

COMMITTEE ON EDUCATION IN ACOUSTICS: SCIENCE EDUCATION AND THE ACOUSTICAL SOCIETY OF AMERICA— ARE WE DOING ENOUGH?

Uwe J. Hansen

*Department of Physics, Indiana State University
Terre Haute, Indiana 47809*

Acoustical Society of America (ASA) educational concerns cover a vast range of interests and disciplines. This includes such diverse university programs as the physical sciences and engineering, life sciences, medicine, and architecture. Some of the concerns are very self-serving such as issues related to the growth of the Society and the vitality of individual technical committees; others are very much oriented to serve society at large, such as the recently issued standard on Classroom Acoustics. The quality of science education in secondary schools is of vital interest, as is the introduction of science concepts at the elementary level. Two examples will serve to illustrate both the concern, and the need for ASA contributions.

In a recent conversation, the Dean of the College of Arts and Sciences at Indiana State University mentioned to me that figures presented at a national conference of university administrators suggest that about 60% of all secondary school physics teachers in the US are over 60 years old, and that there are very few, if any, replacements in the pipeline. Local high school principals comment that they have no problem filling vacancies in nearly all fields, including most sciences, however, not so in physics. This decline in qualified science teachers is of grave concern, especially to scientists. While ASA members are active in a vast range of disciplines, covering nearly all sciences and some of the arts, the physics of sound and vibrations is vital for all of them. Details of both current and proposed ASA activities to address this national need are discussed in the following paragraphs.

A second example suggests that many buildings such as schools and churches are constructed without input from competent acousticians. While on sabbatical at the Physikalisch Technische Bundesanstalt (PTB) in Braunschweig, Germany (their Bureau of Standards), I attended a religious conference in Hannover. This conference was held in a recently constructed church building which included a sanctuary, and a facility of approximately the same size, which usually is used for sports and recreation. The spaces are separated by a set of two classrooms with relatively low ceilings which are closed off by means of folding-door walls. For large audiences the folding doors are opened and the recreation area serves as an overflow. No acoustic delay had been introduced into the electronic amplification system, and reverberation times were rather



large, making the spoken word nearly unintelligible in the overflow area, and music quality totally unacceptable. I was asked to make some suggestions for improvement. I recommended some sound absorbing wall panels and a delay for the speakers in the overflow area. Both suggestions were implemented with significant improvement; however, significantly better results

would have been noticed with appropriate pre-construction consulting.

There clearly is a need for action in four areas:

1. Educating our own
2. Educating acousticians in all fields of acoustics
3. Generating enthusiasm for all sciences in the very young
4. Educating the general public

1. By “our own” I mean ASA members and all who work in some field of acoustics. In fact, as a Society we do a remarkable job of disseminating the results of our efforts in books, hard-copy or electronic journals, as well as in our semiannual meetings. That educational effort has gained us recognition as the world’s premier acoustics organization. Such recognition carries with it an obligation for outreach. To some extent we are meeting that challenge by expanding a parochial outlook to foster international cooperation. This is evidenced by recent joint meetings with the European Acoustics Association, the Mexican Institute of Acoustics, and the Acoustical Society of Japan, and by an increased international ASA membership. Internally our program of tutorials has made us more aware of the efforts of our colleagues in sub-disciplines removed from our own, and the “Hot Topics” sessions have given us the opportunity to view the fore-front of the many fields under the umbrella of acoustics. Workshops and short courses have been instrumental in giving access to our expertise to some of our own people and to others in related disciplines.

2. University undergraduate and graduate acoustics programs, as well as any pre-professional acoustics program fall into the second category. The ASA is contributing to the effectiveness of these programs by providing information about details of acoustics programs in a listing on the ASA web site. ASA student chapters and the ASA Student Council help students to find a home in acoustics. Student receptions, best student paper awards, the Robert W. Young Award for Undergraduate Student Research in Acoustics, and the “Students Meet Members for Lunch” program, furthermore

contribute to student activities. Students in turn have established a mentoring award. The Committee on Education in Acoustics has organized workshops dealing with acoustics demonstrations and laboratory experiments. In high school workshops, readily available spectrum analysis software is introduced and a number of acoustics experiments are discussed, along with ways of using them in the classroom context. Workshops for university teaching laboratories concentrate on more sophisticated experiments, including the use of Lissajous figures to map normal modes by observing the phase change across a nodal line, or constructing a simple impedance head to observe resonances in open and closed tubes. While these efforts have been appreciated locally, much more needs to be done in order to observe measurable results in a national program of science education. The committee has also organized a number of sessions at national meetings dealing with course development and acoustics programs, as well as specific courses in some of the acoustics sub-disciplines, such as medical acoustics, architectural acoustics, and musical acoustics.

3. The third topic is one of outreach. With evidently declining interest in the physical sciences, it becomes increasingly important to generate enthusiasm for such interests in the very young. Interest in physics is rarely initiated in high school. At that level it can be nurtured, but unless excitement is sparked earlier, sciences are frequently perceived as too difficult by this time. To exacerbate the problem, science content in teacher education programs at the elementary level frequently emphasize the life sciences, and the physical sciences are the poor country cousins. This suggests two solutions: teacher workshops, and class visits. Workshops have been supported mostly with ASA technical initiative funds, and also Eisenhower program money. ASA volunteers have visited classes at all levels, some in connection with ASA meetings and some in the communities of residence of the scientists. Both approaches need to be expanded and institutionalized nationally. Efforts are currently ongoing to establish a permanent reservoir of demonstration equipment to support the hands-on demonstration sessions, conducted at most of the ASA national meetings, for classes of high school students and students in elementary schools.

Many of the workshops and class visits have focused on using music as a vehicle to introduce science in the classroom. Music is universally loved and thus provides a remarkable tool to bridge the chasm to "difficult science." At the elementary school level students do not know yet that science is supposed to be hard. Thus that is the ideal time to make the introduction. Most of the elementary workshops proceed along the line of discovering the nature of wave propagation on a long spring, followed by the concept of resonance as exemplified by standing waves on a stretched spring. The harmonic, integral multiple frequencies of higher resonances are observed and related to the harmonic overtone series on string instruments. Participating teachers build a Pythagorean Monochord, which they then take back with them to their classroom. The workshop finances also provide for the long spring, and for a set of tuning forks along with a tube tuned to the same frequency as one of the forks. The science concepts are taught, as are their relations to music

principles and ways of presenting both at the level of the children. (Editor's note: see article in this issue of *Acoustics Today* by Busch-Vishniac and West.)

4. The fourth category is concerned with ASA efforts to increase literacy among the general population, both in general science, and in acoustics. Efforts are underway to improve the ASA web site, with the specific goal of making it more accessible and more exciting. The site should convey general information about acoustics and entice the visitor to find out more. Workshops and short courses, while generally designed for professionals, have included outreach efforts to serve the general public. The annual award for a publication in acoustics by a non-professional has usually been given to a journalist, writing to a lay audience. The Salt Lake City meeting tutorial, Musical Acoustics: Science and Performance, will be open to the public with special invitations to students at all levels. It will intermix introduction of science concepts, relevant to music, with lively jazz performances.

In summary, much has been done, yet much of the energy of the Society remains untapped. The recent assessment of the direction in which the ASA needs to move to maintain vitality, as well as provide additional leadership, both nationally and internationally, included a recommendation for more emphasis on education. With that in mind the immediate past president of ASA appointed an ad hoc committee on educational outreach. Among other things, this committee is recommending that a permanent ASA education officer be employed, in order to accomplish some of the outreach tasks which are simply beyond the scope of a volunteer army. One of the tasks of such an officer would be to tap government and private foundation funds to coordinate efforts on a national scale which have proved so successful on a limited local scale.



With a Ph.D. in Low-Temperature Solid State Physics from Brigham Young University (66) Uwe J. Hansen spent two years at the U.S. Naval Research Laboratory as a NAS/NRC Research Fellow before joining the Physics faculty at Indiana

State University (ISU). About 15 years later he saw the light, or better "heard the sound" and returned to his first love: Musical Acoustics. His research has focused on mode studies in musical instruments, primarily using holographic interferometry and computer animated modal analysis. He is a fellow of the Acoustical Society of America and the Indiana Academy of Science. He has served two terms as chair of the technical committee on Musical Acoustics and two terms as chair of Education in Acoustics. He served as chair of the Physics Department at ISU, and also as president of the Indiana Academy of Science, where he also was chosen as speaker of the year for 1998. After retirement from ISU in 1998 he accepted an appointment as Executive Director of CSUI, a consortium of Midwestern Universities.