The newsletter of
The Acoustical Society of America

ECHOES

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Summer 2004

ASA Celebrates a Happy 75th Anniversary in New York

Photo by Joel Sackett

75th Anniversary Banquet in the Sheraton Imperial Ballroom (see larger print on p. 6-7).

More than 1700 attendees from 38 countries helped the Acoustical Society of America celebrate its 75th birthday in fine style in New York, the city in which it was born! In addition to 101 sessions with over 1200 technical papers, the meeting in-cluded a day of celebration and a gala banquet. The theme of the celebration was "Glorious Past—Looking Forward." The "glorious past" was toasted with congratulatory speeches and a video with highlights from the past. Nine younger ASA members presented their views on how the Society should be "looking forward."

This issue of *ECHOES* includes several photos from the Anniversary meeting, and we plan to include more of them in the Fall issue. If you attended the banquet, you should be able to find yourself in the centerfold, perhaps with the help of a magnifying glass. Many of these photos will appear in color in the online edition.

An article on "Precision Ultrasonic Imaging and Measurement of the Eye," based on one of the papers we heard in New York, appears in this issue. It was a difficult task deciding which paper might best convey the feeling of excitement about the future of acoustics that was prevalent in New York, but medical ultrasound is certainly a leading candidate, and the images are especially interesting to look at.

Many ASA members also attended the 18th International Congress on Acoustics in Kyoto, Japan, April 5-9, so we have included some "echoes" from that memorable event as well. One of the lectures at that meeting was Larry Crum's lecture on "Therapeutic Ultrasound," so we have asked Larry to share a brief summary for the benefit of *ECHOES* readers who were unable to attend. Of course, the printed summary doesn't include the "gee-whiz" videos which were a part of his presentation, but it does convey the spirit. Besides, this complements the ultrasonic imaging article, and gives this issue a medical ultrasound flavor.

Stephanie Berger, © 2004

Ilene Busch-Vishniac, Leo Beranek, Pat Kuhl

Stephanie Berger, © 2004

A 50-year tradition: barbershop quartet singing at ASA banquets.

We hear that...

- **Robert A. Frosch**, senior research fellow at the Belfer Center for Science and International Affairs, John F. Kennedy School of Government, Harvard University, was awarded the 2003 Bueche Award by the National Academy of Engineering. He was cited "for a career of advances in aerospace and automotive technology, and industrial ecology; and for administration of R&D in industry, government, and academia."
- **Victor W. Zue**, Computer Science and Artificial Intelligence Laboratory, Massachusetts Institute of Technology, has been elected to the National Academy of Engineering. He was cited for advances in the understanding of acoustic phonetics and systems for understanding spoken language.
- **Hugo Fastl**, University of Munich was awarded the 2003 Rayleigh Medal by the Institute of Acoustics in the UK. He was cited for his "outstanding and lasting contributions to acoustics, in particular his leadership in psychoacoustics and his pioneering work on sound quality."
- **Juergen Meyer** was awarded the 2004 Helmholtz medal of the German Acoustical Society (DEGA) for his research and teaching in musical acoustics. The Medal was awarded during the joint French-German acoustics meeting in Strasbourg in March.
- **Manfred Schroeder** was elected an honorary member of the German Society for Audiology in 2003.
- **Mike** and **Wendy Gluyas** were recently awarded the Kelvin medal and prize by the Institute of Physics for their outstanding lecture-demonstrations on the physics of sound and music, delivered to more than 200,000 schoolchildren, university students and members of the public throughout the UK, Eire, and internationally. Both retired from full-time education in 1993, but have continued to give their presentation as a retirement activity ever since.

Get involved

Two physicists are presently serving in the US House of Representatives. Both of them have repeatedly urged scientists and engineers to become more involved in politics.

"Politics is not a spectator sport. Yet far too many scientists and engineers sit on the sidelines while major decisions are being made on science policy and funding."—Rep. Vernon Ehlers (R—Michigan).

"Too often scientists avoid politics in the same way that many Members of Congress avoid science. This is a formula for failure."—Rep. Rush Holt (D—New Jersey).

Links to public policy sites for six of AIP's Member Societies are at www.aip.org/gov/pubpol.htm. Policy statements issued by different science coalitions to which AIP and some of its Member Societies belong are described at www.aip.org/gov/polstates.html.

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

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To the Editor

Harvey Fletcher

I have immensely enjoyed your biographical sketches of the seminal era of the ASA; together they have shown an amazing degree of commonality. The most recent article on Harvey Fletcher was especially heart warming.

I was chairman of an effort to establish a Utah section of the Audio Engineering Society in the late '70s. One of our goals was to hold a meeting where we would invite Harvey Fletcher as a guest speaker. His energy was failing at this time, but he graciously agreed, and we met with he and his wife in a small conference room on the BYU campus. The event was a most pleasant evening; as he reminisced about his work at Bell, with Thomas Edison, the military, his project with Leopold Stokowski, and the Millikin oil drop experiments. Regarding the latter, he was a very gracious man. Great men have much in common, but the most significant is a high degree of humility; the accolades flow to them, they are seldom sought.

Richard K. (Jim) Fullmer
Spectrum Acoustical Engineers
Salt Lake City, Utah

Student Council Update

by Andrew Morrison

The Student Council had a productive session at the recent ASA meeting in New York City. Several projects and events for students are in the works for future meetings. All students are encouraged to attend and participate.

At the New York meeting, several students joined the Council for a pub crawl in New York's historic Greenwich Village. Council members increased their visibility and accessibility at the meeting by placing the Student Council logo on their name tags. Meeting attendees are always welcome to direct questions and comments to Student Council members.

Although the New York meeting is still fresh in our memories, we are already looking forward to the Fall meeting in

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Discoveries & Breakthroughs: Bringing Acoustics to TV Viewers

by Ben Stein

The *New York Times* prints approximately 1.7 million copies of its Sunday edition. A typical broadcast of NBC *Nightly News* reaches about 6.6 million households. Recently, however, a short TV piece on acoustics played on almost 10 million televisions across the US.

The news piece, featuring a novel freezer that chills ice cream with sound waves, was part of Discoveries & Breakthroughs Inside Science (DBIS), an NSF-supported science program designed for local television news. Produced by the American Institute of Physics in conjunction with its scientific partners, including ASA, the program's intent is to place more science, engineering, technology, and math topics into the mix of local TV newscasts. Every month, DBIS distributes a dozen 90-second news pieces to over 100 TV stations across the country.

Why is the local TV news audience so important? According to recent studies from the Pew Research Center, which studies attitudes toward the press, politics and public policy, more people in the US rely on local TV newscasts than any other type of medium as their primary source of news. Therefore, to truly reach the general public, AIP thought it was important to reach out to this audience. In 2000, ASA became one of the first sponsors of the program, and remains one of the program's valued scientific partners.

Since the program began in January 2000, we have had the pleasure of producing dozens of pieces on acoustics, with topics ranging from an ultrasound system that allows legally blind teenagers to ride their bikes to measurements of underwater rainfall sounds that will lead to better estimates of global ocean precipitation.

If you've never seen a TV news piece entitled "Discoveries & Breakthroughs," there's a good reason. TV stations incorporate the segments into their newscasts as seamlessly as they can. Therefore, the stations use their own correspondents to narrate the scripts and they superimpose their own graphics when listing the names of the scientists on camera. The pieces are made to look like a "regular" part of the newscast. Therefore, if your local TV station has aired the programs, you may have seen DBIS pieces without even realizing it.

While many other syndicated newsfeeds exist, DBIS may be truly unique in the local television world, as each topic is peer reviewed! We obtain story ideas from sources such as university news releases and meeting programs including ASA's. However, before we approve production on a story idea, an independent outside expert must verify for us that it is a worthwhile topic for the program to feature. Many ASA members have checked out numerous story ideas and the program has been greatly improved as a result.

While we believe the program to be successful (the TV stations even pay to receive the segments), we have never had good quantitative data on how many viewers we are reaching. Thanks to an NSF grant received in late 2003, we received funds to obtain Nielsen ratings for DBIS TV spots over a 13-week period in spring 2004.

During this period, Ben & Jerry's launched a major media campaign to announce a prototype "thermoacoustic freezer" that uses sound to chill ice cream. For this occasion, we produced and aired a piece that featured Matt Poese, a member of the Penn State team that designed the refrigerator.

Ben & Jerry's officially unveiled the refrigerator on Earth Day 2004, resulting in lots of wonderful news coverage, including an National Public Radio piece that you may have heard. But my AIP colleague Martha Heil asked B&J's for permission to air the DBIS piece shortly before Earth Day, as our monthly feed of 12 stories went out a few days earlier.

Ben & Jerry's very graciously granted our request, and the results were amazing. We learned that TV stations in Philadelphia, Salt Lake City, Chicago, Little Rock, Nashville, Austin, and many other cities broadcast the piece on their local TV newscasts during a two-week period in April 2004. Nielsen estimated that the segment played on televisions in 9,487,160 households. With approximately 2.5 people per household, the number of people watching must easily have reached the tens of millions. And this was only for a two-week period.

If you are interested in learning more about the program, please visit the DBIS website at http://www.aip.org/dbis. The site includes some recent videos and has a list of stations that use the program. Also, you are welcome to contact me at bstein@aip.org and AIP senior science editor Emilie Lorditch (elorditc@aip.org) for any feedback or ideas on the program.

Ben Stein, Senior Science Writer in the Media & Government Relations Division at AIP is well known to ASA members, since he handles media relations at ASA meetings.

Stephanie Berger, © 2004

Nathan Vishniac and Ilene Busch-Vishniac enjoy strolling violins.

Precision Ultrasonic Imaging and Measurement of the Eye

Ronald H. Silverman, D. Jackson Coleman, Dan Z. Reinstein, and Frederic L. Lizzi

Because of the transparency of the cornea and lens, the ophthalmologist can use optical devices such as the slit lamp and ophthalmoscope for diagnostic purposes. However, opacities such as corneal scars, cataracts or hemorrhage can limit the usefulness of optical instruments. In addition, certain parts of the eye cannot be visualized optically because of other intervening tissues.

Ophthalmic ultrasonography was until recently performed almost exclusively at a frequency of 10 MHz. This frequency was relatively easy to achieve and process in commercial instrumentation, and provides reasonably good images of the globe and orbital tissues. In the early 1990's, transducers with frequencies of 50 MHz and higher were developed, along with suitable electronic components for signal processing. With increased frequency, resolution improved, and this technology was soon applied to imaging the anterior segment of the eye.

While sector or linear scan geometries are readily implemented, these are not well suited for imaging of the anterior segment of the eye, especially the cornea. Because of the specular character of the corneal surface, these scan modes are ineffective in imaging the peripheral cornea, where the acoustic beam axis will have oblique incidence. This led us to develop a scanning system in which the transducer is moved in an arc matched to the curvature of the eye. In addition, acquisition of raw radiofrequency echo data allows preservation of the full information content of the data and more precise measurement than could otherwise be achieved. *Figure 1* provides an example of an arc scan of the anterior segment of a normal eye.

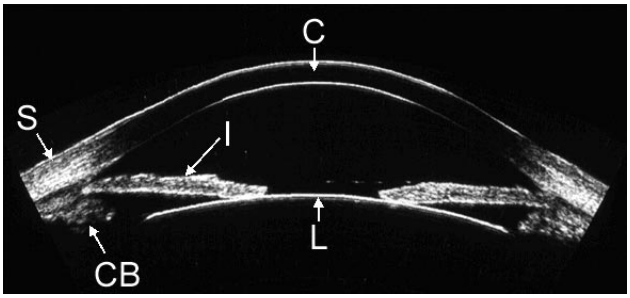

Figure 1. High-resolution ultrasound image of the anterior segment obtained with arc-scan geometry. Visualized structures include the cornea (C), sclera (S) , iris (I), anterior lens surface (L) and ciliary body (CB).

A special area of interest to our group is quantitative biometric evaluation of the cornea, especially in surgical procedures such as LASIK. In LASIK, a blade is used to expose the stroma at a depth of about 160 microns in the central cornea. An excimer laser then vaporizes a programmed pattern of the exposed stromal tissue calculated to correct refractive error. Because the cornea is inherently transparent, ultrasound is an invaluable tool not only for measuring its overall thickness, but measuring the thickness of individual layers including the stroma (about a 500 microns thick), the epithelium (about 50 microns thick), and the surgical interface produced by LASIK within the stroma. 3-D scanning allows measurement of the layers of the cornea and construction of color maps representing the thickness distribution of each layer. This allows the clinician to determine if the cornea is thick enough for a surgical procedure and to identify disease conditions. It can be used to evaluate any abnormalities after surgery.

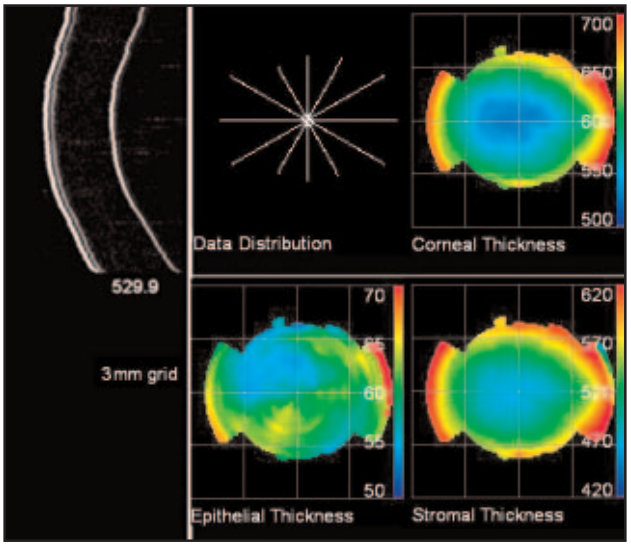

Figure 2. Maps representing the thickness in microns of the layers of a normal, untreated cornea. Maps were generated by analysis of a series of six scans arranged in a meridional series (Data Distribution), a single cross-section of which is shown on the upper left.

Figure 2 shows an ultrasound image of the cornea in cross section and corneal layer thickness maps of a normal, untreated eye. An example of a cornea with pathologic changes more than a year after LASIK treatment is shown in *Figure 3*.

The capabilities of high-frequency ultrasound combined with sophisticated signal-processing methodologies have opened new avenues for imaging and precision measurement of the eye. This technology provides a means for diagnosis of pathology as well as treatment planning and evaluation of the

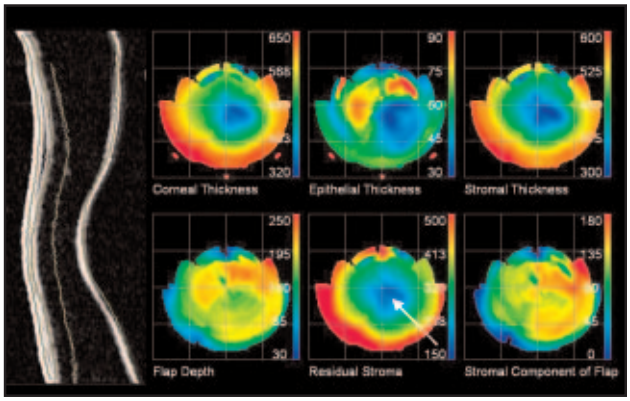

Figure 3. Corneal layer thickness maps one year after LASIK. The scan plane depicted on the left shows central corneal thinning and bulging, a condition resulting from excessive depth of the original treatment. The automatically detected boundaries are superimposed on the image. The maps show that at its thinnest point (arrow), the stroma beneath the surgically induced interface is only 170 microns thick, whereas 250 microns is generally considered the minimum safe thickness value.

eye in vision-correcting surgical procedures, including LASIK and intraocular lens implantation.

Ronald H. Silverman, D. Jackson Coleman, and Dan Z. Reinstein are at the Weill Medical College of Cornell University in New York; Frederic L. Lizzi is at the Riverside Research Institute in New York. This article is based on paper 1aBB4 at the 75th anniversary meeting of ASA in New York.

Virtual orchestra

© Lisa Berg 2004

Bell Labs reunion

Patsy and Murray Campbell

Rossings and Hartmanns

Ulla and Johan Sundberg

Stephanie Berger, © 2004

Bob Beyer and Leo Beranek

© Lisa Berg 2004

Pat Kuhl and the "Looking Ahead" presenters

Stephanie Berger, © 2004

Jim West, Bill Yost, Bill Hartmann

Juliette and George Ioup

Echoes from New York

75th Anniversary Celebration, Acoustical Society of America, Sheraton New York Hotel and Towers, May 25, 2004

Echoes from New York

Photo by Joel Sackett

Therapeutic Ultrasound

by Lawrence A. Crum

Nearly everyone is familiar with the dramatic images that are now produced by diagnostic ultrasound devices, particularly of "baby's first picture", and more recently of "baby's first movie". With the advent of small, inexpensive and portable imaging units that produce high-quality images, this technology has even been brought to small villages in third world countries. Yet, the first major use of medical ultrasound was as a therapeutic approach to brain surgery; in the early 50's, the Fry brothers in Illinois (joined by a then young Floyd Dunn!) used focused ultrasound devices to ablate various regions of the brain in a successful effort to cure Parkinson's disease. However, this early pioneering work was largely forgotten, and ultrasound is now the second most common imaging technology—behind the ubiquitous x-ray—in all of clinical medicine. In the last decade, however, with the advent of transducer array technology, faster and smaller computers, and a growing emphasis in the medical community for less invasive procedures, therapeutic ultrasound has once again capturing the attention of the medical community.

One of the most remarkable, and complicated inventions of nature is the blood clot. It can be life saving—when it magically forms and stops a site of bleeding, or it can be life-threatening—when it blocks an artery in the heart or the brain. Therapeutic ultrasound is now being used both to disrupt clots, and to induce them. When a stroke occurs, most of the time it is an "ischemic" stroke, in which a blood clot forms in an artery in our brain, starving a region of oxygen. If this clot is not dissolved, we lose the functions controlled by this region of the brain, and we suffer some disability. Clinicians have determined that if this clot is removed within a couple of hours, then this disability is often only temporary and full recovery is possible. But how does one dissolve, or remove a clot deep in a blood vessel in our brain? Fortunately, clot-dissolving drugs have been developed, and if these drugs are administered immediately, some clots can be dissolved—that's why the best thing to do if you suspect a heart attack or a stroke is to take aspirin. Many clots however, completely block an artery, and there is no flow that can carry the drug to the site of obstruction. In this case, very small catheters are often used to deliver the drug directly into the clot.

In some cases, when uncontrolled bleeding exists, such as in blunt abdominal trauma from a car accident (Princess Diana died from a torn pulmonary artery), or in the case of the severe wounds received in combat, rapid hemostasis, or cessation of bleeding, is essential. In fact, nearly 50% of combat mortality results from exsanguination, or uncontrolled bleeding. Our group at the Center for Industrial and Medical Ultrasound at the University of Washington in Seattle has sought solutions to this problem by using diagnostic ultrasound to detect the site of bleeding, and high intensity focused ultrasound (HIFU) to induce hemostasis. Diagnostic Doppler ultrasound enables the bleeding site to be detected and the delivery of HIFU to this bleeding site can induce acoustic cauterization, or acoustocautery.

The pioneering work of the Fry brothers to use ultrasound for "bloodless surgery" has finally come of age. Just recently, the FDA approved a device that uses MRI (magnetic resonance imaging) for real-time imaging and targeting of uterine fibroid tissue, and HIFU for tissue ablation. Uterine fibroids affects millions of women, and many treatments, such as a hysterectomy or a myomectomy, don't preserve future fertility. A particular aspect of MRI has been used to measure the temperature of the applied HIFU in (nearly) real time; thus, using the soft-tissue capability of MRI and this temperature measuring aspect, the physician can clearly image the tumor, apply HIFU and watch on the screen as the temperature is increased from body temperature to levels in excess of about 60 oC. If this temperature is realized for over a second, the tissue is killed by a process called coagulative necrosis, in which the cells are killed and the blood coagulated. Using a computer-controlled therapy protocol, the physician can draw on the screen the region to be treated, and the computer automatically guides the HIFU-producing transducer to ablate this tissue. Since the HIFU is applied transcutaneously, i.e., across the skin, this approach is totally non-invasive, bloodless surgery. After the tissue is "cooked" with the HIFU, the body slowly absorbs this dead tissue over several months. In most cases, this "surgery" is performed with minimal or no anesthesia. Of course, MR-guided HIFU therapy requires the use of an expensive superconducting magnet to perform the imaging.

It is satisfying to see that the FDA has approved a device for the treatment of benign tumors, such as uterine fibroids, but in my opinion, the greatest potential for this therapy is in the treatment of malignant tumors, i. e., cancer. For several years now, an Indianapolis company has been developing an image-guided HIFU device for the treatment of prostate cancer. In this application, a small probe containing both an imaging and a therapy transducer is inserted into the rectum, the imaging transducer is used to image the entire prostate, and the therapy transducer is used to provide HIFU to ablate the entire prostate. In this case, the therapy is guided by ultrasound, as TRUS (transrectal ultrasound) is a commonly used imaging modality for examining the prostate. Although not yet approved for use in the US, this system has been used to successfully treat prostate cancer in a minimally invasive manner in over 500 patients in Europe and Japan. A similar system, developed by a French Company, is approved for use outside the US, and has successfully treated over 2000 patients.

This exciting application of ultrasound for bloodless surgery is virtually unknown in the US, and much of the world; however, in China, ultrasound-guided HIFU has been used successfully for several years and is becoming the treatment of choice for many forms of cancer. Currently, companies in Shanghai, Chongqing, and Beijing have

Health Ministry approved devices and over 25,000 patients have been treated.

One of the most promising approaches to disease treatment is in the area of genetic engineering. There are a number of diseases (hemophilia, Huntington's disease, neurofibromatosis) that are due to the lack of certain genes within our DNA. Exciting approaches to genetic engineering involve the insertion of these missing genes into certain cells, and correcting this genetic defect. The problem is that it is difficult to find an efficient method to insert these complex molecular structures into the nucleus of individual cells, and have them survive long enough to produce the necessary proteins that prevent the disease. The standard approach is to use viruses—these organisms cannot replicate themselves on their own, but need to invade living cells and use that cell's protein manufacturing facility to replicate the virus. Thus, one incorporates the missing gene into a virus—not too difficult—and infects a patient with the virus—even less difficult, and then one hopes that the infected cells produce the disease-preventing protein. This approach works well enough to be a standard treatment, but there are several case studies where severe immune responses to the virus have caused great harm to the patient.

An exciting approach is to produce a small microbubble with a layer of liquid surrounding the gas-filled interior. Also attached to the surface of the microbubble are special molecules that have an affinity for a particular tissue, such as the liver or the kidney. Once these drug-carrying microbubbles are introduced into the body, they migrate to the tissue of interest and attach themselves. If one uses low intensity, diagnostic ultrasound, these microbubbles are very efficient scatterers and thus become "contrast agents", enabling one to see the accumulation of these agents in the desired tissue. Next, one increases the intensity of the ultrasound, and the violently oscillating bubbles break their stabilizing shells and deliver the contents of the drug to a specific site. Furthermore, the violent oscillation of the bubbles transiently permeablizes the cell membrane, thus permitting the drug to enter the cell. This site-specific drug delivery has great promise, not only for genetic engineering, but also for the delivery of chemotherapy agents to a specific site, thus reducing the concentrations of the drug required, and the associated undesirable bioeffects.

Therapeutic ultrasound is an exciting emerging technology. It seems almost certain that scalpels, which were used by the ancient Egyptians to perform surgery, will eventually be replaced by non-invasive, image-guided, bloodless surgery devices that destroy unwanted tissue without anesthesia and without pain. The Star Trek Tricorder is here—a bit larger than the one used by "Bones", but soon to be in your local hospital.

Larry Crum, University of Washington, is a former president of ASA and well known to readers of ECHOES. This article is based on his plenary lecture at the 18th ICA in Kyoto.

Charles and Linda Schmid

Dancers at the banquet

Prime Minister Koizumi greeted the ICA by video

Juergen Meyer, Neville Fletcher, Tom Rossing, Isao Nakamura

Scanning the Journals

• Killer whales adjust their **vocal behavior** when boat traffic reaches a certain level, according to a brief communication in the 29 April issue of *Nature*. Recordings in nearshore waters of Washington state made in 1977-81 and in 1989-92 showed no significant difference in the duration of primary calls in the presence or absence of boats, but recordings during 2001-03 showed a 15% increase in call duration in the presence of a high boat density.

• The March/April issue of *Acta Acustica/Acustica* has a review article on "Sound Sources Reconstruction Techniques: A Review of Their Evolution and New Trends," a technical review of the main approaches to **sound source reconstruction** techniques. Methods include 2-D spatial Fourier transform, acoustical holography, boundary elements method, and equivalent sources method. The applicability of these methods for forward propagation and back propagation problems is discussed. Current research subjects are outlined.

• Two years ago, Rusi Taleyarkhan and colleagues made the amazing claim that they found evidence for neutron emission and tritium production in deuterated acetone when blasted with sound to produce sonoluminescence (see Spring 2002 issue of *ECHOES*). Now the researchers report a large and statistically significant emission of neutrons (up to 4x105 neutrons per second), according to a paper in *Phys. Rev. E* **69** 036109. They also measured the rate of tritium production and found that to be consistent with the observed neutron emission rate, assuming it to be due to **deuterium-deuterium fusion**. Control experiments using normal acetone did not result in significant tritium activity or in neutron or gamma-ray emissions.

• Cadherin 23 (CDH23) is an important component of the tip link in **hair-cell stereocilia**, according to a letter in the 29 April issue of *Nature*. CDH23 may participate in mechanotransduction, as mutations in its gene are known to cause deafness and age-related hearing loss. There is some indication that CDH23 and myosin-1c cooperate to regulate the activity of mechanically gated ion channels in hair cells.

• The **acoustic enhancement** system in the new Conference Center at the world headquarters of the Church of Jesus Christ of Latter Day Saints in Salt Lake City is described in the April 19 issue of *Sound & Communication*. With more than 21,000 seats, the Conference Center is the world's largest indoor conference facility. Although the volume is enormous, the natural reverberation time is less than 1.4 seconds when unoccupied due to the enormous amount of absorptive materials in the building.

Student Council Update *continued from page 2*

San Diego. We hope to see many students at the San Diego meeting. A special Student Reception is planned to announce the recipient of the first ever Mentoring Award. The Student Reception is also a great place for students to meet and interact with members of the Society.

The San Diego meeting will also feature a Fellowship Workshop geared specifically for students. The workshop will feature presentations by various funding agencies and a question and answer session for students to get information on various topics ranging from undergraduate opportunities to postdoctoral appointments.

Students attending the ASA meetings are reminded to check the student bulletin board for all the details of the various student activities. Students attending meetings should receive a packet from the Student Council at the registration desk. As always, more information about the Student Council can be found at our website: www.acosoc.org/student. See you in San Diego.

Best Student Paper Awards (New York City Meeting)

Acoustical Oceanography
First: Josh Wilson, Massachusetts Institute of Technology
Second: Christiana Tollefson, Memorial Univ. of Newfoundland

Animal Bioacoustics
First: Susan E. Parks, Cornell University
Second: Jennifer Miklis-Olds, Univ. of Rhode Island

Biomedical Ultrasound/Bioresponse to Vibration
First: Paolo Zanetti, Boston University
Second: Jeremy Bercoff, Laboratoire Ondes et Acoustique

Musical Acoustics
First: Stephanie Weisser, Universite libre de Bruxelles
Second: John A. Mills, University of Texas

Noise (in alphabetical order)
Brian B. Monson, Brigham Young University
Alexander D. Streeter, Dartmouth College

Signal Processing in Acoustics
Mark Gramann, Penn State University

Structural Acoustics and Vibration
First: Sebastian Ghinet, Universite de Sherbrooke

Underwater Acoustics
First: Jed C. Wilbur, Boston University
Second: Shawn F. Johnson, Penn State University

AA Student Design Competition

First Honors: Molly K. Norris, Julie Byrne and Rebecca Simkins, Rensselaer Polytechnic Institute

Commendations (listed in alphabetical order):

- Michael Bono and Michael Colburn, University of Kansas
- Erica Bowden and David Bradley, University of Nebraska
- Kevin Kudwig, Sebastian Otero and Evelyn Way, Rensselaer Polytechnic Institute
- Jacob Mueller, Jonah Sacks and Andrew Eckel, Rensselaer Polytechnic Institute

The only way to meet the mandate for speech intelligibility and simultaneously provide optimum acoustical conditions for the Tabernacle Choir and the new pipe organ was to incorporate electronic acoustic enhancement on a grand scale, according to the article. It is claimed that he enhancement system, which includes more than 300 speakers, can make the hall "sound wet like the Tabernacle or dry like the natural conference hall."

• The brain's capacity to perceive modest pitch changes may be impaired from birth in persons with what is called **amusia**, according to a paper in the May issue of *Psychological Science*. These same persons, however, may recognize slight changes in timing in music.

• An **acoustic radiometer**, which demonstrates acoustic radiation pressure, is described in an apparatus note in the June issue of *American Journal of Physics*. The apparatus consists of two panes attached to opposite ends of a horizontal arm that is pivoted at its center. One side of either pane is acoustically reflective and the other absorptive. The apparatus rotates when placed in an enclosure of high-intensity acoustic noise.

• The ear needs a **noise workout** to keep in shape, according to a note in the 29 May issue of *New Scientist*. A test of 10,000 people around the World revealed that people exposed to loud noises at work had poor hearing, as expected. But the hearing of those living in quiet, rural areas was just as bad, an unexpected result. This note is based on paper 1aNS6 at the New York ASA meeting.

• Physicists at Brigham Young University have developed an **active noise control** system to reduce the noise from cooling fans such as those in desktop computers, according to a note in the 29 May issue of *New Scientist*. The system, which can reduce computer noise by 20 dB, uses four 20-mm speakers at the corners of an 80-mm fan unit along with 4 microphones to sense the noise. This note is based on paper 2pNSb3 at the New York ASA meeting.

• JVC (Victor of Japan) has introduced a new **loudspeaker with a wood cone**, according to a short piece in the April issue of *IEEE Spectrum*. In order to mold the wood, it is soaked in sake, which makes it malleable but allows it to retain its strength. Sound propagates more quickly in wood than in other cone materials such as paper and plastic, and this means the speakers can produce a wider range of frequencies, according to the article.

• Bats living side-by-side may, in effect, be in different worlds, according to a paper in the 10 June issue of *Nature*. Their **hearing is differently tuned** in ways likely to affect their mating and hunting. For echolocation, each subspecies emits a different harmonic of the same fundamental frequency, and their ears are are tuned to this frequency. They seem to communicate with each other via their own echolocation frequency, so they find mates with similarly tuned hearing, a recipe for species splitting.

• An informative article on **hearing loss** appeared in the February issue of *Military Officer*. According to the Centers for Disease Control and Prevention, more than 34 million Americans have some form of hearing loss. Conductive loss occurs when blockage prevents sounds from being carried from the eardrum to the inner ear; sensorineural loss occurs when the inner ear is unable to convert sound waves or the auditory nerve can't transmit them to the brain.

• Sound is arguably the most elusive and personal of all the human senses, according to an article in the 4 March issue of *Architectural Record*. Acousticians now have at their disposal 2D and 3D **ray-tracing** techniques that help determine the path that sound waves will take from source to receiver and communicate the acoustic consequences to visually-oriented architects. The impulse response of a room can be regarded as an acoustic signature, as unique to every space as a fingerprint.

• Supersonic sound waves have been created in human tissue for the first time by exploiting the **acoustic equivalent of Cerenkov radiation**—the light emitted by charged particles when they travel through a medium faster than the speed of light in that medium, according to a paper in the March 22 issue of *Applied Physics Letters*. The results could have implications for ultrasound imaging in medicine. Most ultrasound imaging is done with longitudinal sound waves, since transverse shear waves are strongly absorbed by human tissue. However by focussing longitudinal sound waves in the tissue shear waves are generated and move in a Mach cone. These shear waves can be analyzed to produce an image.

• Wave fronts on the surface of water can be viewed directly, but **acoustic wave fronts** in air require special techniques to make them visible. In the April issue of *The Physics Teacher*, a technique first used by physics teacher Arthur Foley in 1912 is described, and a set of slides of circular wave fronts are shown. Foley's apparatus can be easily reproduced by acoustics teachers and students.

• Archaeologists believe they've found Europe's **oldest wooden musical instrument**, a set of yew-wood pipes found on Ireland's coast, according to an note in the 21 May issue of *Science*. The six pipes, found lying in a wood-lined trough during excavations for a new housing development in Dublin, have been dated at more than 4000 years old, 1500 years older than previous finds. The pipes are in graduated lengths from 29 to 59 cm, and they were likely placed vertically and attached to a bellows.

• The idea that the deep, rumbling sounds used by **elephants** to "talk" to each other may be true, but not over long distances, according to a note in the 19 June issue of *New Scientist*. Researchers took an African elephant out into the farmland around Salinas, California and used a network of geophones to pick up the vibrations in the ground when the elephant rumbled. The rumbles produced very low-frequency surface waves, similar to those generated by earthquakes, but the vibrations traveled only a few hundred meters before dying out.

• **Outer hair cells** of the mammalian cochlea act as local amplifiers, providing the ear's high sensitivity and frequency selectivity. Mechanical deflections of the stereocilia are converted into electrical signals, but the precise relationship between mechanical input and hair-cell response is obscure. Recordings from outer hair cells in the cochlea in near "physiological" conditions show that the transducer currents and receptor potentials are significantly higher than expected and strongly dependent on cochlear location, according to a paper in the 17 June issue of *Nature*.

Acoustics in the News

• Researchers at the Dryden Flight Research Center at Edwards Air Force Base drastically reduced the sonic booms from a U.S. Navy jet by giving it a "nose job," according to a *Yahoo! News* story dated April 27. A custom nose glove was attached to a Navy F-5E jet in order to better distribute the air pressure build-up in front of the supersonic plane and thus soften the sonic booms. Instead of spending hundreds of millions of dollars on a completely new vehicle right away, the NASA program will look at other ways to shape a sonic boom. Modifications to a supersonic aircraft's engine inlets and lift surfaces, for example, could also help shape the sonic boom it creates, according to Ed Haering, principal investigator

• The Siemens Foundation held an unusual symposium "Beautiful Minds, Beautiful Music" that explored the relation between artistic and scientific brilliance, according to a note in the 4 June issue of *Science*. The event featured short performances by five winners of the Siemens/Westinghouse student science competition, followed by a panel of experts discussing the phenomenon. "We were amazed to find that nearly 100% of past winners played a musical instrument," said a spokesperson for the foundation.

• Using digital enhancements of skull fragments dating more than 350,000 years ago, anthropologists argue that these human ancestors probably had hearing similar to that of people today, according to a news note in the 26 June issue of *Science News*. The researchers used a computerized tomography scanner to measure ear structures on three skulls and cranial pieces. Since the ears of social mammals typically match sounds made by fellow species members, the human-like hearing of these ancient folk probably was accompanied by speech.

• Sound recorded on antique wax cylinders and early 78 rpm records can now be recovered without damaging the fragile media, according to a story in the 5 June issue of *New Scientist*, which is based on paper 2pMU4 at the 147th ASA meeting in New York. The source material is scanned using confocal microscopy using scanning and imaging techniques developed for nuclear physics. A noise reduction routine is used to clean up noise from dust and scratches.

• About 80 computer manufacturers met in Beijing to consider a "super-high-fidelity" audio standard aimed at better sound quality over the Internet, according to a story in the 24 April issue of *New Scientist*. Intel high-definition audio (IHDA), for example, will capture sound well beyond human hearing up to 100 kHz. The thinking is that frequencies above the range of human hearing can still subtly improve sound perception.

• Applying time-reversal acoustics (see *ECHOES*, Winter 2002), it is possible to communicate by tapping on tables or desks, according to a story in the 1 July issue of the *New York Times*. A system developed in France by Mathias Fink, Ros Ing, and colleagues uses one or two inexpensive accelerometers and a computer program to locate the source of the tap. The computer calculates the source of the vibration. Dividing the desk into a grid of 500 locations, for example, is like having a switch with 500 levels. "This is a very clever application of time-reversal acoustics,"ASA President William Kuperman is quoted as saying.

• Lie-detector tests more and more use voice stress analysis, according to a story in the 1 July issue of the *New York Times*. Law-enforcement agencies have applied voice-based testing to question thousands of suspects, sometimes by telephone recording. British insurance companies have used it to screen telephone claims in order to detect fraud. The several available applications of the technology work on the same basic principle: that the human voice contains telltale signals that betray a speaker's emotional state. While academic and legal experts debate the merits of the technology, its developers continue to find new uses for it, including airport screening, post-traumatic stress assessment, and even matchmaking.

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