The newsletter of
The Acoustical Society of America

ECHOES

Volume 20, Number 1
Winter 2010

What microphone arrays tell us about bat sonar

James A. Simmons

The Fifth Animal Sonar Symposium was held at Doshisha University in Kyoto, Japan, on September 14-18, 2009. This was the most recent in a series conferences since the first symposium on echolocation took place in Frascati, Italy, in 1966. These gatherings of the discoverers of echolocation and senior researchers with postdoctoral researchers and students have been extremely influential in advancing our understanding of biological sonar in bats and cetaceans. The Acoustical Society of America was one of the organizations that sponsored the Kyoto conference, and it is expected that the majority of papers describing the research presented at the conference will be published in JASA over the course of the next year. Meanwhile, this article will serve as a brief report to the Society about several conference presentations on the common theme of using multiple-microphone arrays to track bat flight in the dark and associate acoustic features of the transmitted signals with spatial dimensions and features of the bat's surroundings. Details about the program content can be viewed at the web site: http://cse.fra.affrc.go.jp/akamatsu/AnimalSonar.html.

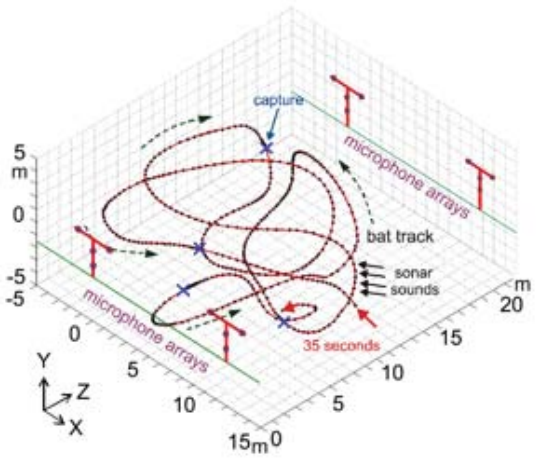


Fig. 1. A 32-second bat track for Japanese house bat from four simultaneously recorded arrays.

Use of microphone arrays to record bats is not new, but the conference presentations represent considerable extensions of these techniques. (Multiple-hydrophone arrays have been used as well for recording the biosonar sounds of cetaceans, which are even more difficult to observe in action than bats flying in the dark.) This technique already has brought us valuable information about the duration and frequency structure of FM bat sounds in relation to how far bats are from background clutter such as vegetation or the ground.

The array design being used by Shizuko Hiryo, Hiroshi Riquimaroux, and their students at Doshisha University serve as a good introduction to the method and what can be learned. They chose a recording site over a small stream in Kyotanabe, Japan, where the Japanese house bat, *Pipistrellus abramus*. The microphones occupy a vertical plane that is set up facing the area where bats have been observed (with bat detectors) to forage for flying insects. Aerial-feeding insectivorous bats emit relatively broadband FM sounds, in the range of 10-150 kHz depending on species, at sound pressures of up to 110-135 dB SPL. Even with unfavorable atmospheric absorption at ultrasonic frequencies, such intense sounds can be detected at distances of 10-15 meters, and their broad bandwidth ensures that the sounds' arrival-time differences between pairs of microphones can be measured with microsecond accuracies to compute sound-source location. Interestingly, the distance to the bat is available, too, even though the microphones all lie in one plane, because the expanding wavefront is slightly curved. Figure 1 shows a long flight path for a Japanese house bat continuously tracked acoustically for about 35 seconds using four of the 4-microphone arrays as a super-array. The whole track is spliced together from segments picked up from one array to the next as the bat moves around in the zone of space about 15 meters on a side. The track shows the location of the bat for each broadcast, the convoluted, looping search pattern taken by the bat, and the locations where the broadcasts are produced. The track shows where four insect captures take place, too, based on the occurrence of "feeding buzzes" in the broadcast sequence. These bats make easily-discerned changes in their sounds when they detect a target

continued on page 3

We hear that . . .

Jeff Fox

- AIP/ASA's Congressional Science and Engineering Fellow **Jeff Fox** has been selected to serve in the office of Senator Jeff Bingaman from New Mexico where he will be working on education issues.
- Reports of the technical committees for 2009 can be read online at http://asa.aip.org/TC_reports2009.html
- Grants of 500 euros are available to help students and young researchers (under 35) attend the International Congress on Acoustics in Sydney next August. Application deadline is February 22. Information can be obtained at www.icacommission.org.

Best student papers (San Antonio)

Acoustical Oceanography
First: Joseph Senne, University of Delaware
Second: Lora Van Uffelen, Scripps Institution of Oceanography

Engineering Acoustics
First: Eric A. Dieckman, The College of William and Mary
Second: Daniel Tengelsen, Brigham Young University

Musical Acoustics
First: Daniel Zietlow, Rollins College
Second: Whitney Coyle, Murray State University

Speech Communication
First: Charles Chang, University of California, Berkeley
Second: Nancy Ward, University of California, Los Angeles

Structural Acoustics and Vibration
First: Julien Meaud, University of Michigan
Second: Christina Naify, University of Southern California

Underwater Acoustics
First: Shima Hossein Abadi, University of Michigan
Second: Jon La Follet, Washington State University

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.

Echoes Editor . . . . . .Thomas Rossing
ASA Editor-in-Chief . . . . . .Allan Pierce
Advisors . . . . . .Elaine Moran, Charles Schmid

Phone inquiries: 516-576-2360. Contributions, including Letters to the Editor, should be sent to Thomas Rossing, Stanford University, CCRMA Department of Music, Stanford, CA 94305 <rossing@ccrma.stanford.edu>

From the Student Council

Eric Dieckman

Greetings from San Antonio! The most recent meeting of the ASA was well attended by students, with approximately 50 students in attendance at the Student Icebreaker and 85 at the Student Reception. The Student Council continues to work toward greater student involvement in meetings, with a new outreach to undergraduate students. A brief orientation was held at the Monday evening Student Icebreaker to give first-time meeting attendees a special welcome to the ASA.

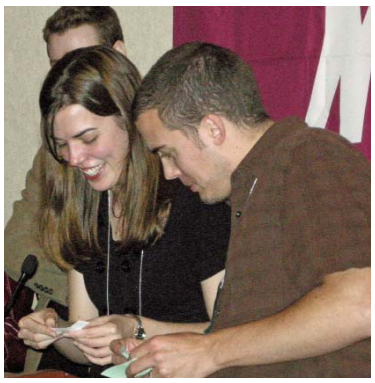
During the Student Reception on Wednesday evening, also attended by 52 professionals, the Student Council mentoring award was presented to Dr. Ken Suslick. Nominations for the next award, which will be presented at the Cancun meeting, are due on March 15, 2010. Nomination forms and information can be found at the Student Council website: http://www.acosoc.org/student/.

We look forward to seeing many more students in Baltimore this coming April!

Eric Dieckman is a graduate student in applied science at The College of William and Mary. He can be contacted at eadieckman@wm.edu.

Eric Dieckman

Kenneth Suslick received the Mentoring Award from the Student Council.



Lauren Ronsse, Student Council Chair, awarded a ticket to the Fellows luncheon to a lucky student.

What microphone arrays tell us about bat sonar

continued from page 1

and then when they complete an interception. In some cases, the part of the flight path between detection and capture sometimes is very straight, implying some degree of prediction of the insect's track by the bat.

Marc Holderied, at the University of Bristol in the UK, is doing intensive studies of European pond bats (*Myotis daubentonii*) flying in transit along a natural corridor of vegetation. His approach also employs a 4-microphone array placed along a road with walls of vegetation on either side, which is scanned with a laser "total station" theodolite to build up a 3-dimensional data set for the space bounded by the vegetation and the road. The resulting synthetic "space" serves as the background for plotting the bats' flight. Because both the bat's location and its position with respect to the background are known, details of each broadcast (duration, frequency structure, curvature of FM sweeps) can be related to the bat's surroundings. Critically, experimentation can be done in the field by setting up a long screen of netting down the middle of the road to restrict the width of the corridor. Holderied finds that the pond bats keep their broadcast durations, and thus sound air-path lengths, well short of the time required for each sound to travel out to the nearest part of the vegetation and back, thus preventing any sort of overlap of broadcasts with emissions. The bat usually keeps interpulse intervals long enough that echoes from parts of the vegetation 5-7 meters or more away are allowed to return before the next sound is emitted. Holderied has hypothesized that errors occurring in the bat's estimation of distance from echo delay due to its forward flight velocity might lead the bat to adjust the duration and FM sweeps of its sounds to "zero out" these errors at a particular distance, which he calls the "distance of focus." The kind of field experimental set-up, with associated use of the microphone array and laser scans of the scene, may help to determine whether this actually occurs.

Kaushik Ghose and Cynthia F. Moss, at the University of Maryland, have exploited the microphone-array method to track flying big brown bats (*Eptesicus fuscus*) in a test room provided with carefully-placed targets and surrounding objects. The microphone array can be used to estimate the direction in which the bat aims its sounds (direction of sonar "gaze") and thus to identify where the bat is paying attention at any given moment

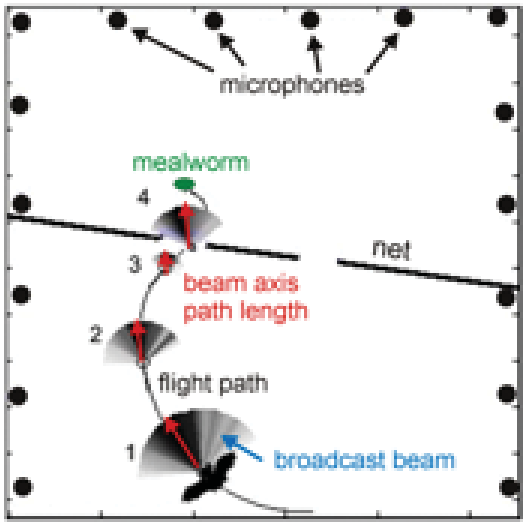


Fig. 2. Ghose-Moss bat head-aim sonar "gaze" tracking during interception flight with obstacles.

in the stream of broadcasts. Figure 2 shows their flight room and the built-in microphone array. In these tests, a net is stretched across the room and the flying bat has to find one of two holes in the net, behind which is a mealworm dangling on a thin thread. The illustrated flight path shows how the bat aims its sounds (red arrows) and adjusts the duration of its broadcasts to keep the path length occupied by the sound shorter than the distance out to the target and back. As it flies across the room, the bat aims its sounds in rapid succession at the edges of the hole in the net and then at the mealworm. Analysis of how the bat takes "looks" at its surroundings with its sonar will tell us what it regards as of greatest importance during the kind of multi-task behavior required of these tests.

James A. Simmons is professor of neuroscience at Brown University in Providence, RI. He is an ASA Fellow, and in 2005 he was awarded the ASA Silver Medal in Animal Bioacoustics for his studies of sonar imaging by echolocating bats.

President Whilow Au with Robert Spindel, winner of the Silver Medal in Acoustical Oceanography.

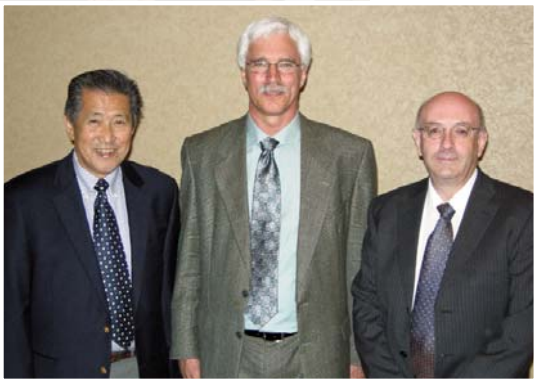
Best papers by young presenters (San Antonio)

Noise
Kenneth Marek, Georgia Institute of Technology
Ashley Woodall, University of Texas at Austin

Signal Processing
Brent Bissinger, Pennsylvania State University
Rashi Jain, New Jersey Institute of Technology

Echoes from San Antonio

New Fellows: Whitlow Au (president), Dennis Paoletti, David Adams, Mostafa Fatemi, Michael Insana, Constantin Coussios, Boris Katsnelson, Ralph Muehleisen, Robert Leisure, Andrew Szeri, Philip Loizou, Oleg Sapozhnikov, Patrick Loughlin, Kevin Smith, Diane Kewley-Port (vice-president), David Mellinger, Diane Dalecki.



Whitlow Au (president) presented Michael Stinson (center) with the Silver Medal in Noise. Stinson was introduced by Gilles Daigle (right),

Committee on Meetings

Clark Penrod and Charles Schmid

The Committee on Meetings is responsible for recommending sites and dates for future meetings of the Society. Selection criteria considered by the committee include a concentration of ASA members willing to serve on the organizing committee, the presence of hotels or other facilities that can accommodate the meeting, and the location as it relates to ease of travel and weather. Committee meetings provide a forum for the exchange of information among meeting chairs and Society officers and staff including budgeting and other topics of interest to local organizing committees for meetings. Chairs of future meetings benefit from the experiences of past chairs, ranging from scheduling events to menu selection.

The voting members include the Committee chair, ASA's vice president and vice president-elect, and the chairs of the current meeting, the two most recent meetings, and the next three meetings. At its recent meeting in San Antonio the committee heard a proposal presented by Tom Ho, Chair of the Hong Kong Institute of Acoustics (HKIA), to hold a meeting in Hong Kong in 2012. It would be joint with the Acoustical Society of China and the ASA, and in combination with the Western Pacific Acoustics Conference (WESPAC). The Committee voted unanimously to recommend approval of this joint meeting to the Executive Council which subsequently approved it.

L to R (meeting site noted in parentheses): Kai Ming Li (Hong Kong), Mardi Hastings (Chair, Baltimore), Whitlow Au (ASA President), Tom Ho (Hong Kong), James Miller (Chair, Providence), Fernando Elizondo (Cancun), Thomas Matula (Chair, Seattle), Lisa Zurk (Chair, Portland), Clark Penrod (Committee Chair and Chair, San Antonio), Sergio Beristain (Co-Chair, Cancun), Michael Stinson (Chair, Montreal), Samir Gerges (Co-Chair, Cancun), Gilles Daigle (Montreal), Tim Hawkins (San Antonio), David Feit (Treasurer) Photo by C. Schmid.

Meetings are the heartbeat of our Society, and there are few forms of service to our Society more important or more rewarding than serving as general chair or as a member of the local committee for one of the semiannual meetings. There is quite a bit of work to do in organizing a meeting, but there is a great deal of help available from past meeting chairs and the Meetings Committee. Any member interested in hosting a meeting should contact Clark Penrod (via asa@aip.org), the chair of the Committee on Meetings.

Scanning the Journals

Thomas D. Rossing

• It is something of a paradox that partial hearing loss can be associated with hyperacusis, a heightened sensitivity to loud sound. According to a paper in the 22 October issue of *Nature*, experiments in isolated rat cochlea now establish the long-mysterious type II **cochlear afferent neurons** as a potential pathway to signal traumatic sound. During loud sound, hair cell activity combined with released ATP (adenosine triphosphate) may provide stimulus for these type II cochlear afferents.

• An article in the August issue of *Acoustics Australia* proposes an **acoustic immersion index** for music performance spaces. The index compares the reverberant sound pressure level with the prompt sound pressure level, including both direct and once-reflected contributions, for organ music in a hall defined only by its geometrical dimensions and reverberation time. Two versions of the index are considered: in the first version a simple calculation gives a constant index value throughout the hall; the second version separates direct and once reflected sound so that the index varies from the front to the rear of the hall.

• A finite-difference time-domain (FDTD) method for predicting **architectural structure-borne sound** is described in the July issue of *Acoustical Science and Technology*. The FDTD method, which combines both longitudinal and shear waves, was originally developed in the field of electromagnetics, but has more recently been used in acoustical fields, including ultrasonics, underwater sound, etc. Considering flexural wave transmission alone is insufficient in many calculations of structure-borne sound. In the FDTD method equations of motion and Hooke's laws of three-dimensional elastic bodies are directly discretized with a difference scheme of a leap-frog algorithm

• A **phonon laser** has been demonstrated by optical pumping of a trapped ion in a crystal according to a paper in the September issue of *Nature Physics*. The optomechanical interaction associated with the scattering force gives rise to a Van der Pol dynamical system in which amplification is provided by stimulated emission of center-of-mass phonons. The fact that phonon laser action is sustained by very low power levels suggests that the ion might be used as an ultrasensitive force probe.

• A review article on "Foundations for a New Science of Learning" in the 17 July issue of *Science* includes a section on **language learning** of interest to acousticians and speech scientists. Early in development, infants have the capacity to distinguish all the sounds across the languages of the world, a capacity shared by nonhuman primates. However, infants' universal capacities narrow with development, and by one year of age, infants' ability to perceive sound distinctions used only in foreign languages is weakened. American infants exposed in the laboratory to Mandarin Chinese rapidly learn phonemes and words from that language, but only if exposed to the new language by a live human being during naturalistic play.

• Traumatic brain injury (TBI), a common battlefield brain injury, can be caused by **blast waves** from nearby explosions that cause relatively small accelerations of a soldier's body, according to a paper in *Physical Review Letters* **103**(10), 108702 (Sept. 3, 2009). According to simulations, the blast waves of grenades, landmines, and other devices can bypass a soldier's helmet, distort the skull and inflict potentially dangerous loads on the brain. These loads may be sufficient to cause TBI, even when there has been no contact with shrapnel from the explosion. Although currently some soldiers are fitted with accelerometers and single-point pressure gauges, the authors suggest that more pressure gauges and strain gauges are needed to determine the nature of the injury.

• The transcription factor FOXP2 is the only gene so far to have been implicated in **human speech**, yet it differs very little from the chimpanzee equivalent. A paper in the 12 November issue of *Nature* proposes that the amino acid composition in the human variant of FOXP2 has undergone acceleerated evolution, and this two-amino-acid change occurred around the time of language emergence in humans. Data provide experimental support for the functional relevance of changes in FOXP2 that occur on the human lineage. The identified targets may have a critical function in the development and evolution of language circuitry in humans.

• **Snodar, an acoustic radar for atmospheric turbulence profiling** is described in a paper in the August issue of *Acoustics Australia*. The 5 kHz monostatic acoustic radar is designed to measure the atmospheric turbulence within the first 200 m of the atmosphere with a vertical resolution of 1 m. An *in situ* calibration target is used to give absolute intensity calibration. Two Snodar instruments are operating in Antarctica during 2009 as part of the completely robotic "PLATO" facility.

• A **new microphone**, which uses the optical total reflection at the boundary surface between glass and air is reported in the September issue of *Acoustical Science and Technology*. The critical angle for total reflection changes by the refractive index of air, which depends on the air density. Changes in sound pressure cause changes in air density. The microphone works well at high frequency, but the sensitivity needs to be improved.

• A paper published 28 August in *Journal of Physics D (Applied Physics)* reports a novel approach to effectively coupling acoustic energy into a two-dimensional **phononic-crystal waveguide**. An acoustic beamwidth compressor uses a gradient-index phononic crystal composed of a square array of solid scatterers embedded in epoxy. By gradually modulating the density and elastic modulus of the scatteres along the direction transverse to the phononic propagation, the beamwidth compressor can efficiently compress the wide acoustic beam to the scale of the waveguide. A beam-size

continued on page 6

Scanning the Journals

continued from page 5

conversion ratio of 6.5:1 and a transmission efficienty of up to 90% is obtained over the working frequency range of the phonic-crystal waveguide. Potential applications include acoustic biosnesors and signal processors.

- The feasibility of imaging peripheral nerves using **acoustic radiation force impulse imaging** (ARFI) is the subject of a paper in the July issue of *Ultrasonic Imaging*. In B-mode ultrasound images, the current standard for guidance, nerves can be difficult to visualize due to the similar acoustic impedance with surrounding tissues, and needles must be aligned within the imaging plane at limited angles of approach that can impede successful peripheral nerve anesthesia. AFRI imaging utilizes acoustic radiation force to generate images that portray relative tissue stiffness differences. Contrast improvements of >600% have been achieved for distal sciatic nerve structures. The results demonstrate the feasibility of using ARFI imaging to improve the visualization of peripheral nervesw during regional anesthesia procedures.
- Plastic CD containers can serve as **inexpensive acoustical resonators** in the laboratory, a paper in the October issue of *American Journal of Physics* points out. A small loudspeaker is mounted in the base, while a microphone is inserted into a hole in the cylindrical body which is easily rotated so that the microphone can sample the angular behavior of the various acoustical modes. The measured frequencies and angular dependence are in good agreement with theory.
- The first person to make a reproducible **recording of sound** was a French printer, Edouard-Leon Scott de Martinville, according to a review of the book *Perfecting Sound Forever: An Aural History of Recorded Music* in the17 September issue of *Nature*. He etched sound waves on a thin film of soot in 1857, although it took another 150 years for his recording of the human voice to be heard. In 2008, scientists at the Lawrence Berkeley Laboratory devised a way of reproducing the sounds Scott had captured in soot and his 10-second recording of "Au Clair de la Lune" was heard for the first time (see Spring 2008 issue of *ECHOES*). Tape recording developed in the 1940s, and multi-track recording developed in the 1950s. The book discusses whether or not recordings are better as a result of technological progress.
- Theoretical and experimental studies on the resonance frequencies of a stretched **circular plate** is the title of a paper in the September issue of *Acoustical Science and Technology*. The paper applies especially to the Japanese nagado-daiko drum, whose chemically treated diaphragm of cow skin is especially stiff. Resonance frequencies of the lowest 15 modes are given as functions of tension and stiffness.
- **Speech recognition** can be improved by joint analysis of throat and acoustic microphone recordings according to a paper in the September issue of *IEEE Transactions on Audio, Speech, and Language Processing*. A proposed multimodal speech recognition system improves phoneme recognition rate to 53%, a significant improvement over throat-only speech recognition.
- Earth's background free oscillations or **seismic "hum"** are excited continuously by the ocean and atmosphere. According to a paper in the 2 October issue of *Science*, cross-correlation analysis of hum signals shows a clear global propagation of background Rayleigh waves. Waves with periods of 10 s are excited by ocean swells. Ambient noise tomography allows exploration of the mantle to depths of 500 km.
- The **middle ear of mammals** is characterized by the loss of embryonic Merckel's cartilage and disconnection of the middle ear from the mandible, according to a paper in the 9 October issue of *Science*. The middle ear and mandible of the early Crustacen mammal *Maotherium* demonstrate that besides orderly evolution from primative to derived characteristics, reversals to more primitive conditions are also to be expected.
- A paper in *Physical Review Letters* **103** 104301 suggests a way to build a **one-way acoustic device**, an acoustic diode, so to speak. The device would consist of a sandwich of acoustic layers. Key to the structure would be a layer of nonlinear material that acts as a filter by changing the frequency spectrum of incoming sound waves. The researchers suggest that acoustic diodies could be useful in improving ultrasound devices such as those used to break up kidney stones.
- Humans use integrate tactile information during **auditory speech perception** without previous training, according to a paper in the 26 November issue of *Nature*. Applying tiny bursts of aspiration (such as would be produced by plosive consonant <p>) to the right hand or the neck made the syllables more apt to be heard as aspirated (for example, causing the listeners to mishear <b> as <p>). Tactile information is integrated in much the same way as visual information.

Acoustical tour of the Majestic Theater

The Alamo

Acoustics in the News

• Magnetic resonance elastography (MRE), developed at Minnesota's Mayo Clinic, uses low frequency sound waves to determine whether tissues and organs are too stiff, a sign of trouble, according to an article in the November issue of *Scientific American*. Through MRE, a device placed on the body near the tissue being tested uses vibration to generate low frequency sound waves that pass through organs that have varying degrees of elasticity. These data are measured and analyzed to determine when tissue is stiffer than it should be, often a sign that it is unhealthy

• A newly discovered gene, called *tospeak* by its discoverers, enables us to speak by helping to keep the vocal tract limber, according to a story in the November issue of *Science News*. Researchers discovered the gene in an Australian family with a speaking disorder. Many of the women in the family have weak, husky voices, while their male relatives cannot speak above a whisper. Family members with the speaking problem have short, thick vocal folds that don't vibrate properly. All of the defects have been linked to a breakdown in relations between *tospeak* and a neighboring gene GDF6, which also helps control bone and eye development.

• A Phoenix bishop received a suspended sentence of 10 days in jail and three years probation for violating a Phoenix noise ordinance because his church rang its bells hourly. The ordinance does not include an exemption for religious worship, though it does provide an exemption for ice cream trucks. According to the June newsletter of the Alliance Defense Fund, the bells have been registered to emit 67 decibels at the nearest property line.

• Scientists have assumed that vocal learning in songbirds starts with subsongs—the bird equivalent of infant babbling. But according to a research note in the 2 July issue of *Nature*, vocal learning begins much earlier—when juveniles first beg for food. Research reported in *PLoS ONE* (2009) reports that when begging, juvenile male chipping sparrows exhibit neural activity in part of the forebrain associated with learned song, and begging patterns appear in the sparrows' first subsongs. Auditory feedback is crucial to vocal learning and distinguishes songs from innate begging calls of females, who do not sing.

• An inexpensive stove for cooking, refrigeration and electricity supply (SCORE) using thermoacoustics is described in the July issue of *Physics World*. The stove is particularly well suited for the needs of rural communities in Africa and Asia. Burning wood, dung or any other form of biomass heats a series of gas-filled tubes creating a temperature gradient along the tubes, which generates sound waves. The sound energy is, in turn, thermoacoustically converted to electricity.

• Flashes of laser light can be used to create sound under water, according to a story in September 8 issue of photonics.com. Efficient conversion of light into sound can be achieved by concentrating the light sufficiently to ionize a small amount of water, which then absorbs laser energy and superheats. The result is a small explosion of steam which can generate a 220-dB pulse of sound. Optical properties of water can be manipulated with very intense laser light to allow nonlinear self-focusing to take place. The new acoustic source has the potential to expand and improve both Naval navigation and acoustic imaging.

• A humpback whale alters its song if another one sings along, according to a story in the November 7 issue of *Science News*. Studying humpbacks with methods adapted from bird research, scientists detected melodic adjustments when a solo singer encountered another singer nearby or when researchers played their songs for whales. Male whales may be using music to tell another male that he is talking to him. Among humback whales, only males boom out long strings of repeating phrases of hums and whups and chirps, sounds which can make a boat vibrate. Although male songbirds sing at each other to claim their territory or seduce females, humbacks don't defend territories. Typically three to eight males surround a female and battle for the position closest to her. The whale recordings were made over four winters off the Pacific coast of Mexico.

• A Working Group on California Earthquake Probabilities of the U.S. Geological Survey has issued a report that could push aside ideas that have long dominated earthquake research and forecasting, according to a news feature in the 15 October issue of *Nature*. One hypothesis views faults as creatures of habit that tend to rupture in earthquakes of about the same magnitude again and again. Another model asserts that big quakes are most likely to stirke in "seismic gaps" that haven't suffered major jolts in a long time. The new idea views earthquakes as a repeating pattern of pressure accumulation and release. Strain would build up in the ground until it reached a critical level, at which point the rocks on one side of a fault jerk forward relative to their neighbors on the other side. Regions hit by a big quake are more likely, rather than less likely, to be struck by another.

• A discussion of 5.1 digital surround sound appeared in the July 16 issue of *The New York Times*. Although many consumers spend their budgets on a new digital TVs, they forget about the ability of digital audio systems to deliver crystal-clear surround sound. Unfortunately the quality of built-in speakers in TV sets has moved backwards in recent years at the same time the cost of surround-sound audio has decreased. In order to avoid stringing wires across the listening room, companies now offer wireless rear speakers.

• A new study reported in the 30 October issue of *Science* indicates that the United States risks losing its economic competitiveness because of a lack of social and economic incentives to pursue careers in science and technology. The percentage of students enrolled in science, technology, engineering, or mathematics dropped only slightly from 1972 to 2000, the percentage of these STEM graduates who were working in STEM occupations rose slightly, but the percentage of top students plunged 14%. Likewise the share of the top quintile still holding STEM jobs 10 years out of college dipped, these graduates being drawn into careers in management and finance.

• "Carleen Hutchins, Innovative Violin Maker, Is Dead at 98"

continued on page 8

ACOUSTICAL•SOCIETY•OF•AMERICA
SUITE 1NO1
2 HUNTINGTON QUADRANGLE
MELVILLE, NEW YORK 11747-4502

Non-Profit Org.
U.S. Postage
PAID
Hicksville, NY
Permit No. 289

Acoustics in the News

continued from page 7

reads a story in the Arts section of the August 9 issue of *The New York Times*. Internationally known for her work in violin acoustics, Hutchins began her career as a high school science teacher. In the late 1940s she began a long association with Frederick Saunders, a Harvard physicist who was studying acoustics (see the Summer 2003 issue of *ECHOES*). The Catgut Acoustical Society, founded by Saunders, Hutchins, John Schelleng, Robert Fryxell and others distinguished itself by publishing a journal (1964-2004) and spearheading the development of a new violin family.

• Almost all peer reviewers get worse, not better, over time, according to a news note in the 11 October issue of *Nature*. The editor-in-chief of a medical journal analyzed the scores that editors at the journal had given more than 1400 reviewers between 1994 and 2008.

• Ultrasound is said to heal chronic wounds that don't respond to other treatments, according to a story in the November 16 issue of *Forbes*. Mist therapy, which in some cases can keep a skin graft alive by spraying on saline droplets that carry ultrasound energy to the graft, is an example of an active wound healing technology. Ultrasound penetrates below the wound and helps to destroy bacterial walls to fight infections.

• Acoustical tweezers, which are much smaller and use 500,000 times less energy than optical tweezers, can be used to position tiny objects, according to a story in the August 28 issue of *Science Daily* (online). Acoustical tweezers work by setting up surface acoustical waves. If two sound sources emitting the same wavelength are placed opposite each other they cancel each other in "troughs." Because sound waves have pressure, they can push very small objects into these troughs. They can be used, for example, to place stem cells on a grid for testing or skin cells on a grid to grow new skin. They can also be used to create patterns of nanoparticles for coatings or to etch surfaces.

• An underwater effort to detect subatomic particles has ended up detecting sperm whales according to a news feature in the 3 December issue of *Nature*. Particle physicists at the Southern Laboratories of the Italian National Institute for Nuclear Physics in Catania were hoping to show that hydrophones on the sea floor could be used to detect neutrinos from deep space. They noted strange clicking sounds which they traced to sperm whales, previously thought rare or even extinct in the area. This led to an unusual collaboration between biologists and particle physicists.