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The Acoustical Society of America

ECHOES

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Global Infrasonic Monitoring of Large Meteoroids

by Douglas O. ReVelle

Networks of low-frequency acoustic detectors, originally built for other purposes, are now finding a new and unexpected use in detecting objects that enter our atmosphere. The orbit of Earth through the solar system passes through much solid particle debris, including pieces of material from both comets and asteroids. We call these arriving particles "meteoroids." The asteroidal and cometary sources have a wide variety of properties, so meteoroids can arrive from very different orbits and belong to one of several types of observed materials. They can be iron, rocky stones, very weak stones (Carbonaceous chondrites) or there are two brands of very weak cometary material as well. This debris can be either very small or very large or have a large range of possible sizes, depending on the source and how long the material has been orbiting in space free from its source and other factors. This material can also have a large range of possible entry speeds and densities.

As Earth moves about the Sun, it acts as a tiny dust mop sweeping up this material which can strongly interact with the atmosphere at very great heights (above 60 miles). On occasion these larger and brighter meteors and fireballs or bolides (the name of the atmospheric phenomena) travel at high speeds to collide with Earth's surface and possibly even produce an extensive crater. This delivery of meteorite samples (the ponderable pieces that reach the Earth intact), originating on other worlds beyond our own, provides a means of studying our own origins as well.

The interaction of these meteoroids with the atmosphere is very strong partly due to the very high speed at entry and partly due to the compressibility of the atmosphere. The entry speed compared to the speed at which sound waves travel, called the Mach number, typically can range from 50–300. For comparison, a typical Mach number of a commercial or military supersonic jet is less than 3. As a direct consequence of this high speed, an explosion is generated along a cylindrical path about the entry trajectory. This deposition of energy along the path constitutes an explosion whose characteristic scale is called the "blast wave radius, which delineates the size of the region in which an explosion has occurred. For large meteoroids capable of penetrating the atmosphere down to heights where a shock wave is formed, this scale can range from a minimum of 10 meters (in order to be recorded at ground level) to many kilometers in length. For comparison, the typical size scale of the sound source in ordinary thunder is about 2 or 3 m.

Sounds that emanate from such sources in the atmosphere can have very large amplitudes, even great enough to break glass windows at close range. Frequencies of such sources can be low enough so that the peak energy is below the range of audible sound waves, which we call "infrasound." As the blast wave radius increases we find that these frequencies become progressively lower. For the famous Siberian meteorite explosion (Tunguska) of 1908, ultra-low sound frequencies of 1/60 Hertz (corresponding to a period of about 1 minute) were observed at great distances from the entry trajectory. As these signals propagate through the atmosphere, the ambient temperature and winds aloft can bend the signals away from straight-line paths, i.e., refraction. They can also be diffracted and scattered as well since this is a wave phenomenon. We now know empirically how to relate the period at maximum amplitude of the sound waves to the source energy. For the blast wave radius values quoted above, source energies range from ~0.00001 kt (1/100 of a ton of TNT) to 10 Mt (megaton) of TNT equivalent (1 kt = 4.186×10^{12} Joules). For comparison, the nuclear weapons dropped in Japan in WWII produced explosions of about 15 kt.

Over the past few years we have observed a number of these very large bolides over a very large energy range. From these data we have been able to locate the sources and calculate the frequency of occurrence of these large bodies at the Earth in a year. The observations at arrays of sensors on the ground using low frequency microphones, separated horizontally by distances of a few hundred meters to a few km typi-

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Acoustics, Acousticians, and the Acoustical Society of America

by William M. Hartmann

Acoustics and acousticians are concerned with sounds of all kinds, from infrasonic to ultrasonic. Our domain spans all media: gasses, liquids, solids, plasmas, and the nervous systems of humans and other animals. We can be found at the bottom of the ocean and at the top of the atmosphere. Our field of activity is vast.

The Acoustical Society of America serves acoustics and acousticians, and it has done so since 1929. The Society has a membership of about 7000 members. By contrast, the number of people worldwide who work as professionals in the vast field of sound exceeds this membership by many times. Why should this be? One possible reason is that those of us who are members are the people who take sound most seriously. We are the people who need to be aware of the latest developments in acoustics; we are the ones who advance the state of the art. But how about the others? The Acoustical Society of America, through its Journal, its meetings, and its regional chapters can serve the professional interests of many more. With this in mind, the Society has recently expanded its opportunities for membership.

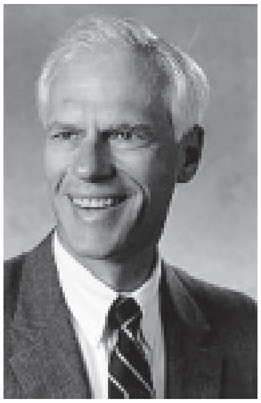
It is now possible to join the Acoustical Society of America as an electronic associate (e-Assoc.). This category of membership is being introduced to make it easier for new members to join the Society on a limited basis that includes many of the benefits of membership. A brochure describing this class of membership, its reduced cost and its benefits, will be widely distributed over the next few years. Briefly, the e-associate member obtains most of the benefits of an associate member, but access to *The Journal of the Acoustical Society of America*, the meeting program, and the References to Contemporary Papers on Acoustics is limited to electronic form. Also, the e-associate does not qualify for a reduced meeting registration cost, cannot vote or hold office, and cannot be considered for fellowship.

A second new class of membership, corresponding electronic associate (ce-Assoc.), is available for individuals from developing countries. The cost of this membership is even further reduced, $35 for a year. A list of eligible countries appears on the Society website. The decision to offer the ce-associate membership grew from the realization that the Society is de facto an international organization with a quarter of its membership and more than half of its Journal articles from outside North America. In this environment the Society wishes to make its benefits globally available.

Together, the two new classes of membership are intended to expand the influence of the Society and its Journal. It is expected that more people will be introduced to the Society's programs, and more people will read the Journal - already one of the world's most frequently demanded scientific publications.

Getting more members, simply for the sake of having more members, is not the object of this exercise. Instead, the Society hopes to expand the scope of every aspect of its scientific and technical program. This expansion comes from the realization that it is essential that the Society remain in the forefront of acoustics and allied areas. Physical scientists, life scientists, and engineers who come to Society meetings should expect to hear the best there is. A part of the Society's goal to stay on top is to make participation in the Society more widely accessible, especially to people in developing scientific areas outside the mainstream of the current technical committees. The new classes of membership are intended to aid that cause. Individual Society members can play an important role in the effort too.

Members can look to their scientific left and right to identify people and ideas that expand the Society's technical scope and maintain the Acoustical Society of America as the place where the most exciting things happen.



William M. Hartmann, Professor of Physics at Michigan State University, was recently awarded the Helmholtz-Rayleigh Interdisciplinary Silver Medal for research and education in psychological and physiological acoustics, architectural acoustics, musical acoustics, and signal processing. He is especially well known for his work on pitch perception and on sound localization.

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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Fun in the Sun in Ft. Lauderdale

The 142nd meeting of the Acoustical Society of America will be held Dec. 3–7, 2001 at the Fort Lauderdale-Broward County Convention Center and the Marina Marriott Hotel in Ft. Lauderdale, Florida. Besides the technical program, which includes 84 sessions with 682 papers, there will be an exhibition, a tutorial, a short course, a fund-raising dinner, two socials, and other special features not to be missed!

The technical program includes a Hot Topics session with papers on Speech Communication, Physical Acoustics and Animal Bioacoustics. The Committee on Archives and History will jointly sponsor two special lectures on the history of acoustics with the Technical Committees on Acoustical Oceanography and Underwater Acoustics. The history of underwater acoustics will be covered by several speakers in session 2pUW titled "How did we get here? Insights into the history of underwater acoustics." The history of acoustical oceanography will be presented by Robert C. Spindel.

The Acoustical Oceanography Mini-Tutorial series continues with two one-hour lectures on small-scale processes in the ocean, to be given in the AO special sessions on Turbulence and Fine Structure Studies. The two distinguished speakers are Ann Gargett (Old Dominion University), who will speak on "Small-scale processes and vertical diffusion in the ocean" in Session 2aAO and John Trowbridge (Woods Hole Oceanographic Institution), who will speak on "Dynamics of bottom boundary layers in the coastal ocean" in Session 2pAO.

A topical meeting, sponsored by Biomedical Ultrasound/Bioresponse to Vibration, will be made up of two special sessions, 2aBB and 2pBB, each session containing invited presentations followed by a short panel discussion that includes audience participation. A one-day colloquium and discussion on the topic "Acoustic Time Reversal and Applications" sponsored by the Technical Committee on Signal Processing in Acoustics will be held on Monday, 3 December. After an introductory invited talk, four subtopic sessions will focus on basic theory and experiments, random and chaotic media, underwater applications, signal processing and communications, and nondestructive evaluation and medical applications.

The Acoustical Society Foundation and the College of Fellows are sponsoring a fund-raising dinner on Wednesday, 5 December, at 6:30 p.m. The dinner will feature Sebastian Junger, author of the popular book and movie "The Perfect Storm," as guest speaker. Sebastian Junger is the son of ASA Fellow Miguel Junger. All proceeds from the dinner will be added to the ASA Endowment.

An equipment exhibit will open on Monday, 3 December, at the Convention Center. Exhibit hours are Monday, 3 December, 5:30 p.m.–7:00 p.m.; Tuesday, 4 December, 9:00 a.m.–5:00 p.m.; and Wednesday, 5 December, 9:00 a.m.–3:00 p.m. The exhibition will include computer-based instrumentation, sound-level meters, sound intensity systems, signal processing systems, devices for noise and vibration control, and acoustical materials. A complimentary social and cash bar will be held 5:30 p.m. to 7:00 p.m. on Monday evening, 3 December, in conjunction with the opening of the exhibition.

A tutorial presentation on Noise Propagation and Prediction Outdoors by Tony F. W. Embleton on Monday evening is the thirtieth in a series of tutorial lectures intended to provide attendees with some understanding and appreciation of areas of acoustical research other than their own specialties.

At the plenary session on Wednesday the Silver Medal in Engineering Acoustics will be presented to Ilene J. Busch-Vishniac and the 2001 Medwin Prize in Acoustical Oceanography will be presented to Timothy J. Leighton.

A short course on applied digital signal processing in acoustics will be held Friday and Saturday in the Atlantic Ballroom on the ground floor of the Marina Marriott Hotel. The course instructor will be Dr. James V. Candy, Chief Scientist for Engineering and Director of the Center for Advanced Signal and Image Sciences at the University of California, Lawrence Livermore National Laboratory. This short course is designed to develop digital signal processing (DSP) techniques that are applicable to acoustical signal processing problems. Participants will obtain a basic understanding of the approaches and their applicability discussed from the practitioner's perspective, rather than that of a DSP expert.

Complete details about the meeting, including paper abstracts, are available from the ASA Website: asa.aip.org.

Program organizing committee for the Ft. Lauderdale ASA meeting.

Sequences from Number Theory for Acoustics, Signal Processing, and Art

by Manfred R. Schroeder

Number theory has been considered, since time immemorial, to be the very paradigm of pure—some would say useless—mathematics. Number theory is the queen of mathematics, according to Carl Friedrich Gauss, the lifelong Wunderkind of arithmetic. What could be more beautiful than a deep, satisfying relationship between the whole numbers—0, 1, 2, 3, and so on? (One is almost tempted to call them wholesome numbers.) In fact, it is hard to come up with a more appropriate designation than their learned name: the integers – meaning the "untouched ones." How high they rank, in the realm of pure thought and aesthetics, above their lesser brethren: the real and complex numbers—e.g.2.88 and the square root of -1.

Yet, as we shall see, number theory can provide totally unexpected answers to real-world problems in physics and engineering, and generate attractive art. Specifically, I will focus on the application of sequences of numbers that have found wide use in concert hall acoustics, deep-ocean monitoring of global warming, error-correcting codes for the Internet, X-ray astronomy, speech synthesis, and precise radar ranging of interplanetary distances for checking Einstein's theory of general relativity. Other applications are in graphic design and the creation of appealing melodies.

How can mere sequences of numbers have so many interesting applications? The basic reason is that the sequences considered here have unique correlation properties, i.e., they have extremely weak relationships or "correlations" with themselves when the numbers are shifted even slightly. This minimal correlation implies maximal distance, just the property needed for constructing good error-correcting codes. Maximal distance means that two sequences, or code words, are as different as possible to facilitate the unambiguous correction of any errors.

The sequences can be represented as many different sine waves added together (a Fourier transform), to create a visual or graphical pattern that corresponds to the sequence: the number 1 represents a spike, and 0 represents a node (a region of zero displacement). Minimal correlation means that the sequences have a flat power spectrum. A flat power spectrum means that the contribution of each of the sine waves is equal. For wall panels known as "diffusors" that have geometric patterns based on such number sequences, this produces wide-angle diffusion—the spreading of sound waves at large angles—which is just what's needed for optimum concert hall acoustics.

Most importantly, the sequences allow the construction of constant-power radar, sonar, or lidar signals with a flat power spectrum. These signals have thus constant power over time and a wide range of frequency values. Constant power in time means maximal power output (from a radar, say) with a peak power limitation. Constant power in the frequency spectrum means (according to Heisenberg's uncertainty principle, which specifies the a level of precision in which certain pairs of variables can be measured) maximum timing accuracy. Thus, these signals allow precision delay measurements in very unfavorable signal-to-noise environments. In this manner, the delay of radar echoes from the planets Venus and Mercury in superior conjunction (when they are behind the sun) have been measured with an accuracy of a few microseconds, thereby confirming Einstein's theory of general relativity (which predicts not only the bending of light near the sun but also the slowing of electromagnetic radiation near massive bodies). This accuracy has been achieved in the face of the fact that as little as 10^{-27}, one billion billion billionth, of the outgoing radar energy is returned to earth.

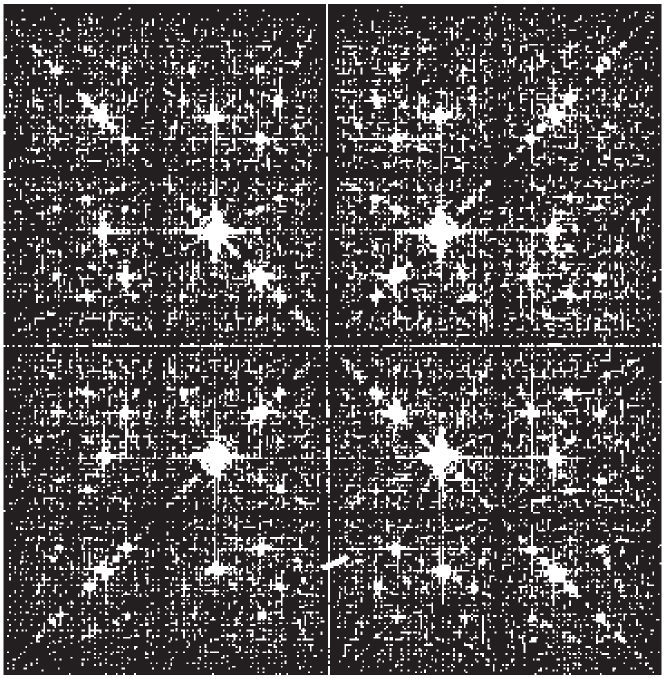
In another application, the delay of sonar pulses transmitted from the Indian Ocean were clearly received in Greenland, a distance exceeding 25,000 km. The delay is a function of the average ocean temperature in the deep-ocean sound channel, itself an indicator of global warming.

The basic mathematics underlying these feats is actually quite simple. For a binary sequence of period-length 7, for example, one starts with, say, three 1s, namely 1,1,1. One now adds the leftmost two terms modulo 2 yielding 1+1=0, which is appended to the sequence already in hand: 1,1,1,0. Continuing this process of adding (modulo 2) the two terms two and three places from the right yields 1,1,1,0,0,1,0,1,1,1,..., which, as can be seen, repeats after seven bits.

For error-correcting applications, the first three bits (1,1,1 in our example) are the information bits and the next four bits (0,0,1,0) are the check bits. This is the fundamental "simplex" error-correcting code of length seven. Elaborations of this scheme (Reed–Muller codes, for example) are ubiquitous in error correcting schemes for transmissions from and to space vehicles, computers and the Internet. The "duals" of the simplex codes (in which information and check bits are interchanged) are the famous Hamming error-correcting codes. For code length seven, the Hamming code adds three check bits to four information bits and can correct precisely a single error (or signal that no error is present).

For other applications, the 0s in the original binary sequences are converted to 1s and the 1s are replaced by -1s. This yields -1, -1, -1, 1, 1, -1, 1, -1, -1, -1, ... which has the already mentioned correlation property: shift the sequence by any amount (other than a multiple of 7), multiply the original

Number Theory



"Prime Spectrum," an example for the application of number theory in graphic design.

and the shifted sequence and add seven consecutive products. This always yields the same low value -1 (compared to multiplying without shifting which yields the high value +7). This correlation property leads directly to the flat-spectrum property that is crucial in many applications.

As an example for the application of number theory in graphic design, see the accompanying illustration "Prime Spectrum" by the author, which shows a pattern directly related to the distribution of prime numbers. To wit: if two whole numbers do not share a common divisor (such as 33 and 35, for example) they are called coprime. Now consider all coprimes from the one million pairs of numbers selected from the range 1 to 1000 and perform a Fourier transform of the coprime data. Fourier transforms extract periodic behavior from any given data and the bright stars illustrate the fact that the distribution of coprime numbers is periodic in two dimensions. The two dimensions here are simply the two dimensions seen in the illustration, corresponding to the two numbers, each running from 1 to 1000 (for more information see the author's book *Number Theory in Science and Communication*). But the actual result of the computation shown here exceeded the author's expectation.

A musical example by Lars Kinderman and Robin Whitehead shows that simple sequences of "Baroque Integers" of numbers can lead to attractive melodies. The sequence, devised by the author, is derived from nothing (0) by appending one more than nothing (1) to give 01. Then 1 is added to each term and appended to the two terms we already have yielding 0112. This process of "add 1 and append" is repeated over and over again: 0112 1223 1223 2334 ... . Next every nth term of this sequence is selected, yielding, for n = 3, 1 2 1 3 3 3. As a final step the numbers are converted to musical notes in the C-major scale, say: 1 = C, 2 = D, 3 = E, etc. Repeated notes are not repeated but simply held longer, thereby imparting a certain rhythm to the tune, which has an appealing baroque, Scarlatti-like quality. This is in effect an example of fractal music; for more information, see the author's book *Fractals, Chaos, Power Laws: Minutes from an Infinite Paradise*.

Manfred Schroeder, recipient of ASA's Gold Medal in Acoustics (1991), has retired from his appointments at the University of Göttingen and AT&T Bell Laboratories. His many other interests include mathematics, languages, photography and computer graphics, skiing and bicycling. This article is adapted from his lay-language version of paper 3aSP1 at the 141st ASA meeting, Chicago, IL.

(Global Infrasonic Monitoring..., continued from page 1)

cally, can be used to determine both the angular great circle distance of the arrival as well as the elevation angle of the signals. This allows us to uniquely locate these sources in three-dimensional space within the atmosphere within certain errors. For example at a range of 3350 km, a bolide of about 0.2 kt was readily recorded infrasonically even as long ago as 1965. Also, from such data we can estimate that the frequency of occurrence of rocky type meteoroids for a energy of 15 kt is about once per year over the globe. At the energy of Tunguska (10 Mt), it is about once every 120 years and this event last occurred about 93 years ago. Corresponding to an energy of 0.1 kt for example, we find a value and associated uncertainty of about 30 ± 9 large bolides/year and this value continues to increase as the source energy decreases and vice versa.

Douglas ReVelle is at the Los Alamos National Laboratory. This paper is based on the lay-language version of paper 2pPAa4 at the 141st ASA Meeting, Chicago, IL

Scanning the Journals

by Thomas D. Rossing

• Bose-Einstein condensates (BECs) are one of the hottest topics in condensed matter physics. This low density collection of ultracold atoms, which has been called the "fifth state" of matter, has some extremely interesting properties. It has been shown, for example, that light waves can be slowed down to a crawl in a BEC. Now, according to a research article in the 27 July issue of *Science*, **large-amplitude sound waves** have been observed in a BEC as well. Quantum shock waves have been created with ultra-compressed slow light pulses in a process analogous to the formation of shock waves in classical fluids.

• People with **developmental dyslexia** have difficulty learning to read, regardless of how intelligent they are. The prevailing view of dyslexia involves the idea that learning an alphabetic writing system requires the brain to map letters to mental representation of the corresponding speech sounds (phonemes). But this view has been challenged, according to a commentary by Franck Ramus in the 26 July issue of *Nature*, by the discovery that people with this disorder also have an array of subtle sensory effects, such as auditory tasks that require the perception of brief or rapid speech and non-speech sounds. Moreover, there is evidence that the brains of some dyslectics have subtle neurological abnormalities in certain areas of the visual and auditory systems, the so-called magnocellular pathways.

• A team of neuroscientists at the University of Helsinki also found that **audiovisual aids can lessen dyslexia**, according to a report in the August 28 issue of the *Proceedings of the National Academy of Sciences.* In each training session, children played a computer game in which sequences of 3 to 15 sounds were represented on the screen as horizontal sequences of rectangles. Sounds that increase in pitch, for example, were symbolized by rectangles that ascend like steps, longer-lasting sounds appeared as longer rectangles, and louder sounds as thicker rectangles. Such audiovisual training yielded substantial improvement on tests of spelling and reading speed and comprehension.

• By exploiting the properties of **surface acoustic waves** (SAW) at short distances and the high resolution of an atomic force microscope, researchers at Stanford University and the Paul Drude Institute in Berlin have developed a technique to study elementary wave phenomena at the highest resolution ever, according to a report in the July issue of *Physics World*. SAW devices consist of so-called interdigital fingers that are made by depositing structures onto piezoelectric materials using lithography. When a radio-frequency electric field is applied to the fingers, they launch a SAW that is received by another pair of fingers. Atomic force microscopes (AFM) can produce images of a material with atomic resolution by scanning the surface with a sharp tip that is a few nanometers wide and attached to a cantilever.

The Stanford-Berlin team has used the nonlinearity of the force acting between the tip and the surface, allowing two waves from the interdigital fingers to be mixed, so that higher frequencies can be detected. The difference frequency can be tuned so that it lies just below the first resonant frequency of the cantilever. If one signal is kept constant, it is possible to detect the amplitude and phase of a high-frequency signal. By observing ultrasonic scattering from small objects, the researchers demonstrate that the technique has high spatial resolution, a new and attractive feature. This new acoustical imaging technique should help scientists to understand the macroscopic elastic properties of composite materials and also shed light on the elasticity of biological materials.

• By using pulsed laser light to produce single bubbles in water and observing them with an intensified charge-coupled device (ICCD) detector as they grow and then collapse, physicists at the University of California have established a link with **multiple bubble sonoluminescence** (MBSL) that may help to understand the latter, according to a paper in the 21 May issue of *Physical Review Letters.* A Nd:YAG laser having a wavelength of 1064 nm produces pulses with a maximum energy of 600 mJ needed to cavitate a pure water sample. The bubbles grow to as large as 2 mm, collapse, and produce light with a spectrum equivalent to a black body with a temperature of 7800 K. In light from the larger bubbles, an OH* molecular band appears, similar to that observed in multibubble sonoluminescence, which can also have bubbles in the millimeter range.

• **Molecular sensing in hearing and balance** is reviewed in an *insight* feature in the 13 September issue of *Nature*. The brief article from the National Institute on Deafness and Other Communication Disorders points out that 28 million Americans are deaf or hearing impaired, making this the third most common chronic condition affecting the elderly. Vestibular and/or balance problems are reported in about 9% of the populations who are 65 years of age or older. Fall-related injuries such as hip fracture are a leading cause of death and disability in the elderly population, and many of these are related to balance disorders. Recent studies in hearing and balance have led to major advancements in our understanding of the signal transduction processes in the auditory and vestibular systems. Hair-cell stereocilia in the cochlea can be viewed as true molecular sensor organelles. Although the exact sequence of events is not well understood, regulation at the level of the hair cell may involve the membrane protein prestin, a novel protein with shared homology to another protein, pendrin, a member of a family of sulphate/anion transport proteins.

• A hundred-year-old **speech machine**, constructed by Dr. Marage in 1901, is pictured in the October issue of *Scientific American*. The apparatus apparently consists of reproductions of the human mouth pronouncing five vowel sounds. "Not

Scanning the Journals

only the larynx but also the cheeks play an important part in the production of sound, adding the harmonies which give the voice its character," an excerpt from the October 1901 issue reads.

- Seismological studies of the Earth's solid inner core have revealed that **compressional waves** traverse the inner core faster along near-polar paths than in the equatorial plane, according to a paper in the 6 September issue of *Nature*. Calculations based on a simple model of polycrystalline texture accounts for this inner-core anisotropy.
- **Cochlear implants may improve vision** along with hearing, according to a paper in the June issue of *Neuron*. Researchers at the Goethe University in Frankfurt compared 18 adults for up to 3 years after they received cochlear implants with 18 volunteers having no hearing problem. Positron emission tomography (PET) scans showed that several brain regions in the auditory cortex that deal with incoming sounds become more active the longer people use implants, as expected. However, meaningful sounds also yield reactions in the visual cortex of implant users. The researchers conclude that perception isn't grounded in simply seeing what is visible or hearing what is audible. Interactions across sensory receiving areas in the cortex may be more widespread than previously suspected.
- Scientists at Oxford University have found **a gene that underlies speech and language**, the first to be linked to this uniquely human faculty, according to a paper in the 4 October issue of *Nature*. The gene was discovered through study of a large family, half of whose members have trouble pronouncing words properly, speaking grammatically and making certain fine movements of the lips and tongue. It was observed that all the affected members have inherited a mutation in a specific gene. The carriers of this variant gene resemble other people who have language impairments. The newly discovered gene which can be compared with the counterpart gene in chimpanzees, may enable geneticists to test whether a specific genetic change produced the modern human brain and made language possible. The discovery may also help answer the vital question of when language evolved, and whether the power it gave modern humans was the primary reason they flourished around the world.
- The July/October issue of *Pour la Science* (French edition of *Scientific American*) is devoted to **sound**, including articles on sound emission, sound imaging, and applications of sound. The introduction is by Jean Kergomard, and authors include Seth Putterman, Steve Garrett, Scott Backhaus, and other names familiar to *ECHOES* readers.

We hear that...

- **William Yost** has been appointed Associate Vice President for Research and Dean of the Graduate School at Loyala University in Chicago. He was formerly Director of the Parmly Hearing Institute and the Interdisciplinary Neuroscience Minor at Loyola.
- **Jan D. Achenbach**, McCormick School Professor, Center for Quality Engineering and Failure Prevention, Northwestern University, received the 2001 William Prager Medal in Solid Mechanics from the Society of Engineering Science.
- **Dan Russell's** website was written up in the "Netwatch" section in the 31 August issue of *Science*. The address of his website is www.kettering.edu/~drussell/demos.html. More acoustics demonstrations can be accessed from Dan's homepage www.kettering.edu/~drussell.
- The ASA **Standards Office** has moved from Wall Street in Manhattan to a new office at 35 Pinelawn Road in Melville, about a mile from ASA headquarters in the AIP building.
- The booklet ***Classroom Acoustics*** is now in its third printing, and a second edition is being considered.
- Plans are being made for the ASA's **75th anniversary meeting** in New York City, May 24–28, 2004. The meeting will be held in the Sheraton Hotel in midtown New York with a possibility of an opening or closing session in Carnegie Hall nearby. The officers and planners welcome ideas for this special celebretory meeting, ASA's first meeting in 30 years in the Big Apple, where it was founded in 1929.
- Newly elected officers of the International Commission for Acoustics (ICA), elected at the General Assembly in Rome in September, include: President: **Gilles Daigle**; Secretary-general: **Suk Wang Yoon**; Treasurer: **Volker Mellert**; and Past President: **Lawrence Crum**. They will serve until the next ICA meeting in 2004.
- **Paul Schomer** has been selected to be the new Managing Dirctor of the Institute of Noise Control Engineering (INCE-USA).
- **Sadaoki Furui** has received the Mira Paul Memorial Award from the Acoustical Foundation of India, recognizing his work in speech analysis and recognition.
- Reports from chairs of the 14 ASA technical committees appear on pages 1215–1222 of the September issue of *JASA*. Each report covers a wide range of activities and recognizes contributions by many ASA members.

Acoustics in the News

- James Sabatier and his colleagues are using a laser Doppler velocimeter to monitor World Trade Center Building 4 for possible shifts in motion that could signal its collapse, according to a story in the September 27 issue of the *New York Times*. So far the instrument is showing a movement of only about 100 microns, according to Sabatier, which is well below the danger level. The smoke-blackened nine-story building is being monitored night and day, however.

  Sabatier, a physics professor at the University of Mississippi, is on sabbatical leave and is working at the Army Night Vision Electronics Sensors Laboratory in Fort Belvoir, Virginia. The army flew him and his velocimeter in a helicopter from Fort Belvoir to Battery Park City, south of the disaster site, on the evening of September 11. He set up his equipment on Church Street about 50 yards from Building 4, and since then he has been working 12-hour shifts monitoring the equipment, which is powered by a gasoline-driven generator. The laser-based device monitors the back-and-forth motion of the building, directing its laser beam off a spot about a third of the way up the façade. Although the vibrations so far have been limited, that may change as heavy equipment begins to clear debris closer to the building. "By this close, constant monitoring, we can let the engineers know immediately if there are any big changes in the frequency and amplitude of the oscillation," Sabatier said.

- Normal hearing aids amplify sound but they provide little information about where the sound is coming from. According to a story in the 27 September online edition of the *New York Times*, however, a research team at the Orebro Medical Center in Sweden has developed a sound localizer that helps people sense the direction from which a sound is coming. The device is a combination of microphones and vibrators fitted onto a pair of eyeglasses. Sound waves picked up by the microphones are analyzed by a device that computes the direction of the a sound source and sends a signal to two vibrators attached at each side of the eyeglass frame. The vibrators touch each temple so that the user can sense the direction from which the sound is originating. A short pulse in the left vibrator means the user should look to the left; a long pulse on the same side means the user should look behind the left shoulder. Other codes indicte sounds coming from directly ahead and behind.

  The researchers are now working to equip the sound localizer with the ability to identify individual sounds. The sound of footsteps, for example, might be represented by a specific pattern. "The idea is to use the sense of touch to provide hearing-impaired people with a detailed picture of their environment," said Lennart Neovius, an engineer on the research team.

- Biologists at Carleton University in Ottawa have reported evidence, for the first time, of acoustic communication among caterpillars. A hook-tip moth larva on a birch or alder leaf, when faced with an intruder of the same species, will scrape an oar-shaped appendage on its tail end across the leaf. As the intruder gets closer to the nest, the host caterpillar adds a second noise, tapping its jaws on the leaf. The noise could be heard by researchers from more than 10 feet away, but caterpillars, who have not hearing organs, sense the vibrations transmitted across the leaf. These vibrations are enough to make the intruder back off in just a few minutes.

- Scientists at AT&T Labs have developed a speech synthesizer that can reproduce the voice of anyone who submits to 10 to 40 hours of voice recording, according to a story in the August 9 issue of the *New York Times*. According to the development team, which includes ASA members Juergen Schroeter, Lawrence Rabiner, and Ann Syrdal, the customized voices could even be based on archival recordings. Imagine the voice of James Dean reminding you to wear your seat belt, the news story teases us.

- Researchers at Purdue University have designed a mathematical model that indicates the regions of an automobile tire that emit different sounds when the tire vibrates on a road surface, according to a news note in the October issue of *Scientific American*. So far, the model, described at the Internoise 2001 meeting in the Netherlands, represents only the tire tread band (consisting of the reinforcing belts and tread pattern), but the researchers are working on a more accurate three-dimensional model.

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