves of similar frequency to a high phase velocity component at approximately double the frequency.

• The brain rapidly forms **links between sounds and actions** that produce them, according to a paper in the January 10 issue of *The Journal of Neuroscience*. The results of magnetic resonance imaging (MRI) brain scans provide evidence for existence of a mirror neuron system in humans similar to that observed in monkeys. Mirror-neuron circuits appear to encode and reflect templates for specific action. They may allow us to comprehend motor acts when they are observed or heard with the need for explicit reasoning about them.

• Observation of negative group velocity propagation of sound waves through an asymmetric loop filter confirm predictions that **faster-than-light group velocity** is possible, according to a paper in the 1 January issue of *Applied Physics Letters*. The spectral rephrasing achieved in a loop filter is sufficient to produce negative group velocities independent of the phase velocity of the spectral components themselves, say the investigators.

• The 9 February issue of *Science* includes a profile of the **Brain, Music, and Sound Research Center** (BRAMS) at the University of Montreal. The investigators, from McGill University as well as the University of Montreal, seek to understand "how humans cooperate to perform together, how children and adults learn to play music, and the relationship between music and language." Already BRAMS researchers have pinpointed areas of the brain involved in the perception of pitch, and they have demonstrated that pianists' ability to remember long, complicated pieces relies on close coordination between distinct motor and auditory memory circuits in the brain. Wireless physiological sensors in some of the seats in a concert hall will monitor heart rate, skin electrical responses, and even facial musculature of audience members who consent to be monitored in order to sense group emotional reactions during live performances.

•The lead paper in the February issue of *American Journal of Physics* is entitled "**Ion acoustic wave experiments** in a high school plasma physics laboratory. The paper, with 19 authors, reviews the experiment, set up at UCLA but used by high school teachers and students as well as university researchers. It also describes the activities of the Los Angeles Physics Teachers Alliance Group (LAPTAG), one of many such alliances supported by the American Association of Physics Teachers. *Wikipedia* describes an ion acoustic wave as "a longitudinal oscillation of the ions (and the electrons) in an unmagnetized plasma or in a magnetized plasma parallel to the magnetic field." "Although the plasma formation is somewhat complicated, running the device is simple," the paper points out.

• "**The Sounds of Spacetime**" is the title of an article in the November-December issue of *American Scientist* which deals mostly with gravitational waves and our attempts to observe them. The "superbly sensitive microphones" that astronomers intend to listen to the "many-voiced soundtrack of the cosmos" include the Laser Interferometer Gravitational-Wave Observatory (LIGO) and the proposed Laser Interferometer Space Antenna (LISA). The frequencies of the gravitational waves "span the same range as a piano keyboard with 20 octaves of sound" (quite a piano keyboard!). Ground-based detectors listen to spacetime wiggles at audible frequencies in a bit over three octaves, or "about the range of a versatile soprano." The most spectacular LISA events will be "huge, roaring events when two very big black holes, somewhere in the universe, spiral together and merge into a single bigger black hole." These events "sing a song called a 'chirp' like a single note on a violin that gets higher only very slowly." The article concludes with a section titled "The String Section" which discusses (you guessed it) string theory, a "still-untested quantum version of Einstein's theory."

• Although sandstone and granite are very different kinds of rock, the **sounds given off before they shatter** are similar and in fact are similar to those detected after an earthquake, according to a paper in the 23 March issue of *Physical Review Letters*. This suggests that cracking is a universal process that occurs in many different materials over a wide range of size and time scales. Detailed statistical analysis of acoustic emission time series from laboratory rock fracture obtained from different experiments on different materials showed that the waiting time distribution can be described by a unique scaling function indicating its universality.

• **Very-low-frequency earthquakes** occur in the transition zone of the subducting plate interface in southwest Japan according to a paper in the 26 January issue of *Science*. The seismic waves they generate predominantly show a long period of about 20 seconds. Megathrust earthquakes with seismic moment magnitudes exceeding 8 occur in this region on about 100-year time scales. Deep low-frequency tremors and slow slip events in Japan have been detected by a seismic network consisting of 750 high-sensitivity seismograph stations. Horizontal accelerometers with a frequency response from 0 to 5 Hz are installed at each station.

• Detailed investigation of a molecule involved in an **inherited type of deafness** reveals a fresh facet to the mammalian auditory system, according to a paper in the 21 December issue of *Nature*.

Scanning the Journals

Mammals react to sounds with exquisite temporal fidelity, a feat that is initiated by precise calcium-dependent signaling in the hair cells of the inner ear. The hair bundle on a cochlear hair cell senses variations in sound-induced pressure in the cochlea, and the resulting signal is transduced and passed via the afferent nerve fiber and the auditory nerve to the brain. The voltage-dependent signal in the hair cell controls calcium channels, prompting calcium influx from outside the cell. The capacity of the auditory system to follow oscillations at several thousand times per second suggests that this calcium-dependent regulatory event may need to be as much as ten times more precise than signaling between most types of neurons. The hair cell has evolved a unique calcium-sensing molecule, otoferlin, for controlling neurotransmitter release. In both mice and humans defects in otoferlin are responsible for an inherited form of deafness called DFNB9.

• Bursts of white noise have been used to test **metacognition** in rats, according to a paper in the March issue of *Current Biology*. Metacognition is the ability to gauge one's own knowledge. The rats were taught to discriminate between bursts lasting two seconds and bursts lasting eight seconds. Then they were given noise bursts of intermediate length that were more difficult to classify as "short" or "long" and given the option to decline the test and accept a lesser reward. As the tests got increasingly difficult, more rats selected this latter option.

• The 10 March issue of *New Scientist* has an article about **hair cell regeneration**. Nearly all vertebrates except for mammals regenerate hair cells, so why can't we? Nobody knows for sure, but perhaps our early mammalian ancestors exchanged the ability to regenerate hair cells for the capacity to hear high-frequencies. Some researchers think the ability may have disappeared when mammals started living longer, since advanced age brings a greater risk of cancer; nature may have switched off some types of cell regeneration to ward off tumors. In 2005 researchers discovered that deletion of a specific gene permits the proliferation of new hairs cells in mice cochlea (see Spring 2005 issue of *ECHOES*). A letter in the 22 June 2006 issue of *Nature* attributes this to p27Kip1. also known as Cdkn1b. Supporting cells from the inner ear of a newborn mouse went through natural division, producing supporting cells and hair cells, but in mice that were 2 weeks old the results were not nearly so good unless the p27Kip1 was knocked out. The possibility that hair cells can re-grow opens up the amazing possibility that people might one day be able to regain hearing.

• The March issue of *Acoustical Science and Technology* features invited review papers on "**Audiovisual multisensory integration**" by Charles Spence and "**Cracking the speech code: How infants learn language**" by Patricia K. Kuhl. The first paper highlights the contribution of both spatial and temporal factors to multisensory integration of auditory and visual stimuli. The evidence supports the view that a number of different factors, both structural and cognitive, conjointly contribute to the multisensory integration of auditory and visual information. The second paper describes how infants tackle language learning. They combine pattern detection and computational abilities (often called statistical learning) with special social skills. Early in development, the brain's neural networks code the properties of the native language, and these networks make it difficult to learn a new language. Learning is strongly influenced by social skills, thus making it difficult to learn a new language from television or audio tape.

• Of his many inventions, the **glass armonica** was probably Benjamin Franklin's favorite, according to an article in the February issue of the *Smithsonian Magazine*. This beloved instrument, which disappeared from the musical landscape in the 19th century, is now enjoying a renaissance. While living abroad as a delegate for colonial America, Franklin enjoyed concerts in which musicians coaxed notes from wine glasses, but Franklin decided he could do better. He commissioned a London glassblower to make a series of bowls in different sizes, each tuned to a different note by virtue of its radius and thickness. Each bowl had a hole in the center, and Franklin nested them on an iron rod which could be rotated by means of a foot treadle very much like a sewing machine. As word of his invention spread, glassblowers produced several thousand armonicas, and composers such Mozart and Beethoven composed music for it.

In the 20th century, scientific glassblowers, such as the late Gerhard Finkenbeiner in Massachusetts, improved on Franklin's design by making the bowls from quartz and using an electric motor to turn the bowls. (Some readers may recall hearing a concert played on an armonica at the special session on glass musical instruments at the 121st ASA meeting in Baltimore in 1991).

• A 78-page review paper "**Discrete-time modeling of musical instruments**" appeared in the January 2006 issue of *Reports on Progress in Physics*. An early collaboration (1961) by Mathews, Kelly and Lochbaum on discrete-time synthesis from vocal tract modeling produced the famous "Bicycle Built for Two," while vibrating string simulations were conducted in the early 1970s by Hiller and Ruiz. Musical instruments have been amongst the most complicated mechanical systems made by humans, and modeling of them using computers is the newest approach to understanding how they work. K-models, wave models and hybrid KW-models are discussed along with many other interesting topics.

• "Reconstruction of **Historical Alloys for Pipe Organs** Brings True Baroque Music Back to Life" is the title of a paper in the March issue of *MRS Bulletin* published by the Materials Research Society. Metallurgists in Germany and Sweden have replicated the alloys used in pipe organs from the Baroque period, and organ builders have used these to construct pipes for replica organs. A copy of a large Baroque organ in Vilnius, Lithuania, for example, is currently under construction at the Eastman School of Music and will be installed in a church in Rochester in 2008.

• A direct-current nanogenerator that is driven by an **ultrasonic wave** is described in the 6 April issue of *Science*. The nanogenerator was fabricated with vertically aligned zinc oxide nanowire arrays placed beneath a zigzag metal electrode. The waves drive the electrode up and down to bend or vibrate the nanowires. A piezoelectric semiconducting coupling process converts mechanical energy into electricity. This approach represents an adaptable, mobile and cost-effective technology for harvesting energy from the environment it is claimed.

Acoustics in the News

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gram on *Leading Edge*, a BBC science program. "How important is it for teachers and pupils to be able to hear each other in a classroom? It's a no-brainer, of course because it is vital for teaching and learning. But that doesn't seem to be the view of some architects, some of whom seem to see acoustic design criteria for classrooms, as an inconvenience they would rather do without," according to Trevor Cox, University of Salford. Programs can be heard at http://www.bbc.co.uk/radio4/science/leadingedge.shtml.

- Mid-ocean ridges are dotted with noisy hydrothermal vents termed "black smokers," according to a note in the 2 February issue of *Science*. From these vents, dark streams of mineral-laced hot water bubble out to enrich the deep ocean and provide niche environments for many organisms. Researchers have recorded the sounds of two black smokers on the Juan de Fuca ridge 2200 m below the ocean surface. Both vents are noisy, exceeding the ambient level by 10 to 30 dB. Broadband acoustic signals included frequencies up to 500 Hz, possibly generated from a combination of volume changes in the flow, turbulence enhanced by fluid heterogeneity, and chimney vibration. Strong single tones may have indicated resonant frequencies of the cavities.
- In a list of 10 things readers would "most like to uninvent" in the March 11 issue of *Parade* magazine, at least half of them are cited because of their noise, including jet skis, leaf blowers, bass amplifiers, car alarms, and cell phones.
- Another chapter in the saga of the ivory-billed woodpecker appears in the 15 March issue of *Science NOW* under the title "Ivory-Billed Imposter?" New evidence casts doubt on the claim that a bird long thought extinct is still alive. In 2005, a report that the bird had definitely been spotted in Arkansas appeared in the daily papers (see Fall 2005 issue of *ECHOES*). A team of ornithologists analyzed sound recordings and reported that the woodpecker was alive and well (see Winter 2006 issue of *ECHOES)*. Now a video suggests that the re-discoverers may have mistaken a large, common woodpecker for the ivory-billed. A new video shows how "ivory-billed-like" a pileated woodpecker can be. The debate continues.
- The horned desert viper can hear sound through its jaw, according to a story in the 17 March issue of *New Scientist*. Although it lies with its head buried in the sand, it can strike with great precision as soon as prey appears. Scientists in Munich have developed a computer model of the snake's auditory system that explains how the snake "hears" its prey by picking up vibrations through the sand. The viper's lower jaw is extremely flexible, allowing it to swallow small animals in one gulp, and on each side is a thick bone connecting the jaw to the snake's ears. The snake's brain processes the difference in arrival time at the two ears to localize the prey.
- On October 9, 2006 seismometers around the world picked up a magnitude 4.2 event in North Korea which could be identified as a blast rather than a quake, according to a news story in the January issue of *Scientific American*. Explosions produce a different mix of waves than do earthquakes. A classic earthquake starts out with a bump of P waves, followed a few seconds or minutes later by a strong batch of slower shear or S waves. By itself a bomb would generate no S waves, but underground explosions can twist the surrounding rock and release some of the same energy that an earthquake would. Hence, observers must consult seismic stations along multiple paths from the event. To verify North Korea's purported test, experts consulted a station in China about 370 km north of the epicenter which captured the clearest signal of the 128 stations in the Global Seismographic Network. Determining the explosive yield is tougher, however. The actual yield could vary by a factor of 10 or more depending on the geology. Best estimates of the North Korean blast are less than a kiloton, because the hard rocks such as granite gneiss, which lie under much of that country, readily transmits seismic waves.

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