The newsletter of
The Acoustical Society of America

ECHOES

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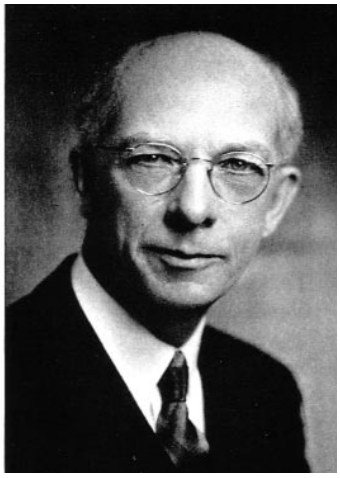
Floyd R. Watson

by Thomas Rossing



Floyd Rowe Watson (1872-1974), a founding member and sixth president of the Acoustical Society of America, is remembered for his pioneering contributions to architectural acoustics, for teaching acoustics to countless students at the University of Illinois, and through his textbooks.

In the summer of 1928, Watson and Wallace Waterfall visited Vern Knudsen at UCLA, and the three of them decided to enlist others in forming an acoustical society. Dayton Miller advised them to include all branches of acoustics. Harvey Fletcher offered to host a discussion at Bell Telephone Laboratories during a December meeting of AAAS in New York to get things moving. The rest, as they say, is history.

Watson was born in Lawrence, Kansas on 23 April 1872, and moved with his family to California. He attended Los Angeles Normal School (later UCLA) and received his bachelor of science at the University of California (Berkeley) in 1899. He was the recipient of several fellowships at Cornell University, where he received his PhD in physics in 1902. He was also married that year to Estell Barden, a mathematics major whom he first met at the University of California.

He joined the physics faculty at the University of Illinois (Urbana), where he rose to full professor of experimental physics in 1917. Much of his early research was on the analysis and correction of acoustical focusing problems arising from concave room surfaces. During World War I he was involved in military acoustical research.

When the Acoustical Society was founded in 1929, the publication of a journal was recognized as an important element in the organization. Watson served on a committee to supervise the publication of the first issue of the *Journal*, which appeared in October 1929 with the constitution and by-laws and the complete texts of papers presented at the first meeting. At the second meeting of the Society, he was appointed as Chairman of the Editorial Board, and he selected the other members (E. C. Wente, P. E. Sabine, H. W. Lamson, F. A. Saunders, and Wallace Waterfall). Waterfall served as Managing Editor until 1933, when the position of Editor was made an elective office, and Watson was elected to this position. He was re-elected in 1936 and continued to serve as editor until 1939.

During his busy architectural consulting career, some of his larger projects were the Purdue Music Hall, Indiana University Auditorium, Indianapolis Coliseum, Eastman School of Music, Tanglewood Music Shed, and the Pentagon in Washington, D.C. When he was over 90, he served as acoustical consultant for the design of Beckman Auditorium at the California Institute of Technology.

Watson was regarded as a great teacher. For many years he taught general physics to all of the premedical and architectural students at the University of Illinois in addition to the acoustics courses that he originated. He also supervised the masters and PhD work of numerous graduate students, including Daniel Martin, who served as ASA president and editor of its *Journal*. One of Watson's undergraduate students wrote that "many shared moments of a long friendship come to mind in illustration of the direct impact he had on individuals near him." Wallace Waterfall, another student, wrote that "no other one man has had a greater influence on my own life than Professor Watson and all of that influence has been good."

He was elected to fellowship in the American Physical Society as well as the Acoustical Society of America, which also made him an honorary member in 1954 at the 25th anniversary meeting. In 1959 he was awarded the Wallace Clement Sabine Medal for his pioneering research in archi-

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We hear that...

• **Peter A. Lewin**, Fellow of ASA and the Richard B. Beard Distinguished University Professor, Drexel University, was elected to the Steering Committee of the World Federation on Ultrasound at the World Congress on Ultrasound (WCU) meeting in Paris in September. He replaces Walter Mayer of Georgetown University. The next WCU meeting is scheduled for Beijing in September 2005.

• **Brandon Pletsch**, iMed Studios, won first place in the multimedia category for a presentation entitled "Auditory Transduction" in the first annual Science and Engineering Visualization Challenge sponsored by the National Science Foundation and *Science* magazine. Pletsch began the animated video when he was a medical illustration student at the Medical College of Georgia. He dissected the outer, middle, and inner ear of a human cadaver in his anatomy courses and built a physical model so he could map which frequency ranges hit which parts of the basilar membrane. The video is accompanied by Beethoven's Ninth Symphony, and snatches of the music trigger movements of each ear part.

• New associate editors of *JASA* include **Shira L. Broschat** (Underwater acoustics), **John B. Schneider** (Computational acoustics), **Edmund J. Sullivan** (Signal processing in acoustics), **Alexandra I. Tolstoy** (Underwater acoustics), and **Sean F. Wu** (General linear acoustics).

Feast to famine

The Summer issue of *ECHOES* had plenty of material, including 5 interesting letters to the editor, to fill 12 pages. That was a feast for the Editor. Then famine struck. One week prior to the deadline for this issue, we had no letters to the editor, only one contributed article, and even the cover biography on Floyd Watson, promised some months ago by a prominent architectural acoustician, was not being written. With help from Elaine Moran (who searched the ASA archives) and Uwe Hansen (who made a trip to the University of Illinois library) we were able to collect enough material for a biography to fit in to our series on "Founders of the ASA," begun in the first 2003 issue in anticipation of our 75th anniversary in 2004. We also made good use of biographical articles on Watson in *JASA* by Daniel Martin (1974) and Vern Knudsen (1960).

Our president, Ilene Busch-Vishniac, deserves thanks for writing a president's message on very short notice. And of course Ben Stein and Charles Schmid, as always, supply us with news notes about acoustics. It's good to have friends!

ECHOES

Newsletter of the Acoustical Society of America

Provided as a benefit of membership to ASA members

The Acoustical Society of America was organized in 1929 to increase and diffuse the knowledge of acoustics and to promote its practical applications.

Echoes Editor . . . . . .Thomas Rossing
ASA Editor-in-Chief . . . . . .Allan Pierce
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The Sounds of Change

By Ilene Busch-Vishniac

When I first joined the Acoustical Society of America as a graduate student at MIT, I was struck by the breadth of the Society. My experience had been limited to architectural and engineering acoustics, and it was enlightening to be introduced to the many other facets of our wonderful field.

In the years since my graduate student days, a good bit about our Society has changed. Our domain has expanded and shifted in emphasis, and acoustics products I never could have imagined (such as the cochlear implant) have become common. We now have more ASA meetings jointly with sister societies, and we sponsor many smaller, focused meetings. *The Journal of the Acoustical Society of America* has grown in topical coverage, and we've added electronic archives and a related on-line publishing forum.

What grabs my attention as much as the change in the Society is what hasn't changed. When I joined the ASA I was struck by the deferential treatment of students and the general warmth of the membership. I learned quickly that the ASA functions through the generous contribution of time and expertise of its members. I also found it was common at meetings for members to trot from one session to another to hear papers on widely varying topics. These defining characteristics of the ASA continue to be our greatest assets.

Next year, in which we will mark our 75th anniversary as a professional society, is a good time to pause and reflect on change and to ask if we are responding to it appropriately. Past President Richard Stern started our thinking about the future, and I've asked him to continue this effort as we engage as a Society in reflection. Two questions that I would particularly like to see us discuss are the following: Are we providing the appropriate services for our members today, and are we establishing ourselves or maintaining our role as leaders in all aspects of the profession of acoustics?

The first of these questions gets to the heart of what we do as a society. We must, ensure that the added value of membership in the ASA far exceeds its cost. Of course, we must balance desires by fiscal realities, so that the future generations of acousticians will be able to count on the existence of the ASA. And naturally, we must not compromise those characteristics we wish to preserve.

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Watson

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tectural acoustics which established criteria for acceptable reverberation in auditoria and stimulated the development of widely used acoustical materials, and for his services as Editor of the *Journal*.

In 1923 he was the author of *Acoustics of Buildings*, the first integrated book on this subject, and went through three editions. He also wrote a book on *Sound* and wrote the article on "Acoustics of buildings" for the *Encyclopedia Britannica*. He was the author of 135 publications, almost all of which he was the sole author. His list of publications would have been considerably greater if he had not adhered to his policy of having his students publish under their own names only.

Floyd Watson, Vern Knudsen, and Wallace Waterfall, three ASA founders (1964). (Courtesy of U. Illinois Archives).

When he was 97 years old, he wrote an informal autobiography which began, "This is an informal account of the early years of my life from birth to age 97 years. The account of later years will have to wait for another time." He recollects that "When I was a junior (at Los Angeles Normal School), Professor Slate, chairman of the Physics Department asked me to be a laboratory assistant. I accepted with all the alacrity that dignity would allow. The position paid $43 a month which took me out of the prime poverty class."

After he received his PhD from Cornell in 1902, he looked for a job. In his own words, "With the degree completed, the next goal was a job—preferably at a university. I found out such a job was open in the Physics Department at the University of Illinois and applied. The application was favorably received, and I was told there was a very good chance of being appointed to the position but that I must have a face-to-face conference with the chairman of the physics department, Prof. Albert Carman. Fortuitously, he was coming through New York state by train, and I was invited to board the train at Syracuse, confer with him for the hour's ride to Utica, and receive my answer by the time the train arrived at Utica. With a very small fund of cash, I bought a roundtrip ticket from Ithaca to Utica, rode to Syracuse, transferred to Prof. Carman's train, and conferred with him. He favored my appointment but said it would have to be approved by President Draper of the University, who was at Lake Mohonk, only a stagecoach ride from Utica. I didn't have the money for the stagecoach ride. I presented my dilemma to Prof. Carman, and he loaned me fiften dollars and wrote a letter of introduction to President Draper, including his recommendation for appointment. Armed with this letter, I made the trip to Lake Mohonk. President Draper saw me and confirmed Prof. Carman's recommendation."

This "job" developed into a position which lasted for 38 years. Most of Watson's early students were in the College of Engineering of which Physics was a part. He developed demonstration experiments with which to enhance his lectures. He developed a ripple tank in which a series of puffs of air on the surface of mercury started waves. To visualize the waves, flashes of light were shined on the mercury surface. "By this device, reflection of waves and other effects could be illustrated." Nowadays we prefer water to mercury in our ripple tanks!

For one year Watson was an assistant dean, but he decided his interests were in research and teaching, so the Dean of Engineering relieved him of administration and reduced his salary.

Watson always maintained a friendly interest in the work and welfare of his graduate students. "Choosing one's life work is not easy and is much of an adventure," he told them. He emphasized to his students the importance of ethics, professionalism, and (of course) of participation in the Acoustical Society. Leo Beranek, who roomed with son Robert at Harvard, remembers Watson as a "generous, kind person." "When he learned that Harvard's acoustics professor F. V. Hunt, had employed me half-time as his research assistant, he said I must go to Acoustical Society meetings. He paid for my transportation, hotel bills and registration fees for three years."

ASA in Longhorn land

Members of the Technical Program Organizing Committee for the Austin meeting

The Acoustical Society will return to Austin, Texas for the fifth time November 10-14 for its 146th meeting. More specifically, the meeting will be at the Renaissance Austin Hotel, which is located in the scenic hills of northwest Austin, with shops, restaurants, and jogging paths nearby. Austin, the capital of Texas, is the home of the University of Texas, as well as numerous museums and galleries. It calls itself the "live music capital of the world," although in November more local attention may be directed toward the U. of T. Longhorns football team.

The first Austin meeting in 1954 occurred just 5 months after the gala ASA 25th anniversary celebration in New York (which included a performance by the Radio City Rockettes). This time Austin has upstaged New York by scheduling a meeting 6 months before the gala 75th anniversary in the Big Apple.

The Austin meeting will include 38 special sessions on such diverse subjects as the acoustics of gas-bearing sediments, sound quality, pianos and bowed strings, and the acoustics of bubbles. The contributions of two Texas acousticians, Elmer Hixson and David Blackstock, will be honored, as will those of Gabriel Weinreich, University of Michigan. Analysis of community response to transportation noise will be discussed in a distinguished lecture by Sanford Fidell, and a "hot topics" session will focus on Acoustical Oceanography, Musical Acoustics, and Noise.

A tutorial presentation on Classroom Acoustics will be given by Peggy Nelson on Monday, 10 November at 7:00 pm. A short course on Time Reversal (Sunday afternoon and Monday morning) will be led by Mathias Fink and William Kuperman, while a Forensic Acoustics seminar with 5 presenters will take place on Friday.

Lest all work and no play make us dull acousticians, the social program will include 2 buffet socials, a concert, and several luncheons, including the Fellows luncheon with Nobel laureate Steven Weinberg as speaker. A Fellows' Hospitality Suite will be open on Tuesday afternoon, 11 November, and the instrument and equipment exposition will open with a reception on Monday evening, 10 November. The University of Texas Wind Ensemble will give a concert presentation at 5:00 pm on Tuesday. A hospitality room for accompanying persons will be open 8:00-11:00 each morning where information about activities in and around Austin will be provided. Students are invited to attend the student reception and to meet one-on-one with ASA members over lunch.

Memories of the 25th anniversary meeting

Exhibitors

146th Meeting of the Acoustical Society of America

EXHIBITOR PROGRAM

Renaissance Austin Hotel
Austin, Texas
November 10 - 12, 2003

Monday, November 10: 5:00 p.m. to 7:00 p.m.
Tuesday, November 11: 9:00 a.m. to 5:00 p.m.
Wednesday, November 12: 9:00 a.m. to 1:00 p.m.

We invite all attendees of the 146th Meeting of the Acoustical Society of America to participate in the ASA Exhibition by visiting the exhibits. The exhibition will include computer-based instrumentation, sound level meters, sound intensity systems, signal processing systems, devices for noise and vibration control, and other exhibits on acoustics.

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Hypocycloids and global sound propagation

By Michael Longuet-Higgins

(extracted from the author's reply at the ASA awards ceremony, 1st Pan-American/Iberian Meeting on Acoustics, 2-6 December 2002 in Cancun, Mexico)

Among my early mentors I would like to mention, in particular, my high-school math teacher, C. V. Durell. Durell would have made a distinguished professor at the average university, but instead he devoted his life to raising the standard of mathematical instruction in British high schools. He strove successfully to enlarge the interests of his students. For instance, in 1924, shortly after Einstein's prediction of the bending of starlight by the sun's gravity had been confirmed by observation, and at a time when only a handful of people understood what it was all about, he brought out a popular and concise introduction called *Readable Relativity*. He had developed the book with the aid of his math class. Today it is still one of the best introductions to relativity for the general public to be obtained anywhere[1].

What did this have to do with my research? Well, when I was 16, working from his textbook on geometry I rediscovered a beautiful theorem on the triangle. It goes like this.

Suppose you have a triangle ABC of any shape whatever. You can, of course, always draw a unique circle through the vertices; see Figure 1. Now take any point *P* whatever on the circumference of that circle and draw the perpendicular from *P* to each side. It is a simple exercise to show that the feet *L, M, N* of the three perpendiculars always lie on a straight line, called the *Simson line* of the point *P*. A question that bothered me was: Suppose you move P around the circle, keeping ABC fixed. What is the envelope of all the Simson lines? In other words, what curve do they all touch?

The amazing answer, it turned out, was that they all touch a *regular 3-cusped hypocycloid*, namely the curve traced by a point on a circle which rolls round the inside of another circle 3 times as large; see Figure 2. The 3 cusps of course are at angular intervals of 120º, whereas the original triangle was of any shape, not necessarily equilateral.

When I took this result proudly to Durell, he wrote to a university colleague, Professor Neville at Reading, who replied that it had been discovered in the 19th century by the great Swiss geometer Jakob Steiner, and is sometimes called Steiner's hypocycloid. In his letter, Neville advised me not to get diverted from mainline research by such a distracting sideline, but Durell himself told me not to worry.

That episode was in fact good preparation for a later discovery in oceanic or atmospheric sound propagation. In 1987 Walter Munk, another of my mentors, instigated an underwater explosion near Heard Island in the southern Indian Ocean. The sound was received near Bermuda, close to the antipodal point of the Earth's surface; not precisely at the antipode because the sound rays were deflected owing to the Earth's ellipticity and other factors. Walter then posed the following

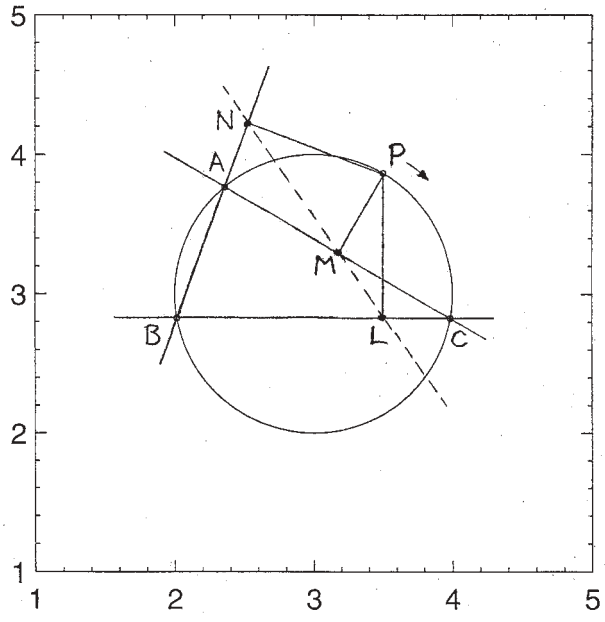


Figure 1. The Simson line (shown dashed) of an arbitrary point P on the circumcircle of a triangle ABC.

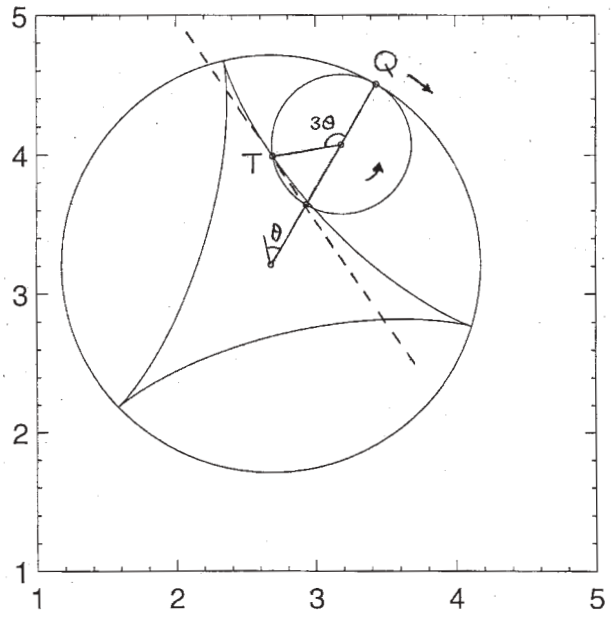


Figure 2. The envelope of the Simson lines of ABC (the Steiner hypocycloid).

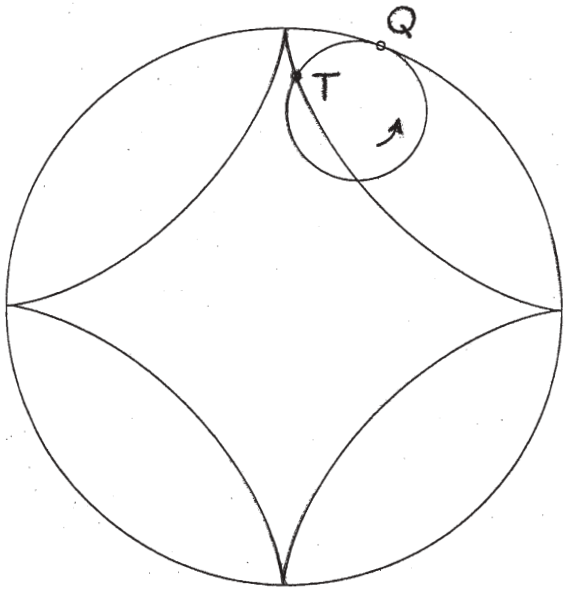


Figure 3. Envelope of the ray-paths near the antipodal point P from a source P on a slightly oblate spheroid.

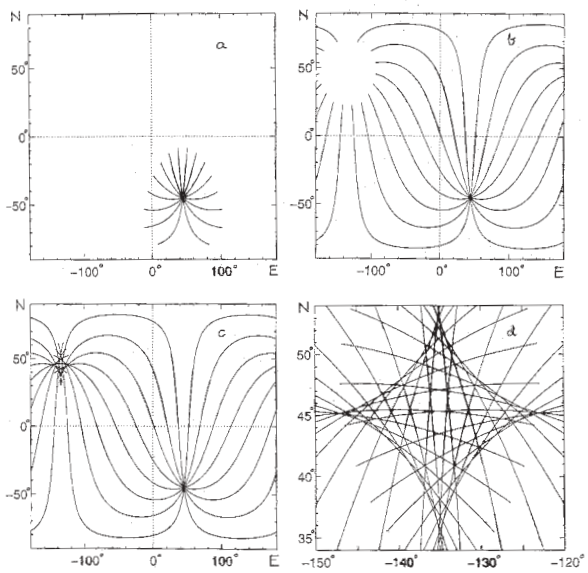


Figure 4a to 4d. Ray-paths (geodesics) from a point source on an oblate spheroid, ellipticity 0.1. Coordinates are longitude and latitude.

problem: What is the *envelope* of the sound rays emitted by a point source on a slightly oblate spheroid (the Earth's ellipticity is about 1/300). In other words, what is the form of the *caustic curve* near the antipode?

To my surprise I found geometrically that the caustic curve is in fact a *4-cusped hypocycloid*, i.e., a curve traced by a point on a circle which rolls inside another circle *four* times as large; see Figure 3. We may call this a *4-star* or asteroid[2]. Just recently I thought I should test this theoretical conclusion by numerically constructing the geodesic curves emanating from a given point on a slightly oblate spheroid having ellipticity 0.1. The result is shown in Figure 4 on a Mercator-like projection. In frames 4a, 4b, and 4c you see the rays spreading outwards from the source. The fourth frame, Figure 4d, is an enlargement of the area near the antipode, showing that the caustic is indeed a 4-star. Inside the locus, and especially close to it, the received sound intensity should be comparatively high.

[1] American edition reprinted by Harper and Row, New York (1960).
[2] *Proc. Roy. Soc. Lond.* **A428**, 283-90 (1990).

President's Message, *continued from page 2*

The second of the questions relates to serving the world outside of our society. This question is meant to ask how best to establish or maintain ourselves as the "go-to" organization for everything related to acoustics, and how we can best lead professionally. The Society's recent work on the classroom acoustics standard is a wonderful example of what I mean by professional leadership. Over several years, a large group of ASA members worked to produce a first ever standard for classroom acoustics, which spells out in clear terms the requisite environment for student learning. The importance of this effort was brought home by the legal challenges to the standard, all of which the standard survived. As a direct result of this work, we might well find long overdue improvements in classrooms nationally. Thus our members led by using their technical expertise to make the world a better place. My question asks if there are other opportunities for us to do the same.

We will certainly create many opportunities for members and friends of the ASA to participate in our process of reflection on the future. And of course, we won't let our 75th anniversary be marked only by thoughts of the future – we will also celebrate our past. The Spring ASA meeting in New York City will include a full day dedicated to a celebration of our birthday with talks, music, tours, a banquet, and many other special events. Please plan on joining me at our upcoming meetings in Austin and New York.

Ilene Busch-Vishniac is the current ASA president. She is a Professor of Mechanical Engineering at Johns Hopkins University in Baltimore, MD where from 1998-2003 she served as dean of the Whiting School of Engineering. Her degrees are from the University of Rochester and MIT, and she held positions at Bell Laboratories and The University of Texas, Austin.

Scanning the Journals

Thomas D. Rossing

• A simple experiment to illustrate **acoustic source radiation** near a large wall is described in the August issue of *American Journal of Physics*. An acoustic simple source is predicted to radiate twice as much sound near an infinite rigid wall as it does in free space due the fact that outgoing waves reflect from the plane and appear to eminate from an image source behind the plane. When the source is close to the plane the total amplitude of the outgoing waves is doubled so the intensity is quadrupled. This can be illustrated with a tuning fork and resonator box. A microphone inside the resonator box is used to determine the effective damping due to radiation.

• People speaking **English as a second language** find each other just as intelligible as do native English speakers, according to a paper in the 8 September issue of *Nature*. The effect works regardless of the speaker's mother tongue. One might suspect that only some languages, like Korean and Chinese, or Spanish and Italian, share sounds that help their mutual intelligibility, but that doesn't appear to be so. Instead, there may be features of the target language that all non-natives omit. American English speakers often fail to sound consonants at the ends of words clearly, for example, making it hard for non-natives to tell one word from another.

• "Subjective Rank-Orderings and Acoustical Measurements for Fifty-Eight **Concert Halls**" is the title of a paper by Leo Beranek in the May/June issue of *Acta Acustica/Acustica*. Based on interviews of conductors, music critics and music aficionados, the halls are rank-ordered according to their acoustical quality. The objective quantities that correlate best with the subjective orderings are BQI (Binaural quality index), EDTmid (early decay time), G125 (strength factor at 125 Hz), SDI (surface diffusivity index), and ITDG (initial-time-delay gap) in that order.

• Abstracts of nearly 500 papers presented at **EURONOISE 2003** are included as a supplement to the May/June issue of *Acta Acustica/Acustica*. The conference was held in Naples, Italy.

• **Quasi-nonpropagating wave sources** in one dimension are discussed in a paper in the August issue of *American Journal of Physics*. The simplest case is a two-point source, which can be defined as an extended source that consists of point drives having the same amplitude, frequency, and phase and appropriately spaced. Complete destructive interference occurs outside the source if there is an odd number of half-wavelengths between the point drives. In realistic situations, small amplitude waves emanate from the driven region, and the source can be described as quasi-nonpropagating.

• The acoustics of three **Australian Aboriginal musical instruments** (The didjeridu, the bullroarer, and the gum-leaf) are discussed in a paper in the August issue of *Acoustics Australia*. The didjeridu is a simple lip-blown wooden tube, which depends upon controlled resonances of the player's vocal tract. The bull-roarer is a wooden slat whirled in a circle on the end of a cord to produce a pulsating roar. The gum-leaf is a leaf from a Eucalypt tree held against the lip as it is blown. The pitch is controlled by vocal tract resonances and is typically about an octave above the female singing voice.

• **Reversed echoes** may fight disease or foster communication, among other things, according to an article in the March 15 issue of *Science News*. Physicists in Europe and the United States have created environments in the laboratory and underwater that exhibit reversed echoing. Sounds are directed to computerized microphone-loudspeaker units that return them in a time-reversed order. The technology shows promise for such a wide range of uses as shattering kidney stones, tracking submarines, and broadcasting different translations of a speaker to different listeners sitting side by side. It's as if ripples formed in a pond by dropping in a pebble collapse back onto the pebble, one researcher observed.

• The Power of Speech is the title of a review article in the 12 September issue of *Science*. In the next few decades, we will be able to control virtually any device in the home by issuing voice commands such as "find me a good classical music station." Speech and language processing is crucial for seamless user access to new and advanced services. The article reviews speech coding, text-to-speech synthesis, automatic speech recognition, spoken-language understanding, and speaker verification systems. Making the user interface between humans and machines as easy to learn as voice telephony is today will require methods ranging from advanced statistical models to machine learning and adaptation.

• **City songbirds** that stake out territories near loud traffic tend to pitch their songs higher than do birds in quieter neighborhoods, according to a report in the 17 July issue of *Nature*. Recordings of a common European species, the great tit, showed a higher minimum frequency in the noisier parts of Leiden in the Netherlands. In the loudest places, engine roars overlapped the lower frequencies of the tits' songs. In such noisy areas, the higher-pitched songs may be more effective in deterring rivals, and these are the songs that the young males are more likely to copy.

• Although acoustics is one of the oldest branches of physics, the question is still raised whether acoustics is a **science or an art**, according to an article in the Spring issue of *Radiations*. The effect of a concert hall on music goes beyond those moments when it links an inspired performer with an eager audience. The design of enclosures and the composition of music have had a dramatic influence on each other. For example, in medieval cathe-

Scanning the Journals

drals with their long reverberation times, music must be played slowly, and organists such as Gabrieli wrote music accordingly. In the Baroque period, music was written to sound good in small chapels with shorter reverberation times.

• Musical taste, rather than geography, may have split Africa's **indigobirds** into multiple species, according to a paper in the 21 August issue of *Nature*. A new analysis gives a genetic underpinning for that idea.

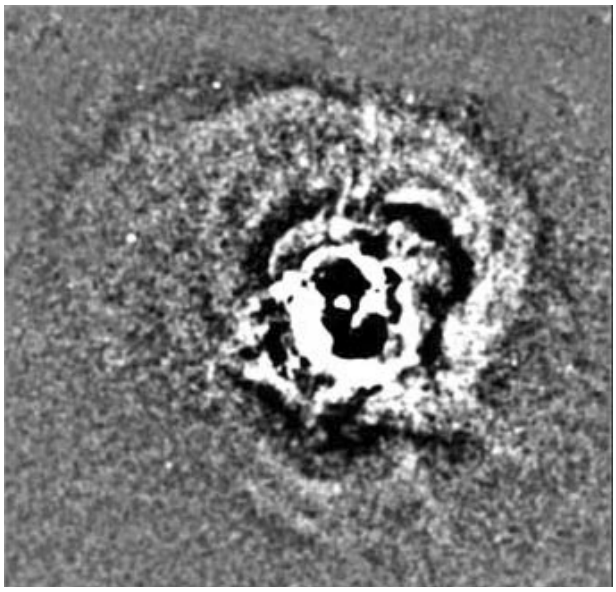
• By using a virus to deliver a gene into the inner ear, scientists at the University of Michigan have coaxed the ears of adult guinea pigs to sprout new hair cells. According to an article in the June 7 issue of *Science News*, this is thought to be the first time that anyone has shown new hair cells can be grown in a mature mammalian ear. Although it hasn't yet been determined whether the **new hair cells** detect sound or properly connect to the brain, the success of the work suggests that it may one day lead to treatments for many types of hearing loss, including that experienced by elderly people.

• Some applications of digital signal processing to hearing accessibility are reviewed in the September issue of *IEEE Signal Processing* magazine. The applications discussed are hearing aids, directional microphones, automatic speech recognition, and cochlear implants. "Dead ends" and future challenges are also discussed in this review.

Acoustics in the News

• Using NASA's Chandra X-ray Observatory, astronomers have for the first time detected "sound" waves from a supermassive black hole, according to an August 9 NASA news release picked up by a large number of newspapers. A 53-hour observation of the central region of the Perseus galaxy cluster has revealed wavelike features that appear to be sound waves. [photo] Emanating from a black hole 250 million light years from Earth, the "note" is the deepest ever detected from an object in the Universe. The ripples are separated by about 35,000 light years.

The image also shows two vast, bubble-shaped cavities, each about 50,000 light years wide, extending away from the central black hole. These cavities are filled with high-energy particles and magnetic fields which push the hot x-ray emitting gas aside, creating density fluctuations or "cosmic sound waves."



"Sound waves" from a black hole 250 million light years away (NASA photo).

• British scientists added infrasound to four pieces of contemporary music at a London concert hall and asked the audience to describe their reactions to the music, according to a story carried on 7 September by Reuters. The audience did not know which pieces included infrasound, but 22 percent reported more unusual experiences when it was present in the music. Their experiences included feeling uneasy or sorrowful, getting chills down the spine, or nervous feelings of revulsion or fear. (Eds note: Unfortunately the story does not indicate the level at which the infrasound was presented).

• A federal judge in San Francisco said a permanent injunction should be issued to bar the Navy from using sonar in about 40 percent of the Pacific Ocean, according to a story in the August 27 *San Francisco Chronicle.* The Navy's sonar plan doesn't comply with three federal statutes, Judge Laporte found, citing provisions in the Marine Mammal Protection Act, Endangered Species Act and National Environmental Policy Act. Despite the judge's ruling, Congress is considering legislation that would allow wider use of sonar technology.

• More than 200 researchers gathered at the University of Maryland for the first international conference on Acoustic Communication by Animals, according to a story in the August 3 *Toronto Star*. The scientists discussed the sounds made by scores of different animals ranging from killer whales to grasshoppers. The conference heard that elephant foot-stomping can send seismic warnings that other ele-

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Acoustics in the News

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phants can detect more than 30 kilometers away, three times farther than their trumpet calls carry. Birds hear parts of their songs that are too subtle for human ears, but it's unclear whether they actually use this hidden information.

Several of the speakers were also featured in an interview on National Public Radio's "All Things Considered" on August 4.

• A study by a team of British and Spanish researchers has shown that powerful underwater sonar can create tissue-destroying gas bubbles in the vital organs of whales and other marine animals, according to a story in the 9 October issue of the *San Francisco Chronicle*. An international naval exercise in the Atlantic Ocean about a year ago caused the stranding of 14 beaked whales on beaches in the Canary Islands. The most likely explanation for the bubbles found in the beached whales, said the scientists, is that the sonar impulses created the bubbles directly in nitrogen that were already suffusing their tissues. Although deep-diving marine mammals do not get the bends because their lungs collapse and expel gases as they dive, the bubble damage appeared to be similar to the damage suffered by divers when they suffer the bends.

• The US Navy has agreed to limit the use of its new underwater sonar to small areas of the far western Pacific Ocean in order to avoid possible harm to whales and other sensitive marine species, according to a story in the 14 October issue of the *San Francisco Chronicle*. The Natural Resources Defense Council and five other groups had sued the Navy in federal court two years ago, charging that the far-ranging sonar system designed to detect and track silent submarines could deafen, disorient, or even kill mammals. The Navy agreed not to test the sonars in areas likely to be visited by the whales during their annual migrations, but it is free to use the system without restrictions if war threatens.

• Using ultrasound to vibrate a section of artery could help to determine the health of a person's circulatory system, according to a TechWatch note in the September issue of *Popular Science*. Researchers at the Mayo Clinic Ultrasound Research Laboratory have developed a system that could be an inexpensive alternative to MRIs.

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