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ECHOES

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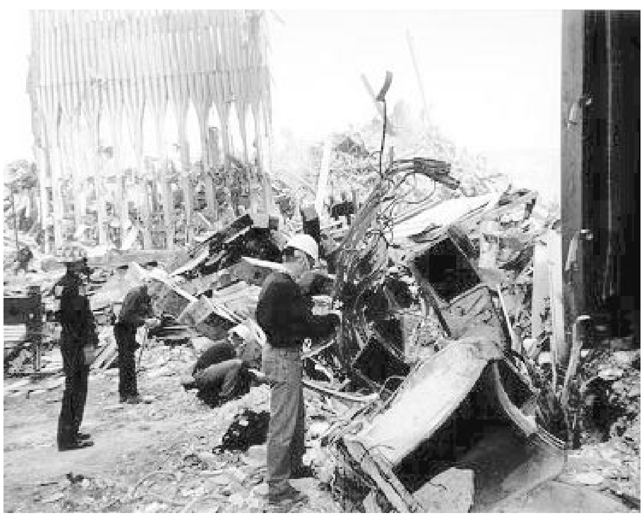
Acousticians Aid in Rescue Operations at the World Trade Center

by Anthony Atchley

Four researchers from the Penn State Applied Research Laboratory and Graduate Program in Acoustics provided technical assistance to rescuers searching for survivors of the World Trade Center (WTC) disaster. Tom Gabrielson, Matt Poese, Anthony Atchley and Tom Donnellan answered a request from the National Institute of Justice (NIJ) on September 14 to come to the WTC site. They were asked to provide acoustics and vibration technical assistance to rescue teams searching for survivors of the collapse. They worked through the night, with help from Ray Wakeland at Penn State, to assemble sets of self-contained, easy to operate microphones and vibration sensors. Although they arrived in New York the next afternoon, logistics of gaining access to site and uncertainty in the stability of the collapse pile prevented the team from getting to ground zero until early Monday morning, September 17.

On Monday morning, they joined personnel from the NIJ, Department of Justice, and Pennsylvania Urban Search and Rescue (USAR) Task Force 1. Tragically, no survivors were found after the first several days following the disaster. Therefore, the team's focus shifted to learning as much as they could about the types of acoustic and vibration devices that the USAR teams had, what improvements could be made, and what types of instruments might be useful in the future.



Three members of the Penn State team (hard hats) make background noise measurements at the World Trade Center site. Tom Gabrielson is in the foreground with Matt Poese and Tom Donnellan behind him. At the right is the Bankers Trust Building.

The Penn State team also used the opportunity to record the acoustic and vibration background in the collapse pile. Geophones (velocity sensors) were placed on steel beams that extended into a deep void, and a microphone was lowered below ground level into a pocket in the rubble. The measurements were taken with sensors deployed in a configuration reasonable for survivor search and at a location with on-going recovery operations and heavy debris removal. These measurements are being analyzed, and the results will be submitted to JASA as a letter to the editor.

The four researchers who worked at the World Trade Center site would like to thank the Pennsylvania USAR team personnel and members of the New York Police and Fire Departments for the invaluable support. They also extend their deepest sympathy to the victims of the WTC disaster and to their families and friends.

Anthony Atchley heads the Graduate Program in Acoustics at the Pennsylvania State University. His research interests include nonlinear acoustics, thermoacoustics, high amplitude acoustic noise, and visualization of acoustic fields.

Other ASA members who used their skills to assist in WTC rescue operations include James Sabatier and his colleagues who monitored Building 4 using a laser Doppler vibrometer (see ECHOES, Fall 2001 issue).

We hear that...

• **Walter Munk** became the first recipient of the Prince Albert I Medal from the International Association for the Physical Sciences of the Oceans (IAPSO). The IAPSO presented the award at its joint assembly with the International Association for Biological Oceanography in Mar del Plata, Argentina in October. Prince Ranier III of Monaco created the award to acknowledge particularly distinguished scientists in the physical sciences of the oceans. Munk, who is a professor of geophysics at the Scripps Institution in La Jolla, California, was recongized for "a half century of superb science and discoveries in physicial oceanography.

• **Stanley Ehrlich** received the first Mira Paul Memorial Award from the Acoustical Foundation, Educational, and Charitable Trurst (AFECT) at a joint meeting of the Acoustical Society of India and the Madras chapter of ASA in Vellore, India. The Mira Paul award is presented annually to an outstanding acoustician whose achievements exemplify the ideals of AFECT, which conducts programs to help deafened individuals.

New Fellows of the Society with ASA President and Vice President — left to right — Mathias Fink, Anthony Galaitis, ASA Vice President Janet Weisenberger, ASA President William Hartmann, Anatoily Ivakin, Jerry Lilly, and Ahmet Selamet.

• **Patricio A. A. Laura**, Fellow Emeritus of ASA, has been appointed Professor Emeritus of Universidad Nacional del Sur in Bahia Blanca, Argentina. Pat is the first Argentinian to occupy this position. He is also a founding member and Fellow of the American Academy of Mechanics.

• **Leo Beranek** and **Pat Kuhl** have been appointed co-chairs of the ASA 75th Anniversary Celebration Committee.

• Funds to support travel to the Cancun meeting in December will be made available for members from South America and Mexico.

• ASA members are entitled to a 25% discount on purchases at the ASA **Online Standards Store**. From the ASA website (asa.aip.org) just click the Standards Store button.

• **Richard H. Bolt**, prominent acoustician, MIT professor, and one of the founders of the firm Bolt, Beranek, and Newmann (BBN) died on January 13 at the age of 90. Bolt and BBN helped design the United Nations Assembly Hall, as well as many of world's finest concert halls. In addition they became pioneers in the computer field, designed the first modem, and played a leading role in the development of ARPANET, the precursor to the Internet. National interest in Bolt and his work peaked in 1973, when he and five other acoustics experts analyzed the 18-minute gap in the Watergate tapes.

Student Council News

by Micheal Dent

The ASA Student Council is pleased to announce that the student section of the ASA website will be posted within the next few months. Students should use this website for job/career information, making contact with other students, planning travel to ASA meetings, and getting all of the latest news relevant to students. We would like to encourage all students to attend the Pittsburgh meeting because of its accessibility to so many colleges and universities. Car pooling is a great option, and you can check out the student section of the ASA website on how to obtain information on student housing options. This is a very economical way for many of you to present your latest research findings. The Student Council would also like to congratulate the winners of the Best Student Paper Awards at the Fort Lauderdale meeting, and we encourage all students to apply for these awards in the future.

Micheal Dent is a recent Ph.D. graduate from the University of Maryland, working on the psychophysics of hearing in birds.

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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Echoes from Ft. Lauderdale

Beautiful Convention Center in Ft. Lauderdale

The 142nd Meeting of the Acoustical Society in Ft. Lauderdale, Florida, 3-7 December was another successful meeting. In spite of reservations about travel, more than 900 members and visitors attended. The technical sessions were held in the Greater Ft. Lauderdale-Broward County Convention Center, which provided attractive and uncrowded meeting spaces. Some meeting events took place in the Marina Marriott Hotel. And the warm sun shined on us!

A special feature was the one-day colloquium and discussion on the topic "Acoustic Time Reversal and Applications" sponsored by the Technical Committee on Signal Processing in Acoustics (see article by Mathias Fink in this issue). Four subtopic sessions focussed on basic theory and experiments, random and chaotic media, underwater applications, signal processing and communications, and nondestructive evaluation and medical applications.

A topical meeting on the Physics of Ultrasound in Relation to the Biology of its Therapeutic Effects included papers on high intensity focused ultrasound and shock wave lithotripters, among other subjects.

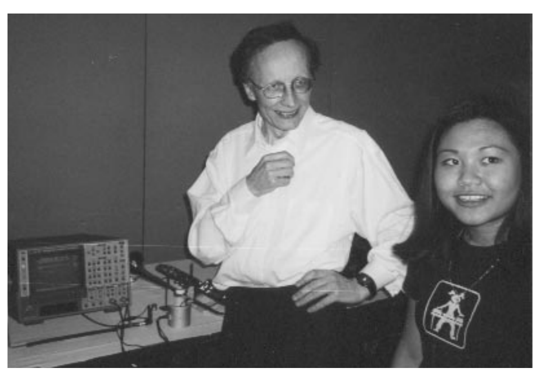
A tutorial presentation on Noise Propagation and Prediction Outdoors was given by Tony F. W. Embleton. This was the 30th in the series of tutorial lectures intended to provide meeting attendees with some appreciation of areas of acoustical research other than their own specialties.

At the plenary session, the Silver Medal in Engineering Acoustics was presented to Ilene J. Busch-Vishniac and the first Medwin Prize in Acoustical Oceanography was awarded to Timothy G. Leighton. Awards for science writing went to Graham Lawton, Colin Gough, and Thomas Rossing, and certificates were presented to 13 new fellows: Shira Broschat, René Caussé, Pierre Divenyi, Mathias Fink, Anthony Galaitsis, Paul Hines, Anatoily Ivakin, Jerry Lilly, Chaslav Pavlovic, Allan Piersol, Ahmet Selamet, Michael Taroudakis, and William Watkins. That the Acoustical Society is truly international is underscored by the fact that two of the 5 new fellows and 2 of the science writing award recipients live outside the United States.

Above: Sergio Beristáin, Jim West, and Charles Schmid plan the Cancun meeting.

Left: Jim and Judy Cottingham enjoy the President's reception.

Right: Barry Larkin demonstrates the HANG at session 2pMU.



Below: Murray Campbell (Scotland) demonstrates the spectrum of a wind instrument to a student at session 2aED.

continued on page 5

Time Reversed Acoustics

By Mathias Fink

Time-reversal invariance, a fundamental symmetry that holds nearly everywhere in microscopic physics, can be exploited in a unique way in Acoustics, to create a variety of useful instruments. In the past, taking advantage of the reversibility of the acoustic propagation that holds in many situations (to the extent that everything is adiabatic) time reversal mirrors (TRMs) have been developed that create time reversed waves. Acoustic reversibility means that, for every burst of sound diverging from a source—and possibly reflected, refracted or scattered by any complex media—there exists, in theory, a set of waves (the time-reversed waves) that precisely retraces all of these complex paths and converges in synchrony, at the original source, as if time were going backwards. Therefore, an acoustic TRM refocuses an incident acoustic field to the position of the original source regardless of the complexity of the medium between the TRM and the "probe" source.

Time reversal mirrors have now been implemented in a variety of physical scenarios from MHz ultrasonics with centimeter aperture sizes to hundreds/thousands of Hz in ocean acoustics with hundred meter aperture sizes. Common to this broad range of scales is a remarkable robustness, exemplified by observations at all scales, that the more complex the medium between the probe source and the TRM, the sharper the focus. The potential for applications in many areas of acoustics is quite high, and at the last ASA meeting in Fort Lauderdale, more than 30 papers were devoted to this topic.

If there are strong analogies between acoustic TRMs and optical phase conjugated mirrors, there are also major differences between both techniques. Not only the way time reversal is implemented is very different (transducer array of reversible transducers versus nonlinear interaction of monochromatic waves) but also the fact that TRM supports broadband pulses that have very different statistical properties in random media (self averaging properties) than monochromatic waves.

The relation between the medium complexity and the size of the focal spot is certainly the most exciting property of TRM compared to standard focusing devices (lenses and beam forming). A TRM acts as an antenna that uses complex environments to appear wider than it is, resulting in a broadband pulse in a refocusing quality that does not depend on the TRM aperture.

This property is due to the fact, that for a TRM, immersed in a random media or surrounded by reflecting boundaries, the multiple reveberations redirect nearly all the information emanating from any source on the TRM. Therefore a TRM can be made of a single transducer or of a small number of them. The transducers will collect nearly all the data needed to focus on the source from all the directions. This will depend on the geometrical properties of the medium and on the TRM bandwidth. Such properties have been observed in various situations, such as in ocean acoustics in shallow water by W. Kuperman's group (Scripps Institution of Oceanography) as well as in ultrasonic propagation in silicon wafers or through granular media in our laboratory.

Such properties open the field of new discrete communications systems in underwater applications as it was experimentally demonstrated by the Scripps team. D. Dowling (U. of Michigan) has also shown that even with a linear TRM array, 3D focusing can be achieved when the sound channel has a random rough bottom. New passive phase conjugation systems have also be implemented at the Applied Physics Laboratory at the University of Washington and it is believed that in the future, electromagnetic communications in diffuse random media like urban communications can be improved by time reversal techniques.

Combining pulse echo techniques and TRM opens a new way of detecting and imaging targets through complex media. In a first step, it was shown that using an iterative illumination of the medium by a TRM, one can select the brightest target and focus optimally on it. In a second step, a new approach to active detection and focusing using arrays of transmitters and receivers was developed, in our group, by C. Prada, allowing selection and focusing on each scatterer. The method was derived from the theoretical analysis of iterative TRM. It consists essentially in the construction of the invariant of the time reversal process. It was shown that the behavior of any time reversal system could be determined by an analysis of a "time reversal operator." This operator can be experimentally measured and it incorporates the effect of geometry, the background medium, and the scattering characteristics of objects within the medium. The diagonalization of the time-reversal operator (DORT method) provides both a measure of the strength of each scatterer and the phase law that can be applied to the array to focus selectively on each scatterer. This technique shows very promising results that combine the superesolution properties of TRM in complex media and pulse echo mode.

Applications of both iterative TRMs and DORT method have been demonstrated in nondestructive testing for defect detection and imaging in noisy samples of titanium. The DORT method has also been implemented in reverberation reduction in the ocean and is under study for target identification. It was recently showed by D. Chambers (Lawrence Livermore National Laboratory) that the spectrum of the time reversal operator for a compact scatterer can be complex and very informative.

Applications of time reversal to medical therapy are also under study in our group. The focal spot of a TRM can track a kidney stone during a lithotripsy treatment. New improvements in this technique have recently been obtained, thanks to time reversal pulse amplification in a solid waveguide. Taking advantage of wave dispersion in the waveguide, a time-reversal operation made on a small number of transducers transforms the long-lasting low-level dispersed wave forms into a sharp intense pulse that can easily destroy kidney stones. Other applications of TRMs to therapy with high intensity focused ultrasound are also under study.

Mathias Fink, a fellow of the ASA, is a Professor at the Ecole Supérieure de Physique et de Chimie Industrielles de la Ville de Paris (ESPCI) and at Paris 7 University (Denis Diderot), France. He is the director of the laboratory Ondes et Acoustique. His current research interests include ultrasonic imaging and therapy, nondestructive testing, underwater acoustics, analogies between acoustics and quantum mechanics and time reversal in physics.

Grand Opening of ASA Online Standards Store

Susan B. Blaeser, Standards Manager

The Acoustical Society of America has opened a new online Standards Store. Customers may now purchase standards online directly from ASA for immediate delivery in Adobe PDF format.

The ASA Standards Store offers the full catalog of standards developed by ANSI Accredited Standards Committees S1 (Acoustics), S2 (Mechanical Vibration and Shock), S3 (Bioacoustics), and S12 (Noise). ASA provides the Secretariat for each of these committees under an agreement with the American National Standards Institute (ANSI). Together these committees maintain more than 120 standards.

In addition to the ANSI-branded standards mentioned above, the ASA Standards Store makes available the full catalog of ISO international standards under ISO/TC108 (Mechanical Vibration and Shock), including its six subcommittees, as well as ISO/TC43 (Acoustics) and ISO/TC43/SC1 (Noise)—more than 200 standards in all—at the lowest prices available in the United States.

To access the Standards Store Online, go to the ASA website (asa.aip.org) and click the Standards Store button. Search for Standards using document number, keyword, standards category or other criteria. The Store uses the latest Oracle technology to make online credit card purchases easy and secure. ASA members are eligible for a 25% discount on purchases.

(Acoustics in the News, continued from page 6)

and freshwater fish throughout the world are known to vocalize. Most of the sounds come from male fish during mating. But fish are also known to screech, croak, and growl when they defend their turf, become startled, or get caught by predators. Some female fish can also make sounds, but they tend to be softer. Male and female fish can also communicate through their mating songs to synchronize the release of eggs and sperm. Most fish make sound by moving special muscles near their swim bladder, an air sac used to control buoyancy. The muscles can contract extremely rapidly against the swim bladder to make a fast drumming sound, or more slowly and at different intervals to make a variety of sounds. The air bladder can act as an amplifier for sounds.

(Echoes from Ft. Lauderdale, continued from page 3)

Sebastian Junger (seated) autographs a copy of his book Fire for Bill Cavanaugh

Colleagues and friends pose with Miguel Junger after special session held in his honor (left to right): John Bouyoucos, Ira Dyer, James Barger, Miguel Junger, Eric Ungar, Murray Strasberg, Leo Beranek, Preston W Smithand Gideon Maidanik

Acoustics in the News

• Biologists have known that a parasitic fly stalks crickets by sound, even though the fly's head is too small for the sound location mechanisms used by most animals. Some flies can pinpoint sound to within 2 degrees, although the side-by-side eardrums of a fly span only about a millimeter. That's because there's a bridge of stiff material connecting the two membranes (see "Scanning the Journals" in *ECHOES* Spring 2001). Paper 2aEA1 by Ronald Miles, et al. at the Ft. Lauderdale ASA meeting described a silicon nitride microphone diaphragms designed to employ similar operating principles, and this idea was reported in the December 8 issue of *Science News*. Using techniques for making microchips, the researchers have made 1-mm by 2-mm silicon diaphragm with a structure that resembles the fly ear. The next step in making a microphone is to attach electrical pickups.

• A baby's adorable babbling brings smiles to parents, but it may also be a precursor to language, according to report in the December 1 issue of *Science News*. Researchers at McGill University cite the fact that babies babble out of the right side of their mouths as evidence that the infantile sounds are more than noise, since past studies have established that people generally open the right side of the mouth more than the left side when talking, whereas nonlinguistic tasks requiring mouth opening are symmetric or left-centered. Linguistic asymmetry is thought to occur because the neural circuits controlling language reside in the brain's left hemisphere, and each brain hemisphere usually operates the opposite side of the body.

• Improving learning by improving classroom acoustics was the subject of a report on *ABC News*, November 9, 2001. Over the past decade, schools in several states, including Florida, New York, Washington and California have microphones and speakers in the classroom to help students hear their teachers, but many acoustical engineers say the microphones are a Band-Aid solution to a critical problem that seriously impedes a student's ability to learn. "Wearing microphones is a solution if using crutches is a solution to broken legs," David Lubman is quoted as saying. "When classrooms are reverberant, amplification doesn't help. It makes it louder but not clearer." Under the new U.S. guidelines classrooms would need to keep noise levels below 35 dB, about the sound level of a quiet country living room. Studies have shown that most classrooms in the United States have sound levels of 45 dB or more. The main culprits in classroom noise (besides boisterous students) are heating and ventilation systems.

• A *so go* (small drum) is a common spectator prop in the stands at baseball and soccer games in Korea. But they also appeared in the Delta Center at Salt Lake City during the speed skating Olympic qualifying races, according to a story in the *Desert News* for October 27. There were roughly 120 Korean fans in the crowd of 3300 for the 500-meter event. Whenever a Korean skater rounded a turn on the track, the fans leaned forward and pounded the *so go* drums furiously. Made of cowhide and hand-painted in yellow, red and blue, the colors of the Korean speed skaters' uniforms, the drums measure 10 inches in diameter. Held by one hand and struck with a bamboo stick, the drums make a hollow sound that rumbles powerfully underneath the yells and cheers of an arena crowd. "High frequency sounds, like yells and whistles, tend to be absorbed, but the low frequency sounds take longer to die out," explained acoustician William Strong.

• A lecture by Wendy Sadler, entitled "Music to your ears: the story of sound, synths and CDs," at the Open University was the first presentation in the 2002 schools lecture tour of the Institute of Acoustics. Sadler, manager for public programmes at Techniquest in Cardiff, is the youngest ever lecturer in the 19-year history of the school tours, according to a report in the December issue of *Physics World*. Her lecture will be followed by visits to 23 schools in England, Scotland, and Wales.

• A team of geneticists at the University of California at San Francisco and Los Angeles has begun a study aimed at finding a gene or genes that may contribute to absolute pitch ability, according to a story in the January 14 *San Francisco Chronicle*. The team, which is hoping to recruit large numbers of subjects for its study, has an online test for prospective subjects at www.perfectpitch.ucsf.edu. The researchers are particularly anxious to find examples of absolute pitch clustered in families. Based on the evidence so far, most scientists believe that genes do play at least a subtle role, perhaps by keeping a developmental window open wider and longer during early childhood, when note-naming ability generally takes shape.

• One of the biggest problems in delivering drugs to tumors is getting them in there, and now it appears that ultrasound may be able to help, according to a story in the December 22 issue of *Science News*. Johnathan Kruskal and his colleagues at Israel Deaconess Medical Center in Boston have shown that exposing tumors in mice to ultrasound can make blood vessels more permeable to drugs, opening up the possibility of getting more into the tumor with a lower dose. How useful this effect will turn out to be is still an open question, but its a promising lead for improving chemotherapy.

• The fans and pumps are so loud on the international space station that astronauts who spend nearly six months on board consider noise one of the top habitability issues, according to a note in the November 20 issue of *Newsday*. "It's sort of like being in a factory," commented NASA astronaut Jim Voss. Even though he wore ear plugs every night while he slept, Voss suffered partial hearing loss during his space station stint, although his hearing recovered to near normal after his return to the relative quiet of Earth in August.

• Although whale song has long been documented in ships' logs, it wasn't until after World War II that scientists first noticed the sounds of fish and the snapping of crustaceans, according to a story in the November 8 issue of *Christian Science Monitor*. Now, more than 700 species of saltwater

continued on page 5

Scanning the Journals

Thomas D. Rossing

• Calculating the elastic properties of iron will help us understand why **sound waves travel faster** along the earth's axis in the inner core, according to an article in the November issue of *Physics Today*. Sound waves in a single crystal of hexagonal close-packed iron travel 12% faster in one direction than in the orthogonal direction at the high temperatures and pressures expected in the Earth's inner core. Thus only 30% of the crystallites in the inner core need to align along the rotational axis to explain the observed seismic anisotropies. [see *Nature* 413, 57]

• **Bird songs** are complex acoustic patterns comprising notes of many frequencies, but the physical processes that produce these songs can be surprisingly simple, according to a paper in *Physical Review Letters* 87, 28101 (2001). Like the human larynx, a bird's vocal organ consists of folds in the passage that connects the lungs to the throat. These folds open and close to produce notes with frequencies between 1 and 2 kHz. Individual "syllables" in the song last between 10 and 300 milliseconds. By treating the vocal organ of a canary as a harmonic oscillator, physicists at Rockefeller University and Ciudad University in Argentina developed a simple formula that accurately mimics at least three distinct notes in the song-bird's repertoire. The formula, which relates the air pressure and elasticity to the frequency of the note, models the spectra of a short falling note, a long rising note, and a medium-length note that rises then falls.

• A new type of **omnidirectional sound source**, consisting of a powerful loudspeaker feeding a small aperture through a reverse horn for concentrating the acoustical energy is described in *Acustica* 87, 505 (2001). Although the total available sound power is less than with traditional omnidirectional (polyhedral) sources, the directivity diagram is much smoother.

• Two interesting papers on **reverberation** appear in the September and October issues of *J. Audio Eng. Soc*. In the September issue, Yang-Hann Kim and Sang-Tae Ahn describe a reverberation model based on objective parameters of subjective perception. The selected objective parameters are reverberation time *RT*, early decay time *EDT*, initial-time-delay gap t_I, objective clarity C_{80}, and strength of arriving energy *G*. These represent the subjective perception of a room or concert hall well, and can be used in designing an artificial reverberator, for example.

In the October issue, Barry Blesser presents an interdisciplinary synthesis of reverberation viewpoints. Artificial reverberator algorithms, which are implemented using digital signal processing, can be best understood by considering their relationships to several disciplines: the perceptual metrics of the auditory system, the statistical properties of the acoustic spaces, the artistic needs of the music culture, and the mixing techniques in the recording studio. Both the early reverberations, containing the unique spatial personality, and the late part, containing the statistically random process, play different roles in each of the related disciplines. The unifying theme is the question of how the human auditory system builds a sense of space.

• A translation of a paper (1978) by H. Bohlen that first describes the "**Bohlen-Pierce scale**," of interest to Western music theorists, appears in *Acustica* 87, 617 (2001). Based on a consonance criterion that is founded on combination tones, the twelve-step scale is derived from the major triad. The same procedure, extended to consonant intervals not used in the twelve-step scale, then leads to a thirteen-step scale. This scale is presented in just and equal tempered tuning. Approaches are shown to a tonal system, based on this scale, and to the realization of 13-tone music.

• A **sonic crystal** is to sound waves in air what a photonic crystal is to light waves or a semiconductor is to electrons: it permits the passage of waves at some energies but not others. According to a paper in the 14 January issue of *Physical Review Letters*, scientists in Spain have used a sonic crystal, an arrangement of aluminum rods, as an acoustic lens for focusing sound waves at audible frequencies. They thereby create an interferometer which, like its lightwave counterpart, causes two wavetrains of soundwaves to interfere with each other in a characteristic pattern.

• Horses and camels have tendons more than 600 mm long connected to muscle fibers less than 6 mm long which may function as **vibration dampers** to protect bones and tendons from potentially damaging vibrations, according to a paper in the 27 December issue of *Nature*. For mammals with masses greater than a few kilograms, tendon elasticity substantially reduces the energetic cost of running. Each time a foot hits the ground, these tendons are stretched, and they recoil elastically as the foot leaves the ground. When the foot of a running animal hits the ground, the impact sets the leg vibrating, at 30 to 40 Hz in horses, and it is thought that the short muscle fibers help to damp out these vibrations.

• An **anomalous acoustoelectric effect** has been discovered in a manganite thin film by a collaboration of physicists in Russia, Poland, and Ukraine, according to a paper in *Physics Review Letters* 87, 146602 (2001). The acoustoelectric effect (AE) occurs when an acoustic wave propagates along an electrically conducting surface and drags electric charge along it due to strong coupling between phonons and electrons. The researchers grew a manganite thin film atop a piezoelectric lithium-niobium-oxygen substrate on which they then launched a surface acoustic wave (SAW). They unexpectedly found that a component of the AE current did not reverse when the SAW traveled in the opposite direction.

Should the ASA have a new logo?

The Public Relations Committee would like your opinion by April 1. Please email the letter corresponding to the logo of your choice to asa@aip.org with the subject header “ASA Logo Poll” or mail it to ASA Logo Poll, c/o Elaine Moran, ASA, Suite 1NO1, 2 Huntington Quadrangle, Melville, NY 11747-4502. Please note that logo (a) is the one we are using at present, and if you prefer not to change logo, vote for (a).

a)

b)

c)

d)

e)

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