Designing the Sonic Environment

by Bill and Mary Buchen

The soundscape

The term "soundscape," first coined by Canadian author and composer R. Murray Schafer, embraces the relationship between people and communities and their acoustic environments. Because the soundscape is fragile and endangered, urban planners and soundscape designers need to work together to generate social, psychological, and aesthetic solutions to achieve a harmonizing balance in our increasingly chaotic sonic environment.

Like landmarks, certain well known and beloved "soundmarks" are beginning to disappear from our soundscape. For example, when San Francisco changed its foghorn system, people knew that a vital sound was missing from their lives and managed to get the familiar sound reinstated. In the 1980s, the Brooklyn Bridge was paved over and motorists no longer heard the familiar hum as their tires rolled over the oscillating grates. This soundmark was lost forever.

Sonic architecture

The concept of sonic architecture incorporates the aural, spatial, and temporal aspects of a built environment. Archetypes for sonic architecture are found in every culture where people gather to make music, celebrate, or worship. Throughout history, many of the world's cultures have had a special area set aside for the creation of music. These sites have had a distinct relationship to the land and community, taking advantage of natural acoustic spaces and phenomena such as caves, echoing canyons, natural amphitheaters, and rock formations. Examples include the Africans' placement of drum arrays over resonating pits, the giant log drums used by the Colombian Utoto Indians, and aeolian (wind) harps found throughout the world.

The reflective and focusing properties of domes and parabolic forms have been developed over hundreds of years. Greek amphitheaters featured carved parabolic forms behind each individual in the audience. The famous Ear of Dionysius near Syracuse in Sicily may have been the first listening device.

Fig. 1. Engraving of "The Temple of Music," an architectural structure depicting the rules of music. From Joscelyn Godwin. Robert Fludd.
We hear that...

The ASA will bestow high honors on two of its members during the Plenary Session of the upcoming meeting in Indianapolis. The Gold Medal will be presented to Ira Dyer, Weber-Shaughnessy Professor of Ocean Engineering at MIT. Victor W. Sparrow, Assistant Professor of Acoustics at the Pennsylvania State University will receive the R. Bruce Lindsay Award.

At its recent annual meeting in San Francisco, the National Hearing Conservation Association (NHCA) honored two ASA members: Larry Royster was presented with the Award for Outstanding Contributions to the Field of Hearing Conservation, and Elliott H. Berger was given the Michael Beall Threadgill Award for Outstanding Service to NHCA.

The Central Institute for the Deaf (CID) in St. Louis has announced the appointment of Ira J. Hirsh, a past President of ASA and Gold Medal recipient, as an Honorary Member of the CID Board of Managers. In November of last year he was also appointed to the Editorial Board of Audiology, the journal of the International Society of Audiology. Coincidentally, he will celebrate his 50th year as an ASA member.

Editor's note: Out of some 7000 ASA members, it goes without saying that many have been honored in some way over the past few months. Echoes depends upon press releases, reminders by colleagues, and the honorees themselves to let us know about these occasions. Please keep us in mind.

President's Message

Dear Fellow Acousticians:

It is with pleasure and thanks that I share my thoughts with you as my year as President of ASA comes to and end (on May 17). During this year I have chosen to focus my efforts on improvements that will assure that our Society remains the world's premier acoustical organization.

Among those improvements are the many advances in communicating our message electronically, such as the Journal on CD-ROM, abstracts for meetings via e-mail, and the introduction of our World Wide Web Home Page (at http://asa.aip.org/). I am grateful to the many dedicated ASA members whose insight and hard work helped bring about these improvements.

These changes are more than an alternate way to communicate and transfer information. They are transforming the way we think and do business. They provide unique opportunities to use sound, video, computer programs, and other data resources in our publications. They also permit easy communication around the globe, minimizing many logistical barriers to interacting and sharing information.

But these new methods for communicating our message are transcended by the strong traditions of our society. The roots of these traditions extend deep because the commitment is great. And the commitment is great because the creations of our minds are illuminated by the sentiments of our hearts. In a sense, our responsibility as officers, chairs of the many ASA committees, and members of the Society is to nurture these roots as the strong winds of change pass over our limbs, tugging at us in this and that direction. As a buffer against being swept too far, we must configure ourselves as a Society that remains anchored in our mission while meeting the changing needs of our members. We must do all of this while maintaining our financial stability. Quite a balancing act!

This is where you come in: to match the challenges of the future with your creativity, and to match your creativity with your commitment and dedication to work for constructive change in the Society. Thus, your needs for professional enrichment and enhancement are supported and the Society will continue to flourish.

It has been a pleasure to serve the Society, and I look forward to working with you to assure our Society's distinguished future.

Robert E. Apfel
Indianapolis Meeting

The May 13-17 ASA meeting in Indianapolis will feature many interesting sessions, workshops, and events.

World Wide Press Room
ASA will again host its World Wide Press Room on the Internet (http://www.sdrm.org/asa2) for use by the news media, science writers, ASA members, and the general public. This will provide access to ASA meeting press releases, abstracts for all papers to be given at the meeting, and special events (such as concerts, lectures, etc.), as well as information about the Society and the field of acoustics. A laptop computer will be available at the meeting to access both the WW Press Room and the ASA Home Page. Members who would like to have pertinent news items considered for inclusion should contact Paul Baxley (baxley@nosc.mil) or Elaine Moran (elaine@aip.org).

Workshops
As a new development, this year’s meeting will include several workshops in addition to the tutorial, the distinguished lecture, and the short course announced previously in the Call For Papers. These workshops represent an attempt to bring a "small meeting" environment into a big meeting. Some of them have no fixed agenda to allow for plenty of free-ranging discussion. They will be held in the hotel’s Mt. Rushmore room.

A session called, “Speech Communication: Informal Workshop on Voice Perception,” will take place all day on Monday, May 13, beginning at 9:00 am. It is co-chaired by David Pisoni and Jody Kreiman, and its purpose is to bring together researchers working on various aspects of voice perception for an informal discussion of both traditional and recent findings. Anyone interested in speech perception, production, and spoken language processing is welcome to attend, bring slides and overheads, and join in the discussion.

Four sessions on "Physical Acoustics and Bioresponse to Vibration and to Ultrasound: Workshop on Therapeutic Applications of Medical Ultrasound" will be held on Tuesday and Wednesday, May 14 and 15. The sessions are organized by Robert Apfel and Larry Crum and will consist of tutorials, special presentations, and audience participation on topics ranging from the fundamentals of the interaction of ultrasound with tissue to the medical applications of ultrasound. The fourth session on Wednesday afternoon will include a tour to the Indiana University School of Medicine to visit laboratories studying lithotripsy and ultrasound "surgery." In addition to ASA meeting attendees, the organizers have invited several members of the medical ultrasound community.

On Friday May 17, a special seminar entitled "Noise Control: A Seminar for Plant Engineers and Product Designers" will take place from 8:30 am to 4:30 pm. Sponsored by the ASA Technical Committee on Noise, the seminar is intended for people who have had little or no contact with noise control and acoustics. The fee of $50 will cover handouts, refreshments, and administration. The speakers will be ASA members who have volunteered their time and expertise, and topics will include how sound is measured, noise control benefits and case histories, design for low noise and quietness control, and hearing protection devices. Advance registration is required. For further information, contact Luc Mongeau (317) 494-9342 or Elaine Moran (516) 576-2360.

Architectural acoustics events
On the afternoon of Tuesday, May 14, David Lubman will present the Vern Knudsen Distinguished Lecture, "Variance and Invariance in Room Acoustics: A Random Walk Through Reverberant Fields" (2pAAa, also in the Mt. Rushmore room). The lecture is sponsored by the Technical Committee on Architectural Acoustics.

(Continued on page 6)
as pipe organs, water clocks with bell chimes, as well as engravings depicting the tuning of the world and a scientific means of using sound as a warning device for approaching armies. Figure 1 shows an engraving by Fludd of "The Temple of Music," a fanciful architectural structure depicting the rules of music.

**Sound park design**

Built environments, such as urban sound parks, can balance and integrate the landscape, cityscape, and soundscape of a particular site. This is done by researching:

1. The landscape, which includes the climate as well as the surrounding geography (mountain, sea, farmland, forest, etc.).
2. The cityscape, meaning the historical, contemporary, and future use of the site, the cultural traditions of the community, the existing architecture and infrastructure, and the patterns of public movement through an area.

3. The soundscape — This category includes an analysis of the existing sound environment including desirable sounds (noise pollution) as well as sound levels and the distance sound travels over the landscape; an analysis of the site's sonic time cycle, meaning daytime vs. nighttime levels and sound events, such as noon whistles, church bells, and train schedules; the identification of sounds specific to a geographic area, including abandoned soundmarks formerly of importance, like steam trains; and finally the acoustic potential of existing resonant spaces, like natural amphitheaters, underground tanks, and the reflective surfaces of surrounding architecture.

**Projects**

In addition to several other sonic projects, we have designed four sound parks. Two of these have been completed: the "Sound Playground" at PS 23 in the Bronx and "Big Eyes/Big Ears: Science Playground" in Airway Heights, in Washington State. Another sound playground, "Sound Carnival" will be completed in the fall of 1996 at a public school in Brooklyn, NY. In addition, we have designed sound installations for the Socrates Sculpture Park in New York City. A major upcoming project is the Adi Surya Gallery, a listening and exhibition space in New Delhi, India. This project is a collaboration between the Indira Gandhi National Center for the Arts, Peter Panikar, Andres Bossard, and ourselves.

Here are some details on two of the sound playgrounds:

**The Science Playground**

The Science Playground was designed for a park in a small town in Washington. The site is dominated by a huge water tower, with a view of an additional water tower and the Spokane mountain range in the distance. Air traffic from a nearby military facility was an important and unavoidable acoustical factor. The design plan featured an earthen mound, referring to the imagery of both the mountains and the water towers, on top of which were placed four interactive sculptural components. An additional "communication" element is sited 150 feet from the platform. The sculptural components are designed for listening and viewing at different levels and distances.

One of these components is pictured in Figure 2, "Big Eyes/Big Ears," a rotating tower incorporating fixed-focus binoculars. Vertical listening pipes extend high overhead to parabolic "ears," through which listeners can hear the sounds of aircraft and track them as they travel across the sky by rotating the tower.

Another sculptural component is the "Speaking Tube Dishes," two vertical parabolic dishes sited 30 feet apart in parallel alignment. The centers of each dish are connected through an underground pipe. Two people can speak or whisper into the centers of the dishes, which focus and

![Fig. 2. Big Eyes/Big Ears, a rotating tower incorporating fixed-focus binoculars and vertical listening pipes connected to parabolic "ears."](Continued on next page)
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reflect sounds at various points between them, and these points are discovered through experimentation and investigation.

"The Well" is another vertical parabolic dish located away from the platform and connecting through an underground pipe to a horizontal dish on the platform's top and through which "long-distance" communication can take place.

**PS 244 Sound Carnival**

This project is being carried out in association with the architectural firm, Montoya-Rodriguez and the landscape architecture firm, Abel, Bainson and Butz. It is an urban playground for PS 244, an elementary school in the East Flatbush section of Brooklyn, primarily a Caribbean community. Two outdoor playground sites were selected: an inner playground for pre-school through second grade and an outer playground for grades 3-6. Because of the proximity of classrooms and also residential areas, sound levels of the installations have been designed to be no greater than the existing levels of children's voices, and the quality of introduced ambient sounds, such as wind bells, has been designed to be subtle and musical.

The "Sound Carnival" theme was chosen to reflect the culture of the school community, with emphasis on traditions of colorful celebration and communal drumming. Children will investi-

gate acoustical phenomena and music making through direct physical interaction.

The outer playground for children in grades 2-6 features a "Drum Circle," which taps into the reverberant properties of a large underground retention tank for rainwater runoff buried under the site. Sound sculptures include a circular bench made of concrete with pipes embedded within the bench and linked acoustically to the underground chamber. Another component of the Drum Circle is the "echo drums," bronze drums resembling Haitian Bata drums. Children hear the sound of the drums rever-

berating within the chamber through the pipe openings in the circular bench. There are also two stainless steel parabolic reflecting dishes for focusing and reflecting sound waves.

![Fig. 4. Talking Drums/Speaking Dishes, bronze drums and stainless steel parabolic dishes connected through underground pipes.](image)

Steel frameworks mounted on the fences at either end of the playground, supporting polychrome wind bells and small mirrored kinetic elements, serve to celebrate the color and glitter of Carnival. The park features several engaging sound sculptures. A grouping of bronze drums, patterned after traditional Pan-African archetypes, functions both as tables and seats. The Palm Pipes, tree-shaped musical structures are played by slapping open ends of stainless steel pipes embedded in the concrete "trunk" to produce tuned percussive sounds. The opposite ends of the pipes form the curved canopy of the "treetop." By listening to the open ends, children also hear the resonance frequency of each pipe tuned to a different note. The Drum Tables and Seats and the Palm Pipes are shown in Figure 3.

Bronze drums and stainless steel parabolic dishes are connected acoustically through underground pipes (Figure 4) to form the Talking Drums and Speaking Dishes installations. The parabolic dishes focus and reflect sound at the drum players' ears.

An inner courtyard for younger children features a network of curvilinear pipes called the Telephone Tubes (Figure 5), which are connected underground. Children communicate by listening and speaking into the "telephones" through the open ends above grade. The pipes are made of polychrome painted steel and the open ends are capped with perforated stainless steel grates.

**Providing meaningful sound**

In a perfect world there is no noise pollution, but our cities are wrought by sonic disturbance. In our work we endeavor to replace today's cacophony with the perception

*(Continued on page 7)*

![Fig. 5. Telephone Tubes, a network of curvilinear pipes connected underground.](image)
Immediately following the lecture will be "An Afternoon with Leo Beranek" (4:45-5:45 pm) to celebrate the well known architectural acoustician's new book, "Concert & Opera Halls: How They Sound." Published by the Acoustical Society of America, the book represents an update of an earlier book with the addition of a considerable amount of new material and analysis. The event will be a reception and book signing in which the author will give a short talk. ASA members will be able to purchase the book at a discount.

Classroom acoustics receives attention

At the Tuesday evening meeting of the Technical Committee on Architectural Acoustics, there will be a discussion of classroom acoustics, a topic that is beginning to receive serious attention from audiologists and acousticians. The topic will be discussed around 8:30 pm and will be introduced by Buzz Towne, who is concerned that the acoustical environments of today's school children are highly reverberant and not conducive to good speech intelligibility. He believes that professionals in acoustics need to intervene in the current "building boom" to ensure that the acoustical performance of our new classrooms is not still 50 years old.

The topic of classroom acoustics will also be raised in an informal session organized by the Technical Committee on Noise called, "Noise: Progress Report and Discussion on the Continuation of ASA's Role in Noise and its Control," Thursday at 11:00 am to 12 noon.

Music making and deliberating

On Tuesday (instead of the traditional Friday), there will be several technical sessions combined with musical performances, sponsored by the Technical Committee on Musical Acoustics. In the morning there will be a special session devoted to reed instruments, chaired by James Pyne. The morning session will climax at 11:00 am with a discussion and demonstration entitled "I clarinetti virtuosi," featuring the Chamber Ensemble of The Ohio State University. Later that afternoon, at 3:15 pm, the Ensemble will perform a concert designed to display its range of musical and dramatic capabilities, which will overlap the social hour in a manner similar to the steel band concert in St. Louis.

Also, as reported in the previous issue of Echoes, Neville Fletcher will present the ASA Distinguished lecture, "Nonlinear Effects in Musical Instruments," Tuesday at 1:00 pm.

On Wednesday afternoon (2:15 pm), Professor Juergen Meyer of the Physikalisch-Technische Bundesanstalt in Braunschweig, Germany, will give a lecture and demonstration on the influence of directivity on the sound heard by an audience during an orchestral performance. His points will be illustrated by the New World Symphony, a prominent youth orchestra from the Indianapolis area. The one-hour concert and demonstration will take place in the Circle Theater, home of the Indianapolis Symphony, and will precede the Plenary Session (see photo on page 3).

Communicating with Congress

In a January 1966 speech, National Science Foundation Director Neal Lane spoke about the need to communicate with Members of Congress.

"Clearly, this is a time of great challenge for science and technology in America. But, I believe we can seize this time as one of opportunity to work together in ways we have never done before. This is not the time to plead for biology vs. chemistry or astronomy vs. engineering, or even basic vs. applied research or technology. It's a time to speak out about the importance of the Federal investment in science and technology, in research and education, in universities, in national laboratories and other institutions -- and in the partnerships that have been formed with industry and other sectors that use the knowledge and technologies for the public good.

"If you don't take it as one of your professional responsibilities to inform your fellow citizens about the importance of the science and technology enterprise, then that public support, critical to sustaining it, isn't going to be there. Who knows more about science, its complex relationship with technology, the linkage between research and education, the often unexpected benefits to society than you? Who has greater credibility in discussing science than you? Who understands better than anyone the price our nation will pay if we fall behind in science and technology in the effort to downsize government?"

Directory of Graduate Education in Acoustics to be revised

One of the responsibilities taken on by the ASA Committee on Education in Acoustics has been the gathering of data on the status of acoustics education in North America. This activity has resulted in publication of the Directory of Graduate Education in Acoustics every few years. A revision of the most recent Directory [see J. Acoust. Soc. Am., 87, 424-444, Jan. 1990] is planned for 1996. Requests for corrections have been sent to institutions that are currently listed.

Contributions to the revised Directory are now being solicited for active graduate programs in acoustics that were not included previously. Information corresponding to that presented in past Directories is desired on fields of research that are covered, and names and addresses of faculty who may be contacted for further information. This year, e-mail addresses and guidance toward relevant World Wide Web pages should also be provided. Submissions as well as questions should be directed to Dr. Wayne M. Wright, Kalamazoo College, Kalamazoo, MI 49006 (e-mail wwright@kzoo.edu).
One day, long-time ASA member Robert Beyer was chatting with a member from the Optical Society. Bob happened to mention the fact that sound preceded light in the creation of the world.

"How do you know?" asked the Optical Society member.

The reply was, "Well, God said, 'Let there be light.'"

Soundings

NSF provides booklet on science and technology funding

In these days of funding quandaries, current information on national funding patterns can be very useful. The Science Resources Studies Division of the National Science Foundation has put out an updated version of its handbook, "Science and Technology Pocket Data Book: 1994" (NSF 94-323). This small reference book provides a number of useful statistics on science and technology funding patterns from information compiled over the past decade. Topics include: 1993 R&D funding patterns; 1995 Federal R&D budget authority by function: academic R&D expenditures; R&D in U.S. industry by year; education of scientists and engineers; working scientists and engineers; and public attitudes toward science and technology.

The book may be obtained by calling (703)306-1777. Most of the data are also available on the World Wide Web at: http://www.nsf.gov/sbe/srs/stats.htm.

Joint meetings scheduled

Mark your calendar now for these jointly sponsored meetings:

- Dec. 2-6, 1996: 132nd meeting of the Acoustical Society of America jointly sponsored with the Acoustical Society of Japan, Honolulu, HI. Contact John Burgess.
- Feb. 13-18, 1997: Seattle, Washington, meeting of the American Association for the Advancement of Science (AAAS), in which ASA has sponsored symposia. Contact Pat Kuhl or Diana Deutch.
- June 15-20, 1997: The ASA meeting will be held in conjunction with NOISE-CON at the Pennsylvania State University. Contact Sabih Hayek.

Violin makers meet

Achieving Tone in Stringed Instruments is the theme of a joint conference of the Catgut Acoustical Society and the Michigan Violin makers Association, scheduled for April 26-28, 1996. Held in Dearborn, Michigan the conference features five technical sessions with 19 papers, all related to building good tone into the instruments. The faculty includes such distinguished violin makers as Martin Schleske, Joseph Curtin, and Carleen Hutchins. Further information and abstracts of the papers are available by calling the CAS office at (201) 744-4029, or fax (201) 744-9197.

Sonic Architecture

(...Sonic Environment, continued from page 5)

of sound that is meaningful and call attention to the act of listening. Sound parks give children the opportunity to "sound off" in a playful and melodious manner, and they also provide children with the opportunity to learn about the science of acoustics in a visually engaging setting.

Bill and Mary Buchen, directors of Sonic Architecture, based in New York City, have collaborated to integrate the sonic and visual arts since 1972. They have designed sound installations for museums, galleries, and public sites throughout the U.S. and Europe. They may be contacted at (212)982-1743 (phone and fax) or via e-mail: sonarc@interport.net. Their web site is http://www.interport.net/~sonarc/main.html. Web Browsers: sonic architecture.
Acoustics in the News

Newspapers

Two articles from The San Diego Union-Tribune reported on the resumption of the ATOC experiments after determining that the death of three humpback whales in October was unrelated to the underwater sound signals generated by ATOC: "Underwater sound experiments cleared in whale deaths; scientists resume tests" by Eric Young (12-2-95), and "Suspension lifted; test of sound at sea begins" by David Graham (12-6-95).

The January 15, 1996 "Science" section of The Washington Post carried an article by David Brown entitled "Tuvan Throat-Singers Perform Feats of Harmonic Acrobatics." The Siberian group Huun-Huur-Tu is able to create vocalizations that sound unfamiliar and sometimes unearthly to the western ear. The process is variously called biphonic, harmonic, or overtone singing. By manipulating the tongue, false vocal folds, and other structures, the singers are able to create distinct resonating chambers within the vocal tract to accentuate or dampen certain harmonics.

A piece in the St. Louis Post-Dispatch by William Allen (1-11-96), "A Disquieting Lack of Quiet" was stimulated by a session on architectural acoustics at the recent ASA meeting in St. Louis. In it the author quotes Ewart Wetherill on the sorry state of acoustical design in contemporary apartments and condominiums. He also refers to Swedish acoustician Tor Kihlman's discussion of actions by the Swedish government and the European Community to reduce noise transmission in multifamily dwellings. The same article was published subsequently in The Dallas Morning News on Jan. 21, 1996 under the title, "Trying to build an edifice of peace for noisy neighbors."

On March 5, 1996 The New York Times carried an article by James Ostreich, "Assessing Carnegie Hall Without the Concrete," in which several music directors, musicians, and critics praise the improved acoustics of Carnegie Hall since the removal of a concrete layer from beneath the stage floor. The decline of the great hall's acoustical properties have been attributed to renovations made in 1986. Interestingly, Leo Beranek mentioned the hall's wood-over-concrete floor in 1962! See p. 8 of the previous issue of Echoes, Vol. 6, no. 1.

Magazines

The January 19 issue of The Chronicle of Higher Education features an article by David L. Wheeler, "Recreating the Human Voice," which discusses the work of Ingo Titze and Brad Story at the University of Iowa in studying and simulating the human voice. [See also the feature article in Echoes, Vol. 4, no. 2, 1994.]

Acousticians Michael Buckingham, John Potter, and Chad Epifanio, have written an article, "Seeing Underwater with Background Noise" for the Feb. 1996 issue of Scientific American. The authors consider the noise that permeates the ocean as a kind of "acoustic daylight" and report on recent experiments showing that it is possible to create images of underwater objects by using ambient noise as a source of illumination.

Richard Wolkomir has written a lengthy and entertaining piece for Smithsonian entitled, "Decibel by decibel, reducing the din to a very dull roar" (Feb. 1996). In it the author describes the work of Richard Lyon and other members of the RH Lyon Corp, analyzing the acoustical properties of noisy appliances and machinery and improving their sound quality.

The subject of acoustics also appears as part of a broader topic in the feature articles of two popularly read publications. The Feb. 19, 1996 issue of Newsweek contains an article by Sharon Begley, "Your Child's Brain," in which the author devotes a section to language development, citing the research of Patricia Kuhl and the development of the brain's "perceptual map" for language. The March, 1996 issue of National Geographic features the article "Emperors of the Ice" by Glenn Oeland, which discusses the ability of emperor penguins to recognize each other's "signature song." The author quotes Ann Bowles on the fact that an emperor chick will "come barreling out to meet" its parent, even in an enormous crowd of penguins, on hearing its parent's distinctive call.