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The Acoustical Society of America

ECHOES

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Acoustics in Canada

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Writing about acoustics in Canada is not unlike writing about acoustics in the US— every technical area of acoustics is covered except that there are a lot fewer people involved. Except for a few university groups and government labs, research is usually conducted by individuals scattered from coast to coast. Rather than providing a comprehensive summary of acoustics research in Canada, we have attempted to highlight our diversity.

DRDC personnel establish a radio repeater on a hilltop on northern Ellesmere Island.

Research in Underwater Acoustics is found both on the Atlantic and Pacific coasts. As an agency of the Department of National Defence, Defence Research and Development Canada's (DRDC) mission is to ensure that the Canadian Forces are technologically prepared and operationally relevant. Since the formation of the organization sixty years ago, underwater acoustics has been a major component of the DRDC applied research program. Considerable successes have been achieved that have addressed every term in the sonar equation, the boundaries of the acoustic wave-guide, transducers, noise generation, and the physical properties of the ocean environment from Tasmania to the Arctic.

Current research in underwater acoustics includes inversion problems and associated global optimization techniques. Modeling methods for propagation, reverberation, and systems are being developed. New transducers and applications for existing transducers are an on-going field of expertise. Underwater communications is a relatively new field of effort that is experiencing growth. Sonar signal processing including tracking, data fusion, and the man-machine interface, provides support to a large number of projects. All of these activities and many others are combined to support large demonstration projects such as the Towed Integrated Active Passive towed-array system, the Rapidly Deployable Systems autonomous surveillance project, the airborne IMPACT processor, and the Remote Mine-hunting System.

In addition to underwater acoustics research conducted in-house, DRDC funds significant effort in industry and universities. DRDC and NSERC (Natural Sciences and Engineering Research Council) were the primary sponsors of the Ocean Acoustics Chair Program established at the School of Earth and Ocean Sciences at the University of Victoria in 1995. NSERC, Satlantic Inc., and DRDC sponsored the Dalhousie University Chair in Acoustics in 1998. Collectively, these research chairs include effort in high-frequency sediment acoustics and bottom classification, hydrodynamic measurements, marine mammal tracking, gas hydrate deposits, matched field inversion, geoacoustic inversion, array element localization, and Arctic ice geoacoustics. International collaborative activities with the USA, United Kingdom, Australia, New Zealand, and NATO countries also broaden the extent of the acoustics research.

In 1929 the first Director of the Division of Applied Physics of the National Research Council (NRC) brought with him a strong interest in ultrasonics thereby opening a line of research activity in the field of acoustics that has grown in scope and breadth ever since. Currently, research in acoustics is active within six NRC Institutes.

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We hear that...

• ASA fellows **James Lynch** and **William Leach** have been elected Fellows of the Institute of Electrical and Electronics Engineers (IEEE). Lynch, at the Woods Hole Oceanographic Institution, was cited "for contributions to sound transmission in shallow coastal waters for mapping bottom boundary layer characterizations." Leach, at Georgia Institute of Technology, was cited "for contributions to electroacoustics and near-field antenna measurements."

• ASA Fellow **Manfred Schroeder** was awarded the 2004 ISCA Medal of the International Speech Communication Association "for his significant scientific achievement in speech communication science." The award was made during the annual meeting of the Association in Korea. Schroeder also received the Technology Prize of the Rhein Foundation for "lifetime achievement in architectural acoustics, psycho-acoustics, computer graphics and speech coding, especially linear prediction." The award, which carries a $65,000 stipend, was made at the Deutsches Museum in Munich.

• Six students from five schools each received **Newman Medals**, a $200 honorarium and a set of books from the Robert Bradford Newman Student Award Fund in 2004, bringing to 163 the total number of Newman medals awarded which are named for Robert Bradford Newman.

Letter from the Editor

This is the space reserved for Letters to the Editor, but we didn't receive any this time, so you'll have to put up with a letter from the editor.

This issue focuses on the Vancouver meeting and on acoustics in Canada. Gilles Daigle kindly agreed to call on several of his Canadian colleagues and put together an overview of acoustics in this vast country, the largest in North America. Many of us recall the meeting in Ottawa a few years ago (tulips and all!), and we all look forward to meeting in Vancouver in May. If you've never crossed the Canadian Rockies by train or car, that is an experience you should consider.

As I assemble this issue, I'm basking in the California sunshine at Stanford University, where I'm a visiting professor during winter quarter. (I thought I would throw that in for the enlightenment of my colleagues in the Midwest and New England who are shoveling snow). Stanford is where I spent my first leave of absence in 1961-62, and while it has changed in 40 years, it is still an outstanding university. I couldn't begin to take in all of the enticing lectures and concerts offered, but I have enjoyed lots of them (even sang in three concerts).

Beginning with the next issue, *ECHOES* may have a new look. As you know, ASA intends to launch a new magazine, and the present plan is to somehow incorporate *ECHOES* into it.

In the future, please send me your Letters to the Editor. Thoughts on acoustics, thoughts about ASA are always welcome. Just keep them short and readable.

Tom Rossing

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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Chemical Detection with a MEMS Microphone

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measurement microphones, but at a much lower device cost.

MEMS fabrication methods are derived from integrated circuit technology, in which large batches of devices are fabricated simultaneously on wafer substrates. Typically a single 150 mm diameter wafer will yield about 2000 microphones suitable for photoacoustics. Even for small fabrication batches of a few wafers, the final cost of the devices will be very competitive compared to conventional technology. The cost target of fully assembled devices with built-in pre-amplifier is below $100 per unit. In comparison, the cost of a high quality measurement microphone with preamplifier is in excess of $1000. While this cost reduction is important, it is somewhat secondary since most of the cost in a photoacoustic detector is in the IR light source used in the system. With the development of low-cost light sources it is expected that the cost of the complete system with a MEMS microphone can be reduced to about $1000–$2000 in large production volumes. The target application for such a system would be to first responders, as well as a national, regional, or local network of static or mobile environmental and homeland security monitors.

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Joint meeting in Vancouver

Members of the Technical Program Organizing Meeting for the Vancouver meeting.

The 149th meeting of the Acoustical Society of America will be a joint meeting with the Canadian Acoustical Association in Vancouver, May 16-20. It is a meeting not to be missed!

The technical program includes 60 special sessions on a wide variety of topics, and over 1060 abstracts have been submited. A "hot topics" session will cover the fields of Physical Acoustics, Psychological and Physiological Acoustics, and Speech Communication, and will also include presentations on the regional chapters program and the student council.

The Technical Committee on Signal Processing in Acoustics will sponsor the 7th Gallery of Acoustics, which will include photographs, videos, and audio clips of images and/or sounds. The Technical Committee on Architectural Acoustics and the National Council of Acoustical Consultants are sponsoring a Student Design Competition. The 2005 task is to design a drama theater complex within an urban mixed-use development.

A workshop on Second Language Speech Learning will be held May 14-15 at Simon Fraser University in Vancouver. Further information can be obtained at http://www.sfu.ca/~mjmunro/swshp.htm.

A workshop on Design and Construction of String Instruments will be held Friday afternoon and Saturday morning, May 20-21, following a special session by the same title on Friday morning. The workshop is designed to bring together professional and amateur instrument makers, performers, and interested acousticians to share some of their “trade secrets.” Participants are invited to bring their instruments for “show and tell” and acoustical testing. Further information is available at http://www.physics.ubc.ca/~waltham/stringworkshop.

A conference entitled “For Whom the Decibel Tolls: Reducing the Impact of Industrial Noise” will be held May 23-26 in Banff the week after the Vancouver meeting. For further information contact the conference chair Daryl Caswell at djcaswel@ucalgary.ca.

Vancouver is a lovely city, and many attendees will want to plan to spend a few days there before or after the meeting. Stanley Park near downtown is an excellent place for a stroll. Queen Elizabeth Park, the public garden of the city, is full of flowers, shrubs, and rare trees. Other notable gardens include the VanDusen Botanical Gardens, the Dr. Sun Yat-Sen Chinese Garden, the Park and Tilford Gardens, and the UBC Botanical Garden on the University of British Columbia (UBC) campus. Also at UBC is the Vancouver Museum of Anthropology.

Social activities at the meeting include two buffet socials, a Women in Acoustics luncheon on Wednesday, and a Fellows luncheon on Thursday (Garry C. Rogers will speak on “Earthquake and Tsunami Hazard in Cascadia”). A hospitality room for accompanying persons will be open 8:00 to 11:00 a.m. each morning.

Members of the Vancouver meeting local committee.

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The NRC Industrial Materials Institute is developing forefront laser ultrasonic technology for probing materials and structures remotely without contact. This novel technology is based on the use of lasers for the generation and detection of ultrasound and can be used to measure thicknesses, detect and image surface or bulk flaws in complex structures, and characterize material microstructure in service or during processing. Applications that have been transitioned to industry include in particular the on-line measurement of the wall thickness of tubes at high temperature (> 1000 degrees C) and the detection of delaminations in polymer-matrix composites used in aerospace. The Institute has also developed ultrasonic buffer rods without reverberation echoes for sensing at elevated temperature with PZT transducers. It is also developing transducers made by a sol-gel process that can be painted on parts or structures for permanent ultrasonic sensing.

The NRC Institute for Microstructural Sciences investigates the acoustical factors affecting the performance of communication systems such as wireless handsets, portable e-mail devices, automatic speech recognition systems, hands-free telephony, and systems meant to assist individuals with hearing impairments. Microphone array technology, directional microphones and loudspeakers, and signal processing strategies are currently being studied. In addition, the Group also maintains specialized acoustical facilities.

The NRC Institute for National Measurement Standards maintains primary acoustical standards, performs calibrations, provides technical consultation and laboratory certification, and maintains and periodically upgrades calibration facilities. Primary calibration of microphones, accelerometers and ultrasound power are disseminated to regulatory agencies, government departments, and the industry, trade, and health sciences sectors.

The NRC Institute for Research in Construction carries out acoustics research projects as part of the Indoor Environment Program. Current research areas include sound insulation of wall and floor assemblies, flanking transmission in framed buildings, and acoustics of indoor spaces (especially classrooms, open-plan offices and auditoriums). Facilities are available for measurements of airborne sound transmission loss of walls, windows, doors, etc., airborne and impact sound transmission through floor assemblies, and to study the effects of structureborne transmission via wall/floor connections on flanking transmission.

The NRC Institute for Aerospace Research (IAR) conducts research in aeroacoustics and structural dynamics for a broad range of aerospace applications. Activities in active noise control are focused on noise reduction in aircraft. IAR's expertise in the active control of flexible structures comprises closed-loop control using classical, optimal, and adaptive control algorithms. IAR has a specialized high-intensity noise testing facility, with two reverberant chambers and a progressive wave tube.

The NRC Institute for Information Technology deals with several aspects of language technology, including development of a Speech Extractor, capable of extracting key phrases from spoken documents of variable audio quality.

Speech research is active at several institutions in eastern Canada. Perhaps most active is the Montréal region, where INRS-EMT (Université du Quebec), ETS (Ecole de Technologie Supérieure) and CRIM (Centre de Recherche en Informatique de Montréal) all have researchers working on automatic speech recognition (ASR), partly in collaboration with industry, e.g., ScanSoft. Projects include medium and large vocabulary voice dictation, keyword detection, text alignment, Text-To-Speech, and Speaker Verification. Also in Québec, the Université de Sherbrooke, where much of the algorithms driving today's cellphone technology were developed, research in auditory signal processing and computational neuroscience is conducted.

At the University of British Columbia (UBC) in Vancouver, research activity is concentrated in the Acoustics and Noise Research Group in the School of Occupational and Environmental Hygiene (SOEH) and in the Department of Mechanical Engineering. This work focuses on architectural, industrial and environmental acoustics and noise control. Activities in other UBC departments include modeling the human vocal-tract, in Electrical Engineering, and stringed instrument acoustics, in Physics.

Moving eastward, the Groupe d'Acoustique de l'Université de Sherbrooke probably has the most sizeable effort in noise and vibration control. The areas of research include the characterization and design of materials, vibroacoustic design, active control, experimental methods, numerical simulations, and transducers.

Canadian research in Psychological Acoustics has been conducted in labs at universities and hospitals, as well as by researchers working in industry and in government facilities. On the west coast, at the University of British Columbia, in the School of Audiology and Speech Sciences, early research was conducted on cochlear mechanics related to critical bandwidth and combination tones, and in the Department of Psychology auditory attention bandwidth was measured. On the east coast, seminal research at Dalhousie University in Halifax has helped scientists and clinicians alike to understand central auditory processes by differentiating types of auditory temporal processing. Between the discoveries about auditory spectral coding on the west coast, and the discoveries about auditory temporal coding on the east coast, psychoacoustic researchers in central Canada have been busy over the last couple of decades trying to understand the spectro-temporal complexities of real-world hearing. At McGill University in Montreal pioneering research launched "auditory scene analysis." At Toronto's Mount Sinai Hospital psychoacoustics has been used to study noise-induced hearing loss. Psychoacoustics research applied to hearing loss has also been advanced by researchers at the University of Western Ontario, at the University of Ottawa, and at the Université de Montréal. Researchers in the Department of Psychology at the University of Toronto have advanced signal detection theory and methodology, while colleagues at the Mississauga campus focused on lifespan changes in hearing, with researchers charting the course of normal infant auditory development, and later exploring binaural and temporal auditory processing by older listeners. Recently, new facilities have been established at the National Centre for Audiology at the University of Western Ontario and at the Centre for Research on Biological Communication Systems based at the University of Toronto at Mississauga. From coast to coast, from theory to practice, from young to old, from healthy to pathological, Canadian psycho-acousticians have made significant contributions over the last four decades and they continue to do so.

Music research has been conducted on infants at the University of Toronto at Mississauga and on adults at the University of Prince Edward Island, but McGill University has lead the country in this area, especially with the recent establishment of a new facility at the Centre for Interdisciplinary Research in Music Media and Technology (CIRMMT). Applied and basic research on auditory physiology and electrophysiology has been conducted in university labs and associated hospital labs at the University of Toronto and also at the University of British Columbia, the University of Calgary, the University of Ottawa, McGill University, and Dalhousie University.

The Acoustics Division of Health Canada provides and implements standards for protection against occupational and environmental noise. Using a state-of-the-art acoustics chamber, measurement methods are developed for use in standards to reduce machinery noise. Information is also generated on the health effects of noise that can be used by both the public and regulatory authorities for risk management. The purpose is to reduce the incidence of noise-induced hearing loss and other non-auditory health effects of noise in Canada. Standards and guidelines are also provided for licensing of medical ultrasound devices and to monitor and enforce compliance of these devices.

Many Canadian acousticians are active in acoustical standards in Canada, the US and internationally. A good deal of this work is coordinated through the Canadian Standards Association (CSA) Acoustics and Noise Control Committee. It is made up of the chairs of various subcommittees. Some, such as the Industrial Noise Subcommittee, are actively writing and looking after a stable of Canadian acoustical standards.

The most widely used Canadian standard is Z107.56 on Employee Noise Exposure Measurement, which was also the basis for an early draft of ANSI S12.19. The Transportation Noise Subcommittee is responsible for Z107.9 on Highway Noise Barrier Design, which formed the basis for the noise barrier section in the US Federal Highway Administration Highway Noise Barrier Design Handbook, making Z107.9 the de-facto North American standard on highway noise barriers.

CSA is currently looking at developing an omnibus standard describing CSA, American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM) and International Organization for Standardization (ISO), and other standards that are reviewed for their utility in Canada. It is hoped that this will be faster and more useful than formal adoption. More and more Canadian standards work is directed at participating in developing and using international and US standards, because it is more cost effective and simplifies harmonization and trade. For example, there is a joint CSA/ANSI working group looking at a North American adoption of ISO 9613(2) titled Acoustics—Attenuation of sound during propagation outdoors—Part 2: General method of calculation.

DRDC personnel Garry Heard, Gordon Ebbeson, and Lloyd Gallop record data in a tent on the ice of the Lincoln Sea while Stan Dusso of Uvic watches.

The Canadian Acoustical Association (CAA) serves as a unifying body for acoustics activity within Canada, analogous to the Acoustical Society of America in the United States. The CAA is an interdisciplinary professional organization that fosters interaction between people working in all areas of acoustics, promotes the growth and practical application of acoustics knowledge, and encourages education, research, protection of the environment and employment in acoustics. The CAA also provides an umbrella organization through which general issues in acoustics can be addressed at a national and multidisciplinary level. These objectives are addressed primarily though three avenues: the CAA's journal, annual meeting, and awards program.

The CAA's quarterly journal, *Canadian Acoustics*, features refereed papers and news items on all aspects of acoustics. Papers present new results/methods in acoustics or report case studies and practical applications, and are published in either English or French. Papers submitted from outside of Canada are common. The journal strives to publish papers within six months of initial receipt, including a rigorous review procedure.

The CAA awards a total of 11 annual prizes (>$8000/year) to encourage and recognize excellence in the study of acoustics in Canada. These include awards at the post-doctoral, graduate, undergraduate, and high-school levels, as well as student awards for CAA presentations and papers. Travel subsidies to the annual CAA conference, and to other acoustics conferences, are also available.

Gilles Daigle, National Research Council (NRC); Stan Dosso, Universtiy of Victoria; Garry Heard, Defence R&D Canada Atlantic; Murray Hodgson, University of British Columbia; Tim Kelsall, Hatch Associates; Douglas O'Shaughnessy, Institut National de la Recherche Scientifique; Kathy Pichora-Fuller, University of Toronto.

Chemical Detection with a MEMS Microphone

Michael Pedersen

Photoacoustic spectroscopy (PAS), which measures the molecular absorption of light energy to provide identification of molecules with high resolution, is a simple and promising technology for use in biochemical sensors and detectors. We describe the development of a MEMS (microelectromechanical systems) microphone specifically for use in photoacoustics instruments.

What is photoacoustics?

The photoacoustic effect of matter was first discovered by Alexander Graham Bell in 1880. He found that if he aimed a strong light source at a surface, and pulsed the light by turning it on and off, an acoustic signal with similar frequency was emitted from the surface. His discoveries led to the spectrophone shown in figure 1. The discovery was considered an oddity of nature, and it took 50 years to develop microphones sensitive enough to actually measure a photoacoustic signal. It was not until 1973, when a detailed theoretical model (the RG theory) was developed by Rosenzweig and Gersho, that the phenomenon was well understood.

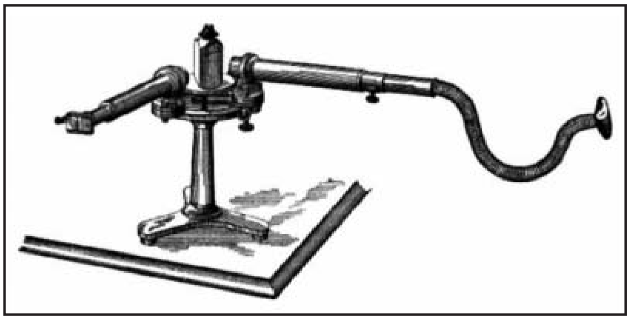

Figure 1: The original spectrophone designed by A.G. Bell.

If the incoming light has energy (a wavelength), that matches the difference between the steady state and an allowed excited state in the molecule, there is a good chance the light will be absorbed putting the molecule into an excited state. The molecule will only remain in this state for a short period and eventually decay back to the steady state. During the decay, the excess energy can be dispersed in the form of fluorescence, a photochemical reaction, or simply as heat. It is the heat that is exploited, since the local heat generation leads to a pressure rise in the surrounding gas, which can be detected with a pressure sensitive microphone.

A basic photoacoustic detector is shown in Figure 2. The light source is pulsed either by turning it on and off, or with a screen wheel as shown. When the wavelength of the light is chosen to coincide with an absorption line in the gas, a photoacoustic signal is generated at the microphone with a frequency similar to the light modulation frequency. It is important to understand that all molecules have unique sets of allowed states, as predicted by quantum theory, which gives each molecule a unique fingerprint. Therefore, with this method it is possible to detect specific molecules with very high sensitivity. Sensitivities to the ppt (parts per trillion) level have been demonstrated.

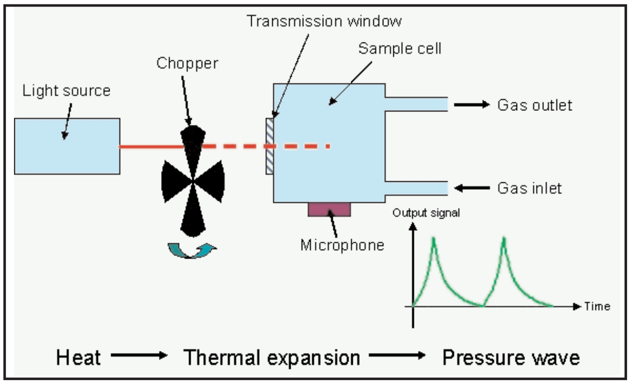

Figure 2: A basic photoacoustic gas detector.

Why use MEMS microphones for this?

The microphones presently used in state-of-the-art photoacoustic instrumentation are very high quality measurement microphones that were originally designed for a general purpose. The most important problems with measurement microphones in this application are:

- Mismatch of frequency response (bandwidth too large).
- High vibration sensitivity.
- High cost.

The frequency range of interest in microphones for photoacoustics is from about 100 Hz to a few kHz. Since the microphones currently used have bandwidths sometimes in excess of 10 kHz, a lot of potential microphone sensitivity is lost. As a result, it is possible to design a much smaller MEMS microphone, which still has higher sensitivity and lower thermal noise level than the measurement microphone.

The vibration sensitivity of microphones is directly related to the thickness of the pressure sensing membrane inside the microphone. Conventional microphones have much thicker membranes than what can be realized in MEMS microphones. In MEMS microphones, typical membrane thicknesses are in the order of 1 micron, and, as a result, a reduction in vibration sensitivity of more than 10 times over conventional devices can be realized. The vibration sensitivity is one of the most important issues, which has largely limited photoacoustic spectroscopy to the laboratory environment where structure-born noises can be minimized. MEMS microphones will help in the realization of rugged photoacoustic field equipment, and hence help the technology compete against other detection methods in the field.

The temperature performance and stability of MEMS microphones is also superior to most conventional devices. Since MEMS microphones are condenser type devices, there is no built-in electret, which may lose electrical charge in high temperature and/or high humidity environments. These devices can therefore meet MIL operating temperature specs of -40°C to 125°C. In fact, the devices are typically built to sustain short solder reflow temperatures of up 350°C. The temperature performance compares directly to high quality condenser type

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Scanning the Journals

Thomas D. Rossing

• "**Quantum whistling** in superfluid helium-4" is the title of a brief communication in the 27 January issue of *Nature*. The authors induced oscillatory motion by forcing superfluid helium-4 through an array of nanometer-sized apertures. The oscillations, which were detected as an audible whistling sound that passed from high to low frequency (an audio recording is available at *Nature's* website). The oscillations appear to follow the so-called Josephson frequency relation. The authors comment that the discovery of this property in helium-4 at the relatively high temperature of 2 K (2000 times higher than a related phenomenon in helium-3) may pave the way for a new class of rotation sensors of unprecedented precision.

• For the first time, researchers have **restored hearing** in deaf mammals, according to a paper in the 14 February issue of *Nature Medicine*. By inserting a corrective gene with a virus, the team induced the formation of cochlear hair cells in the ears of artificially deafened adult guinea pigs. The key to the generation of hair cells is a gene called Atoh1, first discovered in fruit flies in 1998. During fetal development, the gene converts some cells in the ear into hair cells, while its activity is suppressed in supporting cells.

• **Noise-canceling headphones** are the subject of the Working Knowledge column in the February issue of *Scientific American*. The headpone ear cup and ear seal attenuate high-frequency sound, while low-frequency sound that penetrates the seal is cancelled by using a small loudspeaker to create inverse sound waves. Some of the best headphones passively reduce noise by 15 to 25 decibels, and active circuitry can cut another 10 to 15 decibles from low-frequency tones. Actively attenuating frquencies above 1000 Hz remains difficult.

• For some children who go blind, parts of their brains that would otherwise handle visual tasks end up **localizing sound**, according to an article in the 29 January issue of *New Scientist*. Scientists administered positron-emission tomography to 7 sighted adults and 12 adults who lost their vision during childhood. Five of the blind volunteers who showed a keen ear for sound sources, showed prominent blood flow (signalling neural activity) in two areas deep within the visual cortex at the back of the right brain.

• An electromechanical force produced by the **organ of Corti** exhibits a broad resonance which significantly extends the frequency range of the organ's displacement response according to a paper in the December issue of the *Proceedings of the National Academies of Science*. To measure the mechanical impedance of the organ up to 70 kHz an innovative technique involving application of a known force to an atomic force cantilever was used (see *Biophys*. **87**, 1378 (2004)). The results are important for understanding the nanomechanical nature of hearing mechanisms.

• **Earthquake warning** systems are the subject of a News Focus article in the 24 December issue of *Science*. Early warning systems detect actual quakes near their source and issue warnings to automated systems and humans up to several hundred kilometers away. Electronic signals travel faster than seismic waves moving through the earth. The faster moving primary (P) waves radiate directly outward from the epicenter. The secondary (S) waves, which cause the oscillating motions responsible for the most damage, lag by tens of seconds over a distance of a few hundred kilometers. "The P waves carry information; the S waves carry energy." Two early warning systems were put in place in the early 1990s in Mexico and Japan. A network of 12 instruments was installed along Mexico's Pacific coast where seismologists think a magnitude 8 earthquake is overdue. If the system works as intended, residents of Mexico City, 280 km away, could get a 70 second warning, enough to save many lives. Skepticism about earthquake warnings seems greatest in the United States, in part because the most dangerous faults are close to urban areas.

• Hair bundles of **outer hair cells** can produce force on a submillisecond time scale, according to a paper in the 24 February issue of *Nature*. This mechanism could contribute significantly to hearing at high frequency. The fast force generator in the outer hair cells apparently does not suffer from the speed limitation of being voltage dependent as does the mechanism based on the motor protein prestin.

• Stories about snapping shrimps and radar guns have won the "**physics for taxi-drivers**" competition sponsored by *Physics World*. In the December issue, physicist Michael Berry pointed out that physicists need a stock of good stories if they are able to get people excited about phyiscs. He came to this conclusion after giving a stumbling explanation to a taxi-driver who asked him what he did for a living. Huub Eggen, who lives in Utrecht, was the author of the snapping shrimp story.

• Researchers have discovered that deletion of a specific gene permits the proliferation of **new hair cells** in the cochlea, according to a story in the 13 January issue of *Science Express*. The finding is said to offer promise for treatment of age-related hearing loss, as well as loss due to disease, drugs, and noise. The research was done on the cochlea of mice but should apply to other mammalian cochlea as well.

• Some musicians experience **different tastes** in response to hearing different musical tone intervals, according to a brief communication in the 3 March issue of *Nature*. This is a rather unusual example of cross-modal linkage or synaesthesia. To the subject a major third tastes sweet, for example, while a minor third tastes salty.

• The Spring 2005 issue of *Music Perception* is a special issue on **Rhythm Perception and Production**, guest-edited by Doug Eck and Sophie Scott. Several of the authors are active ASA members.

• The November/December issue of *Acta Acustica/Acustica* is a special issue on **Auditory Quality of Systems**. Most of the papers were selected from those presented at the First International Speech Communication Association Tutorial and Research Workshop on Auditory Quality of Systems (AQS03) which was held in April 2003 in Germany. To these were added two overview papers from the workshop organizers.

Acoustics in the News

• Seismic monitoring stations in Djibouti recently joined a worldwide network of 140 stations in 89 countries, according to a story in the January 18 issue of *The New York Times*. Established in the 1990s by the Preparatory Commission for the Comprehensive Nuclear Test Ban Treaty Organization, the network typically records more than a hundred seismic events daily. Although the US has not ratified the Nuclear Test Ban Treaty, it contributes $20 million per year to the network's operation. In the two days following the big quake off Indonesia on December 26, the network recorded some 1500 aftershocks.

• Two teams of astronomers have detected the surviving notes of a cosmic symphony created just after the Big Bang, according to a note in the January 15 issue of *Science News*. The discoverers say that the survival of the acoustic input from this epoch 13.7 billion years ago provides compelling evidence that the blueprint for the present distribution of galaxies was set at the time of the Big Bang by random subatomic fluctuations.

• A telescope that works like "ultrsound for stars" has found a hatchery filled with massive stellar embryos in a dark cloud of cosmic dust, astonomers reported at a meeting of the American Astronomical Society, according to a January 12 story by *Reuters*. Looking at the universe by tracking infrared radiation the Spitzer Space Telescope has found a glowing incubator for developing stars in a bright cloud called the Trifid Nebula. Stellar embryos develop so quickly in dark regions that it is difficult to catch them before they become full-fledged stars.

• Astronomers reported that they had seen in the patterns of galaxies the vestiges of sound waves that rumbled through the universe after the Big Bang, according to a story in the January 11 issue of *The New York Times*. Stars and galaxies tended to form along the ripples of the sound waves where matter was slightly denser, and the pull of gravity was slightly stronger, according to two teams of astronomers at the American Astronomical Society meeting in San Diego. Just as ripples spread out from a pebble dropped in a pond, sound waves spread out from dense clumps, traveling about half the speed of light through the hot gas made of matter. About 400,000 years after the Big Bang, the universe cooled enough that the charged electrons and protons combined to form hydrogen atoms, but the sound waves continued to spread for an additional 600,000 years when the last remaining photons escaped.

• The first sonar images of the seabed battered by the earthquake that triggered Asia's catastrophic tsunami revealed huge ruptures spanning several miles, according to an *Associated Press* bulletin dated February 10. A British naval ship collecting data off the coast of Sumatra obtained the digital images using sonar. The seabed maps show that the 9.0-magnitude quake caused the tectonic plates to clash "like the rumpling up of a carpet." The maps, created with multi-beam sonar, show ridges as tall as 4950 feet that were created over thousands of years by the slow collision of the deep, flat Indian plate and the ragged edge of the Burma plate. The December 26 quake was caused by a sudden movement of the two plates which caused the ridge of the Burma plate to spring up about 30 to 60 feet.

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