The newsletter of
The Acoustical Society of America

ECHOES

Volume 2, Number 2
Summer 1992

Acoustics in Space

Over the centuries people have referred to sounds from space or, more specifically, the music of the spheres. Countless pieces of music have been dedicated to the sun, the moon, the planets, and the stars. But in truth, few claim to have heard or measured sounds emanating from these bodies.

In recent years a less romantic but more realistic generation of sound has begun to take place inside space capsules. Two kinds of acoustical experiments are being conducted aboard the space shuttle. One uses acoustic manipulation to study the physics of liquid drops and the other concerns thermoacoustic refrigeration. In the "Drop Physics Module," scientists are using sound to position and then to squeeze, deform, and otherwise manipulate various kinds of liquid drops. The absence of Earth's gravitational pull enables them to conduct these experiments without using the very high sound pressures necessary on Earth.

The thermoacoustic refrigerator is being sent aloft not for performing experiments, but to find a replacement for the standard freon-based model. Refrigeration is needed in life sciences experiments to preserve biological samples like blood and urine, and in some cases to keep the equipment cool. But conventional refrigerators appear to have a poor track record in space. The acoustic fridge shows promise of much greater reliability in the space shuttle's environment. Moreover, it does not use chlorofluorocarbons (CFCs), which threaten our ozone shield.

Two members of the Acoustical Society of America have actually flown in space and the third is scheduled to be propelled into orbit on June 25th, about the time this edition of *Echoes* goes to press. The first ASA astronaut was Paul Scully-Power, of the Naval Underwater Systems Command in New London, Connecticut, who flew in October of 1984.

Mr. Scully-Power actually went as an oceanographer rather than an acoustician. He had specialized in the study of ocean eddies, circular currents as large as 100 miles in diameter. From his lofty position he was able to view not only circular eddies but spiral eddies and other ocean phenomena, such as the interaction between the southern oceans in

Continued on page 4

Paul Scully-Power

Taylor Wang

Eugene Trinh

We hear that . . .

ASA's new President, **Herman Medwin,** received an honorary Doctor of Science degree from his alma mater, Worcester Polytechnic Institute. Located in Massachusetts, Worcester is the nation's third oldest college of engineering, science, and management.

The National Research Council's Committee on Hearing, Bioacoustics, and Biomechanics (popularly known as CHABA), recently said good-bye to **Milton Whitcomb,** who retired on December 31st after 32 years of service. He has been replaced by **Timothy Margulies,** Study Director of the Committee on Vision as well as CHABA. Dr. Margulies comes to the position from the Johns Hopkins University Applied Physics Labs, followed by a stint at the Nuclear Regulatory Commission.

Gabriel Weinreich of the University of Michigan's Department of Physics was awarded the Silver Medal from the Acoustical Society of France.

The President's Committee on the National Medal of Science selected **George A. Miller** as one of its 1991 recipients. Dr. Miller is James S. McDonnell Distinguished University Professor of Psychology Emeritus at Princeton.

Wolfgang Sachse of Cornell's Department of Theoretical and Applied Mechanics, was elected the first Meinig Family Professor of Engineering. He has been recognized for the development of ultrasonic and acoustic-emission techniques for measuring the properties of materials.

The National Council of Acoustical Consultants is planning a 30th Anniversary Celebration along with its membership meeting and a seminar, following the ASA meeting in New Orleans. For information call Virginia Maguire at (201)379-1100.

ECHOES

Newsletter of the Acoustical Society of America

Provided as a benefit of membership to ASA members

Echoes Editor ..... Alice Suter
Design and Typography ..... Linden Design
Printing ..... Custom Printing

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

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

ASA Editor-in-Chief ..... Daniel Martin
Executive Director ..... Charles Schmid

News from the Executive Council

ASA members should be aware that most of the Executive Council's (EC) deliberations are "open," and anyone interested may attend the meetings as long as there is enough seating.

Results of the 1992 election:

- President Elect, Richard Lyon
- Vice-President Elect, Stanley Ehrlich
- Members of the Executive Council, Gilles Daigle and William Hartmann

Executive Council details ASA's social responsibilities

At the meeting in Salt Lake City the Executive Council voted unanimously to adopt the following resolution:

The Executive Council of ASA has discussed the recent disturbing events in Los Angeles. From these discussions it is clear that institutions such as ours cannot proceed with "business as usual." These circumstances require individuals and institutions to find ways of responding to the cycles of poverty and neglect that are eroding our democracy.

As one constructive measure, the Executive Council urges its members to find ways of interacting at every level in communities and places of work, from one-on-one to collective action, to assure a more equitable and just society where each individual has an opportunity to realize his or her potential.

As a second measure, the Executive Council will redouble its support of ASA's Committee on Education in Acoustics in its work with the Ad Hoc Committee on Opportunities in Acoustics for Minorities in providing special educational experiences for minority students at every level.

By these and other measures our Society—rich in members of great distinction—will continue to aid those who have not been as fortunate, and, in doing so, fulfill our responsibilities of citizenship and humanity.

Jim West, who chairs the Ad Hoc Committee on Opportunities in Acoustics for Minorities, presented the resolution and reported on other activities of the Committee. A program has been initiated to involve students from inner city schools in cities where the ASA will hold its meetings. Five ASA volunteers have agreed to give talks and demonstrations. The EC approved a request to bring two buses of students to the New Orleans meeting to attend such a session.

The Ad Hoc Committee also proposed a scholarship and mentoring program for a minority student. The EC voted unanimously to approve funds for a $12,500 scholarship leading to a graduate degree in acoustics. The sum will be granted to a qualifying individual each year for a period of approximately four years, with the understanding that his or her institution would finance the remaining costs.

Acoustics in Space (from page 1)

spring and the northern oceans in autumn. These kinds of sights had not previously been possible. He had taken along a tuning fork, which he presented to ASA's president Floyd Dunn at the spring, 1985 meeting in Nashville. Lately, the tuning fork resides in the office of ASA's Executive Director, Charles Schmid.

The second acoustician to become a temporary astronaut was Taylor Wang, of the California Institute of Technology's Jet Propulsion Laboratory at the time, now of Vanderbilt University. Dr. Wang's seven-day Spacelab 3 mission included a "Drop Dynamics Module," in which acoustic manipulation experiments were performed on the fluid mechanics of drops and bubbles. These experiments were precursors of the next set of experiments, due to be performed on space shuttle *Columbia* on or around June 25th.

Aboard *Columbia,* the third acoustician/astronaut, Eugene Trinh, will operate three experiments from the Drop Physics Module. (Readers should note the significance of his initials: E.T.)

Taylor Wang floats through the tunnel that connects Spacelab 3's module to its mid-deck

The Drop Physics Module

The relative weightlessness in rockets, called "microgravity," was first seen as a technical challenge. For example, how would fuel be delivered to an engine, or food and water to an astronaut? Once these problems had been solved, the microgravity environment could be viewed as an opportunity for conducting research that would not be possible, or at least practical, on Earth. Acoustic manipulation is one type of research that can be conducted to great advantage in space.

Instead of the intense sound fields that must ordinarily be generated for acoustic levitation, levels of only 130 to 150 dB can be used to position and hold liquid drops against small gravitational forces and accelerations of the space capsule. The carrier frequencies are 1 to 8 kHz, with force modulations of 1 to 30 Hz. These sound waves, generated by four small loudspeakers and reflected off the walls of the acoustic chamber, interact to form ambient minima, where liquid drops and particles collect and remain suspended. By varying the relative frequencies emitted by the speakers, the drops can be manipulated in an interesting variety of ways. They can be deformed, rotated, made to vibrate, divided into smaller drops, and then recombined.

The purpose of these experiments is to test basic theories of fluid physics and to use the acoustic waves to measure material properties. The results have numerous practical applications, ranging from nuclear fission to the design of time-release medicines. In addition, acoustic manipulation has the advantage of "containerless processing," meaning that the drops are studied and manipulated without the danger of being deformed or contaminated by any tool or container.

One of the three experiments to be performed by Dr. Trinh on board space shuttle *Columbia* is the Drop Dynamics Experiment, of which Dr. Wang is the principal investigator. The purpose of the study is to examine the behavior of drops and shells (drops with large bubbles inside), comparing results to theoretical predictions. It involves determining the equilibrium shapes of rotating drops and the shape oscillation frequency of simple and compound drops, and studying methods for centering one component of a compound drop. The results can lead to the development of innovative procedures for transplanting cells in humans by encapsulating living cells with a semi-permeable membrane to protect them from hostile environments.

ASA's recent vice president, Robert Apfel of Yale University, is the principal investigator of a second experiment, entitled the Science and Technology of Surface Controlled Phenomena. This experiment investigates the surface properties of drops as they are affected by surfactants, agents (like detergents) that reduce the surface tension of liquids. Drops will be squeezed acoustically and then released, causing them to oscillate in a quadrupole shape. The frequency and damping of these oscillations will be measured for different surfactants in varying concentrations.

In another part of Dr. Apfel's study, two water drops containing surfactants will be brought into contact and induced to combine, while carefully measuring the techniques used to force the drops to rupture and coalesce. Surfactants are important in many industrial processes, from production of synthetic drugs to enhancement of oil recovery.

A third part of the Drop Physics Module is led by Michael Weinberg of the University of Arizona. It bears the daunting title: Measurement of Liquid-Liquid Interfacial Tension and the Role of Gravity in Phase Separation Kinetics of Fluid Glass Melts. This experiment uses acoustically manipulated spinning drops to measure the interfacial tension between two immiscible (unmixable) fluids in a compound drop.

Acoustics in Space (from page 1)

spring and the northern oceans in autumn. These kinds of sights had not previously been possible. He had taken along a tuning fork, which he presented to ASA's president Floyd Dunn at the spring, 1985 meeting in Nashville. Lately, the tuning fork resides in the office of ASA's Executive Director, Charles Schmid.

The second acoustician to become a temporary astronaut was Taylor Wang, of the California Institute of Technology's Jet Propulsion Laboratory at the time, now of Vanderbilt University. Dr. Wang's seven-day Spacelab 3 mission included a "Drop Dynamics Module," in which acoustic manipulation experiments were performed on the fluid mechanics of drops and bubbles. These experiments were precursors of the next set of experiments, due to be performed on space shuttle *Columbia* on or around June 25th.

Aboard *Columbia,* the third acoustician/astronaut, Eugene Trinh, will operate three experiments from the Drop Physics Module. (Readers should note the significance of his initials: E.T.)

Taylor Wang floats through the tunnel that connects Spacelab 3's module to its mid-deck

The Drop Physics Module

The relative weightlessness in rockets, called "microgravity," was first seen as a technical challenge. For example, how would fuel be delivered to an engine, or food and water to an astronaut? Once these problems had been solved, the microgravity environment could be viewed as an opportunity for conducting research that would not be possible, or at least practical, on Earth. Acoustic manipulation is one type of research that can be conducted to great advantage in space.

Instead of the intense sound fields that must ordinarily be generated for acoustic levitation, levels of only 130 to 150 dB can be used to position and hold liquid drops against small gravitational forces and accelerations of the space capsule. The carrier frequencies are 1 to 8 kHz, with force modulations of 1 to 30 Hz. These sound waves, generated by four small loudspeakers and reflected off the walls of the acoustic chamber, interact to form ambient minima, where liquid drops and particles collect and remain suspended. By varying the relative frequencies emitted by the speakers, the drops can be manipulated in an interesting variety of ways. They can be deformed, rotated, made to vibrate, divided into smaller drops, and then recombined.

The purpose of these experiments is to test basic theories of fluid physics and to use the acoustic waves to measure material properties. The results have numerous practical applications, ranging from nuclear fission to the design of time-release medicines. In addition, acoustic manipulation has the advantage of "containerless processing," meaning that the drops are studied and manipulated without the danger of being deformed or contaminated by any tool or container.

One of the three experiments to be performed by Dr. Trinh on board space shuttle *Columbia* is the Drop Dynamics Experiment, of which Dr. Wang is the principal investigator. The purpose of the study is to examine the behavior of drops and shells (drops with large bubbles inside), comparing results to theoretical predictions. It involves determining the equilibrium shapes of rotating drops and the shape oscillation frequency of simple and compound drops, and studying methods for centering one component of a compound drop. The results can lead to the development of innovative procedures for transplanting cells in humans by encapsulating living cells with a semi-permeable membrane to protect them from hostile environments.

ASA's recent vice president, Robert Apfel of Yale University, is the principal investigator of a second experiment, entitled the Science and Technology of Surface Controlled Phenomena. This experiment investigates the surface properties of drops as they are affected by surfactants, agents (like detergents) that reduce the surface tension of liquids. Drops will be squeezed acoustically and then released, causing them to oscillate in a quadrupole shape. The frequency and damping of these oscillations will be measured for different surfactants in varying concentrations.

In another part of Dr. Apfel's study, two water drops containing surfactants will be brought into contact and induced to combine, while carefully measuring the techniques used to force the drops to rupture and coalesce. Surfactants are important in many industrial processes, from production of synthetic drugs to enhancement of oil recovery.

A third part of the Drop Physics Module is led by Michael Weinberg of the University of Arizona. It bears the daunting title: Measurement of Liquid-Liquid Interfacial Tension and the Role of Gravity in Phase Separation Kinetics of Fluid Glass Melts. This experiment uses acoustically manipulated spinning drops to measure the interfacial tension between two immiscible (unmixable) fluids in a compound drop.

The thermoacoustic refrigerator

The thermoacoustic refrigerator is an efficient, low-tech system powered by a standing wave. Perhaps its most outstanding feature is that it does not use CFCs or other chemicals that endanger the ozone shield. But it is particularly useful in the shuttle environment because it has no moving parts except for a loudspeaker diaphragm and generates very little vibration. This fact bodes well for long-term reliability. Also, it uses no sliding seals, which have failed in other types of refrigerators.

A conventional refrigerator that was taken into space had failed to perform adequately, and most of the biological samples it was meant to cool had been ruined. In the microgravity environment, gas bubbles had collected in the liquid freon, causing destructive high-pressure pulses (like the loud knocking in older steam-heat systems).

The process of thermoacoustic refrigeration was pioneered during the 1980s by the late John Wheatley and his colleagues at the Los Alamos National Laboratory, Gregory Swift, Thomas Hofler, and Albert Migliori. More recent research in this area has been carried out at the Naval Postgraduate School in Monterey, California under the leadership of Steven Garrett. Dr. Garrett's team now includes Tom Hofler, who has relocated, as well as Jay Adeff. All of these researchers are members of the ASA.

The acoustic fridge has achieved high visibility over the last year, with articles appearing in the *New York Times* (2-25-92 by Malcolm Browne), the *Los Angeles Times, Science, Popular Science,* and *Discover.* The project has been funded by the Navy and the Air Force, and most recently by NASA via the General Electric Corporation.

Its components consist of an acoustic driver, a modified loudspeaker, coupled to a resonator, which holds a harmless helium-argon or helium-xenon mixture. Located inside the resonator is a stack of plates made out of mylar (a poor heat conductor). A 160 dB tone at about 400 Hz is emitted by the loudspeaker, setting up a standing wave inside the resonator.

Space thermoacoustic refrigerator

The gas molecules heat up in areas of compression and cool down in areas of rarefaction, and heat pumping takes place along the stack. Like a bucket brigade, heat is shuttled to the warm end of the stack, where it is conducted away by short copper plates acting as a heat exchanger. The cooled gas can then absorb heat from adjacent areas, producing refrigeration or air conditioning.

Fortunately, the intense sound is confined to the resonating tube and isn't a noise problem outside the apparatus.

This January the thermoacoustic refrigerator made its maiden voyage aboard space shuttle *Discovery.* It was part of the "Get-Away-Special" program, where experiments can be tucked on board shuttles if they require no interaction by the crew. The acoustic fridge fit into a 2½ by 3-foot canister mounted on a rack in the shuttle's bay and only needed to be turned on by a crew member.

A number of questions were uppermost in the minds of Steve Garrett and his team. Would the refrigerator survive the ten-day trip? Would it work? Would it leak? Evidently, helium leaks easily, so the team used metal O-rings instead of rubber ones.

Upon their return, the refrigerator worked fine. It had sprung no leaks. But during this particular mission the shuttle had become quite warm, with temperatures up to 120 degrees C in the bay. Evidently, the refrigerator had attempted to start 20 times, but had given up after about one minute each time. The research team believes the system's software was at fault.

The next version of the thermoacoustic refrigerator is scheduled to fly in a little more than a year. In the meantime, research continues apace at the Naval Postgraduate School.

Information on the Drop Physics Module was provided by NASA and the Jet Propulsion Laboratory, with assistance from Arvid Croonquist of the JPL and Bob Apfel of Yale. Jay Adeff and Tom Hofler of the Naval Postgraduate School provided information about thermoacoustic refrigeration.

A note on the importance of thermoacoustic refrigeration . . .	The importance of the thermoacoustic refrigerator increases with concern about the ozone layer. According to recent studies, the problem is considerably more serious than previously thought. Environmentalists maintain that the President's 1995 target date for banning CFC production in the U.S. is not soon enough. The thermoacoustic refrigerator, though still years away from commercial production, provides an increasingly attractive substitute.

New Orleans — Friday October 30th through Wednesday November 4th

New Orleans must be one of America's most desirable convention cities. Mild autumn weather, the picturesque environment, gourmet restaurants, and, of course, jazz, appeal to the tourist and adventurer element in even the most dedicated session attendee. Because the decision to hold the meeting in New Orleans was made somewhat belatedly, the availability of rooms became a problem. Hence the idea of holding the meeting over a weekend. One side benefit will be the savings in airfare because of the Saturday night stay-over.

One possible inconvenience is that Tuesday, November 3rd, is Election Day and U.S. citizens must remember to obtain absentee ballots when preparing for the trip.

On Friday afternoon and Saturday morning a short course on Ocean and Seabed Acoustics will be given by George Frisk of the Woods Hole Oceanographic Institution. Instead of the usual Tuesday, the first regular technical sessions will take place in the afternoon of Saturday, October 31st.

On Saturday evening there will be a social at the Aquarium of the Americas. Admission, food, and transportation will be provided by ASA at no cost.

No sessions are scheduled for Sunday morning, leaving the time free for church, brunch, or committee meetings. The exhibits will open at 11 a.m., there will be technical sessions in the afternoon, and on Sunday evening Ilene Busch-Vishniac of the University of Texas Department of Mechanical Engineering will present a tutorial lecture on Transduction Mechanisms.

Technical sessions are scheduled all day on Monday, Tuesday, and Wednesday. The plenary session will take place on Monday afternoon, at which four silver medals will be presented. Technical committees will meet on Monday and Tuesday nights, and the second social will take place on Monday evening at 6 p.m. with a cash bar and a jazz quartet.

Special session highlights

Some of the more intriguing special sessions and their sponsoring technical committees are:

Virtual environments	Psychological and Physiological Acoustics, Architectural Acoustics, Bioresponse to Vibration
Chaos in music	Musical Acoustics
Jazz performance	Musical Acoustics
Smoking chimneys at the sea floor	Acoustical Oceanography
Insect bioacoustics	Animal Bioacoustics
A tribute to Lothar W. Cremer	Architectural Acoustics, Noise, Musical Acoustics, Structural Acoustics and Vibration
Sonic booms	Physical Acoustics, Noise
Anecdotes on acoustics	Education in Acoustics

And this list is by no means complete....

Tours

There will be a tour to the Audubon Zoo on Sunday morning via Mississippi riverboat or the St. Charles Trolley, the oldest trolley line in the country. Other tours planned include the New Orleans International Airport with a presentation on the airport's noise abatement program and a tour to the Naval Biodynamics Lab featuring human response to ship motion.

Day-trips

The Visitors Program Committee has planned six entertaining trips, which are described in a flyer accompanying the call for papers. There is something for everyone: city tours, tours of great old plantations, art gallery browsing, a flat-bottom boat ride in the Honey Island Swamp, and an evening in the home of former Congresswoman Lindy Boggs, complete with cocktail buffet and jazz band.

The Americans with Disabilities Act: Implications for acoustical design

In July of last year, Congress extended guarantees of equal access to goods and services to 43 million disabled Americans. Implications of this legislation in acoustical design extend far beyond the obvious act of providing assisted listening devices or interpreters for the hearing-impaired, to defining job performance requirements that include communication ability and the acoustical environment in which the applicant will work.

An example of an issue that might arise is whether there should be minimum standards for hearing ability of corrections officers. Walls and ceilings in correctional facilities are usually finished with materials low in sound absorption, which, along with inmate activities, produce a noisy, reverberant environment. Officers supervising inmates must be in constant communication with their support staff as well as with the inmates. Measurements of typical speech and noise levels, along with estimates of the intelligibility required for adequate communication, allow the calculation of necessary hearing threshold levels for corrections officers.

Another area of major impact of the Act is in public accommodation. To assure equal access to services in public places, attention must be given to the environment that will allow adequate communication and the transfer of information such as warnings to disabled individuals.

Noise in schools has been a long-standing problem. Of particular concern are speech- and hearing-impaired students who must communicate with the teacher as well as with each other. Classrooms for these children demand careful planning to achieve an environment as free of interfering sounds as possible. The usual design criteria using NC values, reverberation times, and Speech Interference Levels are inadequate in these situations, and it is necessary to establish criteria specific to the intended population and the anticipated use of the space.

In the courts, the need to provide interpretative services for hearing- and language-handicapped participants is well established, but there have been no guarantees that moderately or mildly hearing-impaired people can understand what is being said in a courtroom. Sometimes courtroom acoustics are so poor that even those with normal hearing have difficulty understanding the deliberations.

Recently, however, the Administrative Office of the United States Courts has issued a new Design Guide for the U.S. Courts. In contrast to earlier recommendations, which specified finishes and furnishings with only minor reference to room acoustics, the new guide provides information to architects, engineers, and judges on how to select acoustical criteria based upon the function of the space. It explains the differences between various levels of privacy and the tradeoffs required to achieve each. With the background provided by the Design Guide, the architect and the judge are able to make informed decisions about the design criteria for each space, enhancing access to the legal process for hearing-impaired people.

The Americans with Disabilities Act presents acousticians with the opportunity to establish acoustical criteria in the areas of employment, accommodations, and communication. It poses a challenge to educate the public and to offer rational, objective bases for decisions that will be made in response to the Act's requirements.

John Erdreich
Ostergaard Acoustical Associates
W. Orange, New Jersey

Concert hall survey

The Concert Hall Research Group, a newly formed consortium of professionals interested in concert hall acoustics, announced the completion of its first series of standardized measurements in nine prominent concert halls. The initial tour included halls in Baltimore, Cleveland, Boston, Philadelphia, Detroit, and Washington, DC. Three measurement teams went to each hall together, each group using its own instrumentation. The three teams were from the National Research Council of Canada, the University of Florida at Gainesville, and the Danish Technical Institute.

This international effort is funded by contributions from acoustical consultants and other interested parties in the United States, France, Japan, New Zealand, and Canada. The ASA has also provided financial support from its technical research budget.

The overall goal of the Concert Hall Research Group is to gain a better understanding of how to design performance spaces. One of the immediate goals is to standardize measurement procedures among the three teams. If the teams can demonstrate good agreement in their results, then each team can measure other halls on its own with confidence that the results are comparable to those of the other teams in other halls. This has the potential to expand greatly the available database of acoustical information on existing halls.

The researchers will spend the next few months reducing their data. The results will then be presented at an ASA meeting and later published in JASA. Future plans call for measurements in more halls and new hardware and software that will permit measurements in occupied halls.

For information on becoming a sponsor, write to Concert Hall Research Group, 327F Boston Post Rd., Sudbury, MA 01776.

If A is success in life, then A=*x*+*y*+*z*, where *x* is work, *y* is play, and *z* is keeping your mouth shut.

—Albert Einstein

Recent EEC directives on acoustics

At the Salt Lake City meeting Dr. Klaus Brinkmann of the German Physikalisch-Technische Bundesanstalt presented a summary of recent activities related to acoustics in the European Economic Community (EEC). After the adoption of a new approach to harmonizing the standards of individual nations, the EEC issued four new directives related to acoustics:

- Council Directive of 12 May 1986 on the protection of workers from the risks related to exposure to noise at work (86/188/EEC).
- Council Directive of 21 December 1988 on the approximation of laws, regulations and administrative provisions of the Member States relating to construction products (89/106/EEC).
- Council Directive of 14 June 1989 on the approximation of the laws of the Member States relating to machinery (89/392/EEC).
- Council Directive of 21 December 1989 on the approximation of the laws of the Member States relating to personal protective equipment (89/686/EEC).

The relevant ISO committees (TC 43 and TC/43/SC 1) are currently engaged in standardization activities involving some 60 projects related to acoustics, with the intent that most of them will be adopted as European Standards.

For further information on EEC directives . . .

For further information on the EEC directives, contact The Delegation of European Communities at (202)862-9500, and ask for the Depository Library in your vicinity. For information on the ISO standards, contact Leif Nielsen, Danish Standards Association, Baunegardsveg 73, DK-2900, Hellerup, Denmark. Tel. 45-39-77-0101.

Transducer workshop

On May 6-8, 1992, the Naval Research Laboratory's Underwater Sound Reference Detachment held the Third International Workshop on Transducers for Sonics and Ultrasonics in Orlando, Florida. The first two workshops were held in France in 1987 and 1990, organized by the Institut Superieur d'Electronique du Nord and the Groupe d'Etude et de Recherche de Detection Sous-Marine in Lille and Toulon, respectively. The purpose of the workshops was to encourage discussion and information exchange about current developments and future needs in transducer technology. Proceedings will be published later this year. For information contact Dr. Michele McCollum, (407)857-5187.

ACOUSTICAL • SOCIETY • OF • AMERICA
500 SUNNYSIDE BLVD.
WOODBURY, NEW YORK 11797

Non-Profit Org.
U.S. POSTAGE
PAID
Seattle, WA
Permit No. 5675