

The newsletter of
The Acoustical Society of America

ECHOES

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Ocean acoustic tomography: Exploring the world with sound

by Alexandra Tolstoy

ACOUSTIC TOMOGRAPHY is a remarkable remote sensing technique based on the cross-sectional imaging of an object using data collected by bombarding an object with sound coming from many different angles. The sound is measured either as it is transmitted through or reflected from the object being studied. On the human scale this technique allows physicians to produce images of functioning internal organs. On larger scales it helps seismic prospectors estimate complicated earth structures.

On ocean scales, acoustic tomography allows the determination of environmental properties over tens of thousands of cubic miles. This knowledge is critical to the understanding of ocean processes like fronts, eddies, currents, and temperature variations, which affect nearly all of life in the sea, as well as weather patterns worldwide.

The fundamental principle is based on the concept that if certain properties of a medium, such as temperature or density, affect sound traveling through it, then by sending acoustic signals through the medium in many different directions we should be able to deduce those properties based on the character of the emerging sound energy. The concept is simple, but its implementation is not.

To determine the properties of a medium with accuracy, we need to:

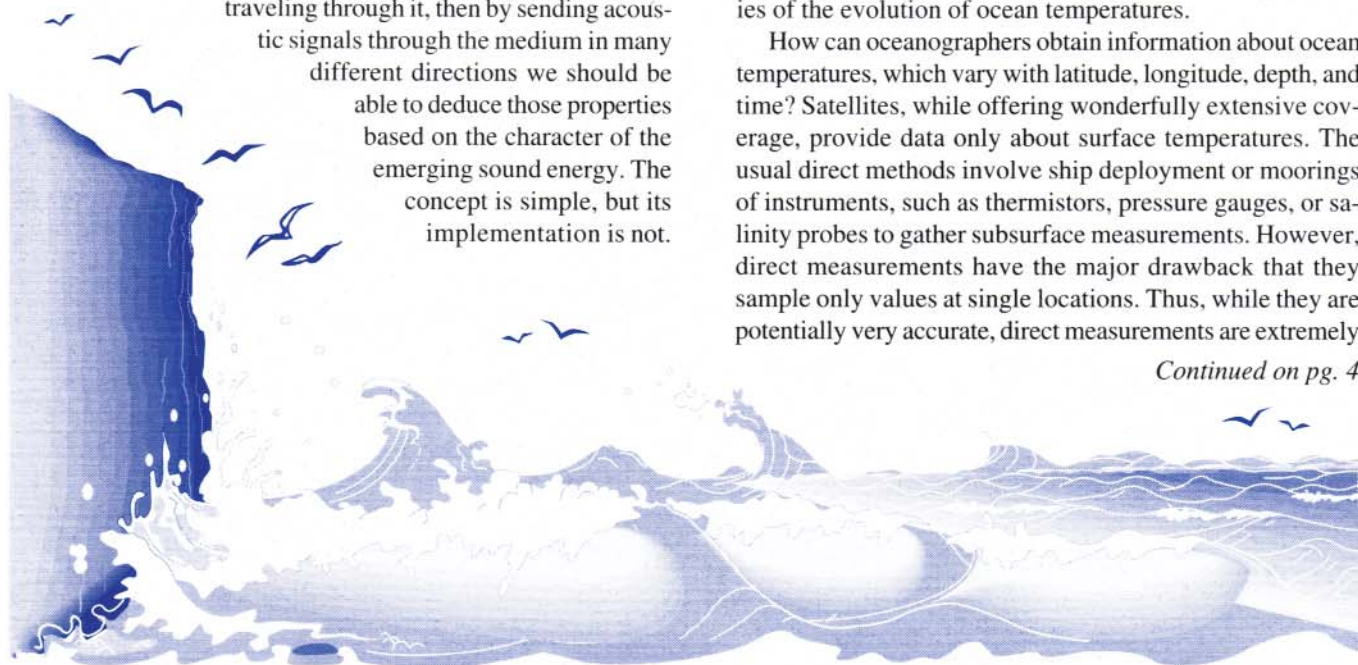
- Design appropriate sources (the signal needs to be strong and coherent at the receiver);
- Model the acoustic propagation confidently or at least account for important behavior like attenuation and phase;
- Gather the acoustic data, which can require high resolution receivers; and
- Solve the associated inverse problem, i.e. uniquely determine what may be hundreds of unknown parameter values varying throughout the medium.

The concept

There is great concern these days about the issue of global warming. Is it truly occurring, and, if so, what measurements do we need to answer that question? What role do the oceans play? It now appears that to address this critical issue the scientific community needs new, long-term, detailed studies of the evolution of ocean temperatures.

How can oceanographers obtain information about ocean temperatures, which vary with latitude, longitude, depth, and time? Satellites, while offering wonderfully extensive coverage, provide data only about surface temperatures. The usual direct methods involve ship deployment or moorings of instruments, such as thermistors, pressure gauges, or salinity probes to gather subsurface measurements. However, direct measurements have the major drawback that they sample only values at single locations. Thus, while they are potentially very accurate, direct measurements are extremely

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We hear that . . .

Two prestigious awards were recently presented to **Alison B. Flatau**, Assistant Professor of Aerospace Engineering and Engineering Mechanics at Iowa State University. The National Science Foundation presented her with the Young Investigator Award, which she will use to research vibration control techniques. The other award is from the American Institute of Aeronautics and Astronautics, which recognized Flatau for her outstanding contributions as student adviser.



Kenneth S. Suslick received the Materials Research Society Medal for his exceptional contribution to materials science at the Society's fall meeting in Boston. The medal specifically recognized his applications of sonochemistry to materials science. Suslick is Professor of Chemistry and Professor of Materials Science and Engineering at the University of Illinois.



Emily A. Tobey was selected for the Nelle C. Johnston Chair in Early Childhood Communication Disorders at the Callier Center for Communication Disorders at the University of Texas in Dallas. Her appointment began on January 1, 1995.



The third Theodore John Schultz Grant, sponsored by the Newman Student Award Fund, was presented to **M. David Egan**, who teaches architectural acoustics in the Department of Construction Science and Management at Clemson University. The grant will support the development of an "Acoustics Sourcebook," to be used as a teaching aid to complement existing textbooks in architectural acoustics.



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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Phone inquires: 516-576-2360. Article submissions and correspondence should be directed to *Echoes* Editor, Acoustical Society of America, 500 Sunnyside Boulevard, Woodbury, NY 11797.

Executive Director's Note

Volunteer yourself (or even others)

One concern often expressed during the reCreation process was that some members don't feel they can participate in the Society's decision-making process. Consequently, the Long-Range Planning Committee, chaired by Ilene Busch-Vishniac, and the Governance Committee, under Stan Ehrlich, came up with these helpful action items at the Austin meeting:

1. **Volunteering for ASA Committees:** The usual form requesting information for the ASA Membership Directory will be mailed to you in January. This year we have also included a sheet asking for your interest in participating in the activities of ASA's technical or administrative committees. This will not guarantee your selection, but it will guarantee that chairs of the committees you designate will consider your nomination.
2. **Nominations for Society Elections:** The request for nominations of officers has not been prominently advertised in the past, but it will now be highlighted in the Journal. Your nomination of a colleague (or yourself) will be sent to the nominations committee for consideration, chaired this year by Chester McKinney. The Committee will then make the final recommendations for the slate of candidates for the 1996 election.
3. **Nomination of Fellows:** Many members ask me why "so-and-so" is not a Fellow of the Society. They often don't realize that *they are already authorized to send a cover letter, dossier, and two supporting letters via the Executive Director to the Membership Committee, and their candidate will be considered for Fellowship.*

I have participated in a number of volunteer organizations in addition to the ASA, and I am always amazed at how these groups unintentionally overlook talented candidates who travel in circles outside their own. The Committee on the Status of Women recognized this when they developed a list of women members not currently serving on committees. This list has been helpful in selecting nominees and committee members.

If you would like to be considered for a committee, please fill out and return the sheet accompanying the directory questionnaire. Or, if you see a member whom you believe qualifies for fellowship, write or call us for information on how to make it happen.

Thanks in advance for improving the participation in our Society.

—Charles Schmid
 Executive Director, ASA

ASA to meet in nation's capital

The 129th meeting of the Acoustical Society of America will take place May 30–June 3 at the Renaissance Hotel, 999 9th St NW, Washington, DC. Details are available in the Call for Papers or by calling ASA's Woodbury NY office at (516) 576-2360. A stimulating program of technical papers, short courses, and tours is planned, including the tutorial lecture "Flow-Induced Sound" by Alan Powell, and the short courses "Ocean and Seabed Acoustics" by George Frisk and "Basic Digital Signal Processing in Acoustics" by John Burgess.

Taking advantage of Washington's many opportunities, the social will be held at the Air and Space Museum on Wednesday evening, May 31, and tours are planned for the Holocaust Museum and the National Museum of Women in the Arts, as well as the more usual Washington sites.

One meeting highlight will be the "Gala Guitar Evening" at the Lisner Auditorium on Thursday, June 1, featuring renowned guitarists Carlos Barbosa Lima, Ricardo Cobo, and Kurt Rodarmer, in addition to three contemporary master builders of guitars. Dr. Michael Kasha will introduce the evening, speaking on "The Art, History, and Science of the Guitar." Tickets may be purchased by filling out the form in the Call for Papers or by calling ASA's Woodbury office. Proceeds will benefit ASA's Endowment Fund.

With respect to practical matters, you are encouraged to make your room reservation early. Room sharing may be initiated by leaving your name with ASA's Woodbury office. Also, discounts are available from American Airlines, and hearing tests will once again be available. There will be another Fellow's Luncheon with speaker (93 participated at the Austin luncheon) and meeting abstracts will be available on PINET or INTERNET in early March, a benefit which is expected to continue for future meetings.

Planning Committee agrees on priorities

The Long Range Planning Committee held an interim meeting at ASA's Woodbury office in October of 1994 to discuss topics emerging from the reCreation process. The meeting was chaired by Ilene Busch-Vishniac and attended by 15 other committee members. After examining numerous issues, the committee agreed on five top priorities:

- ASA's financial viability
- Nature of the *Journal* (a five-year plan and ten-year vision, including electronic publishing);
- Development of a strategy for cultivating new members;
- More communication among ASA members;
- Format and schedule of ASA meetings.

The committee then passed a series of recommendations to ASA's Executive Council:

- To establish a committee to recommend a plan for ensuring the Society's long-term financial viability
- To charge the Publications Policy Committee with developing a five-year plan for all ASA publications

- To require administrative committees to file a report of their activities for publication in the *Journal* twice a year

The committee also stated that it would provide an open forum at meetings to report on the reCreation process and other items of concern to the Society membership. As a result, the first "Town Meeting" was held recently in Austin, at which the top five priorities were presented. The meeting provided the membership with an opportunity to discuss the issues and express their opinions. The meeting consensus was that the ASA should enhance its relationship with the regional chapters and improve its educational outreach. Further Town Meetings will be held at future ASA meetings.

ASA video committee seeks ideas

Proceeds from the Tokyo String Quartet concert held during the Cambridge meeting will be used to produce a professional video introducing fifth and sixth graders to the marvels of acoustics. Emily Tobey, chair of the ASA Video Committee, is seeking exciting, state-of-the-science topics in acoustics that might serve as suitable video segments. All ASA members are encouraged to submit ideas of entertaining acoustical demonstrations or "hot" topics to the Committee, whose members include Bennett Brooks, Herman Medwin, Maureen Stone, and James West. A brief description of your idea should be sent as soon as possible to Emily Tobey, Callier Center for Communication Disorders, Univ. Texas Dallas, 1966 Inwood Rd., Dallas, TX 75235.

Entries sought for science writing awards

ASA is requesting entries for its annual science writing awards for items published or aired in 1994. One award will be presented to a journalist (print, photo, video, or audio), the other to a professional in acoustics. Awards will be presented during the plenary session at ASA's Fall meeting in St. Louis and will be accompanied by a check for \$1000.

The awards recognize and stimulate distinguished writing (or producing) that improves public understanding and appreciation of acoustics. Judging criteria include: relevance to acoustics, accuracy, understandability to lay persons, interest, newsworthiness, size of audience or readership, clarity of communication, and originality.

The winner of the 1993 journalist's award was science writer Jane E. Brody of *The New York Times*, for the Nov. 9 article, "Picking Up Mammal's Deep Notes." Winning the science writing award for acousticians was Masakazu Konishi for the article, "Listening with Two Ears," which was published in the April issue of *Scientific American*.

Entries for the 1994 awards should be postmarked no later than April 15, 1995 and sent to: Elaine Moran, Acoustical Society of America, 500 Sunnyside Blvd, Woodbury, NY 11797. For further information call 516-576-2360.

OCEAN ACOUSTIC TOMOGRAPHY—from pg. 1

limited in their ability to provide thorough information at a reasonable cost over a sizable region. By contrast, indirect methods involve the use of far less invasive and far more efficient measurement/estimation techniques. An example of such a method is low-frequency acoustic tomography.

Low-frequency sounds (10-500 Hz) in the deep ocean can travel amazingly long distances, assuming the absence of land masses which block transmission. This is a consequence of the ocean sound channel, the SOFAR (short for SOUNd Fixing and RANGing) channel, which effectively guides energy away from loss-inducing boundaries like the bottom and the surface. Moreover, lower frequencies suffer less from seawater absorption and from overall attenuation as they encounter, along their speedy travels, bubbles and other scattering objects that are small in relation to their long wavelengths.

Sound in the ocean travels at approximately 1500 m/s compared to 300 m/s in air. The exact speed varies critically as a function of temperature and pressure: increased speed results from higher temperatures and pressures. Sensitivity to temperature is the key to the ocean tomography technique as it is commonly applied today. Of course, when we say that the sound-speed is "sensitive" to temperature, we mean that it varies plus or minus only 25 m/s (a few percent!) throughout the upper 1000-meter depth of ocean. This variation, however, is enough to observe significant differences in long distance signals, assuming that the signals will be strong, coherent, and stable.

In 1960, depth charges fired off Perth, Australia, generated low-frequency sounds that reached hydrophones off Bermuda 3.5 hours later—half way around the world at a range of almost 20,000 kilometers. This observation confirmed that low frequencies could indeed be loud and stable over very long ranges. This information, plus the long understood importance of the rule of temperature on acoustic propagation, generated what has become the exciting field of ocean acoustic tomography.

The different approaches

In 1979, W. H. Munk and his colleagues were the first to propose ocean acoustic tomography as a scheme for large scale monitoring. By studying the changes in arrival times of many acoustic signals sampled over a wide variety of paths (through latitudes, longitudes, and depths), three-dimensional maps of ocean temperature can be produced. This "time-of-flight" method requires that:

- Time keeping must be very precise since fluctuations of only one or two milliseconds must be resolved to image the temperatures to an accuracy of 1 degree Celsius;
- Source and receiver positions must be known very accurately, to within a fraction of the signal wavelength;
- The individual signal/ray arrivals must be clearly resolvable, which translates into a requirement for a broadband source and long ranges;

- The sources must be controllable, of moderately high intensity, and reliable.

In "moving ship" tomography, a ship broadcasts the source periodically as it moves around the perimeter of a region of interest where hydrophones are located. A major difficulty with this approach is that it is time consuming; it may take two weeks to complete a transit for a region 250 km by 250 km. The ocean can change significantly over that period, particularly if eddies or fronts move through. The resulting image map will represent only a "smeared" or averaged picture of the region's properties.

A subsequent variation of this technique involves a family of fixed "transceivers" (transmitter-receiver combinations). An associated system of pingers, high-frequency sound sources mounted on the ocean bottom, helps update position information on the transceivers regularly. This "moored" tomography approach is a major improvement in terms of its ability to construct snapshots of the region and to estimate current speeds by means of reciprocal transmissions. It also offers the only foreseeable prospect for a long-term monitoring system that is continuous or nearly so. This approach has the disadvantage, however, that the moorings can be quite expensive, up to \$100,000 each. Thus, the moorings are usually deployed in limited quantities, resulting in sparse acoustic samplings, since the information can be processed only for paths between moorings.

Recently, another variation on these techniques has been proposed, although it has not been experimentally tested to date: "matched field processing" (MFP) tomography. This approach requires multiple arrays of receivers and can use either traditional sources, such as those used in the other methods, or very simple sources, such as air-deployed explosive shots, as illustrated in figures 1 and 2. For each shot/signal, we transform the received acoustic data from the time to the frequency domain and then examine the field's complex interference patterns of phase and amplitude as seen on each array of receivers. Thus, we are no longer restricted to a "time-of-flight" approach, with the constraints mentioned above. In particular, we no longer need to worry about synchronized transmissions. The new approach is concerned only with how the field varies spatially along the arrays, *not* how it varies in time.

MFP tomography has the advantage that the low-frequency signals are easy to generate with shots and have less sensitivity to data contamination by fluctuations due to such conditions as rough surface scattering, bubble scattering, and tides. In addition, low-frequency signals, with their long wavelengths, require less accuracy with respect to known source and receiver positions. Finally, the method offers potentially very high resolution snapshot images of the 3-D ocean volume, given a reasonable distribution of shots. For example, with shots dropped from a plane every 25 km, a 250 km by 250 km area can be imaged in only a few hours.

Unfortunately, you never get something for nothing. A

major disadvantage of the MFP technique is that it requires multiple hydrophone arrays to receive the signals, preferably vertical arrays at least 1000 m long. These arrays have been notoriously expensive to build and difficult to deploy. Fortunately, present technology appears to be on the verge of producing lightweight, air-deployable, long vertical arrays. Also, the MFP approach requires a highly accurate and computationally fast propagation model (it is quite computer intensive). To date, we have used a simplified model, based on adiabatic normal modes, which may not be appropriate in regions of high environmental variability, such as the Gulf Stream. Finally, if shot sources are used, this approach produces only a single snapshot and is not very cost effective when continuous monitoring is required.

Important issues remaining

Some approaches to tomography have been successfully demonstrated and much has been learned about where things can be improved. There remain, however, unanswered questions about the credibility and accuracy of the temperature maps produced by such indirect means, as well as other practical questions. For example, how much resolution is actually achievable and what are the trade-offs in terms of a given method and affordable resources? How can we incorporate as much of the available data as possible from satellites, drifting sensors, survey ships, and moorings? What about hybrid methods that combine moving sources and receivers to result in synthetic aperture arrays for the data processing? How

much resolution will be needed for the data to be provided to the oceanographic modelers grappling with the global warming issue? And what about the environmental impact of such programs, particularly with respect to marine mammals?

These issues and more are being industriously examined by the general ocean acoustics community and by the specialist tomographers, by committees, and by individual researchers and policy makers.

We can certainly conclude that the field of ocean acoustic tomography is rapidly evolving and ever improving. Its tremendous potential to image large areas of ocean, even an entire world of ocean, is driving technological and computational developments at a rapid pace. Of widespread interest are the intense efforts to reduce implementation costs and to produce more efficient, simpler processing designs and algorithms. If you need large scale, 3-D, relatively rapid and efficiently produced maps of ocean temperatures, then this is the technique to use. In the final analysis, in spite of all the remaining questions, ocean acoustic tomography is the only real game in town.

Alexandra Tolstoy, Ph.D., is a Senior Scientist with Integrated Performance Decisions, a subsidiary of Analysis and Technology, Inc. in Honolulu, Hawaii. She is an ASA Fellow and chairs ASA's Committee on the Status of Women. She is also a Senior Member of IEEE, the author of the monograph "Matched Field Processing for Underwater Acoustics," and gave a short course on the subject at the recent ASA meeting in Austin.

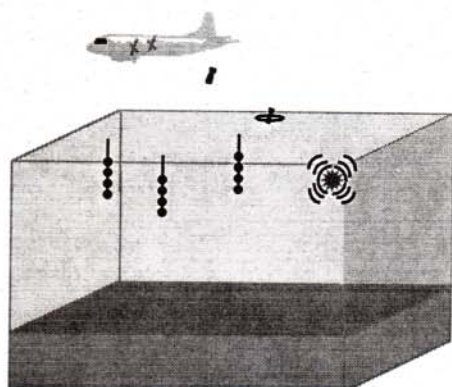


Figure 1

Illustration of matched field acoustic tomography. An airplane drops shot sources that sink and explode below the ocean surface. The resulting acoustic signal is measured by three vertical arrays of hydrophones floating in the ocean.

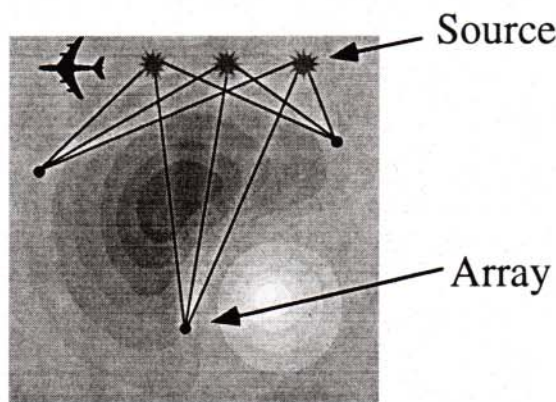


Figure 2

An overhead view of the ocean region as seen from the airplane, showing the acoustic transmission paths from the explosive sources to the vertical arrays. Also shown are two ocean eddies, indicated by the light and dark shadings. Information on the structure of the eddies can be determined from an analysis of the acoustical transmission path.

OPINION During the past few years I have repeatedly run afoul of the dBA Police—those within the acoustical community who eschew all use of the terms “dB(A)” and “dB(C)” in the text of journal articles, the labels of graphs, and in the spoken word. They contend that the formal and lengthy terminology, “A-weighted sound pressure level,” or the slightly more concise “A-weighted sound level” must be used. The dBA Police argue that it is the sound level that is A-weighted and not the decibel. I ask, “Who cares?”

The question of whether the sound level or the decibel is weighted is inconsequential to the understanding of the actual measurement or the data that result. In fact, as Dix Ward has averred, “If one is to get technical about it, isn’t it the sound rather than the level that is A-weighted?” Pursuing that arcane argument to the n^{th} degree would lead, as Ward points out, to the absurd literary form of “the measured level of the A-weighted sound was 85 dB.”

It has also been asserted that the term “dB(A)” leads to confusing and inaccurate statements, such as “the window must have a 35 dB(A) sound rating.” I suggest, however, that such sloppy phraseology is engendered by carelessness or misunderstanding on the part of the

authors and not by the use of simplified nomenclature.

In my opinion, the purpose of precise and standardized terminology is to assure that the written word accurately conveys information in a clear and unambiguous manner. Effective and concise terminology will do that with as few letters, symbols, and words as possible. Conservation of the printed word and hence the writer’s time, the journal’s paper, and the reader’s patience are as important as the subtle (and arguable) implications of the placement of a suffix.

In my experience, no reader familiar with A-weighting has ever been misled or confused by the phrase, “the sound level was 85 dB(A).” Conversely, deleting all use of the suffix “A” and mention of A-weighting in text and graphs, once the use of that filter characteristic is initially defined, can be ambiguous and confusing.

As with the spoken word and the literary masterpiece, usage and common understanding within the scientific community bring about changes in the language and the definitions of acceptability. It’s time to make that switch with A-weighted sound levels. While we’re at it, let’s be really brazen and remove the superfluous brackets so that we can succinctly state, “It was 85 dBA.”

—Elliott Berger



REJOINDER I was happy that the Editor of *Echoes* offered me the opportunity to respond to Elliott Berger’s Opinion, in which he advocates abandoning the long-standing, but not-well-enforced, policy of *The Journal of the Acoustical Society of America* and other archival journals against adding any modifier to a unit symbol other than an internationally standardized prefix such as μ for micro (10^{-6}). In spite of some publications that give the unit for sound level as “A-weighted decibels,” the decibel is not frequency weighted. The instantaneous sound pressure signal is frequency weighted, not the unit of measure (the decibel).

The author of the statement about a window’s “35 dB(A) sound rating” may have been careless or lacked understanding, but those problems stemmed from widespread and careless use of dB(A), or dBA, to mean all kinds of A-frequency-weighted quantities.

I agree with the goals stated in Berger’s fourth paragraph, but not the conclusion. Many different interpretations have been the result of the “suffix.” What should a reader understand from: “one-third-octave-band sound pressure level in dB(A),” or “sound power level in dBA?” I have even seen the expression $10^{\text{dBA}(t)/10}$ in a proposed description of A-weighted sound exposure level. There are also: “dBA levels,” “dBA meters,” and statements such as “measure the dBA”.

The fundamental problem is that dB(A), or dBA, has no unique meaning. There are readers who are familiar with the A-frequency weighting, but who have been misled and confused by the phrase “the sound level was 85 dB(A).” That phrase does not say whether the sound level was a maximum fast (F) or maximum slow (S) exponential-time-weighted sound pressure level, nor does it give any hint about the measurement period. It could even mean a one-hour average sound level.

Additional examples of the confusion caused by “dBA” include workplace noise exposure limitations on the peak value of a “sound level” in units of “dBA,” and local noise ordinances that prescribe measurements of “dBA” instead of the exponential-time-weighted and A-frequency-weighted sound pressure level.

Because the conditions described in the final paragraph of Berger’s Opinion do not now exist, it would be unwise to alter the policy that articles published in archival journals must provide clear and unambiguous descriptions of quantities that have been measured or calculated. The units of measure and corresponding unit symbols should not be changed from those that have been long standardized in national and international standards.

We should always say explicitly what we mean and not assume a common understanding of “dBA” in technical or popular writing.

—Alan H. Marsh

Contributions to *Echoes*’ “Opinion” section may be submitted to the *Echoes* Editor, Acoustical Society of America, 500 Sunnyside Blvd., Woodbury, NY 11797. Because of space limitations contributions should not exceed 450 words.

Acoustics in the News

Noise continues to be a popular subject in the media. On Nov. 19, Canada's national newspaper, *The Globe and Mail*, carried the story, "Sound breeds fury as noise pollution grows," by Joan Breckenridge. The article discussed sources and effects of environmental noise. London's *The Mail* on Sunday ran two stories in September by Alison Gordon: "Driven to death by the tyranny of noise" (9-11-94) and "A decent man, tortured by noise and then murdered" (9-18-94), and several letters to the editor on noise (9-18). In addition to the lurid details about a noise-related crime, several testimonials from adversely impacted citizens were included. The "New Jersey Weekly" section of *The New York Times* (10-23-94) contained a lengthy piece about the noise from jet-equipped race cars, "monster trucks," and other hot rods at the Old Bridge Raceway. The article, "A Raceway That Isn't Music to All Ears" by Joanne Kadish, also describes the efforts by residents of neighboring Manalapan Township to get the noise abated.

Two other articles in *The New York Times* are of acoustical interest: In "Wreckage in the Desert Was Odd but Not Alien," (9-18-94) writer William J. Broad describes the formerly-classified surveillance system known as "Project Mogul," devised by geophysicist Maurice Ewing. The high-altitude system was intended to detect acoustic signals from nuclear-test blasts thousands of miles away. It was only used for a short period, however, because high-level winds tended

to blow the balloons out of radio communication range with the ground. The other article of interest, "New Shot at Cold Fusion By Pumping Sound Waves Into Tiny Bubbles," by Malcolm W. Browne appeared on 12-20-94. The writer refers to research in sonoluminescence showing that very high temperatures are produced by the imploding of sound-bombarded bubbles; high enough, some speculate, to produce fusion, although the realization of "sonofusion" appears to be a long shot.

Two articles on sonoluminescence also appeared recently in the October 14 issue of *Science*: "Sonoluminescence" by Lawrence A. Crum and Ronald A. Roy and "Effect of Noble Gas Doping in Single-Bubble Sonoluminescence" by Robert Hiller, Keith Weninger, Seth J. Putterman, and Bradley P. Barber. Again, in the December 16 issue, "Can Sound Drive Fusion in a Bubble?" writer Robert Pool addresses sonoluminescence and the possibility of fusion (at least on a very small scale), and refers to related discussions that took place at the recent ASA meeting in Austin.

The December 16 issue of *Science* contains three additional articles relating to acoustics. Robert F. Service's, "Capturing Sound, Light, and Strength With New Materials," refers to discussions at the recent Materials Research Society meeting of steps toward making "photophones." These devices would convert flashes of light directly into

Continued on next page

Society Pages

Galloway, Marsh, and Young honored

After a long gestation, the revised version of S1.1, American National Standard for Acoustical Terminology, was finally published in January of 1994, replacing the previous S1.1 of 1960.

ASA Standards Director Tony Embleton gave special recognition to three ASA members at the recent meeting in Austin by stating:

"Many individuals and small groups of individuals worked hard in the past 15 years to produce a new standard, and all made some progress. But the new S1.1 might never have come to fruition if it had not been for the tremendous efforts of three special individuals under the superb leadership of Bill Galloway."

He went on to say that Bill Galloway had spent at least 2000 hours on S1.1 over the past two years, and both Alan Marsh and Bob Young had spent a comparable amount of time between them.

Because their unique contributions merited some unique form of recognition, the three were presented with special copies of their S1.1-1994 standards, each bound in dark red leather, printed on parchment paper, and bearing the recipient's name in gold lettering on the front cover.

Gallery of signal processing in acoustics

Picture this: The Interdisciplinary Technical Group on Signal Processing in Acoustics is planning a gallery of images and videos depicting signals or processes in acoustics for ASA's St. Louis meeting, Nov. 27-Dec. 1, 1995. Contributions are invited from all technical areas of acoustics. The gallery will be on display during the meeting and entries will be judged by a panel of referees on the basis of originality, ability to convey and exchange information, and aesthetic appeal. Entries may be in the form of either a poster or a short video. Publication and future display of outstanding entries is being considered. For information on submissions, including details on size and text of posters and format of videos, contact David J. Havelock: phone (613) 993-7661 or email, david.havelock@nrc.ca.

"On September 8, 1894, after 73 years of life, which yielded a record almost unsurpassed of work in physiology, anatomy and physics, Herman Ludwig Ferdinand von Helmholtz died."

From "50 and 100 Years Ago,"
Scientific American, November 1994

Miscellaneous Soundings

ACOUSTICS IN THE NEWS—from pg. 7

sound, thereby speeding the telecommunications process (p.1807). In "Even a Robot Cricket Always Gets Her Mate," Sunny Bains describes the synthesizing of listening behavior in crickets (p. 1809). In "Vertebrate Vibrations" ("Random Samples" section, p. 1910), editor Constance Holden cites the presentation by Peter Narins at the recent ASA meeting in Austin. Narins has found that two types of frogs send out percussive signals to lure the opposite sex: the white-lipped frog by hitting his throat sac against the ground, and the Malaysian tree frog by tapping her toes.

Recent issues of *Technology Review* have carried several articles relating to acoustics. In the Aug./Sept. issue, David Brittan's "Phenomena" section discusses the filtering of everyday sounds by Tomasz Letowski to provide audiological stimuli that are more likely to elicit responses from young children than the traditional sine waves. In the October issue, Simson Garfinkle expounds on Steven Garrett's development of thermoacoustic refrigeration in "The Coolest Sound." The December issue carries the article by Vincent Kiernan, "Detecting Forgotten Land Mines," which describes experiments by U.S. and Australian acousticians using sound to locate individual land mines, even those made from ceramics and plastic. In that same issue, "Reducing the Risks of Ultrasound" by Nira Woreman calls into question the practice of ultrasound screening of women with "low-risk" pregnancies.

Two acoustically relevant portraits appeared in recent issues of *Scientific American*. "On the Trail of Wild Elephants," by Marguerite Holloway, describes the work of researcher Cynthia Moss, including a discussion of elephants' infrasonic vocalizations (Nov., 1994). In "The Man Who Would Hear Ocean Temperatures" (Jan. 1995), Philip Yam characterizes the life and work of well-known acoustical oceanographer Walter Munk.

Hearing conservation conference

The National Hearing Conservation Association (NHCA) and the National Institute for Occupational Safety and Health (NIOSH) will hold a jointly sponsored conference in Cincinnati, March 22-25, 1995. The conference is also supported by the ASA and other "affiliates." The theme will be "Reaching out for underserved workers: Strategies for the next century." Among the featured topics will be:

- Targeting populations that are not currently receiving hearing conservation and noise control services
- Technologies for communicating in noisy environments
- The interaction of noise with other agents.

Scheduled speakers include OSHA Director Joseph Dear and NIOSH Director Linda Rosenstock. For further information, contact:

NHCA Executive Director Michele Johnson
Phone (515)243-1558, fax (515)243-2049.

New regional chapter is born

The Inland Northwest Chapter of the Acoustical Society of America has petitioned the Executive Council for chapter status and has submitted its charter and bylaws for approval. The new chapter encompasses the area east of the Cascades in Washington and all of Idaho. Its first meeting took place on Nov. 15, 1994 on the campus of Washington State University in Pullman. The meeting time coincided with a visit by Allan Pierce, who, as part of the ASA Technical Initiative Program, spoke on sonic booms and other progressive waves. For information on the new chapter, contact Philip Marston (509) 335-5343 or David Egolf (208) 885-7482.



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