The newsletter of
The Acoustical Society of America

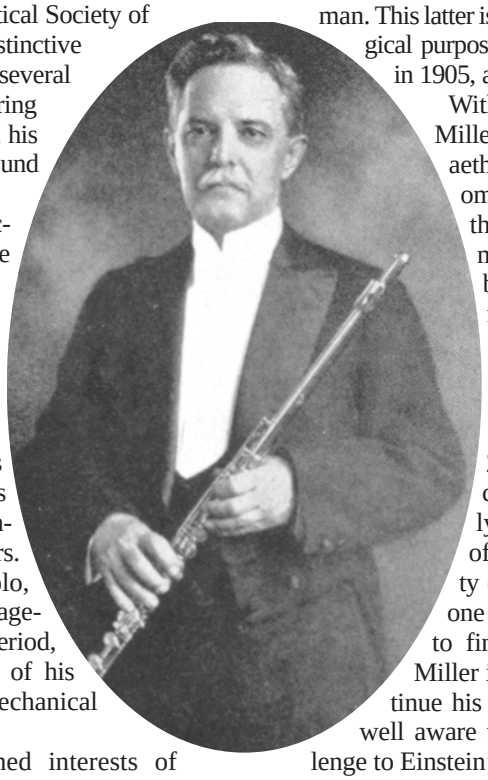
ECHOES

Volume 13, Number 1
Winter 2003

Dayton C. Miller

by Peter Hoekje

Dayton Clarence Miller (1866–1941), a founding member and second president of the Acoustical Society of America, is remembered for his distinctive contributions in the early 20th century in several fields. Acousticians appreciate his pioneering analysis of sound waveforms and spectra, his accurate measurements of the speed of sound in air, and his study of flutes and their acoustics. But, he is also known for meticulous measurements of aether drift, for the first surgical x-ray, and for the huge flute collection he donated to the Library of Congress. He balanced an outstanding scientific research career with a devotion to the arts and education.



As a small boy, Dayton started his musical and acoustic explorations on his father's fife.[1] His father bought him his first full-size flute on his thirteenth birthday, but it was too big for his small fingers. Eventually he also obtained a piccolo, which the young boy found more manageable until his fingers grew. During this period, he also spent many hours in the shop of his father's hardware store, acquiring mechanical skills by building telescopes and a flute.

Forever committed to the combined interests of astronomy, music, and the popularization of science, Miller performed a flute solo and gave a lecture on the sun at his own graduation ceremony at Baldwin University in 1886. He pursued his astronomy interests in graduate study at Princeton University under the supervision of Charles Young, receiving the D.Sc. in 1890. He had hopes of returning to Princeton to work on their new telescope, but soon found himself teaching mathematics at the Case School of Applied Science. He quickly became Professor of Physics, and then chair of the Physics Department, where he remained until his retirement. His undergraduate physics students at Case would include Philip Morse (ASA President 1950–51) and Robert Shankland, who later returned to Case as a faculty member.

In 1895, Miller began to study the x-rays recently discovered by Roentgen. His early radiographs include the arm of his wife, a full body composite of himself, and an injured railroad brakeman. This latter is claimed to be the first use of x-rays for surgical purposes. Tragically, his laboratory assistant died in 1905, apparently from radiation-related illness.

With the encouragement of Edward Morley, Miller revisited the 1887 Michelson-Morley aether drift experiment with a new interferometer in 1902, and continued working on this problem for nearly 30 years. In making measurements, the interferometer would be set in motion once and would rotate freely for an hour while the experimenter made observations of the fractional fringe displacement, several times throughout each rotation. Miller claimed to have walked 160 miles and made 200,000 observations of fringes in the course of his experiments! He consistently arrived at an observed aether drift speed of about 10 m/s, with a claimed uncertainty of 1 m/s or less, and this result was only one third of the drift speed value he expected to find. Einstein and Lorentz came to visit Miller in Cleveland and encouraged him to continue his measurements. The popular media were well aware that his results posed a significant challenge to Einstein's relativity theory. In time, the industrialist Ambrose Swasey endowed a chair at Case with $100,000 for Miller, enabling him to work solely on aether drift. The discrepancy was never resolved during his lifetime, but Shankland later reanalyzed Miller's data and concluded that it was consistent with a null result.

At the same time that Miller was working on his interferometer, he also began to design a device for acoustic waveform analysis that came to be known as the phonodeik. A wide mouth sound input cone led to a small, thin diaphragm, to which a fine thread under spring tension was attached. The thread passed over a small pulley on an axle supported in jewel bearings, and a mirror on the axle would scan a beam of light across a 5" width strip of moving film. The system response extended to about 10 kHz, apparently. One of the early appli-

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We hear that...

- **William Lang** received the Distinguished Noise Control Engineer Award at a joint meeting of the Greater Boston ASA Chapter and the Institute of Noise Control Engineering on October 28. The award includes an engraved silver Paul Revere bowl. Bill is the third winner of the award. Previous recipients have been George Maling and Leo Beranek, who presented Bill for the award.
- **James Candy**, Chief Scientist for Engineering at the Lawrence Livermore National Laboratory and Adjunct Professor at the University of California, Santa Barbara, received the Distinguished Technical Achievement Award at the IEEE Oceans 02 Conference in Biloxi, Mississippi.
- The application deadline for the seventh **Theodore John Schultz Grant** has been extended to June 30, 2003. The grant provides partial support for the development of improved teaching methods, new curricula, or research in architectural acoustics education. For information about the grant and application information, see http://www.newmanfund.org.
- The American Physical Society bestowed the Otto LaPorte Award on **Andrea Prosperetti** for his "breakthroughs in the theory of multi-phase flows, the dynamics of bubble oscillations, underwater sound, and free-surface flows and for providing elegant explanations of paradoxical phenomena in these fields." Prosperetti is the Charles A. Miller Jr. Distinguished Professor of Mechanical Engineering at Johns Hopkins University.

ASA Founders

In 2004 the Acoustical Society of America will celebrate its 75th anniversary with a gala meeting in New York, the city in which it held its first meeting in 1929. In the next issues of *ECHOES*, we plan to feature short biographies of some of these founders. A biography of Dayton Miller, the second president of ASA, appears in this issue. We welcome comments on this series, of course, and even your votes for your "favorite founders" to be featured in forthcoming issues.

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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To the Editor

Do we really need that money?

My compliments to the authors of the attractive and useful feature invited articles that *ECHOES* publishes, BUT:

The ads have uglified an otherwise nice, friendly, informative newsletter. Do we really need that money?

Herman Medwin
4021 Sunridge Rd, Pebble Beach, CA 93953

Editor's note: *The ads in the Fall 2002 issue were included on a trial basis and included ads only from exhibitors at the Cancun meeting. This service was provided as a benefit to the exhibitors and meeting attendees. No fees were charged to the exhibitors for these ads.*

One Society

by Thomas D. Rossing

I don't very often editorialize, but this issue has only one Letter to the Editor, so the editor will write a letter to the readers.

Our Society was founded 74 years ago to bring together scientists and engineers interested in acoustics, the science of sound, and its many applications. We often think about and write about the diversity of interests within the Society, but we do not so often think about the unity of the Society. I think we need to emphasize the unity of acoustics.

To facilitate the operation of the Society, and especially to assure rich program content at meetings and in the *Journal*, we have 13 technical committees, each representing an area of acoustics. Members designate the three technical areas that interest them the most, and most members participate in the activities of one or more technical committees. The extent to which members attend sessions sponsored by technical committees other than their own can only be guessed at, but it appears to be quite large, especially on the part of older members of the Society. Nothing does more to preserve Society unity than hearing and participating in the discussion of papers in areas of acoustics other than one's own. It is this cross-fertilization that often leads to some of the most original ideas in acoustics, as in other sciences.

Likewise, reading papers in several different areas in our excellent journal is a good way to generate new ideas about one's own research field. This could probably be encouraged by including "lay language" summaries or expert commentaries on papers, as is done in such journals as *Science* and *Nature*. At the expense of adding to the *Journal*, I would like to see this given serious consideration.

The Society encourages excellence in research, and it recognizes this with its medals and awards. The awards plenary session is one of the events at meetings which I always look forward to attending. I am always pleased to discover the interesting work of some distinguished acoustics researcher that I have previously overlooked. Some people have argued that we give too many awards, but I couldn't disagree more strongly. On the contrary, I am sure that there are distinguished acousticians whose work we fail to recognize. If I could change one thing in the Society, it would be the rather arbitrary limits on the number of medals that can be awarded in any one year and certainly the quotas on medals and awards in a particular area of acoustics. (When a particularly significant breakthrough occurs, it should not take years, due to quotas in a particular area, to recognize the key contributors, one at a time). Quotas, which lead to competition between clusters of technical areas, do not further the purpose of medals and awards.

As we look forward to our gala 75th anniversary celebration, I hope that the unity of acoustics will be a dominant theme.

ACOUSTICAL SOCIETY OF AMERICA

The Acoustical Society of America was founded in 1929 to increase and diffuse the knowledge of acoustics and promote its practical applications. Any person or corporation interested in acoustics is eligible for membership in this Society. Further information concerning membership, together with application forms, may be obtained by addressing Elaine Moran, ASA Office Manager, Suite 1NO1, 2 Huntington Quadrangle, Melville, NY 11747-4502, T: 516-576-2360, F: 516-576-2377; E-mail: asa@aip.org; Web: http://asa.aip.org

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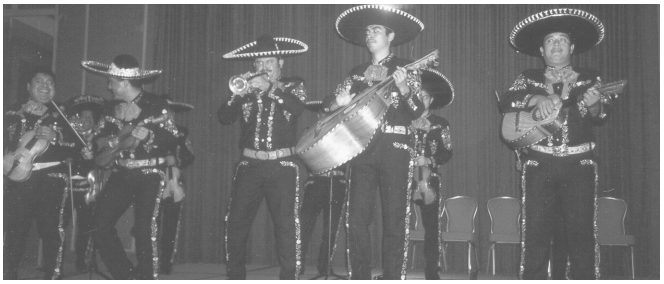
Echoes from Cancun

The First Pan-American/Iberian Meeting on Acoustics in Cancun was a smashing success! Much to be thanked and congratulated are the cochairs, James West, Samir Gerges, and Sergio Beristain; the technical program chair, Kevin Shepherd; the vice chair, Charles Schmid; the cultural program chair Rebeca de la Fuente; and the local weather chair, whoever it was! Some 1330 registrants enjoyed the sunshine as well as the fine program of 1100 papers in 113 technical sessions.

The opening ceremonies included welcoming speeches and music by a Mayan children's choir as well as a mariachi band. A welcoming drink on Monday night marked the opening of the exhibits, and the customary buffet socials were held at poolside accompanied by the roar of ocean surf. A post meeting tour to the archeological sites at Chichén Itzá on Saturday and Sunday included visits to the Valladolid and Balancanche Caves and a demonstration of acoustical effects at the pyramid of Kukúlkan.



Tutorial lectures on "Architectural Acoustics" and "Industrial Noise Control" took place on the first and last conference days. The Committee on Archives and History sponsored lectures on echo-Doppler diagnostic technology and on the history of animal bioacoustics. At the Awards Ceremony all three societies presented awards.

Most attendees look forward with anticipation to the second Pan-American/Iberian meeting.

Participants play a 12-meter "flute" created by Leonardo Fuks at Session 3pMU.

A playful stamp honoring Owen Plumbly, Inventor

Ben Mahmoud, an artist in DeKalb, Illinois, has created a playful stamp honoring Owen Plumbly, railroad switchyard operator in Scott Depot, West Virginia, from 1830 to 1875.

In his switchyard there was but one switch to direct a train coming from the northwest to one of two tracks. The Baltimore & Ohio trains had to be switched to the tracks that veered north, while the Chesapeake & Cullodian trains had to be switched to the tracks that continued along the Poca River to the southeast. Communications were not reliable in those days, and it was always uncertain which train would be approaching the tracks. This was further complicated by the fact that the trains coming from the northwest came into view only a few yards from the switch because of the landscape.

Plumbly changed all of this in 1832 with his invention and his remarkable memory for sound. The device, worn by Plumbly, would amplify the sound of the approaching trains before they rounded the mountain from the northwest. He was able to discern from the sound of the locomotive which train was approaching and direct the proper position of the switch. This made it possible for trains to move past the switchyard without stopping, thus hastening the trains through the area.

Mahmoud's stamps, recognizing Plumbly and his acoustical invention, are printed sheets of 18 in the denomination of 34 pu (Poca Post units).

The Acoustician as Tourist

Some observations by Charles Schmid, Executive Director

That we acousticians are a special breed of tourist was exemplified during a delightful excursion to the ancient Mayan city of Chichén Itzá which followed the First Pan-American/Iberian Meeting on Acoustics recently held in Cancun, Mexico. The photo below shows meeting Co-Chair Sergio Beristain clapping his hands to demonstrate the unique echo pulse train received from the stairs of the Pyramid of Kukúlkan constructed by the Mayans between 1100 and 1300 A.D. Listening intently to the bird-like chirps were some of the 200 acousticians who participated in the two-day post-meeting tour. The second photo shows acoustical consultant David Lubman explaining to ASA members how the Mayan priests may have made use of the wonderful acoustics of the Ball Court. (Our ears counted at least seven echoes, but David's equipment recorded 14!)

As part of the two-day excursion to the Yucatan Peninsula, we visited deep underground caves used by the Mayans. In one huge, damp cavern I looked over to see Leo Beranek bring his hands together for the traditional clap to determine reverberation time. What member of the Acoustical Society, whether or not they are an architectural acoustician, can resist a clap in a concert hall or any other reverberant space?

Last September ASA's president, Dick Stern, and I had an afternoon open in Seville, Spain before making a presentation to the European Acoustics Association regarding a joint meeting in 2008. Using our free time to tour the nearby Castle Alcázares, we came upon a beautiful covered pool which was only 20 feet across but must have been over 150 feet long. Its mirror surface held beautiful reflections of arches designed by Moors 500 years ago. But to Dick it was an opportunity to demonstrate surface waves. A British couple exited after exclaiming over the beauty of the site, leaving us alone in the vault. Without hesitation, Dick reached over and generated an impulse wave. We were mesmerized as it slowly traversed the water tank, hit the distant wall, and began its return. When the wave was partway back another group of tourists entered. Rather than explain destructive interference, and apologize for the distorted surface which was once perfectly flat, we quietly left.

Past president Bill Hartmann spent his sabbatical last year in Boston, the city which is home to the Mapparium, a unique glass sphere with a 30 foot diameter located in the Mary Baker Eddy Library. On four occasions, after the tourists left the library, Bill and his colleagues set up recording equipment on the walkway which traverses the sphere. They measured various attributes caused by the many reflections from the sphere which affect human listening and localization, and are now analyzing their data.

If you happen to be with *ECHOES* editor Tom Rossing in a city with significant bells, be prepared for (or ask for) an informative tour with him. Also any visit to the Capitol in Washington D.C. should include standing in the spot where John Quincy Adams placed his desk to take advantage of special reflections to eavesdrop on a certain fellow Congressman on the "other side" of the old House chambers. I'm sure many of our readers know of other tourist sites where they can produce similar acoustical examples. Not surprisingly, this time-honored tradition was covered by Lord Rayleigh in 1877 in his book *Theory of Sound* in which he describes the long reverberation times at the Baptistery at Pisa and the "whispering galleries" found in the circular gallery of the dome of St. Paul's Cathedral in London.

Tourists can in turn be accidental acousticians! This begins with small children instinctively yelling in a tunnel or at a wall upon sensing the presence of an echo. It may include others who are inquisitive enough to consult with experts, which might have been the case for Lord Rayleigh. David Lubman and Sergio Beristain both visited Chichén Itzá long before they devised the demonstrations we heard in December. We are indeed fortunate to work in a field where demonstrations surround us in our travels as well as in daily life, and which can be used to interest and educate others about acoustics. And at the same time, we can enjoy ourselves—as we recently did at a Mayan temple at Chichén Itzá.

Note: More information on ancient acoustics and acoustical tourism can be found in session 3aAA and 4aAAb in the Cancun meeting program (Journal of the Acoustical Society of America, Vol. 112, No. 5, Pt. 2, Nov. 2002).

Scanning the Journals

by Thomas D. Rossing

- **Manipulating coherence** is the title of a special feature section in the 15 November issue of *Science*. The lead article, entitled "Doing the Wave in Many Ways," includes a discussion of time reversed acoustic waves and the work of Mathias Fink and his colleagues (see the Winter 2002 issue of *ECHOES*). Included in the section are review articles on "Coherent Optical Information Systems," "Coherence with Atoms," "Spontaneous Bose Coherence of Excitons and Polaritons," "Cavity Quantum Electrodynamics: Coherence in Context," and "High-Powered Short-Pulse X-ray Lasers." This section is especially interesting to those of us who have tried in our teaching to stress the similarity of different types of waves.
- According to forensics experts, if **CCTV cameras recorded sound** as well as video, they could add a new dimension to fighting gun crime, according to a story in the 2 November issue of *New Scientist*. During a riot in Patagonia in April 1997, for example, a bystander was shot dead. A journalist videotaping the event recorded 17 gunshots on the soundtrack, but the picture was so blurred no one could see who fired the fatal shot. By reconstructing the crime with firecrackers, however, a crime team was able to place the source position of 11 of the shots by analyzing echoes. The main suspect was acquitted, although it was not possible to determine which of four men running near the police line fired the fatal shot. With more CCTV cameras covering our streets, safety would be increased.
- **Recalling melody** is the job of a part of the brain known as the rostromedial prefrontal cortex, according to a paper in the 13 December issue of *Science*. Researchers at Dartmouth College, who used functional magnetic resonance imaging (MRI) to detect the part of the brain active in response to specific stimuli, found that the ability to recognize music is contained in a centrally located area just behind the forehead, a part of the brain that also plays a key role in learning and in the response and control of emotions. In the study, eight people who had studied music for at least 12 years listened to the music and were asked to pick out specific tones and to detect notes played by a flute-like instrument instead of a clarinet which had dominated the music. As they performed these tasks, the functional MRI tracked which parts of the brain were active.

  In the same issue of *Science* is a perspectives article, "Mental Models and Musical Minds," which provides background to the paper by reviewing the neuroscience of music perception and cognition. One of the most developed areas in the cognitive science of music is the description of pitch structures in Western tonal-harmonic music, including musical scales, harmonics, and the relations between musical keys. Tonal maps may be distributed over the brain. The processing of music is extremely complicated, and provides insight into the way the brain functions in complex tasks.
- Solitary waves (**solitons**) maintain a constant shape as they travel with little dissipation because the speed of the waves in the medium depends on frequency in just the right way. Theory predicts both "up" and "down" solitons, but only recently have "depression" or down waves been observed and reported in a paper in the 11 November issue of *Physical Review Letters*. A research team in Paris and Lyon used a special channel and a rectangular wave maker to create **depression solitons** on the surface of mercury and a magnetic inductive sensor to detect them.
- Animal mating calls that exert a comparatively high sound pressure propagate over greater distances and generally have greater attractive power. Male Bornean tree-hole frogs cleverly exploit the **acoustic properties of cavities in tree trunks**, according to a communication in the 5 December issue of *Science*. By tuning their vocalizations to the resonant frequency of the hole, these frogs enhance their chances of attracting females. The frogs initially vary the frequency of their call until resonance is reached, and they can track this resonant frequency as it varies due to a changing water level in the tree trunk, for example.
- **Ferroelectric crystals can remember sound**, according to a paper in the 9 September issue of *Physical Review Letters*. Researchers at the University of Mississippi sent acoustical waves through a lithium niobate sample and saw the tone reappear a moment later. The researchers applied a tone pulse to a thin sample of lithium niobate sandwiched between two transducers, it rang like a bell and then quieted down, but a signal with the same frequency appeared 70 microseconds later, as well. The ferroelectric crystal had apparently stored acoustical energy and then released it. Ferroelectrics turn vibrations into electromagnetic waves, so the authors believe the sound pulse generates an electric field that temporarily displaces charges within the crystal. The magnitude of the echo appears to depend on the concentration of domains in the crystal.
- A new **method of auralization**, based on the reproduction of multichannel impulse responses using wave-field synthesis (WFS) is described in a paper in the October issue of *Journal of the Audio Engineering Society*. Three microphone array configurations are considered: linear, cross, and circular. When properly implemented, this method enables the perceptual assessment of the complete hall without the use of headphones, and it can be applied to both calculated impulse responses for modeled halls and measured impulse responses for existing halls.
- The September/October issue of *Acta Acustica/Acustica*, a special issue on **Underwater Acoustics**, includes papers on sea floor characterization, scattering and reverberation, signal and data processing, acoustics of inhomogeneous media, sound propagation modeling, acoustics in fisheries, geoacoustic inversion, ocean acoustic tomography, acoustic imaging, nonlinear acoustics, acoustics in environmental monitoring, transducers and calibration, and instrumentation and measurement presented at the Sixth European Conference on Underwater Acoustics (ECUA2002) held in Gdansk, Poland.
- A supplement to the September/October issue of *Acta Acustica/Acustica* includes abstracts of the papers presented at **Forum Acusticum Sevilla 2002**. Keynote lectures were on "The EU noise policy and its research needs," "Phenomena, theory and applications of near-field acoustic levitation," "Speech quality in modern telecommunication," "Modelling in auditorium acoustics–from ripple tank and scale models to computer simulations," and "Macrosonics: Phenomena, transducer and applications."

(continued on page 8)

Dayton C. Miller

(Dayton C. Miller, continued from page 1)

cations of this device was Miller's attempt to answer an age-old question: does the material of a flute affect the sound it produces? He compared the signals produced by flutes made of wood, glass, silver, and a gold flute he himself built. He might have made a platinum flute, also, but observed that the value of the machining would be twice that of the precious metal itself! The flutes had measurably different sounds, but the explanation eluded him.

Dayton Miller's phonodeik being used to analyze the sound of several pianos

The phonodeik also found use in analysis of other musical instruments, the human voice, the efficiency of fog signal equipment, and the transmission characteristics of communications and sound reproduction equipment. However, Miller recognized the need to extend the capability to spectral analysis and resynthesis. After a visit to the Paris instrument maker Rudolf Koenig, he brought back a copy of the Henrici Harmonic Analyzer that could calculate the amplitudes of fourier series components by following the waveform trace.[2] Miller complemented these instruments with the construction of a Harmonic Synthesizer, which has a sequence of tuned resonators whose excitation amplitudes can be adjusted.

In 1918–19, Miller was invited to conduct a series of tests on sound waves from gun blasts at Sandy Hook Proving Ground, in order to understand the problem of shell shock. The measurements made there also enabled him to significantly improve the precision measurement and theory of the speed of sound waves.

He is also credited with the acoustical design for concert halls at the Chicago Civic Opera House and the National Academy of Science, chapels at Dennison College, Bryn Mawr, and Princeton, and two prominent Cleveland churches. Features of his 1930 design for Severance Hall in Cleveland include a number of lighting recesses in the ceiling that aid in sound scattering without detracting from the appearance of the ceiling surface. Shankland[3] reported that Miller would complain that the private boxes detracted from the acoustics, but he had been unable to convince the hall's patron to do without them. One evening performance found Miller and student Shankland hiding in an alcove near the stage, surreptitiously dangling a microphone into the hall and waiting for a prearranged moment when the full orchestra would abruptly cut off a loud, final chord. Maestro Sokoloff held his hands in the air to maintain silence in the hall for an extra second or so, so that the conspirators could obtain an accurate and realistic measurement of the reverberation time with full audience and orchestra.

Full-body x-ray of Dayton Miller

The flute collection Miller had been acquiring and cataloging throughout his life finally grew so large that he was unable to display them. After plans fell through to house them at the Smithsonian, interest was expressed by the Library of Congress, which eventually appointed a curator for the 1500 or so flutes and numerous books and other materials.

Miller's scientific oeuvre includes seven books and numerous articles in publications from *Science* to the *Journal of the Acoustical Society of America* and the *Reviews of Modern Physics*. But, he believed that, "[The scientist] of all people should not be detached from public affairs, but should allow the human side of his nature to grow simultaneously with his scientific development."[4] He contributed generously to his community, belonged to some 40 organizations, and presented over 500 popular science lectures. Described as a "musician first, and all of the time,"[5] he played the flute and composed music. The influence of Dayton Miller on acoustics and the other fields he touched continues to be felt to this day, through his ideas, innovations, measurements, and heritage.

References

[1]Maynard, William J., Dayton C. Miller, his life, work, and contributions as a scientist and organologist. Brookville, N.Y., 1971. Available online at http://memory.loc.gov/ammem/dcmhtml/may0a.html. Much of the background information on Miller's life is compiled in this reference.

[2]Fickinger, William, History of Physics Research at Case Western Reserve University, manuscript in preparation. This reference also contains significant information about Miller's x-ray and interferometer experiments.

[3]Late in his life, Shankland still occasionally gave guest lectures to acoustics courses at CWRU.

[4]Cleveland Plain Dealer, 9 April 1930.

[5]Cleveland Plain Dealer, 24 December 1926.

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Acoustics in the News

- Don Gilmore, an inventor in Kansas City, has developed a piano that tunes itself in 40 seconds by warming the strings with electric currents, according to a story appearing on Reuters and also in the 7 December issue of *New Scientist*. The strings are set to excess tension, so that a microcomputer-controlled current will adjust the tension of each string and keep it in tune.
- Ocean observatories use sound to track events such as earthquakes and volcanoes, according to a story in the 7 December issue of *Science News*. Natural underwater temperature and pressure gradients create a corridor in which sound can travel for thousands of kilometers. The U.S. Navy, for example, uses permanently placed hydrophones to monitor this sound fixing and ranging (SOFAR) channel in the Pacific Ocean. Listening to SOFAR sounds, researchers at NOAA's Pacific Marine Environmental Laboratory have located tens of thousands of ocean-floor earthquakes and several volcanic eruptions that were not detected by land-based seismic monitors. Recently, the group took portable hydrophones to the Atlantic Ocean and recorded sounds of volcanic activity in the Mid-Atlantic Ridge.
- Papers on ultrasonic sterilization presented at the Cancun meeting also attracted the attention of *Science News* (7 December issue). Shock waves of about 55 MPa, generated by electrical discharge (paper 3aBB5 by A. M. Loske) were found effective in destroying bacteria. Also noted was that moderately increasing the pressure dramatically boosts microbe destruction (paper 4pBB13 by Cunefare, Carter, and Ahern).
- An environmental group has asked a federal judge to suspend a National Science Foundation (NSF) funded sea-floor mapping expedition off Mexico that it claims led to the deaths of two whales, according to a story in the 25 October issue of *Science*. The case was filed by the Idyllwild-based Center for Biological Diversity. NSF rejects a link between the deaths and the air guns used by shipboard researchers to generate sound waves, adding that the researchers were following the law.
- LSI Logic proposes to use sound to repair microchips (US patent 6372520), according to a story in the 16 November issue of *New Scientist*. Beams of high-speed particles used to implant semiconductor impurities can damage the silicon wafers, leaving surface pits and cracks. High-temperature annealing can repair this damage but may destroy the chip's circuitry. High-intensity sound waves can repair the silicon by making surface molecules mobile enough to fill the pits and cracks without using high temperatures.

(Scanning..., continued from page 6)

- **Conversion of two-channel stereo to a five-channel format** has been extensively considered, and a paper in the November issue of *Journal of the Audio Engineering Society* discusses an algorithm for doing so. It is desirable to maintain compatibility of multichannel audio with existing two-channel systems in use today. An effective sound distribution to the surround channels is achieved by using a cross-correlation technique, and a robust stereo image is obtained using principal component analysis.
- A novel functional imaging technique has been used to reveal two different distinct types of **neural responses associated with the same auditory stimulation**, according to a paper in the 6 September issue of *Science*. One shows a transient pattern, while the other has a sustained response. The anatomical distribution of these responses is partially segregated and correlates with the functional and morphological distinction of core and belt areas. The more transient response is found in belt areas, whereas the sustained response is localized to the core of the auditory cortex.
- "Incremental training increases the **plasticity of the auditory space map** in adult barn owls" is the title of a paper in the 19 September issue of *Nature*. The plasticity in the central nervous system that underlies learning is generally more restricted in adults than in young animals. The auditory localization pathway has been shown to be far more limited in its capacity to adjust to abnormal experience in adult than in juvenile barn owls. However, the results reported in this paper show that there is substantially greater capacity for plasticity in adults than was previously recognized.

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