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The Newsletter of the Council for Accreditation in Occupational Hearing Conservation

Contemporary Technology for Hearing Conservation Audiometric Monitoring

By Richard W. Danielson, Ph.D. [1], *Amanda Azman AuD.* [2]

Ultimately, the most important product of a hearing conservation program is the prevention of hearing loss, not the amount of hearing protection that has been purchased or whether employees are attending their annual training sessions. Audiometric testing directly reveals whether hearing losses are actually occurring in a plant. With audiometric data, we can assess overall program effectiveness, alert workers of impending hearing loss, and reveal potential employer liabilities for compensable hearing loss. Without the ability to efficiently analyze audiometric data or produce effective reports, our programs become fruitless and unproductive. Consequently, if audiometric data are such vital end-products, then effective audiometric technologies serve as the prime architect and generator of these fundamental data. These technologies, consisting of audiometers, associated peripheral hardware, and database/reporting software, deserve our consideration in this issue of the UPDATE.

If you are now conducting audiometric tests, you may have become so comfortable with your current equipment and recordkeeping system that it might seem like "this is the way things are supposed to be." However, could it be possible that one day your management might notify you that it's time to replace the audiometer, due to age or condition (or maybe due to an increase in your workload)? If that happens, where would you turn, and what criteria would you use, to shop for replacement instrumentation and database technology? The purpose of this article is to help you recognize some criteria of features currently available in audiometric equipment and audiometric database management software. Perhaps this information might help you plan for ways to enhance your program's efficiency and effectiveness (provided that budgetary constraints aren't exceeded). Even if you don't think that you're currently "shopping" for such technology, you may find it worthwhile to consider what's changed (and what has not changed) in this element of hearing loss prevention.

The evolution of audiometric equipment to our current microprocessor-controlled audiometers has been relatively deliberate since "self-recording audiometers" were popular, several decades ago, in military and industrial hearing conservation programs. Of the various audiometers now marketed for use in hearing conservation programs, it's reasonable to assume that there's no perfect audiometer system for all scenarios. A small, in-plant HC program may require a basic audiometer, with fewer features than are needed by a service that uses mobile vans to support multiple companies in different cities. Basic manual audiometers can cost between $600 and $1,500, while microprocessor audiometers can cost approximately $1,500 to $5,500, depending on options ordered. But price shouldn't serve as the only criterion for audiometer equipment selection. A choice of audiometer and peripherals will be influenced by obvious issues like the number of employees needing tests, protocols used in the plant for audiometry and professional review of audiometric data, and capital operating resources.

As shown in Table 1 (on page 5), several other considerations can be applied when choosing a new audiometer system. These considerations are intended to help spark questions that can be discussed with the equipment manufacturer or your equipment provider (e.g., someone affiliated with the National Association of Specialty Equipment Dealers, or NASED) about your needs. Since CAOHC doesn't intend to endorse any particular product or vendor, only general features will be addressed here, not specific manufacturers or models.

NEW DEVELOPMENTS IN AUDIOMETRIC HARDWARE

If your audiometric data will be saved electronically for analysis and reporting (see the discussion on audiometer software, later in this article), an interface with a computer becomes important. This link may be via a standard wired connection (e.g., RS-232, USB cable or Firewire), or even with wireless communication (up to 30 feet from the computer). In any case, consider how the data can be transferred to the computer, as well as how the audiometer can access data from previous tests in the database. If the level of activity requires testing more than one person simultaneously, it will be important that the audiometers can link to a controller and

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CAOHC Approved Courses

When you are registering for a recertification course (or if your fellow staff member is registering for the first time at a certification course), please confirm with the registrar that "this is a CAOHC approved" course. Only certified Course Directors, who have received a course approval certificate from the CAOHC Executive Office, can conduct an occupational hearing conservation course that leads to CAOHC certification or recertification. Course Directors must display this certificate of approval in view of their students. If you don't see it, please ask your Course Director.

If you are uncertain whether the course you are planning to attend is certified by CAOHC, please contact Chris Whiting at the CAOHC office at 414/276-5338 or e-mail info@caohc.org

Chair's Message

By James D. Banach, MBA

Tempus fugit… especially as summer slides into autumn. There is never enough summer. Oh certainly there is enough humidity, but never enough summer. There has been a play being performed here in Milwaukee this summer featuring a local actor who reflects on his memories of summer. It is mostly full of good simple humor and a few poignant segments that touch the heart. Many of the memories portrayed lead me to recall my own experiences growing up in Milwaukee.

Tempus fugit… wasn't it just a blink ago that I was selected by the council to chair CAOHC. I remember wondering how I'd squeeze the duties in and how we would work together as a council. I especially wondered how I'd get these columns done. November quickly approaches, and a new chair will be in place. I get to retire to the role of wisdom council. And so this is my chance to look back, and to look forward.

Mostly as I look back, it is the people who come to mind and all their hard work. At times we forget that this is a group of volunteers who give their time and effort without compensation. In Malcom Gladwell's book "The Tipping Point," he refers to three types of people necessary for change to happen. He categorizes them as connectors, mavens and salespersons. Connectors are characterized by knowing lots of people, having an active imagination, and being able to put the two together. Mavens are information specialists, sticklers for detail; they love to give advice and to educate others. And finally the salesperson is exuberant, expressive and full of it. Certainly in this group we have some of each. As we approach November some will be leaving the council and new folks will come on board. The good news is that whether looking back or looking forward I can see a balance being maintained.

Soon to depart are Dick Danielson and Elliott Berger. Additionally I'll be moving over to Past Chair status. I can tell you two of the three are tireless contributors that have gone way beyond professionalism to exhibit their passion for hearing conservation and all that goes into teaching others how to inspire and educate.

Dick is without question a connector. No matter what the topic, Dick knows someone who's studying that concept or would like to be studying it. And as for an active imagination, he is unparalleled in the workshops for his relentless desire to find another way to present the same old material.

Elliott is the consummate maven. If it has to do with hearing protection, he knows it. If it has to do with vocabulary, spelling, or grammar, he knows it. If it has to do with lighting, sound systems, ceiling height… he knows it. And he surely loves to share his knowledge.

As for me, yeah, I'm a salesman… always have been, always will be. I'm most qualified in the "full of it" skill.

So how will we possibly survive these changes? Well the good news looking forward is that Laurie Wells will be replacing Dick as a representative of AAA. She too is a connector, and is one of the few people who could seamlessly take over in the role. Lee Hager is certainly a maven in hearing conservation and will be a great replacement for Elliott as a representative of AIHA. And as for this salesperson, Mary McDaniel will be the new chair representing ASHA, and she is an extraordinarily passionate seller of the hearing conservation ideals.

A couple of other changes are happening too. We welcome Dr. James Wesdock who will be representing ACOEM in place of Dr. Peter Rabinowitz who is taking a sabbatical. We owe Peter a great deal for all his work on the Professional Supervisors course. Thank you Peter.

And finally there is one change we'd do most anything to prevent, and that is the departure of Barbara Lechner as Executive Director. A few of us got together with

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OHC Corner

Resources in Hearing Conservation

By Mary McDaniel, AuD

Searching for hearing conservation resources on the web can be a daunting task. For example, on my first Google search "hearing conservation" I came up with 2,710,000 hits. This was overwhelming! Of course, I could have added additional search terms to focus more narrowly on noise measurement, audiometric equipment, test providers, professional supervisors, educational materials, hearing protectors, etc. The reality is there are innumerable hearing conservation resources available if you're willing to spend some time 'surfing the web.' Fortunately for me, since I don't want to spend a lot of time digging, the first five listings in the Google search were all winners. What follows is a brief discussion of just some of the great features about these five websites. If you are looking for information about hearing conservation, these sites are a great place to start – and they may well have all the answers to whatever questions you might have.

- National Hearing Conservation Association (NHCA) at: **www.hearingconservation.org**
  This website offers comprehensive information for its diverse membership. The NHCA comprises audiologists, industrial hygienists, physicians, nurses, safety professionals, OHCs, service providers, and manufacturers, and their website provides pertinent information for all. One click on the 'Resources' button offers a drop-down menu to further assist you. This site has one of the most comprehensive bibliographies and is searchable by general topic, title, or author. This is also a good place to find a service provider working in your geographic area — be it mobile testing, noise measurement, noise control, etc. The NHCA also offers several interesting and helpful teaching tools to assist you with hearing loss prevention training.
- Occupational Safety and Health Administration at: **www.osha.gov/SLTC/noisehearingconservation/index.html**
  This is the place to access federal rules and regulations on hearing conservation. There you will find a listing of the regulations, how employers must comply, how to evaluate noise in the workplace, how to control noise exposures, and what constitutes an effective hearing conservation program. OSHA also has a great e-tools button that provides additional info regarding all components of hearing loss prevention. You'll find this link on the address above in an outlined box (or scroll to the bottom of the page) — select "eTools" and then "Noise and Hearing Conservation" to access detailed information for an effective program. Don't forget to check out the Safety Health and Information Bulletins (SHIB). Key in words such as "accommodation" or "hearing-impaired" and be linked to a document regarding innovations in reasonable accommodation for the hearing impaired worker. And although they did not make the 'top-5' on the Google search, you might also want to check out the website for:

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OHC Spotlight

The Spotlight focuses this issue on OHC Jane Mitchell, who is a nurse practitioner working for a large multinational oil corporation with a refinery in Billings, Montana. In her role, Jane sees refinery employees for occupational health issues as well as regulated and required exams.

Jane joined the refinery in 1993 and also became CAOHC certified in March of 1993. She obtained a Masters Degree as a Family Nurse Practitioner from the University of Wyoming. In Jane's role, she encourages employees to wear hearing protection both off and on the job. She also encourages compliance with the hearing conservation program and completing annual audiograms. The employees are excellent at wearing hearing protection devices (HPDs) as required by the employer.

Jane's knowledge enables her to do some diagnostic analysis. Subtle or sudden changes on an audiogram can be indicative of serious medical problems such as acoustic nerve tumors, diabetes, or viral neuritis.

On one occasion, an employee noted dizziness off the job. Jane discussed the causes of dizziness and then administered an audiogram. The employee had significant hearing loss in one ear. When compared with previous audiograms, it was clear that this hearing loss was new which lead Jane to suspect a medical problem. The employee was referred to a specialist where an acoustic nerve tumor was confirmed and treated successfully. The person is doing fine now.

Jane enjoys downhill and cross-country snow skiing and fishing. Jane has a large family in Billings, including a 96 year-old grandmother. She was recently engaged to be wed. The photo shows Jane and her catch of the day, a large mouth bass, while fishing at Toledo Bend Reservoir on the Texas-Louisiana border with her fiancé.

CAOHC Appoints a new Executive Director

CAOHC bids a fond farewell to its longtime Executive Director, Barbara Lechner, who has retired after twelve years of dedicated service to CAOHC as of September 2007. Her leadership and commitment to CAOHC have made her an invaluable employee. She will be dearly missed by many in the field especially by those on the Council. Her aspirations for retirement include spoiling her new granddaughter, playing competitive doubles tennis with her husband, and also learning to play the guitar! We wish her much happiness and success in her retirement.

As part of CAOHC's commitment to ensuring a smooth transition, a new Executive Director was hired as of September 24, 2007. Eloiza Altoro-Acevedo, MS, CAE who has over ten years of experience working with associations. Her career includes work with the Milwaukee Council on Alcohol and Drug Dependence, the Mental Health Association of Wisconsin and most recently the Wisconsin Certification Board. As the Executive Director of the Wisconsin Certification Board, she was responsible for the administration of credentialing substance abuse counselors, human services prevention professionals and substance abuse clinical supervisors for the State of Wisconsin. She also has an MS in Human Services, with an emphasis in management and organizational leadership and is a Certified Association Executive (CAE) through the American Society of Association Executives.

We welcome Eloiza and look forward to working with her at CAOHC.

Resources in Hearing Conservation – continued from page 3

- The Mine Safety and Health Administration at: **www.msha.gov**
- The Federal Railroad Administration at: **www.fra.dot.gov**
  for specific information about these two regulatory agencies.
- Council for Accreditation in Occupational Hearing Conservation (CAOHC) at: **www.caohc.org**
  If you haven't already been to CAOHC's website, now is the time! Along with all the information provided there about the CAOHC certification process, this is where you can easily find a listing of upcoming CAOHC classes for technicians, archives of the UPDATE newsletters, numerous resources and links, and you can also find a geographical listing of Certified Professional Supervisors to assist you in managing the audiometric testing portion of your program. Don't hesitate to click on the "Contact CAOHC" menu selection to send a question to the CAOHC Council. These questions are forwarded for a timely response to a Council member with specific knowledge or expertise regarding your question.
- The National Institute for Occupational Safety and Health (NIOSH) at: **www.cdc.gov/niosh**
  This site has a wealth of information regarding hearing loss prevention and is an excellent resource for hearing conservation professionals. From the NIOSH web page, conduct searches on "noise" or on "hearing conservation" to access these rich resources. Search the NIOSH website using the term "noise exposure" and you'll be linked to the complete text of the NIOSH "Revised Criteria" document. This document is considered by many to be a "best practices" approach to preventing occupationally related noise-induced hearing loss and a must read for the serious occupational hearing conservationist.
- Oklahoma State University - Environmental Health & Safety at: **www.pp.okstate.edu/ehs/links/noise**
  This website, number four of the five hits on Google, contains much of the regulatory information provided on the other sites and offers several pertinent articles and publications, but it also offers links to fourteen other websites of interest. These links are not unique to this site, it's just that they are conveniently listed as you scroll down the page to resources.

This is by no means a complete listing of hearing conservation resources; it is merely a starting point. There are few questions that cannot be answered or products and services that cannot be reviewed at these sites or their links. Don't be overwhelmed by the vast amount of information available, be thankful there are so many well organized websites to make your research manageable. Good luck with your search.

Mary McDaniel is the owner of Pacific Hearing Conservation, Inc. in Seattle, WA., and a CAOHC Course Director. She is currently serving as the CAOHC Council's Vice-Chair. You may reach her at mmm@iinet.com

Contemporary Technology for Hearing .... – continued from page 1

Table 1: Hardware considerations when purchasing a microprocessor audiometers.

MICROPROCESSOR AUDIOMETER CONSIDERATION	SPECIFIC QUESTIONS
Interface to a computer	Are direct connections to a computer and database software available? Can data be transferred electronically from (or to) your audiometer?
Interface to other audiometers	If needed, how can audiometer test more than one person simultaneously?
Manual entry of data (e.g., ID, thresholds)	Is the method of data entry (keyboard or touch screen) appropriate for your situation?
Manual audiometry option	How easily (intuitively) is manual audiometry performed?
Audiogram storage	Can audiograms and data be stored on the audiometer (if testing is done in remote areas)?
Recognition of errors (e.g., person responds too often)	Does microprocessor audiometer recognize errors (and how many)? Does it alert the operator (and how)?
Duration of microprocessor-driven test	With standard protocol, how long does it take to test typical person?
Microphone	Is there a talk-over mike? If so, is it mounted on audiometer's console or on headset?
Instructions	Are recorded instructions available? If desired, are instructions available in languages other than English?
Choice of test protocol	Can you change protocols (e.g., first ear tested, include 8 kHz)?
Price range	Does the cost fit your business plan?
Calibration of earphones	Does audiometer hold calibration data for comparison with daily listening checks? Does audiometer recognize if earphones are different than the set used in calibration?
Portability	Can the unit be transported to other locations (if needed)? What does unit weigh?
Printer capability	Does system have an internal printer? Require an external printer? Allow use of both?

to the computer. Some audiometers allow entry of identifying information (e.g., employee name and ID number, previous baseline data, and responses to questions about histories) with full-size keyboard entries, while others use touch-sensitive screens or keypads for alpha-numeric entries. Of course, it may not be feasible (or necessary) to always link the audiometer and computer. If the testing is done onsite at the plant, you may find it far more efficient to just transport the audiometer to the location and leave the computer in your office or clinic for later interconnections. If that's the case, your audiometer's internal memory can be a real asset. Audiometers can store audiometric data from a few dozen records to over a thousand audiograms. Depending on the software you choose, you can then have access to these records when the employees arrive for hearing testing. Later, the new audiometric records and data can be downloaded to the overall database at your convenience (e.g., when you've arrived home from your trip). Some units even operate on battery power, should your location be so remote.

A microprocessor-driven audiometer's basic advantage has been that these units can be programmed to apply standard audiometric testing rules, without an operator (although NOT without oversight of the Occupational Hearing Conservationist, or OHC). For instance, when an employee depresses the response button when no tone is present or has an excessive number of false positive responses, microprocessor audiometers can stop the test and alert the OHC of the problem, providing the option to reinstruct or abort the test. CAOHC's requirements to learn manual audiometry are based, in part, on the concept that such problem tests can be efficiently expedited onsite by switching to manual audiometric testing. Some audiometers will integrate the manually-determined threshold with thresholds from other frequencies, to complete the record. Moreover, if multiple tests are being conducted but don't all end at the same time, the audiometer operating system can be programmed to continue presentations of a test signal to those who finished quickly, until all have completed the test. Some microprocessor audiometers have a talk-over circuit so that the OHC can communicate with the tested employee (e.g., "Your test is completed. Do not remove your earphones, but sit and wait quietly"). Some models use digital signal processors to play pre-recorded sound files with instructions in languages (sometimes a dozen or more) other than English. This feature may be a real boost to the success of your program, if your employees do not possess strong English skills. Up to 25 customized test questions can be created and used with some audiometers.

While it might seem intuitive that all audiometers use a standard audiometric (e.g., the Hughson-Westlake) technique, ask your vendor about how hearing thresholds are determined by a specific audiometer. This can affect the duration of the test and (more importantly) the validity of the hearing thresholds. Some audiometers allow changes in the default protocols (choice of OSHA, Canadian or other criteria), should the Professional Supervisor and OHC desire.

As described in Table 1, you can also consider other audiometer options like set up and customization, calibration

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of more than one set of earphones (and even recognition that an unrecognized set of earphones has been used), portability (e.g., weight and convenience factors), biological checks, printers (built-in or peripheral), and audiogram backups.

NEW DEVELOPMENTS IN AUDIOMETRIC DATABASE SOFTWARE

An OHC who supports a small program, with only a few dozen noise-exposed employees, can quickly appreciate the frustrations of calculating Standard Threshold Shifts without support of automation (e.g., to track baselines and use age corrections). Table 2 provides some specific considerations and questions related to audiometric database management software that can be applied to designing your own (should you choose to take on that task) or when shopping for a program that has been commercially prepared (and undergone troubleshooting to clear out bugs). While relatively few audiometer systems are being marketed (and once introduced, don't change dramatically for a few years), audiometer software technologies are quite diverse and can be customized. This variety is, logically, intended to meet specialized needs of the users.

As shown in Table 2, some of the features of the software extend the capabilities of the audiometer (e.g., storage of audiograms), while other features greatly exceed functions available on the audiometer itself. Ferreting out sources for audiometric software is a bit more complicated than contacting an audiometer equipment vendor, since software developers can range from those with proprietary links tied to a specific audiometer to independent vendors who aim to support multiple lines of audiometers. In some cases, the hearing conservation database software is part of a larger occupational health care system. It's possible to locate software vendors via the National Hearing Conservation Association, your NASED point of contact, or (of course) Google searches.

When considering software options, you may find that the conditions of purchase are linked to a license agreement that might allow only one plant's database to be maintained. If needed, though, a more comprehensive combination of databases can be maintained (for instance, when a consultant is reviewing audiograms from multiple sites). Your vendor may limit the number of separate locations that can be maintained, as well as the number of OHCs and reviewers who can be simultaneously using the software.

One clear advantage of an electronic database is how it maintains records of calibration data, OHC certifications,

Table 2: Considerations when choosing audiometric database software

AUDIOMETER SOFTWARE CONSIDERATION	SPECIFIC QUESTIONS
Audiogram storage	Is capacity adequate for audiogram database?
Database platform	Is platform proprietary? Windows-based or DOS?
Modules	Is software dedicated to hearing conservation or a module of larger occupational health system?
Software licensing	How many users may use license and/or can use system simultaneously?
Price range	Is software's price fixed, negotiable, based on use of services, or based on amount of purchase?
Initial purchase	What products and services are provided with the initial cost and for how long? What happens after that?
Daily calibration or functional check	Are audiometer checks required before any testing is done? Does system prompt user to perform check?
Employee notification forms	How does the software support employee notification of STS? Does the employee notification provide all OSHA-required elements? What additional information is also provided?
Reporting capabilities	Can reports be customized for user specifications? Can the user configure reports? Will the software company include report configuration services with purchase, or will such service require additional fees? Are a variety of reports available?
Maintenance fee	How are upgrades, maintenance and customer/technical support handled after initial coverage is over? If through a maintenance agreement, what is the cost?
Other costs	Is there a charge for training in, and implementation of, the software? Any other additional charges?
Professional review	Is a professional review service available, or provided with the product? If available are such review services required? If review services are used, what is the turn-around time (to receive results)?
OSHA 300 Log	Will the software generate your OSHA 300 log and automatically flag workers for inclusion?
Baseline revision	Are baseline revisions handled using NHCA Guidelines or other criteria? Does software revise baseline automatically, or is revision made only after professional input?
Medical referral	What criteria generate a medical referral? (AAO-HNS or other?) Do questions relate to physical symptoms (dizziness, fullness, tinnitus, pain)? How is a record cleared so that it doesn't continue to appear as needing a medical referral?
Additional notes	Does software include data fields to document other notes and findings that could affect hearing test results or compliance with the hearing conservation program (e.g., illness, non-use of HPDs, cerumen impaction)?
Data back up	How does the software handle audiometric data "back-ups"? Are back-ups done automatically? How often? Is the source of backups secure?
Technical support	How accessible is technical support? How will the vendor address your problem (e.g., by phone, remote connection, site visit etc.)? Is there a toll free number or email access to technical support?
Written reports (in non-English language)	Can notification forms be printed in languages other than English?
Data conversion	How are data from previous software handled? Is there a fee to convert data to work with the new software?
Multimedia	Is an interactive demonstration available to preview product?
Web-based	If the application is web-based, how are security and accessibility issues handled?

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60 Years of Hearing Conservation and Hearing Protection Research and Development at Wright-Patterson Air Force Base

By Richard L. McKinley

Background of Wright-Patterson Air Force Base

The history of the Wright-Patterson Air Force Base, of the Air Force itself, and even of aviation, is of interest in framing the story that I would like to share. The issuance of a patent to the Wright Brothers in 1906 brought about the creation on August 1, 1907, of the Aeronautical Division of the Army Signal Corps. Congress voted the first appropriation for military aviation in 1911 and expanded the service into an Aviation Section of the Army in 1914. In 1917, Wilbur Wright Field was opened to train pilots and gunners during World War I, followed shortly by the creation of the adjacent Fairfield Air Depot, in what is today Fairborn, Ohio. In 1924, with the closing of the McCook Field test facility, the Dayton community purchased 4500 acres including the leased area on which Wilbur Wright Field was located and named the combined facility Wright Field for the Wright Brothers. Wishing to recognize the contributions of the Patterson family (owners of National Cash Register), an area of Wright Field was renamed Patterson Field on July 6, 1931, in honor of Lt. Frank Stuart Patterson, who was killed in 1918 during a flight test. In 1948, Wright Field and Patterson Field were merged under the name Wright-Patterson Air Force Base.

From US Signal Corps to US Air Force

- Aeronautical Division, U.S. Signal Corps 1907 - 1914
- Aviation Section, U.S. Signal Corps 1914 - 1918
- Division of Military Aeronautics 1918 - 1918
- U.S. Army Air Service 1918 - 1926
- U.S. Army Air Corps 1926 - 1941
- U.S. Army Air Forces 1941 - 1947
- United States Air Force 1947 - Present

Hearing Conservation – Hearing Protection at Wright-Patterson Air Force Base

Dr. Henning von Gierke

In 1947, Dr. Henning von Gierke, together with several colleagues from the Helmholtz Institute in Germany, came to the United States to work for the Army Air Corps in the Bioacoustics Section of the Biophysics Branch of the Aero Medical Laboratory at Wright Field near Dayton, Ohio. Henning's early years at Wright Field were dedicated to understanding the magnitude and effects of aircraft noise on humans. The 40's and early 50's saw the development of the first generation of jet engine aircraft. Henning's Doctor of Engineering dissertation in 1937 accurately predicted the level and spectrum of noise produced by jet flows from a nozzle and in sheet flow. Today's predictive computer models are only marginally better than von Gierke's 1937 method.

In 1948, the newly formed Air Force published the first hearing conservation regulation, AFR 160-3 "Precautionary Measures Against Noise Hazards" that established requirements for prevention of illness and injury from operating and testing jet and rocket engines where hazardous noise levels existed. In this 1948 Medical Services regulation, overall exposures were never to exceed 95 dBA and were recommended to be kept below 85 dBA. Individuals exposed to over 130 dB for longer than 5 minutes per 24 hours were required to have weekly audiograms and if the loss was over 20 dB they were temporarily reassigned until hearing recovered. The regulation also made pre-employment audiograms mandatory.

Soon the research group grew to include pioneering researchers like Dr. Horace (Hop) O. Parrack, one of the charter members of the National Academy of Science Committee on Hearing, Acoustics, and Bioacoustics (CHABA) and Lt Col Elizabeth "Betsy" Guild. Hop Parrack led the way in October 1956 to the first recognized comprehensive hearing conservation program, either within or outside the military. This program required measurements of 8-hour integrated noise exposures as well as octave-band requirements. It included a hearing conservation data card to record the noise exposures, audiograms, and hearing protection data. These cards were stored in a hearing conservation repository.

Elizabeth "Betsy" Guild

While Dr. Parrack was working on hearing conservation, Betsy Guild was flying in any and every aircraft which would give her a seat. Betsy would work on measuring noise and speech communication on almost every flight she took. She was a one-person test team. She was the first woman to fly supersonic, the first woman to fly in a B-52, the first person to measure aerodynamic noise at supersonic speeds, and many others. She was awarded the Air Medal for the courageous pursuit of information to protect others. Her achievements included development of adequate hearing protection and voice communications systems, studies of individual and community response to noise, studies of sonic boom and of rocket noise. Few individuals have personally experienced the first–hand knowledge of so many different noise environments to determine their impact on performance and safety. The Military Audiology Association honors her many contributions to the field of hearing conservation by annually presenting The Elizabeth Guild Award for outstanding service.

Henning von Gierke's research on intense aircraft noise exposures defined new data on human tolerance limits, noise-induced hearing loss, auditory pain, and hearing protection, all of which stand today. In 1957, he introduced with others the equal energy hypothesis as the time-intensity trade-off for the Air Force hearing conservation regulation. Many years later he chaired the International Standards Organization (ISO) working group that prepared and obtained consensus for the adoption of ISO 1999, which used the equal energy rule as the basis for determining the relationship between occupational noise exposure and the estimate of the resulting hearing impairment.

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60 Years of Hearing Conservation.... – continued from page 7

Also during this time, 1956 & 1957, the Biological Acoustics group at Wright-Patterson working with RCA designed, developed, and demonstrated the first Active Noise Reduction Headset. The work was led by Willard Meeker, and developed the basic equations for an analog feedback ANR controller that are still used today. During this time, work on improved passive hearing protectors, earmuffs and earplugs, and communication headsets was being led by Dr. Charles Nixon. Also during this time Dr. von Gierke developed a lumped parameter model for passive earmuffs that still provides significant insight into the performance of circumaural hearing protectors. The mid-fifties also saw the completion of a dedicated acoustics research building designed by Air Force experts working with consultants from Bolt, Beranek, and Newman (BBN). The building was originally designed as a national acoustics laboratory with 6"-12" monolithic concrete walls, floors, and ceiling throughout the building. Special rooms were actually rooms-within-rooms and over 20 different heating and cooling systems were used to prevent noise from going thru the ventilation system to unintended locations.

Henning also helped to address the noise problems of residents near air bases. Working with his colleagues he led the ten-year development of a comprehensive procedure for prediction of aircraft noise exposure near airports, estimating community response, and land use planning for the Air Force, published in 1964. This methodology provided the basis for the procedures in use today.

The 1960s saw work on high-level continuous noise effects by Henning, Captain George Mohr, and others from the Army, Navy, and NASA (National Aeronautics and Space Administration). The researchers exposed themselves to levels up to 160 dB and recorded non-auditory responses to the noise. This pioneering research led to the inclusion of a 150 dB whole body non-auditory noise exposure limit in the Air Force noise regulation.

In the early 1970s, Major Dan Johnson led pioneering work in the auditory and non-auditory effects of high level 150-170 dB infrasound. In a series of experiments, he investigated the effects of infrasound on vestibular function, cognitive performance, and respiration. Dan also led an interagency agreement with the US Environmental Protection Agency (EPA) sponsoring a longitudinal study of hearing thresholds in children. Captain Mark Stephenson was the principal research audiologist at that time, in charge of the data collection and analysis for this pioneering study. Mark also continued the legacy of hearing protection work for the bioacoustics group. Henry Summer, of the bioacoustics group at Wright-Patterson, in 1974 developed the ear-insert-receiver, a custom molded earplug with a hole or bore and a snap ring to enable the use of an earphone receiver with the earplug. The advantage was that the communications could be delivered directly to the eardrum or tympanic membrane, while the listener had the double noise protection of the custom earplug and an earmuff. This design was used by the F-15 and F-16 maintainers during the seventies and has more recently been reincarnated in systems like the CEP (communications earplug) and ACCES (attenuating custom communication enhancement system).

Also during this time, von Gierke chaired the EPA task force charged with meeting the Congressional mandate to "identify levels of environmental noise requisite to protect public health and welfare with an adequate margin of safety." The findings in the task force's "Levels" and "Criteria" reports have provided the basis for non-occupational noise criteria in the United States for the past 30+ years. It should also be noted that Alice Suter, who was then part of the EPA's Office of Noise Abatement and Control was detailed to Wright-Patterson AFB, and also contributed substantially to the "Levels" document.

Throughout the seventies, the team of Dan Johnson, Charles Nixon, and Mark Stephenson conducted a series of long duration (24-48 hours) noise exposure studies. The results of these efforts were used to establish recommendations for safe noise exposures that are in use today by the Department of Defense (DoD), NASA, OSHA, and NIOSH. In the later seventies, Dan worked with Henning and United States and international researchers developing the first noise dosimeters and standards for human exposures to impulse noise. Dan and Charles also worked together on a single number noise reduction rating that accounted for the general spectral content of the noise. This C-A metric was found to be more accurate than the NRR (Noise Reduction Rating) and was nearly as easy to use. The user only had to measure the overall C-weighted noise level and the A-weighted noise level and subtract the two. The result was then used to look up one of five single-number attenuations for a hearing protector binned on groups of C-A values.

Also in the late seventies, a young biomedical engineer, Rich McKinley joined the bioacoustics group and started a modern effort on developing active noise reduction headsets. The bioacoustics lab working with Bose Corporation demonstrated the practical ANR headset for both military and civilian use in 1978. During this time McKinley also worked on developing noise exposure criteria for women who had become pregnant and had jobs that involved significant noise exposures.

The bioacoustics group of von Gierke, Nixon, and Johnson also led the debate on noise exposure criterions and exchange rates technically advocating the 85 dBA, 8 hour, 3 dB/doubling or equal energy criterion. They advised the US EPA on the criterion and worked to get it established in the DOD. While OSHA established 90 dBA and a 5 dB/doubling exchange rate and the US EPA was using 85 dBA and 3 dB/doubling, the Air Force, Army, and Navy, chose a political middle ground at 84 dBA and 4 dB/doubling. The DOD criterion was used until the late 90s by the Army and Air Force when they changed to the almost universal 85 dBA and 3 dB/doubling. Currently the Navy is still using the 4 dB/doubling exchange rate.

The 1980s saw an increased focus on speech communication led by Dr. Tom Moore and Rich McKinley. Together they developed a standardized procedure called the Coordinate Response Measure (CRM) for measuring speech intelligibility across many languages. The test has found many uses in multi-talker speech tests. The bioacoustics group, with Rich McKinley and Mark Ericson leading, also demonstrated in 1987 the first synthetic 3-D audio cue generator. This system digitally processed audio streams such as radio into two signals for the left and right ear. When presented over headphones the listener perceived an apparent sound source location. This was

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Certification Workshop for Course Directors

The Council will conduct a Course Director Workshop on Tuesday, February 19, 2008 at the Portland Marriott Downtown Waterfront Hotel in Portland, Oregon. This workshop will be held prior to the National Hearing Conservation Association (NHCA) conference.

The Course Director (CD) is the individual responsible for planning and conducting training courses for OHCs. The Director is responsible for ensuring that specific CAOHC guidelines are followed and for determining the qualifications and competence of participating faculty members. Course Director certification and recertification is granted for a five-year period.

This workshop is a requirement for certification of new and recertifying Course Directors. Attendees are to submit an application and fee for approval by the CAOHC Screening Committee prior to the workshop. An additional workshop registration application fee is applicable.

All questions may be directed to the Executive Director, at 414/276-5338. Application and registration is available on-line at www.caohc.org/workshop/

Interim ACOEM representative joins Council

James C. Wesdock, MD MPH was recently appointed by the American College of Occupational and Environmental Medicine (ACOEM) as an interim representative on the CAOHC Council during the one-year sabbatical for Peter Rabinowitz, MD MPH.

Dr. Wesdock currently serves as the Corporate Manager of Occupational Health for Alcoa, Inc. He is also an Associate Clinical Professor in the Department of Epidemiology and Community Health at Virginia Commonwealth University's Medical College of Virginia.

He received his medical degree from Hahnemann University School of Medicine in 1985 and completed his Family Medicine residency at the Medical Center of Delaware in 1988, and his Occupational/Environmental residency and Masters in Public Health from the University of Oklahoma College Of Public Health in 1993. Dr. Wesdock is Board Certified by the American Board of Family Medicine and is also Board Certified in Occupational Medicine by the American Board of Preventive Medicine. He is a fellow of the American College of Occupational and Environmental Medicine and the American Academy of Family Physicians, and past president of the Virginia College of Occupational and Environmental Medicine.

Dr. Wesdock's was welcomed to the Council July 1, 2007 and has been serving on the committees previously assigned to Dr. Rabinowitz.

NHCA to Present Hearing Conservation Conference

Join the National Hearing Conservation Association (NHCA) for their 33rd annual conference, in Portland, Oregon, from February 21-23, 2008 at the Marriot Downtown Waterfront Hotel. The NHCA annual conference is a well-attended event consisting of great workshops, presentations and exhibits ranging from "big-picture" presentations about hearing loss prevention (such as NIOSH research and hearing loss prevention for the military), to practical talks that contain information you can use next week (such as field verification of hearing protection and hearing loss prevention for kids).

The NHCA 33rd annual conference will also include a fun Friday-evening activity at the Oregon Museum of Science and Industry, featuring the Dangerous Decibels® exhibit and a special state-of-the-art planetarium experience.

Come experience the big city excitement and small town charm of Portland, Oregon at the NHCA 33rd Annual Conference, February 21-23, 2008.

Check the NHCA website in the near future at www.hearingconservation.org for more information or call the NHCA office at 303/224-9022.

Contemporary Technology for Hearing .... – continued from page 6

daily functional check data, patient medical histories, noise exposure records, medical referrals, and other data for documentation and quality control. Currently, software options can offer (to some degree, more or less) an abundant amount of documentation, as shown in Table 2. Moreover, reports can be generated (either from an established set or customized) to indicate medical referrals, STS rates, trends, and reports of hearing loss among individuals, shops, or companies. As indicated in the table, you may find that the software company might charge an additional fee for customizing reports (or for allowing you to generate ad-hoc reports). You may also consider other software options (listed in Table 2) like capabilities to generate individual letters to employees (in languages other than English, if needed), flagging workers who have triggered an OSHA-recordable hearing loss or medical referral, or documentation of other notes (e.g., cerumen impaction) that might be relevant for the Professional Supervisor (PS) who reviews your data. Don't forget that the recommendation of the PS is required for problem audiograms, including decisions re baseline revision. Although the software might offer an "alert" re a need for baseline revision, the PS may override the revision alert if warranted. Don't trust the software to drive your hearing conservation program; use a knowledgeable PS (with the scope of practice outlined at www.caohc.org/professional_supervisor/scope_of_practice.php). Your PS will also be especially concerned about how your audiometer software can convert audiometric data (either by import or export functions), so be sure to coordinate your decision processes with your PS. While the effectiveness of your audiometric testing program benefits markedly from good recordkeeping, it's important to tailor your efforts to best use time and resources effectively. As Daniel J. Boorstin once said, "Technology is so much fun but we can drown in our technology." Designers of audiometric equipment and audiometric database management technologies are aware of our need to be efficient, yet thorough. As you contemplate your future needs in this area, feel free to shop around, express your specific needs and coach the vendors who are earnestly seeking to develop technologies that contribute to our required jobs in hearing loss prevention.

The opinions expressed are neither those of the National Space Biomedical Research Institute nor of the National Institute for Occupational Safety and Health.

Dr. Dick Danielson is an associate professor for Baylor College of Medicine and works for the National Space and Biomedical Research Institute at Johnson Space Center.

Dr. Amanda Azman is a research audiologist with the National Institute for Occupational Safety and Health at the Pittsburgh Research Laboratory

Chair's Message – continued from page 2

Barbara to share some stories and dinner, and to let her know just how much we have appreciated all her care and concern. Of all the changes coming in CAOHC, this is the one that will be hardest for us to weather. But when you listen to Barbara's retirement ideas, you can't help but be jealous and wish her a very long and healthy one.

But that is enough about us. What about you? Which are you in the field of hearing conservation? Are you a connector, a maven or a salesperson? As an OHC or a course director, you bring all that you are to your work and that is a key to the greatness of CAOHC, that it is a blend of so many perspectives, skills and styles. Who have you touched, inspired, educated about the wonders of hearing and the need to protect it?

Tempus fugit… when you get to work with caring professionals in an area that you care about deeply, the time flies. With it comes change as we transition to our new leaders. With new energy building on past excellence, good things are bound to arise. CAOHC – there is no equal.

OHC Spotlight and YOU!

If you would like to be considered by the editorial staff for a future "OHC Spotlight" feature, please contact Eloiza Altoro-Acevedo at the CAOHC office by e-mail: info@caohc.org or by phoning 414/276-5338.

FOR SALE

Audiometric Testing Booth by Industrial Acoustics: The booth measures 28" wide x 39" deep x 76" high; with a window 23" x 29". This booth is "ready to go." Asking price: $1,800 OBO, FOB Harrisburg, PA. We will include a Tremetrics RA-400 Audiometer at no additional charge. Phone: 717/448-1211.

UPCOMING OHC CERTIFICATION AND RECERTIFICATION COURSES* 2007

*The listed dates indicate day one of the scheduled classes; certification courses are 20 hours in length; recertification classes are 8 hours.

Current as of September 2007 (for a complete list of courses visit our website at www.caohc.org); for the most current list of courses contact the CAOHC office at 414/276-5338.

Begin Date	State	City	Course Director	Phone
Begin Date	State	City	Course Director	Phone
11/15/2007	Mexico	Mexico City	Jorge Morales	52-55-5374-0625
11/15/2007	PA	Pittsburgh	Roger Angelelli	412-831-0430
11/15/2007	TN	Chattanooga	Melette Meloy	678-363-9897
11/15/2007	WI	Milwaukee	James Jerome	317-841-9829
11/16/2007	NC	Morrisville	Thomas Cameron	919-657-7500
11/16/2007	NJ	Piscataway	Ellen Kelly	732-238-1664
11/16/2007	OH	Dayton	Chris Pavlakos	937-436-1161
11/16/2007	PA	Pittsburgh	Roger Angelelli	412-831-0430
11/19/2007	AZ	Phoenix	John Elmore	800-357-5759
11/20/2007	AZ	Phoenix	John Elmore	800-357-5759
11/24/2007	Columbia	Cali	Fernando Rengifo-Caicedo	202-297-5314
11/28/2007	IL	Chicago/Oak Park	Robert Beiter	708-445-7171
11/28/2007	NC	Greensboro	Cheryl Nadeau	336-834-8775
11/29/2007	IL	Chicago/Oak Park	Robert Beiter	708-445-7171
12/02/2008	MA	Auburn	Steven Fournier	508-832-8484
12/03/2007	CT	Windsor	Pamela Gordon	978-697-2073
12/04/2007	CT	Windsor	Pamela Gordon	978-697-2073
12/04/2007	MA	Auburn	Steven Fournier	508-832-8484
12/05/2007	AL	Birmingham	Georgia Holmes	205-934-7178
12/05/2007	GA	Atlanta	Linda Moulin	770-475-2055
12/05/2007	GA	Atlanta	Melette Meloy	678-363-9897
01/03/2008	IL	Rockford	Charles Russell	815-964-5445
01/04/2008	IL	Rockford	Charles Russell	815-964-5445
01/16/2008	CA	Fairfield	Charles Fankhauser	707-746-6334
01/17/2008	CA	Fairfield	Charles Fankhauser	707-746-6334
01/22/2008	CA	San Diego	Kirsten McCall	425-254-3833
01/23/2008	CA	San Diego	Kirsten McCall	425-254-3833
02/11/2008	NE	Omaha	Thomas Norris	402-391-3982
02/12/2008	MA	Aburn	Steven Fournier	508-832-8484
02/13/2008	NE	Omaha	Thomas Norris	402-391-3982
02/26/2008	WA	Monroe	Mary McDaniel	206-706-7352
02/26/2008	WA	Monroe	Mary McDaniel	206-706-7352
03/11/2008	CA	Sacramento	Kirsten McCall	425-254-3833
03/11/2008	MA	Auburn	Steven Fournier	508-832-8484
03/12/2008	CA	Sacramento	Kirsten McCall	425-254-3833
04/08/2008	MA	Auburn	Steven Fournier	508-832-8484
04/15/2008	CA	Ontario	Kirsten McCall	425-254-3833
04/16/2008	CA	Ontario	Kirsten McCall	425-254-3833
05/06/2008	MA	Auburn	Steven Fournier	508-832-8484
06/02/2008	NE	Omaha	Thomas Norris	402-391-3982
06/03/2008	WA	Monroe	Mary McDaniel	206-706-7352
06/03/2008	WA	Monroe	Mary McDaniel	206-706-7352
06/04/2008	NE	Omaha	Thomas Norris	402-391-3982
06/17/2008	MA	Auburn	Steven Fournier	508-832-8484
07/09/2008	IL	Rockford	Charles Russell	815-964-5445
07/10/2008	IL	Rockford	Charles Russell	815-964-5445
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09/02/2008	WA	Monroe	Mary McDaniel	206-706-7352
09/02/2008	WA	Monroe	Mary McDaniel	206-706-7352
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10/06/2008	NE	Omaha	Thomas Norris	402-391-3982
10/08/2008	MA	Auburn	Steven Fournier	508-832-8484
10/08/2008	NE	Omaha	Thomas Norris	402-391-3982
11/05/2008	MA	Auburn	Steven Fournier	508-832-8484

60 Years of Hearing Conservation.... – continued from page 8

the first 3-D audio display technology demonstration. The lab also developed an auditory localization facility (ALF) to assist in their development of 3-D audio displays. ALF is a 15-ft diameter geodesic sphere with 277 Bose loudspeakers over its surface. The mid-eighties also saw a substantial military construction project that doubled the size of the acoustics laboratory and more than doubled the number of acoustic test rooms.

Photo of an auditory localization facility (ALF).

The 5th generation fighter aircraft, the F-22 and the F-35 Joint Strike Fighter began their development in the 1990s. The bioacoustics group was leading the way with improved hearing protection for the pilots using ANR and incorporating 3-D audio displays into flight test aircraft for demonstration and flight test. In 1999, at the ASA (Acoustical Society of America) meeting in Berlin, Germany, Henning von Gierke was awarded the Gold Medal for his outstanding contributions to science and the society.

The new century saw increased focus on improving hearing protection. The motivation was perceived increases in noise levels from new aircraft and the importance of improving communication capability, enhancing safety, and reducing hearing damage risk. John Hall and Rich McKinley collaborated with Adaptive Technologies, Inc (ATI) to develop a high-performance active noise earplug. There was an extensive collaboration of the Air Force and Navy during this time focused on improved hearing protection for aviation personnel. Over $15 million was spent during the 7-year period on technology development and demonstration. The combined programs saw developments in passive custom molded communications earplugs, demonstration of active bone-conduction reduction for single frequencies, passive bone-conduction noise helmets, custom earmuffs, high-output (130 dB) earplug drivers, and basic research in bone-conduction pathways, models, and reduction techniques.

Throughout the 60-year legacy, the Wright-Patterson bioacoustics group, now the Battlespace Acoustics Branch of the Air Force Research Laboratory, has been a national and international leader in developing hearing conservation guidelines and criteria, in the development of hearing protection technologies, and in the development of national (ANSI) and international (ISO) standards in acoustics. The contributions and legacy of Henning von Gierke and the group he started, have been recognized by the research community in the many awards they have received and the fond recollections of those who knew them well and have benefited from their leading-edge contributions.

Rich McKinley is the Senior Technical Advisor at the Air Force Research Laboratory at Wright-Patterson Air Force Base. He has enjoyed working with many of the leaders and scientists mentioned in this review article.

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Photographs of Guild E., available at, www.militaryaudiology.org/eguild.html.

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