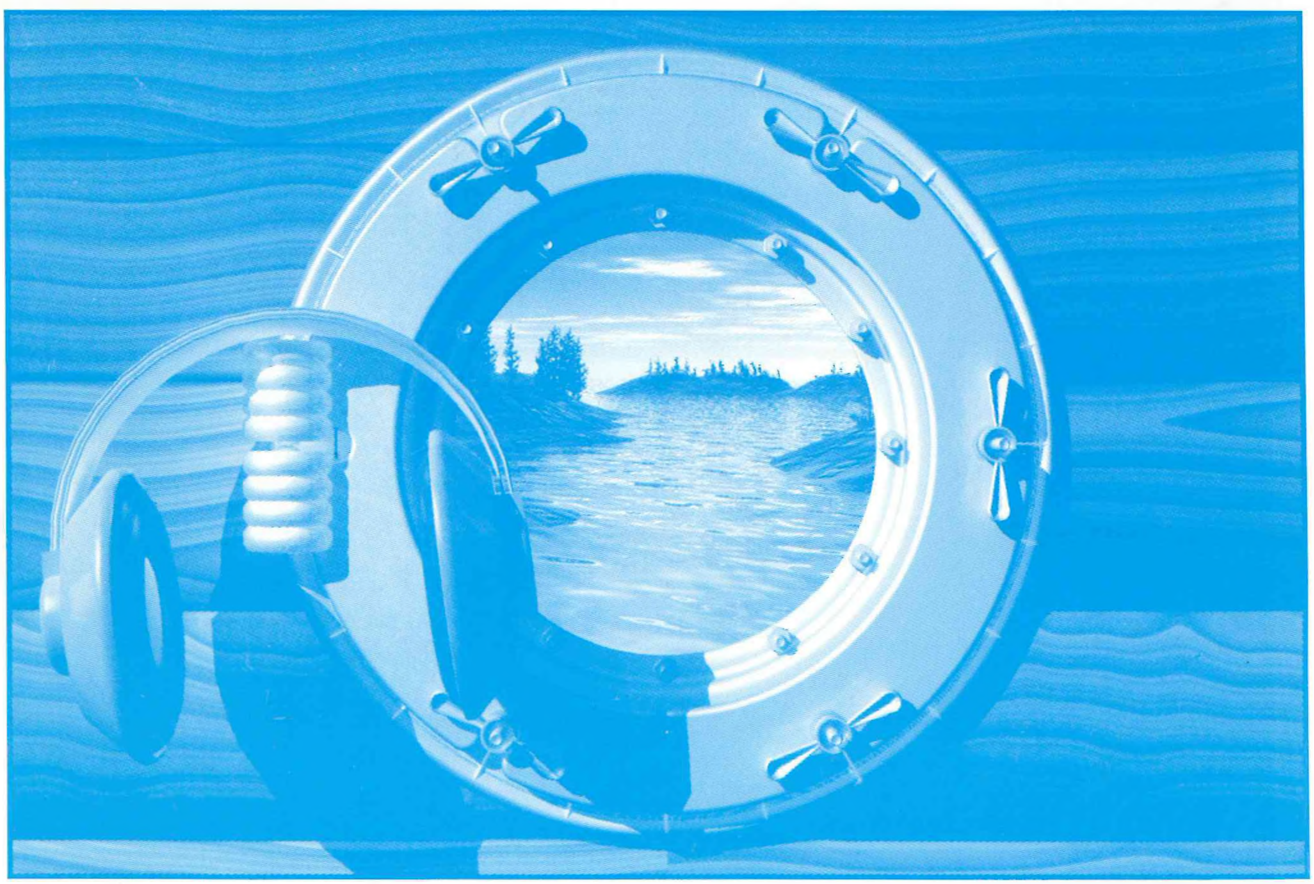
ISSN 0711-6659

canadian acoustics
acoustique canadienne

MARCH 1997 | MARS 1997
Volume 25 — Number 1 | Volume 25 — Numéro 1



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EDITOR-IN-CHIEF / REDACTEUR EN CHEF

Murray Hodgson
Occupational Hygiene Programme
University of British Columbia
2206 East Mall
Vancouver, BC V6T 1Z3
Tel: (604) 822-3073
Fax: (604) 822-9588
E-mail: hodgson@mech.ubc.ca

EDITOR / REDACTEUR

Chantal Laroche
Dépt. d'orthophonie et d'audiologie
Université d'Ottawa
545 King Edward
Ottawa, Ontario K1N 6N5
Tél: (613) 562-5800 ext^{n}/poste 3066
Fax: (613) 562-5256
E-mail: claroche@aix1.uottawa.ca

ASSOCIATE EDITORS / REDACTEURS ASSOCIES

Advertising / Publicité

Chris Hugh
Hatch Associates Ltd.
2800 Speakman Drive
Mississauga, Ontario L5K 2R7
Tel: (905) 403-3908
Fax: (905) 824-4615
E-mail: CHUGH@HATCHCOS.COM

News / Informations

Francine Desharnais
DREA - Ocean Acoustics
P. O. Box 1012
Dartmouth, NS B2Y 3Z7
Tel: (902) 426-3100
Fax: (902) 426-9654
E-mail: desharnais@drea.dnd.ca

ÉDITORIAL / EDITORIAL

Dans ce numéro, vous trouverez trois articles techniques, le premier portant sur les normes auditives du personnel marin, le deuxième sur les émissions otoacoustiques et le dernier sur les lignes directrices concernant le bruit d'aéronefs. Une note sur les activités dans le domaine de l'acoustique en Nouvelle-Écosse est aussi publiée.

Vous pourrez, par ailleurs, prendre connaissance de l'appel de communications pour la Semaine d'acoustique canadienne 1997 qui se tiendra à Windsor. Les organisateurs du congrès planifient vous présenter un évènement de haut calibre. Faites parvenir vos résumés de communication avant la date limite du 23 mai.

Je crois qu'un nombre significatif de dons a été acheminé à l'association pour le Prix Raymond Hétu. Je m'apprête à communiquer avec mes collègues du comité "Prix Raymond Hétu" afin de décider du meilleur usage du fonds, et de faire une proposition au Comité des Directeurs de l'ACA et à ses membres. Toutes les suggestions à cet égard sont bienvenues.

Tel que promis, des changements au sein du comité éditorial de l'Acoustique Canadienne ont été mis en place et quelques actions ont été prises. Vous noterez, ci-bas, que quelques places sont maintenant libres. Quiconque est intéressé à combler un des postes vacants peut communiquer avec moi.

This issue presents three technical articles, on hearing standards for ship personnel, otoacoustic emission and aircraft noise guidelines, as well as a note on acoustical activities in Nova Scotia.

Also published in the Call for Papers for Acoustics Week in Canada 1997 to be held in Windsor. The conference organisers are planning to put on a great show. Get your abstracts in for the May 23 deadline.

I understand that a significant amount of funds has now been donated towards a Raymond Hétu Prize. I will be contacting my fellow members of the Hétu Prize committee to decide how best to use the fund, and to make a proposal to the CAA Directors and members. All input to this decision is welcome.

As promised, a review of the Canadian Acoustics Editorial Board has taken place and some action taken. You will note below that some positions are now vacant. Anyone interested in filling the vacant positions should contact me.

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Canadian Acoustics / Acoustique Canadienne 25(1) 3-9 (1997) ***Research article / Article de recherche***

ASSESSMENT OF OCCUPATIONAL HEARING REQUIREMENTS

Stanley Forshaw
3958 Sherwood Road
Victoria, B.C. V8N 4E6

Kevin Hamilton
Ergonomics and Human Factors Group
B.C. Research Inc.
3650 Westbrook Mall
Vancouver, B.C. V6S 2L2

ABSTRACT

The Canadian Coast Guard is presently reviewing its medical standards and, in particular the physical requirements that are essential for safe and effective marine operations. Typically, hearing standards used by many defence and transportation organizations are based on pure-tone thresholds and do not address the suprathreshold requirements of an individual's duties or work environment. This paper summarizes the research that has been directed towards identifying the onset of hearing handicap and examines current standards in the light of this research. Recommendations are made concerning the procedures that should be employed in setting occupational hearing standards.

SOMMAIRE

La Garde Cotière Canadienne revise présentement les standards médicaux, en particulier les exigences physiques qui sont essentielles pour la sécurité et l'efficacité des opérations maritimes. Typiquement, les standards auditifs utilisés par les différentes organisations de défense et de transport sont basés sur les seuils des sons purs et ne considèrent pas les exigences de supraseuil des fonctions d'un individu ou de l'environnement de travail. Cet article résume la recherche qui porte sur le seuil d'apparition du handicap auditif et examine les normes actuelles reliées á cette recherche. Des recommandations sont faites concernant les procédures qui devraient être employées lors de l'établissement de normes auditives au travail.

1. INTRODUCTION

Hearing impairment[1] in everyday activities can have many consequences. At the individual level it may hinder speech communication and social interaction. It may also have an economic impact by restricting employment opportunities and affecting job performance and safety.

The effect of hearing impairment on job performance is of particular concern when voice communication is an essential duty. In the aviation and marine environments, for example, speech is used frequently when messages are short and interactive and must be conveyed quickly. It is critical that what needs to be heard and understood is heard and understood.

1. "Impairment" denotes a pathological condition that affects an individual's abilities, compared to non-impaired or normal abilities. "Disability" is related to actual or presumed reduction in ability to remain employed at full wages. "Handicap" describes the disadvantage in everyday circumstances resulting from a disability or impairment (WHO, 1980). The clinical manifestation of hearing impairment is the beginning point for evaluating auditory handicap and disability.

Depending on the severity of an individual's impairment and the degradation of the speech signal due to poor-acoustic or sound-transmission conditions, messages received by the individual may be perceived correctly in total or in part, or may be misunderstood entirely.

As a result, it has been necessary for responsible jurisdictions to adopt appropriate hearing standards as a condition of employment where hearing ability may have an impact on operational effectiveness and safety. Currently, the Canadian Coast Guard (CCG) is reviewing its medical standards to define the critical components of medical fitness, including hearing, that are essential for safe and efficient operations. This paper summarizes the major findings of a review of the scientific literature on hearing standards and clinical procedures that pertain to the assessment of hearing handicap in support of the ongoing CCG medical review program.

2. CLINICAL HEARING TESTS

Hearing threshold, or hearing level (HL), is measured with reference to the mean hearing sensitivity of young adults with no hazardous occupational-noise exposure or known hearing impairment. Hence, 0 dB HL at a given frequency is the sound pressure level (SPL) of the pure-tone stimulus that can just be detected on average by young normal-hearing adults. Persons who are able to hear pure tones below 15 dB HL across a range of frequencies (250, 500, 1000, 2000, 3000, 4000, 8000 Hz) are considered to have normal hearing. Hearing losses in excess of 15 dB may appear at one frequency, a group of frequencies, or the entire range. When HLs average 25 dB across the frequency range from 500 to 2000 Hz, difficulties begin to be encountered in hearing everyday sounds in everyday conditions. At 30 dB HL, most individuals are aware of their hearing deficit. When their deficit reaches 40 to 65 dB HL, those affected have difficulty hearing conversation at distances beyond about 2 metres (Anon, 1994).

Although HLs are important for quantifying hearing loss, they offer no direct information about a possible handicap in terms of the ability to understand speech in social and occupational environments. Hence, hearing loss should also be evaluated primarily in terms of speech-perception impairment. This is accomplished in two ways. The first is by determining the threshold of hearing for speech, termed the speech reception threshold (SRT). It is the hearing level at which 50 per cent of two-syllable words are heard correctly. The second procedure is a discrimination test, in which monosyllabic words or simple sentences are presented approximately 40 dB above an individual's SRT, and is scored as per cent correct. Since hearing handicap is first perceived when listening to speech in noisy conditions, discrimination ability is often measured in a background of noise at a number of speech-to-noise (S/N) ratios.

3. PREDICTING THE ONSET OF HEARING HANDICAP

The exact level of the onset of hearing handicap, termed the 'low fence', has been the subject of much debate. A fence that is set too high would result in persons with a handicap being ineligible for disability compensation, and workers in noisy environments being denied regulatory protection. Furthermore, persons performing critical communication tasks might not be able to perceive speech adequately (Suter, 1989). If the fence is set too low, individuals would be compensated even though their hearing losses resulted entirely or in part from presbycusis (hearing loss due to aging). Regulations would be unnecessarily stringent and expensive, and workers would be disqualified from jobs which they could perform satisfactorily.

Early procedures for estimating hearing handicap were based on pure-tone thresholds, typically the three-frequency average of HLs at 500, 1000 and 2000 Hz (AAOO, 1959). Subsequent research data for impaired speech perception in noise led to the inclusion of the HL at 3000 Hz in the average with the low fence set at 25 dB (AAO, 1979). The British Association of Otolaryngologists and the British Society of Audiology recommended a low fence of 20 dB for the mean HLs at 1000, 2000 and 4000 Hz (BAOL/BSA, 1983).

Acton (1970) and Suter (1978, 1985) attempted to pinpoint the HL at which persons with mild hearing losses begin to lose speech perception. They estimated that hearing handicap begins at an average HL of 19 dB at 1000, 2000 and 3000 Hz. This value translates to approximately 9 dB at 500, 1000 and 2000 Hz, and 22 dB at 1000, 2000 and 4000 Hz, since most individuals with mild sensorineural impairments[2] have threshold profiles that slope toward the high frequencies. Suter noted that the selection of a fence depends on the definition of hearing handicap and the conditions under which the handicap is assessed. Smoorenburg also studied the question of the low fence. He defined the onset of hearing handicap as the point at which an individual begins to notice a handicap in somewhat noisy everyday situations (Smoorenburg, 1986, 1992). He identified this point as an average HL of 30 dB at 2000 and 4000 Hz.

In an extensive investigation of speech-perception handicap, Robinson *et al* (1984) tested normal-hearing and hearing-impaired subjects in a variety of listening tasks. The tasks covered a number of situations including a simulated social gathering, a set of public address announcements recorded at the Waterloo Railway Station, and a telephone listening situation involving speech and noise. The listeners were also tested for speech discrimination with CVC (consonant-vowel-consonant) monosyllables at several S/Ns.

The results showed large differences between the two groups of subjects. There were also large differences within the groups and even within the same subjects' responses across tests. The mean HL at 3000, 4000 and 6000 Hz correlated most highly with performance on the three simulations, and the mean HL at 1000, 2000 and 3000 Hz correlated best with the speech discrimination tests. It was concluded that a threshold of handicap could not be identified because the threshold is dependent on the difficulty of the test. Hence, the selection of any one set of conditions for the definition of 'beginning-of-handicap' is necessarily arbitrary. Since their threshold data were in the range 27 to 34 dB HL, averaged over the frequencies at 1000, 2000 and 3000 Hz, they decided on a low fence of 30 dB at these three frequencies.

4. CURRENT HEARING-PERFORMANCE CRITERIA

Notwithstanding the uncertainty associated with specifying a threshold of handicap, the general consensus of the research cited herein points to a low fence between 19 dB at 1000, 2000

2. Pathologies that involve the inner ear (cochlea) and/or the neural pathways between the cochlea and the auditory cortex are termed sensorineural. Pathologies of the external or middle ear that interfere with the conduction of sound pressure variations to the inner ear are termed conductive.

and 3000 or 4000 Hz; and 30 dB at 1000, 2000 and 3000 Hz, or at 2000 and 4000 Hz (see Table 1). In the light of this, the hearing standards of a number of defence and transportation jurisdictions are summarized as follows.

4.1 Health and Welfare Canada (H&W)

The Occupational Health Assessment Guide, issued by the Occupational and Environmental Health Services Directorate of H&W Canada (Anon, 1994), prescribes minimum standards for pre-placement and periodic medical examinations of civilians. The Class 1 Hearing Standard requires average HLs not greater than 25 dB in the better ear and 30 dB in the poorer ear in the frequency range 500-3000 Hz (Table 2). The standard may be met with a hearing aid.

4.2 Canadian Forces (CF)

The CF uses Hearing Categories for the initial assignment of personnel to its various military occupations. Hearing Category H1 requires HLs not greater than 25 dB in both ears in the frequency range 500-8000 Hz (Table 3). H1 Category is generally required for air-crew selection. An experienced officer or trades-specialist who experiences a reduction in Hearing Category is considered for retention in his/her occupation on individual merit by a Career Medical Review Board (CMRB). Although not stated, the CMRB relies in part on the results of a full audiometric assessment including speech reception and discrimination testing when reviewing hearing-loss referrals.

TABLE 1.
ESTIMATES OF THE ONSET OF HEARING HANDICAP IN TERMS OF HEARING LEVELS AVERAGED OVER A RANGE OF FREQUENCIES

ONSET OF HANDICAP	FREQUENCY RANGE	SOURCE
19 dB HL	1000, 2000, 3000 Hz	Acton (1970), Suter (1978, 1985)
25 dB HL	500, 1000, 2000, 3000 Hz	AAO (1979)
20 dB HL	1000, 2000, 4000 Hz	BAOL/BSA (1983)
27-34 dB HL	1000, 2000, 3000 Hz	Robinson *et al* (1984)
30 dB HL	2000, 4000 Hz	Smoorenburg (1992

TABLE 2.
HEALTH AND WELFARE CANADA HEARING CLASSIFICATIONS

STANDARD	AVERAGE HEARING LEVEL IN BETTER EAR	AVERAGE HEARING LEVEL IN POORER EAR	FREQUENCY RANGE
Class 1	No more than 25 dB HL	No more than 30 dB HL	500-3000 Hz
Class 2	No more than 25 dB HL		500-3000 Hz
Class 3	No more than 30 dB HL		500-3000 Hz
Class 4	No more than 30 dB HL		500-2000 Hz

The above H&W Classes apply with or without hearing aids.

**TABLE 3.
CANADIAN FORCES HEARING CATEGORIES (1995)
(A-MD-154-000/FP-000)**

CATEGORY	HEARING LEVEL	FREQUENCY RANGE
H1	Not to exceed 25 dB in each ear.	500-8000 Hz
H2	Not to exceed 25 dB in each ear.	500-3000 Hz
H3	Not to exceed 50 dB in either ear.	500-3000 Hz
H4	Not to exceed 50 dB in either ear which cannot be improved to a higher Category with surgery or the use of a hearing aid.	500-3000 Hz

Category H2 is the maximum assigned for hearing assisted by hearing-aid amplification.

4.3 Canada Transportation Commission - Railway Act

The Canadian Railway Act (Anon, 1985) states that individuals employed by a Canadian railway company in specified occupations must not have hearing less than 20/20 when tested by means of the human voice, or a HL not greater than 20 dB at 500, 1000 and 2000 Hz. Where an individual is able to hear in each ear and repeat an ordinary conversation or names and numbers spoken in a conversational tone by an examiner at a distance of 20 feet, the hearing of the individual is expressed by the fraction 20/20. If the greatest distance at which the conversational voice can be heard is 10 feet, the fraction is 10/20. No railway company can retain in the specified occupations, an individual who has hearing less than 15/20 in the better ear and 5/20 in the poorer ear, or 10/20 in each ear, or has HLs of 40 dB or greater at 500, 1000 and 2000 Hz. Waivers can be obtained for assignments in which the hearing loss does not prevent the proper and safe performance of the assignments.

4.4 U.S. Air Force Hearing Threshold Profiles (AR 40-501, 1987)

The U.S.A.F. Hearing Profile H1 specifies that at 500, 1000 and 2000 Hz, HLs must not exceed 25 dB in each ear. At 3000, 4000 and 6000 Hz, the sum of the HLs at these frequencies for both ears must not exceed 270 dB. Occupations or activities requiring the H1 Profile include Flying Classes I and IA, initial selection for Air Traffic Controller Duty, initial selection for Missile Launch Crew, and Air Force Academy Admission.

4.5 U.S. Army Hearing Threshold Standards for Aviators and Applicant Aviators

The U.S. Army has drafted revised Hearing Threshold Standards for flight personnel (Mason, 1995). Applicant aviators may not have HLs exceeding 25 dB at 500, 1000 and 2000 Hz, 35 dB at 3000 Hz, 55 dB at 4000 Hz, and 65 dB at 6000 Hz. Trained personnel who do not meet this standard are referred for a complete audiological evaluation including binaural speech reception and discrimination testing. They are not returned to flying duties if their binaural speech discrimination is less than 84 per cent and/or the individual subjectively feels unsafe while flying due to hearing loss..

4.6 U.S. Army Hearing Profiles for Non-Flying Personnel (AR 40-501, 1987)

The U.S. Army Non-Flying H1 Hearing Profile requires HLs not greater than 25 dB at 500, 1000 and 2000 Hz and not greater than 45 dB at 4000 Hz. Officers initially assigned to the Armour, Artillery, and Infantry branches, as well as to the Corps of Engineers, Military Intelligence, Military Police Corps, and Signal Corps must meet the H1 profile. If an individual's hearing deteriorates, the individual may still be retained if he or she can demonstrate a continuing ability to perform the required duties or is able to perform these duties with the help of a hearing aid. In occupational specialties where communication and signal detection are particularly important, the Army lists hearing requirements in addition to the H1 profile. For example, occupations such as Air Traffic Control Radar Controller, and Interrogator must be able to hear a wide range of human voice tones. Infantrymen must be able to hear oral commands in outdoor areas from distances up to 50 metres.

4.7 U.S. Navy Hearing Standards (NAVMED 1980 and 1984)

At present, U.S. Navy flight training candidates must have HLs in both ears not exceeding 25 dB at 500, 1000 and 2000 Hz, 45 dB at 3000 Hz, and 60 dB at 4000 Hz. Qualification for commission requires the average HL at 500, 1000 and 2000 Hz not to exceed 30 dB, and no single frequency to exceed 35 dB. HLs at 3000 and 4000 Hz cannot exceed 45 and 60 dB respectively.

4.8 U.S. Coast Guard

The U.S.C.G. hearing criteria for appointment, enlistment and induction are an average HL not exceeding 25 dB at 500, 1000 and 2000 Hz and no single frequency greater than 35 dB, and HLs not exceeding 45 dB at 3000 Hz, and 60 dB at 4000 Hz.

4.9 Royal Australian Navy (RAN)

The Royal Australian Navy specifies hearing standards in terms of the ear with the poorer HLs. Hearing Standard 1 (HS1), for example, permits HLs not greater than 15 dB at 500 Hz and not greater than 25 dB at 1000, 2000 and 4000 Hz in the poorer ear. In addition, acoustic specialist occupations require frequency-discrimination capability of ± 30 Hz at 1000 Hz (Anon, 1991).

5. DISCUSSION

Examination of the standards summarized above indicates that only three fall within the low-fence ranges shown in Table 1: the H&W Canada Class 1, the CF Hearing Categories H1 and H2, and the RAN Category HS1. Of these, the CF and RAN standards are the most stringent, specifying HL requirements at individual frequencies, rather than an average HL across a range of frequencies, and not permitting hearing aids for the H1 and HS1 categories. The other military standards miss the low-fence range in that they are more tolerant of hearing loss at 3000 and 4000 Hz. In this regard, Hétu (1994) has noted that frequently occupational requirements involving auditory capabilities have been based on medico-legal definitions of hearing that were adopted to compensate employees affected by noise-induced hearing loss.

As noted, many of the above standards permit the use of hearing aids[3]. Certainly, persons whose losses are primarily conductive and use a well-fitted and properly adjusted conventional (non noise-reduction) hearing aid can understand speech almost as well, as do persons with normal hearing, at least in the absence of high levels of extraneous sound.

Substantial advances have been made both in the development of improved hearing aids utilizing digital electronics and signal processing. The results of research on multichannel systems and on noise-reduction techniques suggest that the new hearing aids will be able to overcome, in part at least, the degradation of the acoustical signal between a speaker and a listener in situations where competing sounds and reverberant conditions are less than ideal (CHABA, 1991). It is not clear, however, how well these new technologies can ameliorate the speech-perception in noise problems experienced presently by individuals with severe sensorineural impairments (Van Tasell, 1993).

Interestingly, the difference between the H&W Class 1 and Class 2 requirements is one of binaural capability. An individual with a unilateral or asymmetrical hearing loss, as is possible with the Class 2 criteria, may achieve some degree of localization by moving his or her head. However, the person may not gain the advantage in understanding speech in noise or competing voices when the speech and the interfering sound come from spatially separated sources (Del Dot *et al.*, 1992).

The question that has not been resolved in the literature is whether a listener with a mild to moderate unilateral sensorineural hearing loss, who wears a hearing aid to attain bilateral-loudness balance, can localize effectively (Laroche, 1994). It is well known that sensorineural hearing pathologies can result in diminished frequency selectivity through a broadening of the auditory filters (Patterson, 1976). Since localization in noise is determined to a great extent by the frequency resolving ability of the ear (Canévet *et al.*, 1986), individuals with sensorineural hearing losses may be limited in their ability to localize sound sources in noise (Hétu, 1994).

6. CURRENT CANADIAN COAST GUARD HEARING REQUIREMENTS

The Canadian Human Rights Act (Anon, 1989) prohibits any policy or practice that deprives an individual or class of individuals of any employment opportunities on a prohibited ground of discrimination. The Act points out, however, that it is not a discriminatory practice to refuse, exclude, suspend, limit, specify or prefer in relation to any employment if the employer establishes the practice to be based on a *bona fide* occupational requirement.

Currently, CCG seagoing personnel are required to meet the H&W Class 1 pure-tone threshold hearing standard. The H&W Assessment Guide notes, however, that pure-tone audiometry is seldom directly relevant to an occupation and should only be regarded as an indicator of hearing ability. A major thrust of the CCG medical review program, then, is to ensure that the procedures and criteria for assessing the ability of individuals to perform their duties are realistic and are based on the hearing requirements of these duties.

Within the CCG, ships' officers and crew work in a number of

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3. Although not specified in the H&W or CF standards, an individual needing the amplification provided by a hearing aid to meet a required Class or Category should be tested wearing the hearing aid. Audiometer pure-tone stimuli are presented to the individual from one or more loudspeakers within a sound-treated room in which reverberation and the entrance of extraneous sounds are kept to a minimum (ANSI, 1977).

disciplines. These include deck, radio, engine, logistics/supply, electronics/electrical, utility seamen and training instructors, and college cadets. In deck, engine and logistics duties, officers and crew are required to understand or discriminate orders and instructions that are directly spoken or shouted, as well as voice and tone signals from radios, telephones, bells, whistles and various types of alarms (CCG, 1990).

It can also be important for officers and crew to be able to identify changes in sound characteristics and the direction from which sounds emanate. The former, for example, is relevant in terms of identifying both normal and abnormal variations in machinery and engine sounds. The ability to localize the directional component of sound may be required to identify the position of buoys during reduced visibility. These auditory requirements can be continuous during sustained operations, and are frequently carried out in proximity to constant high levels of noise.

7. RECOMMENDATIONS

Identifying hearing requirements for CCG seagoing personnel should involve a detailed ergonomic task analysis of the auditory components specific to each officer and crew function, taking into account crew-station ambient-noise levels and the acoustic characteristics of ships' communications equipment. The analysis would incorporate a complete description of the auditory task including time on the task, work load, the criticality and frequency of the task, types of potential errors as a result of missed communications, and the consequences of such errors relative to mission safety and crew performance.

This type of analysis would serve two purposes. First, it would provide the task detail that may be missing in typical job descriptions, including requirements for auditory capabilities such as binaural hearing. Second, an analysis of auditory requirements would provide an operational framework for evaluating the hearing-perception capability of the individual who wears a hearing aid to maintain a required level of hearing, or the individual whose hearing has dropped below the required level and does not wear a hearing aid. The H&W Assessment Guide points out that a person's inability to meet rigid standards under artificial conditions (e.g., clinical pure-tone threshold testing) should not call for automatic rejection or for restricted employment (Anon, 1994).

Accordingly, it would be necessary to carry out pre-employment and periodic speech-discrimination and localization tests of these individuals, with their hearing aids, in realistic noise and/or reverberation environments. The results would be used in conjunction with auditory task-analysis data to make a reasonably founded assessment of the individual's ability to perform his or her duties.

Careful consideration must also be given to experience and skill sets which have been developed and refined over years of service. Individuals can learn sophisticated coping strategies to deal with communication and performance in noisy environments (Acton, 1970). In these cases supervisory assessment of the individual's ability to fulfil task requirements should be an important consideration.

Abel (1993) has employed two tests that are particularly sensitive in assessing speech-discrimination problems in realistic noise conditions. In the first, the Four Alternative Auditory Feature Test (FAAF) (Foster and Haggard, 1979), the listener is presented with four printed words, and on hearing a spoken word, responds by choosing one of the four alternatives. The stimuli and alternative responses have been chosen so that errors (e.g., first- or last-consonant discrimination errors) reveal speech-perception performance in terms of a set of acoustic, phonetic and perceptual features rather than simply the percentage of consonant targets that are heard correctly.

The second, the Speech Perception in Noise Test (SPIN) (Kalikow *et al.* 1977), consists of sentences which are presented in babble-type background noise. The listener's response is the final (key) word in the sentence. The sentences are of two types: high-predictability items for which the key word is somewhat predictable from the context, and low-predictability items for which the key word cannot be predicted from the context.

Both of these tests are commercially available on tapes and can be administered in any hearing-science laboratory or audiology clinic. At present, there are no standardized procedures for the evaluation of localization capabilities (Laroche, 1994). Before a complete and valid auditory assessment can be made of a hearing-impaired individual seeking to gain or retain employment in occupations involving particular listening skills, relatively simple tests must be developed for all the required skills, taking into account unilateral and bilateral hearing losses and the use of hearing aids.

8. ACKNOWLEDGEMENT

The reviews and assessments reported in this paper were funded by Transport Canada through the Transportation Development Centre under TDC-TIES Contract No. T8200-1-1550/01-XSD, awarded to BC Research Incorporated.

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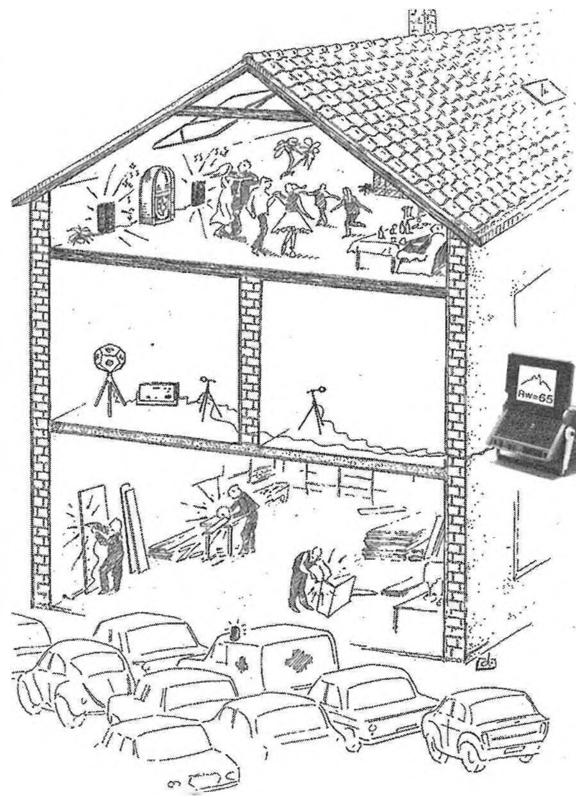

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Canadian Acoustics / Acoustique Canadienne 25(1) 11-17 (1997) ***Research article / Article de recherche***

AN INVESTIGATION OF THE CORRELATION BETWEEN DISTORTION PRODUCT AND TRANSIENT EVOKED OTOACOUSTIC EMISSIONS IN THE HUMAN AND THE CHINCHILLA

H. Hamrahi and R. V. Harrison
Department of Physiology
University of Toronto
Toronto, Canada, M5S 1A8

ABSTRACT

Otoacoustic emission recordings are being used as a clinical tool in detecting cochlear hearing loss. Whilst transient evoked otoacoustic emissions (TEOAEs) possess high sensitivity, their frequency specificity has been questioned. For more reliable information about threshold changes at specific frequencies, distortion product otoacoustic emissions (DPOAEs) are being used. It is the aim of this study to investigate the correlation between these two types of evoked OAEs. The study is comprised of two parts. The first part involves measurements of DPOAE and TEOAE amplitudes in eighteen ears of nine normally-hearing humans, in the 1 to 5 kHz range. The second part of the study employs a similar protocol with recordings made from 18 normally-hearing *chinchilla* ears. In the first investigation, human DPOAE responses are plotted against the corresponding TEOAE responses across a whole frequency range (1 - 5 kHz). The chinchilla data are similarly analyzed and the results from both investigations suggest some correlation between DPOAE and TEOAE amplitudes in the 1-5 kHz frequency region.

SOMMAIRE

Ont se sert des émissions 'otoacoustic' comme résultats des 2 investigations suggère une corrélation entre les amplitudes DPOAE et TEOAE outils pour détecter la perde d'ouïe 'coehlear'. Même si les émissions 'otoacoustic' (TEOAEs) possèdent une grande sensibilité, les caractéristiques de leurs fréquences ont été questionnés. Pour de l'information plus assujetti a une fiabilité plus grande a propos des points de changement de tolérance a des points de fréquences spécifique, les distorsions produit 'otoacoustic' émissions (DPOAEs) sont utilisé. Le but de cette étude est d'étudié la corrélation entre ces deux types d'OAE non-spontane. Cette étude comprend 2 parties. La première partie comprend la prise de mesure des amplitudes DPOAE et TEOAE dans dix- huit oreilles de neuf humains d'ouïe normal, d'un écart de 1 à 5 Khz. La deuxième part de cette étude emploie une procédure similaire de prise de mesure de 18 oreilles de *chinchilla* d'ouïe normale. Dans la première investigation les donner des résultats DPOAE sur les humains sont placer sur un graphe contre les donner correspondante TEOAE a travers des fréquences de 1-5 Khz. Les donnés des chinchillas sont analysés de façon similaire et les résultats des 2 investigations suggère une corrélation entre les amplitudes DPOAE et TEOAE dans la zone de fréquence de 1-5 Khz.

1. INTRODUCTION

Since the early 1980's, advances in auditory science have provided clinicians with new methods to test and screen against cochlear hearing loss, especially in high risk neonates. These advances, are the result of David Kemp's discovery in 1978 that low stimulus levels elicit a delayed response in the form of an acoustic emission which can be recorded in the external ear canal.

Approximately, 35% to 55% of normal human ears exhibit spontaneous otoacoustic emission (Probst, 1990). These spontaneous otoacoustic emissions are thought to be caused by the activity of outer hair cells within the cochlea and perhaps with energy which is of metabolic origin. The exact mechanism of production of these emissions has not yet been definitively determined. However, a number of experiments have shown that the hair cell can expand and contract during activation and perhaps feed back mechanical energy to the basilar membrane. This movement can subsequently be recorded as sound waves in the external meatus (Brownell, 1984).

Almost all normal ears produce *evoke* otoacoustic emissions, of which, there are two types: distortion product OAEs (DPOAEs) and transient evoked OAEs (TEOAEs). Both types of emission can conveniently be detected by fitting a miniature microphone with a built-in sound source, in the external ear. When low level, click-stimuli are presented, the high frequency components of the TEOAE are detected with the least delay, and the lower frequency ones, with longer delays (Kemp et al., 1990). Only individuals with a normally functioning cochlea are capable of producing TEOAEs, and this makes TEOAE measurements a useful clinical tool.

In cochlear hearing loss, or as the cochlea ages, a significant decrease in the TEOAE amplitudes is observed until the frequency components are at or below the noise floor (Norton et al., 1990).

One current use for these emissions is to screen for cochlear hearing loss in high risk neonates, as well as to monitor objectively, other types of cochlear hearing loss in children and adults. The use of TEOAEs in neonatal cochlear hearing loss, has received much attention for a number of reasons. They provide a method by which a newborn's hearing can be examined non-invasively. Moreover, the method is less time consuming than auditory brain stem evoked potential recording, and does not require any behavioral response.

However, TEOAEs exhibit a number of limitations when used in a clinical setting. For example, with a hearing loss of more than 25 dB, TEOAEs disappear and as a result hearing thresholds cannot be determined. Moreover, the frequency specificity of screening methods involving TEOAEs has been questioned (Probst and Harris, 1993). Hence, methods involving TEOAEs are limited only to label a cochlea as "normal" or "abnormal."

Distortion product OAEs are evoked emissions that are produced at non-stimulus frequencies, when the cochlea is subjected to two continuous pure tone frequencies. They are predictable phenomena with respect to the frequency at which they occur. For example, in response to a two-frequency stimulus f1 and f2, one of the largest DPOAE amplitudes always appears at 2f1-f2 (Kim, 1980). DPOAE measurements have recently become more used in auditory studies, partly because they are potentially more frequency specific than TEOAEs (Probst and Harris, 1993), and partly because there are more devices available on the market to measure DPOAEs than TEOAEs.

Many experiments have supported the theory that DPOAEs are an electromechanical manifestation of the non-linear processes involving the cochlear outer hair cells. However, it is not clear whether the mechanism by which DPOAEs are produced is the same as that involving the production of transient evoked OAEs. A study by Wier et al. (1988) for example, has demonstrated significantly different effects of salicylates on the two types of evoked OAEs in the same ear. Consequently, the question arises as to which OAE measurement is most appropriate for clinical purposes. It has been argued that the amplitude of discreet DPOAEs do not closely correlate with corresponding TEOAE frequency components. It is therefore crucial, to examine the relationships, if any, between the TEOAE response amplitudes and those of the distortion product responses. Such comparisons between DPOAE and TEOAE response amplitudes have not yet been undertaken in animal models. For this purpose we have used the chinchilla. In this study, we examine the correlation between the two types of OAEs in this species, as well as in the human, so as to provide a better understanding of the nature of, and the correlation between DPOAEs and TEOAEs. Our experimental hypothesis is that the distortion product otoacoustic emission amplitudes *are* correlated with the transient evoked otoacoustic emission amplitudes at corresponding frequencies, in the 1 kHz to 5 kHz frequency range.

2. MATERIALS AND METHODS

2.1 Subject

Two species were used in this experiment; humans and chinchillas.

Humans

Nine adult humans who ranged in age from 21 to 42 years old, and had normal hearing thresholds within 20 dB of audiometric norms (0.5 - 8 kHz). These subjects were screened against having upper respiratory inflammatory diseases, or prior history of conductive hearing loss. Human subjects were tested in the awake state, in a seated position.

Chinchillas

Nine adult chinchillas with normal audiometric thresholds were used, ranging in weight from 445 grams to 690 grams. Animal studies were carried out in the anaesthetized animal using the following regime. Loading dose: atropine sulfate - 0.04 mg/kg; xylazine - 2.5 mg/kg; and ketamine hydrochloride - 15 mg/kg, with supplementary doses of ketamine hydrochloride.

The chinchilla data were all collected in a sound attenuation booth which provided more than 30 dB of isolation across all audiometric frequencies.

All animal experiments, were carried out in accordance to strict guidelines of the Canadian Council on Animal Care and the Local Animal Care Committee.

2.2 Recording Systems

Two recording systems were used; one for recording distortion product OAEs and one for transient evoked OAEs. Each system was comprised of: a host 386 computer, running on MS DOS; an ILO computer interface card; an ILO dual channel analogue signal conditioning unit; and ILO92 or ILO88 software. The recording systems were standard and commercially available from Otodynamics Limited, with no significant modifications. The setups for these recording systems are shown in figures 1 and 2.

2.3 Recording Protocol

Human Ear

1. The conscious human subject was seated in an upright position, while keeping swallowing and other movements to a minimum.

2. The microphone/sound source(s) assembly (i.e. the probe) was then fitted snugly in the external ear canal with the aid of a soft disposable probe tip.

3. One DPOAE and one TEOAE recording were measured in each of the subject's two ears. The probe assembly was not moved within each recording session. A sample of the raw data is illustrated in Figure 3. The upper panel shows TEOAE recordings. The lower section shows the "DPOAE audiogram."

4. The DPOAE recording was done under default setting (stimulus level = 70 dB SPL, rejection threshold = 8 mPa) and was terminated after 2 sweeps. The TEOAE recording was also done under default setting (stimulus level = 75 dB pk, rejection threshold = 47.3 dB) and was terminated after 260 averages were performed.

Chinchilla Ear

1. The anesthetized chinchilla was placed with its head

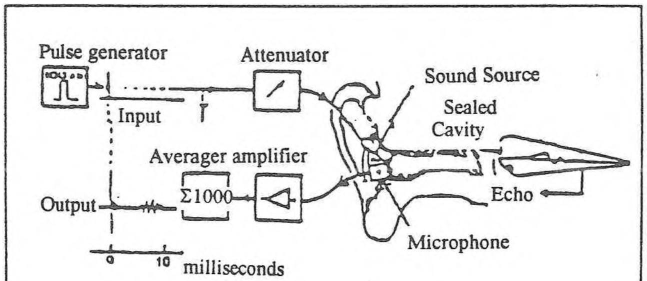


Fig. 1 Setup of the TEOAE recording system. (Adapted from Kemp et al. 1990). Pulses produced by the pulse generator are attenuated and introduced to the external meatus. The otoacoustic emission (labelled "echo") which is generated is detected by the microphone, amplified, and averaged to improve signal to noise ratio.

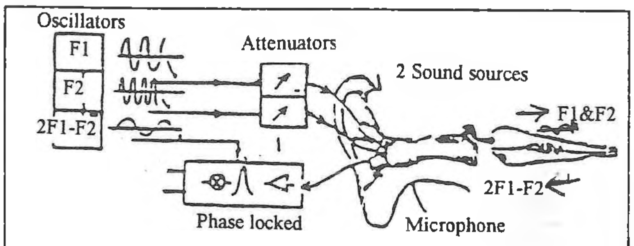


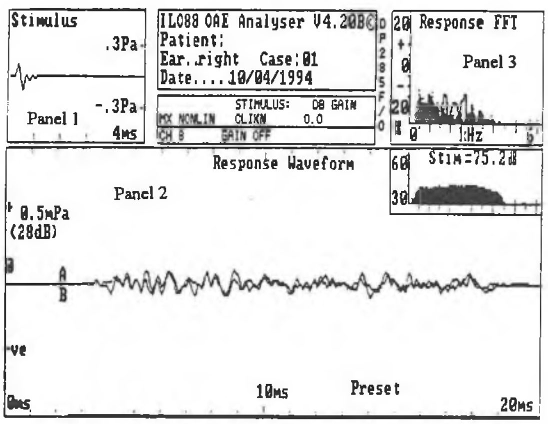
Fig. 2 Setup of the DPOAE recording system. (Adapted from Kemp et al. 1990). In this setup, two sound sources produce f1 and f2 signals. Within the cochlea, these signals generate the distortion product 2f1-f2 which is detected in the external canal by the microphone. The 2f1-f2 distortion product is separated out with a phase-locked amplifier.

in a normal position.

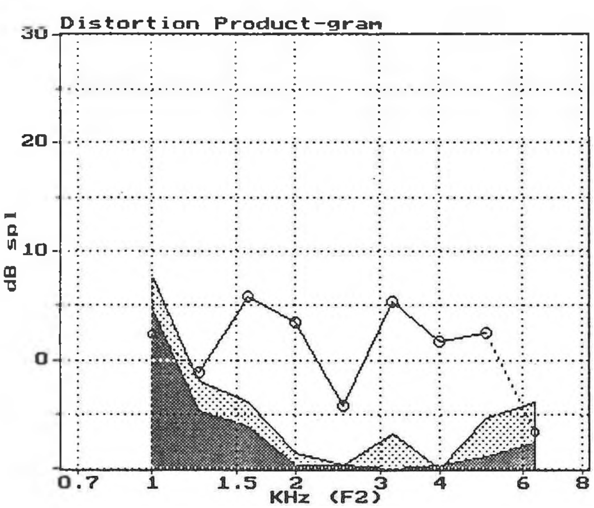
2. Same as Step 2 above for the human ear.

3. Three consecutive records of each type of evoked OAEs were collected from each ear. This procedure made it possible to detect, by comparing the 3 recordings, any instances where ambient noise or other artifact caused an evoked OAE to be erroneously recorded. Sample outputs for the raw data are shown in Figure 4: TEOAE in the upper panel; distortion product - gram in the lower panel.

Three recordings of one type of evoked OAE (e.g. DPOAE) were made from one ear, then the other type of evoked OAEs was recorded without readjusting probe fit in the ear. This ensured that the DPOAEs and the TEOAEs were recorded under identical conditions, at least with respect to the fitting of the probe. This procedure was carried out in both ears and collectively, six recordings were gathered from each ear of the chinchilla.

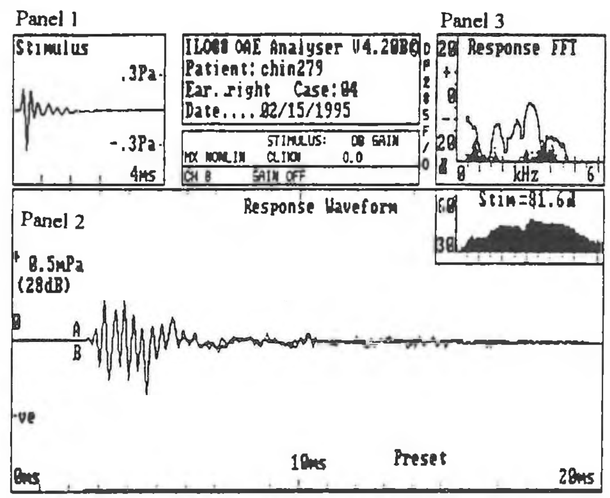


(a)

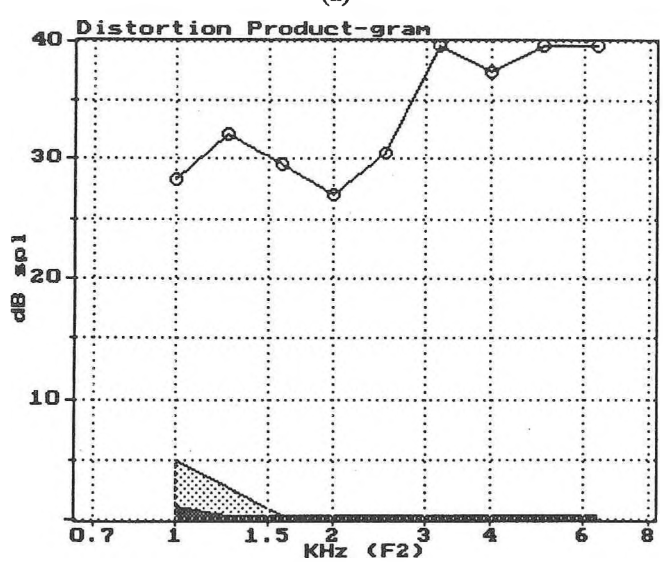


(b)

Fig. 3(a) The standard ILO 88 output generated in the recording of human TEOAE amplitudes. Refer to the text for a description of panels. (b) The standard output of the ILO 92 software used to record human DPOAEs in the study.



(a)



(b)

Fig. 4(a) The standard ILO 88 output generated in the recording of chinchilla TEOAE amplitudes. Refer to the text for a description of panels. (b) The standard output of the ILO 92 software used to record chinchilla DPOAEs in the study.

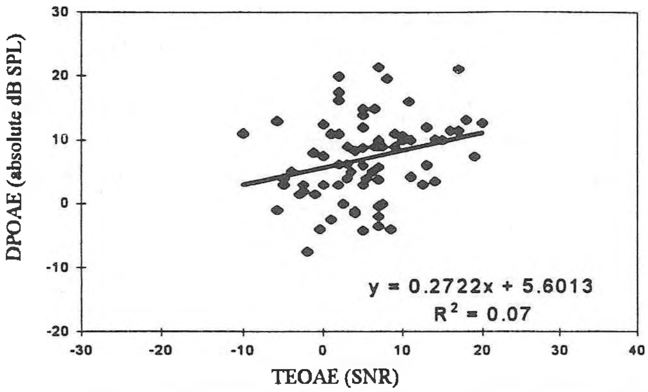


Fig. 5 The plot of the human DPOAE amplitudes (absolute dB SPL) against those of TEOAE (dB signal above noise) in the entire 1 to 5 kHz frequency range. The correlation between the DPOAEs and the TEOAEs is characterized by a positive-slope linear regression with a correlation coefficient value of R^2=0.07.

4. The same default recording conditions were used as in Step 4 of the human recording protocol.

3. RESULTS

Figures 3 and 4 show examples of the raw data collected from individual human and chinchilla subjects, using ILO92 and ILO88 devices. The ILO88 output (figures 3a and 4a) gives the waveform of the stimulus presented at the external ear (Panel 1). Panel 2 displays the response waveforms in time domain. The cross-power spectrum for the response waveform, is shown in Panel 3. The ILO 92 output is shown in figures 3b and 4b and displays graphically, the ($2f_1 - f_2$) response amplitudes above the noise floor, as a function of frequency.

3.1 Human Data

Figure 5 shows DPOAE amplitudes (absolute dB SPL) from the 18 ears plotted against their corresponding TEOAE amplitudes (dB signal above noise) for all frequencies from 1 kHz to 5 kHz. The correlation is represented by an R^2-value of 0.07. Furthermore, a linear regression through the data points has a positive slope.

In further analysis, the DPOAE and TEOAE responses are divided into 2 categories: (1) High Frequency Responses: OAE responses generated in the 3 to 5 kHz frequency range, and (2) Low Frequency Responses: OAE responses in the 1 to 2 kHz frequency range. The data are shown in the plots of figures 6 and 7, respectively.

In the high frequency data, shown in Figure 6, the linear regression again has a positive slope, and the correlation coefficient (R^2) is 0.10. Similarly, the plot of DPOAE against TEOAE responses, for the low frequency category (Fig. 7), has a positive-slope regression and the correlation coefficient is 0.11.

3.2 Chinchilla Data

Figure 4 displays records obtained from one of the chinchillas in the study.

The data collection protocol for the chinchilla was different than for human subjects, in that three recordings of each type of OAE were performed on each ear. The resulting

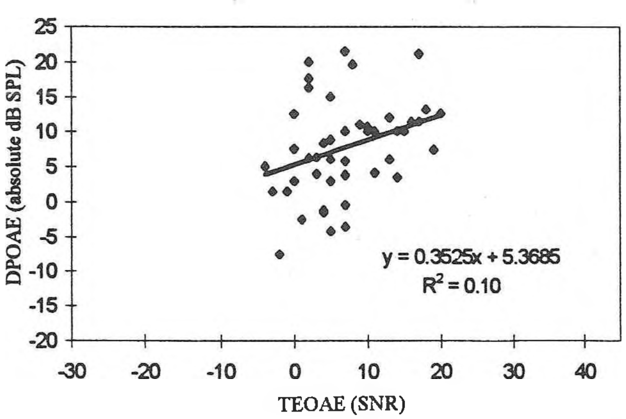


Fig. 6 The plot of human DPOAE responses versus the TEOAE responses, in the High Frequency Response Range (3-5 kHz).

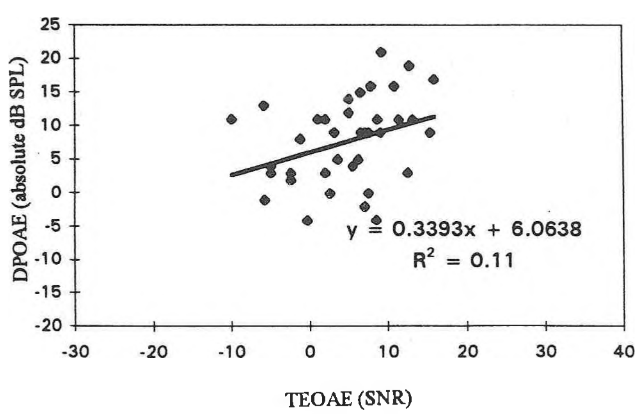


Fig. 7 The plot of the human DPOAE against TEOAE amplitudes, in the Low Frequency Range (1-2 kHz).

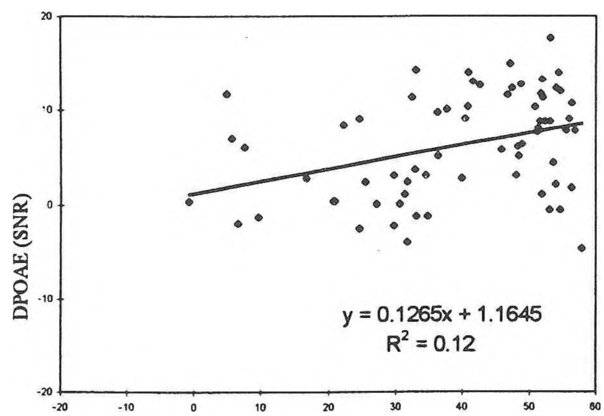


Fig. 8 The plot of the averaged, chinchilla DPOAE amplitudes (dB signal above noise level) against those of averaged TEOAEs (absolute dB SPL) in the entire 1 kHz to 5 kHz frequency range. The linear regression has a positive slope with a correlation coefficient of $R^2 = 0.12$.

three DPOAE amplitudes were averaged and plotted against the average of the three TEOAE amplitudes, at 1 kHz intervals, from 1 to 5 kHz. In all cases we use dB signal above noise level. The resulting plot is shown in Fig. 8. A linear regression exhibits a positive slope, as in the plots for human responses. The correlation coefficient (R^2) is 0.12.

4. DISCUSSION

The plots of DPOAE versus TEOAE amplitudes, for both humans and chinchillas, have positive slopes which indicate that as TEOAE responses increase, so do the DPOAE responses. However, the correlation (R^2) values associated with these linear regressions are low: 0.07 - 0.11 for the human data; 0.12 for the chinchilla data. Nevertheless, a statistical analysis of the data (Spearman rank order correlation) does indicate a significant relationship between DPOAE and TEOAE amplitudes in all cases (see Table).

Similar comparisons between DPOAE and TEOAE amplitudes have been carried out in human subjects by Probst and Harris (1993), as well as Smurzynski and Kim (1992). In both of these studies, higher R^2 values were reported.

Probst and Harris (1993), reported R^2 values from 0.4 to 0.6. These values are considerably higher than the ones reported in the present study. The reason for this discrepancy is unclear. However, Probst and Harris chose subjects with a wide range of hearing thresholds. In fact, over 75% of the data were collected from ears of subjects with sensorineural hearing loss. This high percentage of pathologic data, resulted in many points in the lower left hand corner of the DPOAE versus TEOAE plot, since pathologic ears generally give rise to low-amplitude DPOAE and TEOAE responses. These low amplitude data pairs may have increased the correlation coefficient of the linear regression analyses.

The study by Smurzynski and Kim (1992), also reported higher correlation coefficients ($R^2 = 0.16$ to 0.22) than observed in this paper. This discrepancy is not due to inclusion of pathologic data, since their subjects are reported not to have suffered from any type of hearing loss.

Although some correlation has been established between distortion product and transient evoked otoacoustic emissions in this study, as well as in the studies of Probst and Harris, and Smurzynski and Kim, findings have been reported in the literature that indicate otherwise. One such experiment was conducted by Martin et al. (1988), which showed that small laboratory animals have DPOAE amplitudes that are much larger than those of primates. However, they also observed that these small animals possess smaller TEOAE amplitudes than primates, leading them to conclude that perhaps DPOAEs and TEOAEs are produced by separate mechanisms. Furthermore, Wier et al. (1988) have showed that salicylates affect the 2 types of evoked OAEs differently in humans, indicating DPOAEs and TEOAEs to be only indirectly related.

The present study supports the notion that DPOAEs and TEOAEs are correlated, at least to a limited extent, and this fits with the generally accepted notion that they are generated by the same non-linear, biomechanical processes of the cochlea. As such, clinical measurements

Table: Statistical analysis of the correlation coefficients for the human and chinchilla data.

	Human (all freq)	Human (high freq)	Human (low freq)	Chinchilla Data
Spearman Correlation Coefficient	0.26	0.33	0.35	0.35
P value*	0.02	0.02	0.03	0.003
N	76	46	30	70

* For P values below 0.05, there is a significant relationship between the two variables.

of the two types of evoked OAEs may be used interchangeably. Moreover, since both types of evoked OAEs have shortcomings, for example in terms of frequency specificity and sensitivity (Probst and Harris, 1993), they may be used *jointly* to provide a more powerful diagnostic tool in assessing the functional integrity of the cochlea.

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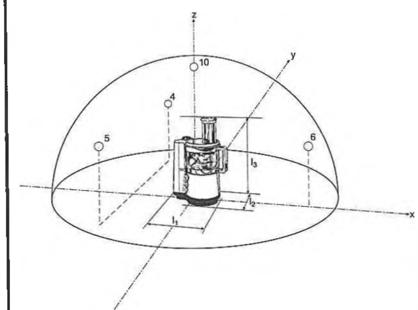

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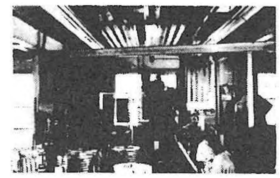

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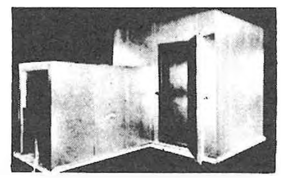

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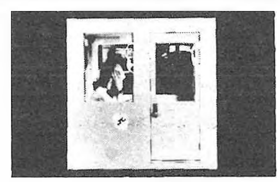

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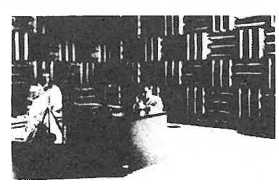

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AMENDMENT TO PART IV (AIRCRAFT NOISE) OF TRANSPORT CANADA'S GUIDELINES "LAND USE IN THE VICINITY OF AIRPORTS"

Thomas Kelly, ing. (P. Eng.)
Aviation Environmental Engineer
Transport Canada Aviation[1]
Ottawa, K1A ON8

ABSTRACT

In May 1996, Transport Canada (TC) issued an amendment to Part IV (Aircraft Noise) of its TP 1247 guidelines entitled "Land Use in the Vicinity of Airports". TP 1247 is published by TC to familiarize planners and legislators with the operational characteristics of airports which may influence land use outside the airport property boundary. Its purpose is to recommend, where applicable, guidelines to ensure that land use is compatible with airport operations. Land zoning is a provincial responsibility which is delegated to local authorities. Consequently, local planning authorities are not bound by TP 1247. This paper will describe this amendment which clarifies TC's opposition to the construction of new residential development between Noise Exposure Forecast (NEF) 30 and 35. TC has clarified the Land Use Table and the text of Part IV of TP 1247 to recommend that construction of new residential development between NEF 30 and 35 not be undertaken and has emphasized the decision making role of local authorities. In 1992, TC commissioned the National Research Council of Canada (NRC) to assess the validity of the NEF measure and the results of the NRC study support this amendment. This clarification will help protect both the public and airports without making TP 1247 overly restrictive.

SOMMAIRE

En mai 1996, Transports Canada (TC) a publié une modification à la Partie IV (Bruit des aéronefs) des lignes directrices de son TP 1247 intitulé "Utilisation des terrains au voisinage des aéroports". Le TP 1247 est publié par TC pour familiariser les planificateurs et les législateurs avec les caractéristiques opérationnelles d'aéroport qui peuvent influer sur l'utilisation des terrains hors des limites des propriétés aéroportuaires. Le but est de recommander, le cas échéant, des lignes directrices permettant de s'assurer que l'utilisation des terrains est compatible avec l'exploitation des aéroports. Le zonage d'aéroport est une responsabilité provinciale déléguée aux autorités locales. En conséquence, les autorités locales de planification ne sont pas obligés au TP 1247. Ce document décrira cette modification qui clarifie l'opposition de TC à la construction des nouvelles constructions ou les nouveaux développements résidentiels donnant lieu à la prévision d'ambiance sonore entre les NEF 30 et 35. Particulièrement, TC a clarifié le tableau d'utilisation des terrains et le texte de la Partie IV du TP 1247, pour recommander de ne pas entreprendre de construction de nouveaux développements résidentiels entre les NEF 30 et 35, et a souligner le rôle de prise de décision des autorités locales. En 1992, TC a fait appel au Conseil national de recherches (CNR) du Canada pour évaluer la validité de la mesure NEF, et les résultats de l'étude du CNR soutiennent cette modification. Cette clarification aidera à protéger à la fois le public et les aéroports, sans que le TP 1247 soit trop restrictif.

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1 The author is now employed by NAV CANADA as an Environmental Specialist.

1. INTRODUCTION

Transport Canada (TC) is responsible for maintaining the currency of TP 1247 [1] and the Noise Exposure Forecast computer program. The NEF measure is the heart of Part IV (Aircraft Noise) of TP 1247.

An accurate assessment of the annoyance resulting from exposure to aircraft noise is essential to both aviation planners and those responsible for directing the nature of development of lands adjacent to airports.

Part IV of TP 1247, discusses noise measurement, annoyance prediction, the Noise Exposure Forecast (NEF) and the Noise Exposure Projection (NEP). It also contains an assessment of various land uses in terms of their compatibility with aircraft noise. TC has been using TP 1247 and the NEF measure since the mid 1970s.

In the early 1990s TC realized that its recommendations relating to residential construction between NEF 30 to 35 required clarification. This was due to gradual residential encroachment towards airports which could result in subjecting the public to negative aircraft effects and adversely effecting the operational integrity of airports, e.g. operational restrictions resulting from noise complaints.

At around the same time TC also realized that its land use planning tool, the NEF measure, required re-validation. This was based on knowledge of the NEF's derivation (almost half a century ago) a changing aeronautical acoustical climate, more recent scientific information [2], sociological studies on the effects of modern aircraft noise on humans and how to forecast it, and knowledge of the NEF's practical limits. Consequently TC decided that it was timely to examine the NEF measure and, its interpretation, in terms of community response in today's Canadian aeronautical and acoustical climates.

The Institute for Research in Construction (IRC), of the National Research Council of Canada (NRC), was requested to submit a project proposal to undertake this study. The NRC had previously participated with TC and Canada Mortgage and Housing Corporation (CMHC) in the original development of TP 1247. Thus, the NRC was already intimately familiar with the history of the NEF and its development in Canada and has resident expertise in this area.

In April 1992, a contract was awarded to the NRC to perform the NEF Validation Study. The work was carried out by NRC over a two year period. NRC has provided TC with three reports and a Bibliography over the duration of the project [3, 4, 5].

It became evident that the results from the NEF Validation Study would have an impact on the decision to amend TP 1247. Therefore, TC decided to consider the results of this study before making this amendment [6].

A brief account of the NEF Validation Study's results, as they pertain to making the TP 1247 amendment, is given below; followed by a description of the amendment.

2. NEF VALIDATION STUDY: AIRCRAFT NOISE LEVEL CRITERIA

The work carried out by the NRC assessed the validity of the NEF model in the present and future Canadian context. The issues evaluated included the details of the forecast method, the basis for relating the forecasts to community response, and practical changes to the current strategy.

More specifically, the NRC examined the historical development of the NEF; evaluated the details of the NEF calculation procedure, e.g. the equal energy principle, the EPNL metric, night-time annoyance weighting, forecasting aircraft events, technical accuracy and comparisons with methods used in other countries; evaluated user's experiences and requirements and evaluated the effects of changes and special cases. The NRC finally proposed aircraft noise level criteria.

The NRC performed a synthesis of results, based on all information gathered from all sources, and provided TC with a reading on the following: how well the NEF measure performs; its weaknesses and strong points; how well the NEF procedure is expected to perform in the future, and recommendations for changes and future work to solve identified problems.

The NRC study underlined the fact that the basic NEF concepts did not come from systematic studies and there was never any thorough attempt to calibrate the NEF measure in terms of negative human response. Early estimates of acceptable noise levels of aircraft noise were determined from experiences with consulting case studies of various types of community noise. Acceptable limits can be set in terms of the onset of various unavoidable negative effects of aircraft noise, for example speech interference and annoyance responses. Therefore, based on the results of its study, the NRC proposed acceptable aircraft noise level criteria which included limits in terms of NEF values.

NRC proposed that the following noise level criteria thresholds be adopted in terms of NEF values: NEF 25, the onset of negative effects of aircraft noise; NEF 30, homes should include additional sound insulation; NEF 35, no new homes should be built. (These NEF values refer to those calculated by the Transport Canada NEF computer program which can be approximately equated to the American Day Night Sound Level (L_{dn}) using the relationship L_{dn} = NEF + 31, and not L_{dn} = NEF + 35 which is derived using the American Integrated Noise Model (INM). Intrinsic computer program calculations such as the ground attenuation and peak planning day calculations account for this difference. These different calculation methods result in the Canadian computer program producing larger contours than the American INM.

These thresholds of acceptability are based on the very extensive analyses of current knowledge on the effects of aircraft noise on people. NRC states that while the limits recommended are thought to represent a balanced interpretation of the available data, other conclusions are possible. Two particular weaknesses in the arguments used in establishing these limits might lead to more restrictive land use planning limits. First, the calculations that led to these thresholds were based on the assumption of a well insulated northern home with sealed windows. Areas where windows are typically open could support an argument for more restrictive limits for acceptable aviation noise levels. Second, the assumed long term benefits of added insulation have not been proven and clearly do not influence outdoor response. There is no reliable evidence that added sound insulation improves the more general acceptability of aviation noise. Thus, NRC states that a cautious approach might be to accept more restrictive limits until it can be demonstrated that added sound insulation does improve the acceptability of aviation noise.

3. AMENDMENT TO PART IV OF TP 1247

In addition to the problems associated with gradual residential encroachment towards airports other issues that influenced TC in making this amendment included:

1. Air carriers and airports have had difficulty appealing to some provincial municipal boards to prevent residential development applications in NEF 30 to 35 areas because, although responsibility for land use is a provincial jurisdiction, some provincial policies on land use near airports are indecisive and the municipal boards rely on the guidelines contained in TP 1247.

2. TP 1247 does not address the issue of outdoor noise climate and municipalities are not always vigilant in ensuring that sound insulation is provided by developers.

3. The gains made in reducing the size of noise contours due to the gradual phase-in of quieter aircraft (a considerable investment in new technology), producing a land buffer zone around airports, will not be realized if these lands are allowed to be developed for residential use. (At the time of writing, TC is examining the role of noise exposure contours play as a land use planning tool).

4. It is possible that noise contours will expand again in the future due to an increase in air traffic movements. Lands presently situated between NEF 30 to 35, will then be exposed to higher noise doses which would be clearly incompatible for residential development. It is important that municipalities realize that airports require adequate protection from encroachment of non-compatible development in this eventuality.

While recognizing these issues TC understands that TP 1247 are guidelines only because land zoning is a provincial responsibility which is delegated to local authorities.

Cognizant of the NRC's findings and wanting to maintain the operational integrity of airports, as well as protecting the public from negative effects of aircraft noise, TC decided to clarify its opposition to new residential construction between NEF 30 and 35. However, TC continues to emphasize the role of local authorities in approving land use planning applications in its guidelines.

Accordingly, in May 1996 TC issued a third amendment to the seventh edition of TP 1247 stating the following: "Transport Canada does not support or advocate incompatible land use (especially residential housing) in areas affected by aircraft noise. These areas may begin as low as NEF 25. At NEF 30, speech interference and annoyance caused by aircraft noise are, on average, established and growing. By NEF 35 these effects are very significant. New residential development is therefore not compatible with NEF 30 and above and should not be undertaken".

Previous to this amendment, the Land Use Table of Part IV indicated that residential construction between NEF 30 and 35 may be acceptable in accordance with the appropriate note and subject to the limitation indicated therein. Now, the Land Use Table of Part IV says NO to the construction of new residential construction or development between NEF 30 to 35 and refers the user to Explanatory Note B.

The Explanatory Note B has now been changed to read:

"This Explanatory Note applies to residential construction between NEF 30 and 35 only. New residential construction or development should not be undertaken.

If the responsible authority chooses to proceed contrary to Transport Canada's recommendation, residential development between NEF 30 and 35 should not be permitted to proceed until the responsible authority is satisfied that: 1) appropriate acoustic insulation features have been considered in the building design[1] and 2) a noise impact assessment study has been completed and shows that this development is not incompatible with aircraft noise. Notwithstanding point 2, the developer should still be required to inform all prospective tenants or purchasers of residential units that speech interference and annoyance caused by aircraft noise are, on average, established and growing at NEF 30 and are very significant by NEF 35."

The reference in this text refers to the CMHC publication entitled "New Housing and Airport Noise", NHA 5185/05. Authorities are referred to this document for assistance in determining appropriate noise insulation features for a particular residential development. The NRC, CMHC and TC developed this technique for selecting residential building components based on NEF values. The information contained in this document requires updating.

The "responsible authority" is the province or municipality.

4. CONCLUSION

In May 1996 Transport Canada amended Part IV (Aircraft Noise) of its land use planning guidelines (TP 1247) to discourage residential encroachment towards airports which could result in subjecting the public to negative aircraft effects and adversely effecting the operational integrity of airports. TC hopes that this initiative, which is supported by the NRC's NEF Validation Study, will provide clear guidance to users of TP 1247.

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STATE OF ACOUSTICS IN NOVA SCOTIA

Terry J. Deveau

Seimac Limited, 271 Brownlow Ave., Dartmouth, NS, B3B 1W6
deveau@seimac.com

SUMMARY

The current level of activity in acoustics research in the province of Nova Scotia is briefly reviewed, including a discussion of per capita concentration of professional membership. This paper is an adaptation of an invited talk presented to the 1996 Annual General Meeting of the Institute of Acoustics of Atlantic Canada, held at the Bedford Institute of Oceanography, 1996/05/31

SOMMAIRE

Le degrée d'activité dans le métier de la recherche en acoustique en Nouvelle Ecosse est brièvement revue, comprenant une discussion du concentration par capita des membres des associations professionelles. Ceci est une révision d'une présentation faite à la Réunion Générale Annuelle de l'Institue d'Acoustiques Atlantique Canadienne, qui a eu lieu à l'Institue d'Océanographie de Bedford, 1996/05/31.

INTRODUCTION

At one of the regular meetings of the Board of Directors of the Institute of Acoustics of Atlantic Canada in the spring of 1995, the suggestion arose to have ten-minute presentations of the "State of Acoustics" in each of the four Atlantic provinces at the up-coming Annual General Meeting. Although the topic is impossibly too broad to be able to do it any kind of justice within the time allotted, the author felt it would be an interesting and fun assignment, and agreed to present for Nova Scotia. The following paper is an adaptation of the prepared text of the presentation.

PROFESSIONAL MEMBERSHIP

In an attempt to gauge the state of acoustics in Nova Scotia, the membership of professional associations may be the most obvious place to start. Acoustics is something people do, so one should consider *who* is doing it. Although there are many acoustics practitioners who are not members of a professional association, those who *are* form the most visible subgroup. There are four associations that will be considered in this context; although doing so is not intended to suggest that these four, or these four alone, are the definitive *professional* associations of acousticians; it is simply a label of convenience for the purpose at hand.

Acoustical Society of America (ASA). With a history dating to 1928, the ASA is recognised as the leading association for professional acousticians, attracting a membership of about 7000 from all parts of the world.[1] Its peer-reviewed Journal (JASA) is the premiere publication for acoustics research. The 1995 membership directory lists **23 members** in Nova Scotia, which at **25 per million** population, is a significant concentration, compared to 295 members in all of Canada (10 pM), and 5360 in the US (20 pM).

It is interesting to note that per capita ASA membership in Nova Scotia compares favourably with such states as California (24 pM) and Pennsylvania (22 pM), while remaining at about one third the concentration of the best-represented states, Massachusetts and Connecticut (each 71 pM). These concentrations are depicted graphically in Figure 1. Already we see that Nova Scotia has an identifiable place in the North American acoustics community.

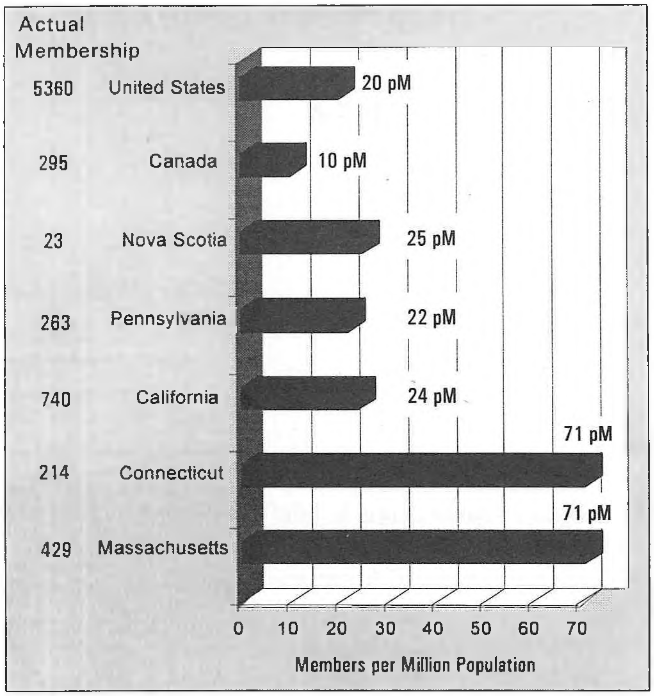


Figure 1. Comparison of 1995 ASA membership concentration between Nova Scotia and several other areas.

Canadian Acoustical Association (CAA). CAA is the professional, interdisciplinary organisation that fosters communication among people working in all areas of acoustics in Canada. It is an umbrella organisation through which general issues in education, employment and research can be addressed at a national level. It publishes the journal *Canadian Acoustics.*[2] In 1995, the CAA had 313 Canadian members (11 pM); of which **19** were also Nova Scotian **(20 pM)**. [3] This presents a consistent picture (Figure 2) with the data on ASA membership; and indeed, there is a very high membership overlap between the two organisations in Canada.

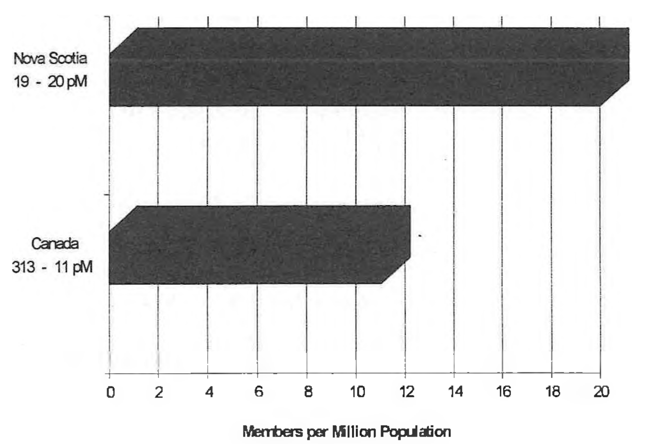


Figure 2. Comparison of 1995 CAA membership concentration between Nova Scotia and all of Canada.

Halifax Chapter of the Canadian Acoustical Association (HC-CAA). With a membership of about **30**, the local chapter deserves individual treatment from the CAA in general; not only because it is separately incorporated and carries out a set of programs that are supplemental to the services of the CAA, but also because its very existence highlights the strength of the acoustics community in Halifax Metro, and by extension, Nova Scotia. To the author's knowledge, it is the CAA's only presently-active local chapter. It presents a running series of seminars and site visits, actively promotes the introduction of acoustics to school children, and facilitates informal gatherings of its members.

Institute of Acoustics of Atlantic Canada (IAAC). A public meeting was held in Halifax in May 1990 to discuss a proposal to create a professional acoustics association in the region.[4] This eventually led to the IAAC's formal inauguration in May 1992. While serving all four Atlantic provinces as a nucleus for cooperation and exchange among acoustics practitioners, the IAAC has enjoyed strong support from its Nova Scotian members.

For 1995/96 the membership roll lists 18 members (12 individual and 6 corporate memberships), Nova Scotia accounts for **11** of these **(61%, 7 individual and 4 corporate)**. One might be tempted to surmise from this figure that Nova Scotians are *over*-represented in the IAAC membership, perhaps by virtue of its location here. However, evidence presented in the following section suggests that this is not the case.

OTHER PRACTITIONERS

The **Atlantic Canada Acoustics Inventory (ACAI)** was completed by Guptill Consulting Services in 1992, at the initiative of the IAAC (with sponsorship from the Federal and Provincial governments).[5] From a total of 735 entries, it lists 231 for Atlantic Canada, which report some professional, commercial, or institutional involvement in acoustics; of these, **161** were based in Nova Scotia.[6] Seen in the light of this **70%** figure, the IAAC membership appears to *under*-represent the Nova Scotian presence, if anything.

Figure 3 shows a comparison between the number of Nova Scotian registrations in each of the groups discussed above, and the number of Atlantic Canadians in the same group. The consistency in the relative size of the Nova Scotian co-

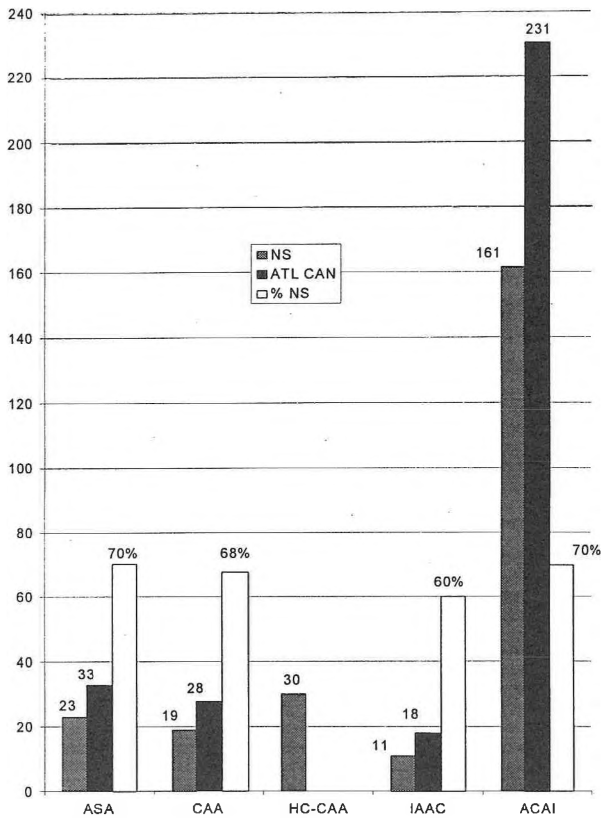


Figure 3. Comparison of 1995 association membership between Nova Scotia and all of Atlantic Canada.

hort in each of the four multi-provincial groups is remarkable.

In reality, we have only touched upon the most visible tip of the iceberg in this quick round-up of acoustical Nova Scotians. We know that the music and broadcast industries, in their many facets, could also be brought under this umbrella, as could voice-communications, navigation aids, medical ultra-sound, etc. The numbers of these practitioners of applied acoustics would certainly dwarf those of the R&D effort that we have already presented.

AREAS OF INTEREST

As one might expect, given Nova Scotia's intimate and enduring relationship with the sea, the lion's share of the professional activity in acoustics is centred around underwater acoustics; whether in support of military applications, fish finding and assessment, or sub-bottom geological investigation. Of the 23 ASA members, for example, 20 listed underwater acoustics among their top three areas of interest. Other areas of R&D cover practically the entire spectrum, including animal bioacoustics, architectural acoustics, speech communication, noise and vibration, music, etc.

PRINCIPAL CENTRES

The bulk of the acoustics R&D in Nova Scotia is concentrated, as one might expect, in a number of major institutions. The acoustics involvement in each centre is briefly surveyed below.

The Defence Research Establishment Atlantic (DREA). DREA has been active in underwater acoustic research and development for over fifty years. This R&D effort has included research into the ocean environment, development of acoustic sources, receivers, and equipment to process and display acoustic data, and development of military sonar systems.[7]

The Bedford Institute of Oceanography (BIO). The BIO program in acoustics is mainly involved in the use of underwater acoustics to study various ocean and fresh water parameters. Since the first patent was granted in 1907 for an underwater acoustics device to measure water depths, acoustic methods to obtain oceanographic measurements have become increasingly important in areas including bathymetric surveys, the measurement of ocean currents, geophysical research, the assessment of ocean biomass, the migratory patterns of fish, and even to climate prediction.[8]

Dalhousie University (DAL). Currently, more than 20 of Dalhousie's faculty members are engaged in teaching and/or research on a full- or part-time basis in acoustics fields. They can be found in the School of Human Communication Disorders, and in the Departments of Psychology, Oceanography, Biology, and Medicine, as well as in a number of other disciplines related to Neuroscience. The University thus has considerable strength in several areas that are pertinent to the study of acoustics.[9]

PRIVATE COMPANIES

It is difficult to gauge the number of Nova Scotian companies that derive significant revenues from the study and application of acoustics; the ACAI records 52, which should be considered as a lower-bound. To mention just one example, I could acknowledge my own employer, Seimac Limited, which provided support for this investigation. Based in Dartmouth, NS, with a staff of about 40, Seimac has been involved in ocean-related R&D for about 17 years. There are currently about six people employed here whose work generally relates to underwater acoustics a good part of the time.

CONCLUSION

In conclusion, I believe it is fair to say, that by virtue of the revenues generated, acoustics is important to Nova Scotia; and by virtue of the valuable contributions of its practitioners, Nova Scotia is important to acoustics.

[1] *Membership Directory and Handbook 1995*, Acoustical Society of America, Woodbury, NY, 1995.

[2] The Canadian Acoustical Association, *membership brochure*, 1993.

[3] *Membership Directory 1995*, Canadian Acoustics, Vol. 23, No. 4, p55-67, 1995/12

[4] Cliff Tyner, IAAC Chairman, *private communication*, 1994/03/17.

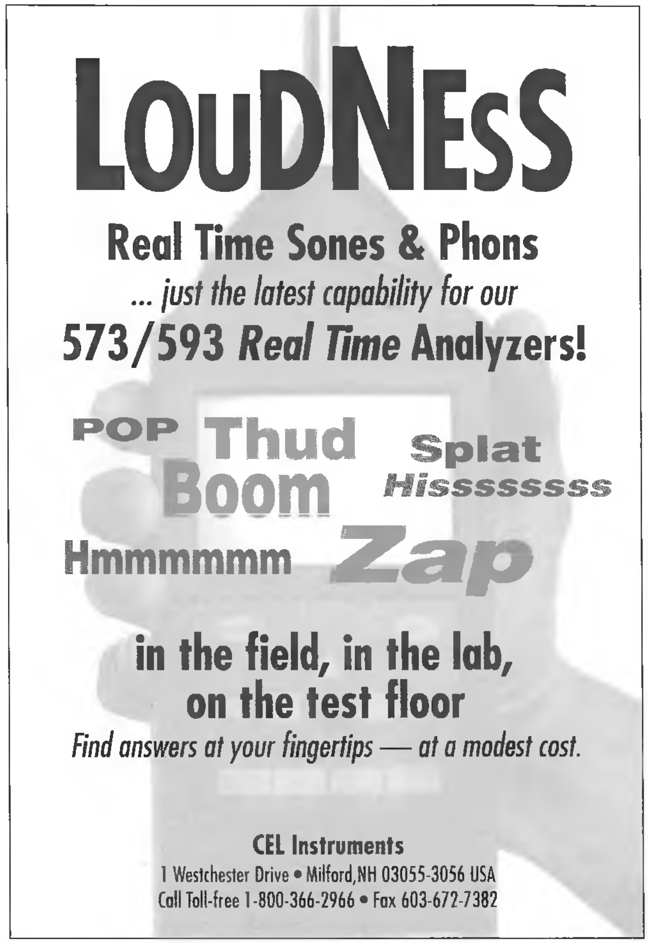
[5] Technology Transfer & Industrial Innovation (TTII, joint Federal/Provincial) funding: 68%, Defence Research Establishment Atlantic (Federal) funding: 32%. Jerry O'Neill, TTII, *private communication*, 1991/12/23.

[6] Fred Guptill, *Atlantic Canada Acoustics Inventory*, Guptill Consulting Services, 1992/03.

[7] R.F. Brown, Chief, DREA, *private communication*, 1992/01/22

[8] Stephen B. MacPhee, Regional Science Director, DFO, and D. I. Ross, Director, AGC, EM&R; Bedford Institute of Oceanography, *private communication*, 1992/01.

[9] Dennis Stairs, Vice-President (Academic & Research), Dalhousie University, *private communication*, 1992/02.



Prix de l'ACA à la mémoire de Raymond Hétu

L'assemblée des directeurs de l'Association canadienne d'Acoustique et le comité du Prix Raymond Hétu ont décidé d'établir un nouveau prix, à la mémoire de Raymond Hétu, qui serait financé en tout ou en partie par des dons des membres de l'ACA. A leur demande, j'invite donc les membres à faire parvenir leurs dons pour ce prix. Des fonds substantiels ont déja été promis. S. v. p. me faire parvenir vos chèques libellés au nom de l'Association canadienne d'Acoustique et y inscrire, Re: Prix Raymond Hétu. Un reçu d'impôt sera émis.

CAA Prize in Memory of Raymond Hétu

The Board of Directors of the Canadian Acoustical Association, and the Raymond Hétu Prize Committee, have decided to establish a new prize in memory of Raymond Hétu which would be financed all or in part by donations from the members of the CAA. At their request, I invite you to make donations towards this prize. Substantial funds have already been promised. Please send cheques made out to the Canadian Acoustical Association and marked, Re: Raymond Hétu Prize to me. A tax receipt will be issued.

Murray Hodgson - *Président, Comité du Prix Raymond Hétu / Chair, Raymond Hétu Prize Committee*

CALL FOR PAPERS
Acoustics Week in Canada 1997
SYMPOSIUM, October 8 - 10

This years CAA conference will deal with sound quality within the Environment, Society and Industry. Presentations covering acoustics within theses areas are solicited. A number of special technical sessions on particular themes have already been created. The list of the special sessions is as follows:

Sound quality
Psycho-acoustics
Automatic Speech Recognition
Speech Production
Architectural Acoustics
HVAC
Legislation/Environment Noise
Industrial Noise Control
Vibration Control
Physiological Acoustics
Speech Perception
Occupational Hearing Loss & Hearing Protection
Musical Acoustics
Airport (transportation) Noise
Underwater Acoustics & Sound Propagation
Active Noise Control
Canadian Standards

Submitted abstracts will be incorporated into the program by assigning them to the existing sessions or creating new sessions when necessary.

To submit an abstract:

- Send an abstract of 250 words maximum to the technical program chair **before 23 May 1997**. This deadline will be strictly enforced. The abstract should be prepared in accordance with the instructions enclosed in this issue of **Canadian Acoustics**

- A notification of acceptance will be sent to the authors by 5 June 1997 with a registration form.

- A **one-page** summary paper, prepared in accordance with the enclosed instructions, will be sent to the technical program chairman by **18 July 1997**. This deadline will be strictly enforced. The summary papers will be published in the proceedings issue of **Canadian Acoustics.**

Address the abstracts and summary papers to:

Dr. Robert Gaspar
Dept. of Mechanical and Materials Engineering
University of Windsor
Windsor ON N9B 3P4
Tel. (519) 253-4232 X 2619, Fax. (519) 973-7062
e-mail: gasparr@engn.uwindsor.ca

Registration fee: the registration fee for the Symposium and the completed registration form must be sent with the summary paper.

Summary of dates:

23 May 1997	Deadline for receipt of abstracts.
5 June 1997	Notification of acceptance.
18 July 1997	Deadline for receipt of summary paper, registration form and registration fee.
8 - 10 October 1997	Symposium.

Student competition: student participation to the Symposium is strongly encouraged. Monetary awards will be given to the three best presented papers. Students must signify their intention to compete by submitting the ***"Annual Student Presentation Award"*** form in this issue, to be enclosed with the abstract.

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APPEL DE COMMUNICATIONS
Semaine canadienne d'acoustique 1997
SYMPOSIUM, 8 - 10 octobre

Cette année, la thème pour Semaine Canadienne d'Acoustique 1997 est Environnement, Société, et l'Industrie. Des présentations vent sollicitées sur tous les domaines de l'acoustique et des vibrations. Un nombre de session techniques portant sur la thème vent déjà planifiées. En voici la liste:

Le Qualité du Son
Physio-acoustique
Parole
Contrôle du Bruit en Milieu de Travail
Acoustique Musicale
Contrôle du Bruit de l'Aéroport et des Aéroplanes
Acoustique Sous-marine
Contrôle Actif du Bruit
Contrôle du Vibration
Psycho-acoustique
Audition
Audiologie
Acoustique Architecturale
HVAC
Règlements et Bruit Environmental
Contrôle du Bruit Industriel
Normalisation Canadienne

Les présentations soumises seront réparties dans les sessions précédentes ou dans d'autres sessions si besoin est.

Pour soumettre une présentation:

- Envoyer un résumé de 250 mots maximum au responsable technique **avant le 23 mai 1997**. Cette échéance devra être scrupuleusement respectée. Les résumés devront être préparés en suivant les instructions incluses dans ce numéro d'**Acoustique canadienne**.

- Une notification d'acceptation du résumé sera envoyée aux auteurs avant le 5 juin 1997 avec un formulaire d'inscription au Symposium.

- Un sommaire de une-page, préparé suivant les instructions incluses dans ce numéro d'**Acoustique canadienne,** devra être envoyé au responsable technique **avant le 18 juillet 1997.** Cette échéance devra être scrupuleusement respectée. Les sommaires seront publiés dans les actes du Symposium.

Veuillez faire parvenir les résumés et les sommaires à:

Dr. Robert Gaspar
Dept. of Mechanical and Materials Engineering
University of Windsor
Windsor ON N9B 3P4
Tel. (519) 253-4232 X 2619, Fax. (519) 973-7062
e-mail: gasparr@engn.uwindsor.ca

Frais d'inscription: les frais d'inscription au Symposium et le formulaire d'inscription dûment complété devront être expédiés avec le sommaire.

Résumé des dates importantes:

23 mai 1997	Date limite de réception des résumés.
5 juin 1997	Notification d'acceptation.
18 juillet 1997	Date limite de réception du sommaire, du formulaire d'inscription et des frais d' inscription.
8 - 10 octobre 1997	Symposium.

Concours étudiants: la participation des étudiants au Symposium est fortement encouragée. Des prix en argent seront décernés pour les trois meilleures communications. Les étudiants doivent indiquer leur intention de participer en complétant le formulaire ***"Prix annuels relatifs aux communications étudiantes"*** qui figure dans le présent numéro et en le joignant au résumé.

Instructions for the Preparation of Abstracts

1) Duplicate copies of an abstract are required for each meeting paper; one copy should be an original. Send the copies to the Technical Program Chairperson, in time to be received by the deadline. Either English or French may be used. A cover letter is not necessary. **2)** Limit the abstract to 300 words, including title and first author's name and address; names and addresses of coauthors are not counted. Display formulas set apart from the text are counted as 40 words. Do not use the forms "I" and "we"; use passive voice instead. **3)** Title of abstract and names and addresses of authors should be set apart from the abstract. Text of abstract should be one single, indented paragraph. The entire abstract should be typed double spaced on one side of 8 1/2 x 11 in. or A4 paper. **4)** Be sure that the mailing address of the author to receive the acceptance notice is complete on the abstract, to insure timely deliveries. **5)** Do not use footnotes. Use square brackets to cite references or acknowledgements. **6)** Underline nothing except what you wish to be italicized. **7)** If the letter l is used as a symbol in a formula, loop the letter l by hand and write "lc ell" in the margin of the abstract. Do not intersperse the capital letter O with numbers where it might be confused with zero, but if unavoidable, write "capital oh" in the margin. Identify phonetic symbols by appropriate marginal remarks. **8)** At the bottom of an abstract give the following information: **a)** If the paper is part of a special session, indicate the session; **b)** Name the area of acoustics most appropriate to the subject matter; **c)** Telephone and fax numbers, including area code, of the author to be contacted for information. Non-Canadian Authors should include country; **d)** If more than one author, name the one to receive the acceptance notice; **e)** Overhead projectors and 35mm slide projectors will be available at all sessions. Describe on the abstract itself any special equipment needed.

Instructions pour la Préparation des Résumés de Conférences

1) Deux copies du résumé sont requises pour chaque papier soumis; une des copies doit être un original. Envoyer les copies au Président du Comité technique, suffisamment à l'avance pour qu'elles soient reçues avant la date de tombée. L'anglais ou le français peut être utilisé. Une lettre de présentation n'est pas requise. **2)** Limiter le résumé à 300 mots, incluant le titre, le nom et l'adresse du premier auteur; les noms et les adresses des co-auteurs ne sont pas comptabilisés. Les formules en retrait du texte comptent pour 40 mots. Ne pas utiliser la forme "je" ou "nous"; utiliser plutôt la forme passive. **3)** Le titre du résumé, les noms et les adresses des auteurs doivent être séparés du texte. Le texte du résumé doit être présenté en un seul paragraphe. Le résumé entier doit être dactylographié à double interlignes sur une face d'une page 8 1/2 x 11 pouce ou du papier A4. **4)** S'assurer que l'adresse postale complète de l'auteur qui doit recevoir l'avis d'acceptation est inscrite sur le résumé afin d'assurer une livraison rapide. **5)** Ne pas utiliser les notes de bas de page. Utiliser les crochets pour les références et les remerciements. **6)** Ne souligner que ce qui doit être en italique. **7)** Si la lettre l est utilisée comme symbole dans une formule, encercler la lettre l à la main et écrire "lc ell" dans la marge du résumé. Ne pas introduire la lettre majuscule O dans les chiffres lorsqu'elle peut être confondue avec zéro, mais se cela n'est pas possible, écrire "O majuscule" dans la marge. Identifier les symboles phonétiques à l'aide de remarques appropriées dans la marge. **8)** A la fin du résumé, fournir les informations suivantes: **a)** Si la communication fait partie d'une session spéciale, indiquer laquelle; **b)** Identifier le domaine de l'acoustique le plus appropié à votre sujet; **c)** Les numéros de téléphone et de télécopieur, incluant le code régional, de l'auteur avec qui l'on doit communiquer pour information. Les auteurs étrangers doivent indiquer leur pays; **d)** S'il y a plus d'un auteur, mentionner le nom de celui qui doit recevoir l'avis d'acceptation; **e)** Des projecteurs à acétates et à diapositives seront disponibles dans chaque session. Indiquer les besoins spéciaux, si nécessaire.

Instructions pour la Préparation des Articles à être Publiés dans le Cahier des Actes du Congrès

Général - Soumettre un article prêt-à-copier d'un maximum d'une page présenté en deux colonnes. Ne pas inclure de sommaire. Tout le texte en caractères Times-Roman. Disposer les figures dans le haut ou le bas des pages si possible. Lister les références dans un format logique à la fin du texte. Envoyer l'article au président du Programme Technique avant la date de tombée . Le format optimal peut être obtenu de deux façons:

Méthode directe - Imprimer directement sur deux feuilles 8.5" x 11" en respectant des marge de 3/4" dans le haut et sur les côtés et un minimum de 1" dans le bas. Titre en 12pt. caractères gras, en simple interligne (12pt), centrés sur la page. Le reste du texte en 9pt en 0.75 (9pt) interligne, dans un format en deux colones, avec une largeur de colonnes de 3.4" et une séparation de 1/4". Noms des auteurs et adresses centrés sur la page avec les noms en caractères gras. Les titres de sections en caractères gras.

Méthode indirecte - Dactylographier ou imprimer comme suit, réduire au trois-quart (s.v.p., s'assurer de bonnes photocopies) et assembler l'article sur un maximum de deux pages 8.5" x 11" avec les côtés et un minimum de 1" dans le bas. Titre en 16pt avec 1.33 (16pt) interligne, centré sur la page. Le reste du texte en 12pt avec simple (12pt) interligne. Noms et adresses des auteurs centrés sur la page avec les noms en caractères gras. Titres des sections en caractères gras. Imprimer les colonnes de texte sur quatre feuilles 8.5" x 14" avec une largeur de colonnes de 4.5", une longueur maximum de 12.25", en laissant de la place pour le titre, les noms et les adresses sur la première page.

Instructions for Preparation of Articles to be Published in the Conference Proceedings Issue

General - Submit the camera-ready article on a maximum of one page in two-column format. Do not include an abstract. All text in Times-Roman font. Place figures at the top and/or bottom of the pages, if possible. List references in any consistent format at the end. Send to the Chairperson of the Technical Programme by the deadline. The optimum format can be obtained in two ways:

Direct method - Print directly on two sheets of 8.5" x 11" paper with margins of 3/4" top and sides, and 1" minimum at the bottom. Title in 12pt bold with single (12pt) spacing, centred on the page. All other text in 9pt with 0.75 (9pt) line spacing, in two-column format, with column width of 3.4" and separation of 1/4". Authors' names and addresses centred on the page with the names in bold type. Section headings in bold type.

Indirect method - Type or print as follows, reduce to three-quarters size (please ensure good copies) and assemble article on a maximum of two 8.5" x 11" pages with margins of 3/4" top and sides, and 1" minimum at the bottom. Title in 16pt bold type with 1.33 (16pt) line spacing, centred on the page. All other text in 12pt with single (12pt) line spacing. Authors' names and addresses centred on the page with the names in bold type. Section headings in bold type. Print individual text columns on four sheets of 8.5" x 14" paper with a column width of 4.5", a maximum length of 12.25", and leaving room for the title and names and addresses on the first page.

ANNUAL STUDENT PRESENTATION AWARDS

The Canadian Acoustical Association makes awards to students whose papers are presented at the CAA Annual Symposium. Students contemplating presenting papers at the Symposium should apply for these awards with the submission of their abstract.

RULES

1. These awards are presented annually to authors of outstanding student papers that are presented during the technical sessions at Acoustics Week in Canada.
2. In total, three awards of $500.00 are presented.
3. Presentations are judged on the following merits:
   i) The way the subject is presented;
   ii) The explanation of the relevance of the subject;
   iii) The explanation of the methodology/theory;
   iv) The presentation and analysis of results;
   v) The consistency of the conclusions with theory and results.
4. Each presentation is judged independently by at least three judges.
5. The applicant must be:
   i) a full-time graduate student at the time of application;
   ii) the first author of the paper;
   iii) a member of the CAA;
   iv) registered at the meeting.
6. To apply for the award, the student must send this application simultaneously with the abstract. Multiple authors are permitted, but only the first author may receive an award.

PRIX ANNUELS RELATIFS AUX COMMUNICATIONS ETUDIANTES

L'Association Canadienne d'Acoustique décerne des prix aux étudiant(e)s qui présenteront une communication au congrès annuel de l'ACA. Les étudiant(e)s qui considèrent présenter un papier doivent s'inscrire à ce concours au moment où ils (elles) soummettent leur résumé.

REGLEMENTS

1. Ces prix sont décernés annuellement aux auteurs de communications exceptionelles presentées par des étudiants lors des sessions techniques de la Semaine Canadienne d'Acoustique.
2. Au total, trois prix de 500$ sont remis.
3. Les présentations sont jugées selon les critères suivants:
   i) La façon dont le sujet est présenté;
   ii) Les explications relatives à l'importance du sujet;
   iii) L'explication de la méthodologie;
   iv) La présentation et l'analyse des résultats;
   v) La consistence des conclusions avec la théorie et les résultats.
4. Chaque présentation est evaluée séparément par au moins trois juges.
5. Le candidat doit être:
   i) un étudiant à temps plein de niveau gradué au moment de l'inscription;
   ii) le premier auteur du papier;
   iii) un membre de l'ACA;
   iv) un participant au congrès.
6. Afin de s'inscrire au concours, l'étudiant doit envoyer ce formulaire d'inscription en même temps que son résumé. Plusieurs auteurs sont permis, mais seul le premier auteur peut recevoir le prix.

APPLICATION FOR STUDENT PRESENTATION AWARD AT ACOUSTICS WEEK IN CANADA

FORMULAIRE D'INSCRIPTION POUR LES PRIX DECERNES AUX ETUDIANTS LORS DE LA SEMAINE CANADIENNE D'ACOUSTIQUE

NAME OF THE STUDENT:________________________________NOM DE L'ETUDIANT

SOCIAL INSURANCE NUMBER:________________________________NUMERO D'ASSURANCE SOCIALE

TITLE OF PAPER:________________________________TITRE DU PAPIER

UNIVERSITY/COLLEGE:________________________________UNIVERSITE/COLLEGE

NAME, TITLE OF SUPERVISOR:________________________________NOM ET TITRE DU SUPERVISEUR

STATEMENT BY THE SUPERVISOR: The undersigned affirms that the above-named student is a full-time student and the paper to be presented is the student's original work.

Signature:________________________________

DECLARATION DU SUPERVISEUR: Le sous-signé affirme que l'étudiant(e) mentionné(e) ci-haut est inscrit(e) à temps plein et que la communication qu'il (elle) présentera est le fruit de son propre travail.

Date:________________________________

APPLICATION FOR STUDENT TRAVEL SUBSIDY TO ACOUSTICS WEEK IN CANADA

Travel subsidies are available to students presenting papers at Acoustics Week in Canada if they live at least 150 km from the conference venue, if the subsidy is needed, if supporting receipts are submitted, and if they publish a summary of their paper in the proceedings issue of *Canadian Acoustics*.

I wish to apply for a CAA Travel Subsidy: _____yes _____no.

STATEMENT BY THE SUPERVISOR: The undersigned affirms that the CAA Travel Subsidy, combined with other travel funds that the above-named student may receive to attend the meeting will not exceed his/her travel costs.

Signature:________________________________

FORMULAIRE DE DEMANDE DE REMBOURSEMENT POUR FRAIS DE DEPLACEMENT A LA SEMAINE CANADIENNE D'ACOUSTIQUE

Un remboursement de frais de déplacement est offert aux étudiants qui présentent une communication lors de la Semaine Canadienne d'Acoustique, s'ils demeurent à plus de 150 km du site du congrès, si le remboursement est nécessaire, si les reçus à l'appui sont soumis et s'ils publient un résumé dans les Actes du Congrès.

Je désire demander un remboursement: _______oui _______non.

DECLARATION DU SUPERVISEUR: Le sous-signé affirme que le remboursement, jumelé à d'autres fonds que l'étudiant(e) ci-haut mentionné(e) peut recevoir ne dépasseront pas ses coûts réels de voyage.

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NEWS / INFORMATIONS

CONFERENCES

The following list of conferences was mainly provided by the Acoustical Society of America. If you have any news to share with us, send them by mail or fax to the News Editor (see address on the inside cover), or via electronic mail to desharnais@drea.dnd.ca

1997

12-14 May: Third AIAA/CEAS Aeroacoustic Confernce, Atlanta, GA. Contact: Stephen Engelstad, Lockheed Marine Aeronautical Systems, D/73-47, Z/0-685, Marietta, GA 30036, Tel: 770-494-9178; Fax: 770-494-3055; E- mail: sengelstad@fs2.mar.1mco.com

12-16 May: FASE Symposium on Hydroacoustics, Jurata/Gdansk, Poland. Contact: Institute of Experimental Physics, Gdansk University, Wita Stwosza 57, 80-952 Gdansk, Poland: Fax: +489 58 413175; E-mail: fizas@halina.univ.gda.pl

20-22 May: SAE Noise and Vibration Conference, Traverse City, MI, USA. Contact: SAE/MJA, 3001 W. Big Beaver Road, Suite 320, Troy, MI 48084, USA; FAX: +1 810 649 0425.

21-23 May: 25th Annual Meeting Italian Acoustical Association, Perugia, Italy. Contact: F. Astrubali, Istituto di Energetica, Via G. Duranti 1-A/4, 06125 Perugia, Italy; FAX: +39 75 582 5596; E-mail: rossi@apollo.isten.ing.unipg.it

5-7 June: Conference on ICP and Inner Ear Pressure, Bath, UK. Contact: British Society of Audiology, 80 Brighton Rd., Reading RG6 1PS, UK; Fax: +44 1734 351915.

15-17 June: NOISE-CON 97, State College, PA. Contact: Institute of Noise Control Engineering, P.O. Box 320, Arlington Branch, Poughkeepsie, NY 12603, Tel.: 914-891-1407; FAX: 914-463-0201.

15-20 June: Eighth International Symposium on Nondestructive Characterization of Materials, Boulder, CO. Contact: Debbie Harris, The Johns Hopkins University, Ctr. for Nondestructive Evaluation, 102 Maryland Hall, 3400 N. Charles St., Baltimore, MD 21218, Tel.: 410-516-5397; FAX: 410-516-7249, E-mail: cnde@jhuvms.hcf.jhu.edu

16-20 June: 133rd Meeting of the Acoustical Society of America, State College, PA. Contact: Acoustical Society of America, 500 Sunnyside Blvd., Woodbury, NY 11797, Tel.: 516-576-2360; Fax: 516-576-2377; E-mail: asa@aip.org; WWW: http//asa.aip.org

18-21 June: 3rd European Conference on Audiology, Prague, Czech Republic. Contact: Paediatric Otolaryngologic Clinic, Faculty Hospital Motol, V Uvalu 84, 15018 Prague 5, Czech Republic; FAX: +42 2 2443 2620.

24-27 June: 1st European Conference on Signal Analysis and Prediction, Prague, Czech Republic. Contact: ESCAP Secretariat, Institute of Chemical Technology, Technicka 5, 166 28 Praha 6, Czech Republic; Fax: +42 2 243 11082; E-mail: escap@vscht.cz; WW: http://www.vscht.cz/escap97/

25-27 June: 5th International Congress of the International Society of Applied Psycholinguistics, Porto, Portugal. Contact: Maria da Graça Pinto, Universidade do Porto, Faculdad de Letras, Via Panorâmica, s/n, PT-4150 Porto, Portugal; FAX: +351 2 610 1990.

25-27 June: 12th Echocardiology Symposium and 9th Meeting of the International Cardiac Doppler Society, Rotterdam, The Netherlands. Contact: LMC Congress Service, P.O. Box 593, 3700 AN Zeist, The Netherlands, FAX: +31 343 533 357.

CONFÉRENCES

La liste de conférences ci-jointe a été offerte en majeure partie par l'Acoustical Society of America. Si vous avez des nouvelles à nous communiquer, envoyez-les par courrier ou fax (coordonnées incluses à l'envers de la page couverture), ou par courrier électronique à desharnais @drea.dnd.ca

1997

12-14 mai: 3e conférence d'aéroacoustique de l'AIAA/CEAS, Atlanta, GA. Renseignements: Stephen Engelstad, Lockheed Marine Aeronautical Systems, D/73-47, Z/0-685, Marietta, GA 30036, Tel: 770-494-9178; Fax: 770-494-3055; E- mail: sengelstad@fs2.mar.1mco.com

12-16 mai: Symposium FASE sur l'hydroacoustique, Jurata/Gdansk, Pologne. Renseignements: Institute of Experimental Physics, Gdansk University, Wita Stwosza 57, 80-952 Gdansk, Poland: Fax: +489 58 413175; E-mail: fizas@halina.univ.gda.pl

20-22 mai: Conférence SAE sur le bruit et les vibrations, Traverse City, MI, E-U. Renseignements: SAE/MJA, 3001 W. Big Beaver Road, Suite 320, Troy, MI 48084, USA; FAX: +1 810 649 0425.

21-23 mai: 25e rencontre annuelle de l'Association italienne d'acoustique, Perugia, Italie. Renseignements: F. Astrubali, Istituto di Energetica, Via G. Duranti 1-A/4, 06125 Perugia, Italy; FAX: +39 75 582 5596; E-mail: rossi@apollo.isten .ing.unipg.it

5-7 juin: Conférence sur l'ICP et la pression de l'oreille interne, Bath, Royaume Uni. Renseignements: British Society of Audiology, 80 Brighton Rd., Reading RG6 1PS, UK; Fax: +44 1734 351915.

15-17 juin: NOISE-CON 97, State College, PA. Renseignements: Institute of Noise Control Engineering, P.O. Box 320, Arlington Branch, Poughkeepsie, NY 12603, Tel.: 914-891-1407; FAX: 914-463-0201.

15-20 juin: 8e symposium international sur la caractérisation non-destructive des matériaux, Boulder, CO. Information: Debbie Harris, The Johns Hopkins University, Ctr. for Nondestructive Evaluation, 102 Maryland Hall, 3400 N. Charles St., Baltimore, MD 21218, Tel.: 410-516-5397; FAX: 410-516-7249, E-mail: cnde@jhuvms.hcf .jhu.edu

16-20 juin: 133e rencontre de l'Acoustical Society of America, State College, Pennsylvanie. Renseignements: Acoustical Society of America, 500 Sunnyside Blvd., Woodbury, NY 11797, Tel.: 516-576-2360; Fax: 516-576-2377; E-mail: asa@aip.org; WWW: http//asa.aip.org

18-21 juin: 3e conférence européenne en audiologie, Prague, Czech Republic. Renseignements: Paediatric Otolaryngologic Clinic, Faculty Hospital Motol, V Uvalu 84, 15018 Prague 5, Czech Republic; FAX: +42 2 2443 2620.

24-27 juin: 1e conférence européenne sur l'analyse et la prédiction de signaux, Prague, République Tchèque. Renseignements: ESCAP Secretariat, Institute of Chemical Technology, Technicka 5, 166 28 Praha 6, Czech Republic; Fax: +42 2 243 11082; E-mail: escap@vscht.cz; WW: http://www.vscht.cz/escap97/

25-27 juin: 5e congrès international de la Société internationale de psycho-linguistique appliquée, Porto, Portugal. Renseignements: Maria da Graça Pinto, Universidade do Porto, Faculdad de Letras, Via Panorâmica, s/n, PT-4150 Porto, Portugal; FAX: +351 2 610 1990.

25-27 juin: 12e symposium d'échocardiologie et 9e rencontre de la Société internationale du doppler cardiaque,Rotterdam, Pays Bas. Information: LMC Congress Service, P.O. Box 593, 3700 AN Zeist, The Netherlands, FAX: +31 343 533 357.

2-4 July: Ultrasonics International '97, Delft, The Netherlands. Contact: W. Sachse, Dept. of Theoretical and Applied Mechanics, Cornell Univ., Ithaca, NY 14853; Fax: 607 255 9179; E-mail: sachs@msc.cornell.edu

9-13 July: International Clarinet Association, Texas Tech Univ., Lubbock, TX. Contact: Keith Koons, Music Department, Univ. of Central Florida, P.O. Box 161354, Orlando, FL 23816-1354, Tel; 407-823-5116; E-mail: kkoons@pegasus.cc.ucf.edu

14-17 July: 6th International Conference on Recent Advances in Structural Dynamics, Southampton, UK. Contact: N. Ferguson, ISVR, University of Southampton, Southampton SO17 IBJ, UK; FAX: +44 1703 593033; E-mail: mzs@isvr.soton.ac.uk

18-22 August: 3rd EUROMECH Solid Mechanics Conference, Stockholm. Contact: B. B. Storakers, Department of Solid Mechanics, Royal Institute of Technology, 100 44 Stockholm, Sweden; E-mail: 3esmc@hallf.kth.se

19-22 August: International Symposium on Musical Acoustics, Edinburgh. Contact: D.M. Campbell, Department of Physics and Astronomy, University of Edinburgh, James Clerk Maxwell Building, Mayfield Road, Edinburgh EH9 3JZ, Scotland; Fax: +44 650 5902; E-mail: Isma.97@ed.ac.uk; WWW:http://www.music.ed.ac.uk/research/conferences/isma /

20-23 August: New Zealand Acoustical Society Biennial Conference, Christchurch, New Zealand. Contact: NZ Acoustical Society, P.O. Box 1181, Auckland, New Zealand.

21-23 August: ACTIVE 97 Inter-Noise Satellite Symposium, Budapest, Hungary. Contact: ACTIVE 97 Secretariat, POAKFI, Fou 68, 1028 Budapest, Hungary; Fax: +36 1 202 0452.

24-27 August: 1997 World Congress on Ultrasonics, Yokohama, Japan. Contact: S. Ueha, Precision and Intelligence Lab., Tokyo Inst. of Technology 4259 Nagatsuta, Midori-ku, Yokohama 226, Japan; Fax: +81 45 921 0898; E-mail: wcu97@pi.titech.ac.jp

25-27 August: Internoise 97, Budapest, Hungary. Contact: OPAKFI, Fo. u. 68, 1027 Budapest, Hungary; Fax: +36 1 202 0452.

1-4 September: Modal Analysis Conference - IMAC-XV Japan, Tokyo, Japan. Contact: N. Okubo, Chuo University, 1-13-27 Kasuga, Bunkyo-ku, Yokyo 112, Japan; FAX: +81 3 3817-1820; E-mail: jmac@okubo.mech.chuo-u.ac.jp

7-11 September: American Academy of Otolaryngology--Head and Neck Surgery, San Francisco, CA. Contact: American Academy of Otolaryngology--Head and Neck Surgery, One Prince St., Alexandria, VA 22314. Tel.: 703-836-4444; FAX: 703-683-5100.

9-12 September: 31st International Acoustical Conference "Acoustics - High Tatra 97", High Tetra, Slovakia. Contact: E. Rajcan, Technical University Zvolen, 96053 Zvolen, Slovakia; FAX: +42 855 321 811; E-mail: 31iac@tuzvo.sk

10-12 September: Biomechanics of Hearing, Stuttgart, Germany. Contact: EUROMECH Colloquium 368, W. Schiehlen, Institute B of Mechanics, University of Stuttgart, 70550 Stuttgart, Germany; E-mail: wos@mechb.uni-stuttgart.de

15-18 September: 3rd Fluid Mechanics Conference, Gottingen. Contact: G.E.A. Meier, DRL-Institut fur Stromungsmechanik, Bundestrasse 10, 37073, Gottingen, Germany; E-mail: efmc972msfdl.gwdg.de

2-4 juillet: Ultrasonics International '97, Delft, Pays-Bas. Renseignements: W. Sachse, Dept. of Theoretical and Applied Mechanics, Cornell Univ., Ithaca, NY 14853; Fax: 607 255 9179; E-mail: sachs@msc.cornell.edu

9-13 juillet: Association internationale de la clarinette, Texas Tech Univ., Lubbock, TX. Renseignements: Keith Koons, Music Department, Univ. of Central Florida, P.O. Box 161354, Orlando, FL 23816-1354, Tel: 407-823-5116; E-mail: kkoons@pegasus.cc.ucf.edu

14-17 juillet: 6e conférence internationale sur les progrès récents en dynamique structurale, Southampton, Royaume-Uni. Renseignements: N. Ferguson, ISVR, University of Southampton, Southampton SO17 IBJ, UK; FAX: +44 1703 593033; E-mail: mzs@isvr.soton.ac.uk

18-22 août: 3e conférence EUROMECH sur la mécanique des solides, Stockholm. Renseignements: B. B. Storakers, Department of Solid Mechanics, Royal Institute of Technology, 100 44 Stockholm, Sweden; E-mail: 3esmc@hallf.kth.se

19-22 août: Symposium international sur l'acoustique musicale, Edinbourg. Renseignements: D.M. Campbell, Department of Physics and Astronomy, University of Edinburgh, James Clerk Maxwell Building, Mayfield Road, Edinburgh EH9 3JZ, Scotland; Fax: +44 650 5902; E-mail: isma.97@ed.ac.uk; WWW:http://www.music.ed.ac.uk /research/conferences/isma/

20-23 août: Conférence biennale de la Société d'acoustique de la Nouvelle-Zélande, Christchurch, Nouvelle-Zélande. Renseignements: NZ Acoustical Society, P.O. Box 1181, Auckland, New Zealand.

21-23 août: ACTIVE 97 Symposium satellite d'Inter-Noise, Budapest, Hongrie. Renseignements: ACTIVE 97 Secretariat, POAKFI, Fou 68, 1028 Budapest, Hungary; FAX: +36 1 202 0452.

24-27 août: congrès mondial de 1997 sur les ultrasons, Yokohama, Japon. Renseignements: S. Ueha, Precision and Intelligence Lab., Tokyo Inst. of Technology 4259 Nagatsuta, Midori-ku, Yokohama 226, Japan; Fax: +81 45 921 0898; E-mail: wcu97@pi.titech.ac.jp

25-27 août: Internoise 97, Budapest, Hongrie. Renseignements: OPAKFI, Fo. u. 68, 1027 Budapest, Hungary; Fax: +36 1 202 0452.

1-4 septembre: Conférence sur l'analyse par modes - IMAC-XV Japon, Tokyo, Japon. Info: N. Okubo, Chuo University, 1-13-27 Kasuga, Bunkyo-ku, Yokyo 112, Japan; FAX: +81 3 3817-1820; E-mail: jmac@okubo.mech.chuo-u.ac.jp

7-11 septembre: Académie américaine d'otolaryngologie - Chirurgie de la tête et du cou, San Francisco, CA. Renseignements: American Academy of Otolaryngology--Head and Neck Surgery, One Prince St., Alexandria, VA 22314; Tel.: 703-836-4444; FAX: 703-683-5100.

9-12 septembre: 31e conférence internationale d'acoustique "Acoustics - High Tatra 97", High Tetra, Slovakia. Renseignements: E. Rajcan, Technical University Zvolen, 96053 Zvolen, Slovakia; FAX: +42 855 321 811; E-mail: 31iac@tuzvo.sk

10-12 septembre: Biomécanique de l'audition, Stuttgart, Allemagne. Renseignements: EUROMECH Colloquium 368, W. Schiehlen, Institute B of Mechanics, University of Stuttgart, 70550 Stuttgart, Germany; E-mail: wos@mechb .uni-stuttgart.de

15-18 septembre: 3e conférence sur la mécanique des fluides, Gottingen. Renseignements: G.E.A. Meier, DRL-Institut fur Stromungsmechanik, Bundestrasse 10, 37073, Gottingen, Germany; E-mail: efmc972msfdl.gwdg.de

22-24 September: Second Biennial Hearing Aid Research and Development Conference, Bethesda, MD. Contact: National Institute of Deafness and Other Communication Disorders, 301-970-3844; FAX: 301-907-9666; E-mail: hearingaid@tascon.com

22-25 September: 5th European Conference on Speech Communication and Technology, Patras, Greece. Contact: G. Kokkinakis, Department of Electrical and Computer Engineering, University of Patras, 26110 Rion-Patras, Greece; Fax: +30 61 991 855, E-mail: gkokkin @wcl.ee.upatras.gr

23-26 September: Fluid-Structure Interaction in Acoustics, Delft, The Netherlands. Contact: EUROMECH Colloquium 369, A.H.P. van der Burgh, Faculty of Technical Mathematics and Informatics, University of Technology, P.O. Box 5031, 2600 GA Delft, The Netherlands; E-mail: burgh @dv.twi.tudelft.nl

6-9 October: Oceans '97 MTS/IEEE, Halifax, Canada. Contact: IEEE Travel and Conference Management Services, 445 Hoes Lane, Piscataway, NJ, 08855-1331, USA. Tel: (908) 562-5598; Fax: (908) 981-1203.

7-10 October: 1997 IEEE Ultrasonics Symposium, Toronto, Canada. Contact: S. Foster, Department of Medical Biophysics, Sunnybrook Health Science Ctr., 2075 Bayview Avenue, Toronto, Ontario M4N 3M5, Canada; E-mail: stuart@owl.sunnybrook.utoronto.ca

8-10 October: 1997 Acoustics Week in Canada, Windsor, Canada. Contact: Dr. R. Ramakrishnan, Vibron Ltd, 1720 Meyerside Drive, Mississauga, Ontario, L5T 1A3. Tel.: (905) 670-4922; FAX: (905) 670-1698.

19-21 November: WESTPRAC VI 97, Hong Kong. Contact: S.K. Tang, WESTPRAC Secretary, Department of Building Services Engineering, The Hong Kong Polytechnic University, Hung Hum, Hong Kong; FAX: +852 27746146; E-mail: besktang@polyu.edu.hk

1-5 December: 134th Meeting of the Acoustical Society of America, San Diego, CA. Contact: Acoustical Society of America, 500 Sunnyside Blvd., Woodbury, NY 11797, Tel.: 516-576-2360; Fax: 516-576-2377; E-mail: asa@aip.org; WWW: http//asa.aip.org

15-18 December: 5th International Congress on Sound and Vibration, Adelaide, Australia. Contact: ICSV5 Secretariat, Department of Mechanical Engineering, University of Adelaide, South Australia 5005, Australia; FAX: +61 8 8303 4367; E-mail: icsv5@mecheng.adelaide.edu.au

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23-27 March: DAGA 98 - German Acoustical Society Meeting, Zürich, Switzerland. Contact: DEGA, Physics/Acoustics Department, Universität Oldenburg, 26111 Oldenburg, Germany; FAX: +49 441 798 3698; E-mail: dega@aku.physik.uni-oldenburg.de

8-10 June: EAA/EEAA Symposium "Transport Noise and Vibrations", Tallinn, Estonia. Contact: East-European Acoustical Association, Moskovskoe Shosse 44, 196158 St.-Petersburg, Russia; FAX: +7 812 127 9323; E-mail: krylspb@sovam.com

22-26 June: 135th meeting of the Acoustical Society of America/16th International Congress on Acoustics, Seattle, WA. Contact: ASA, 500 Sunnyside Blvd., Woodbury, NY 11797, Tel.: 516-576-2360; FAX: 516-576-2377; E-mail: asa@aip.org, WWW: http://asa.aip.org

13-17 September: American Academy of Otolaryngology--Head and Neck Surgery, San Francisco, CA. Contact: American Academy of Otolaryngology--Head and Neck Surgery, One Prince St., Alexandria, VA 22314. Tel.: 703-836-4444; FAX: 703-683-5100.

22-24 septembre: 2e conférence biennale sur la recherche et le développement des prothèses auditives, Bethesda, MD. Renseignements: National Institute of Deafness and Other Communication Disorders, 301-970-3844; FAX: 301-907-9666; E-mail: hearingaid@tascon.com

22-25 septembre: 5e conférence européenne de la communication et la technologie de la parole, Patras, Grèce. Renseignements: G. Kokkinakis, Department of Electrical and Computer Engineering, University of Patras, 26110 Rion-Patras, Greece; Fax: +30 61 991 855, E-mail: gkokkin @wcl.ee.upatras.gr

23-26 septembre: Intéractions fluide-structure en acoustique, Delft, Pays-Bas. Renseignements: EUROMECH Colloquium 369, A.H.P. van der Burgh, Faculty of Technical Mathematics and Informatics, University of Technology, P.O. Box 5031, 2600 GA Delft, The Netherlands; E-mail: burgh@dv.twi.tudelft.nl

6-9 octobre: Oceans '97 MTS/IEEE, Halifax, Canada. Renseignements: IEEE Travel and Conference Management Services, 445 Hoes Lane, Piscataway, NJ, 08855-1331, USA. Tel: (908) 562-5598; Fax: (908) 981-1203.

7-10 octobre: Symposium de 1997 de l'IEEE sur les ultrasons, Toronto, Canada Renseignements: S. Foster, Department of Medical Biophysics, Sunnybrook Health Science Ctr., 2075 Bayview Avenue, Toronto, Ontario M4N 3M5, Canada; E-mail: stuart@owl.sunnybrook.utoronto.ca

8-10 octobre: Semaine canadienne d'acoustique 1997, Windsor, Canada. Renseignements: Dr. R. Ramakrishnan, Vibron Ltd, 1720 Meyerside Drive, Mississauga, Ontario, L5T 1A3. Tel.: (905) 670-4922; Fax: (905) 670-1698.

19-21 novembre: WESTPRAC VI 97, Hong Kong. Renseignements: S.K. Tang, WESTPRAC Secretary, Department of Building Services Engineering, The Hong Kong Polytechnic University, Hung Hum, Hong Kong; FAX: +852 27746146; E-mail: besktang@polyu.edu.hk

1-5 décembre: 134e rencontre de l'Acoustical Society of America, San Diego, Californie. Renseignements: Acoustical Society of America, 500 Sunnyside Blvd., Woodbury, NY 11797, Tel.: 516-576-2360; Fax: 516-576-2377; E-mail: asa@aip.org; WWW: http//asa.aip.org

15-18 décembre: 5e congrès international sur les sons et vibrations, Adelaïde, Australie. Renseignements: ICSV5 Secretariat, Department of Mechanical Engineering, University of Adelaide, South Australia 5005, Australia; FAX: +61 8 8303 4367; E-mail: icsv5@mecheng.adelaide.edu.au

1998

23-27 mars: DAGA 98 - Rencontre de la Société allemande d'acoustique, Zürich, Suisse. Renseignements: DEGA, Physics/Acoustics Department, Universität Oldenburg, 26111 Oldenburg, Germany; FAX: +49 441 798 3698; E-mail: dega@aku.physik.uni-oldenburg.de

8-10 juin: Symposium EAA/EEAA "Bruit et vibrations des transports", Tallinn, Estonia. Renseignements: East-European Acoustical Association, Moskovskoe Shosse 44, 196158 St.-Petersburg, Russia; FAX: +7 812 127 9323; E-mail: krylspb@sovam.com

22-26 juin: 135e rencontre de l'Acoustical Society of America/16e congrès international d'acoustique, Seattle, WA. Renseignements: ASA, 500 Sunnyside Blvd., Woodbury, NY 11797, Tel.: 516-576-2360; FAX: 516-576-2377; E-mail: asa@aip.org; WWW: http://asa.aip.org

13-17 septembre: Académie américaine d'otolaryngologie - Chirurgie de la tête et du cou, San Francisco, CA. Renseignements: American Academy of Otolaryngology--Head and Neck Surgery, One Prince St., Alexandria, VA 22314. Tel.: 703-836-4444; FAX: 703-683-5100.

Transportation Reasearch Board
A1F04 Conference on
Transportation Related Noise and Vibration
1997 Summer Meeting

CALL FOR PRESENTATIONS

You are cordially invited to attend and participate in the activities of the Transportation Reasearch Board's A1F04 Summer Conference on Transportation Related Noise and Vibration, to be held between

July 20 to 23, 1997
in
Toronto, Ontario, Canada

The meeting will focus on current topics relating to rail/transit noise and vibration, aircraft noise, and highway traffic noise. Also featured at this conference will be over 15 exhibits and three field trips and tours.

This years conference will be held at the Delta Chelsea Inn in the heart of downtown Toronto. A block of rooms has been reserved for conference participants at the special rate of $124.00 (approximately $95.00 US) for both single and double accommodations, per night. The rate and room availability is guarranteed up to June 20, 1997 so please make your hotel reservations early and be sure to mention that you are attending the Transportation Research Board (TRB) summer conference.

Titles of presentations must be submitted by **April 1. 1997** with abstracts being submitted no later than **June 15. 1997**. Please forward all submissions to:

Soren Pedersen
Ministry of Transportation
Surveys and Design Office
301 St. Paul St., 2nd Floor
St. Catharines, Ontario, Canada M9R 1T1

Phone (905) 704-2291
Fax (905) 704-2050

We look forward to seeing you in Toronto

Ontario
Ministry
of
Transportation

Hatch Mott
MacDonald

The Canadian Acoustical Association
l'Association Canadienne d'Acoustique

PRIZE ANNOUNCEMENT

A number of prizes, whose general objectives are described below, are offered by the Canadian Acoustical Association. As to the first four prizes, applicants must submit an application form and supporting documentation to the prize coordinator before the end of February of the year the award is to be made. Applications are reviewed by subcommittees named by the President and Board of Directors of the Association. Decisions are final and cannot be appealed. The Association reserves the right not to make the awards in any given year. Applicants must be members of the Canadian Acoustical Association. Preference will be given to citizens and permanent residents of Canada. Potential applicants can obtain full details, eligibility conditions and application forms from the appropriate prize coordinator.

Edgar and Millicent Shaw Postdoctoral Prize in Acoustics

This prize is made to a highly qualified candidate holding a Ph.D. degree or the equivalent, who has completed all formal academic and research training and who wishes to acquire up to two years supervised research training in an established setting. The proposed research must be related to some area of acoustics, psychoacoustics, speech communication or noise. The research must be carried out in a setting other than the one in which the Ph.D. degree was earned. The prize is for $3000 for full-time research for twelve months, and may be renewed for a second year. Coordinator: Sharon Abel, Mount Sinai Hospital, 600 University Avenue, Toronto, ON M5G 1X6. Past recipients are:

1990	*Li Cheng*	*Université de Sherbrooke*	*1995*	*Jing-Fang Li*	*University of British Columbia*
1993	*Roland Woodcock*	*University of British Columbia*	*1996*	*Vijay Parsa*	*University of Western Ontario*
1994	*John Osler*	*Defense Research Estab. Atlantic*			

Alexander Graham Bell Graduate Student Prize In Speech Communication and Behavioural Acoustics

The prize is made to a graduate student enrolled at a Canadian academic institution and conducting research in the field of speech communication or behavioural acoustics. It consists of an $800 cash prize to be awarded annually. Coordinator: Don Jamieson, Department of Communicative Disorders, University of Western Ontario, London, ON N6G 1H1. Past recipients are:

1990	*Bradley Frankland*	*Dalhousie University*	*1993*	*Aloknath De*	*McGill University*
1991	*Steven D. Turnbull*	*University of New Brunswick*	*1994*	*Michael Lantz*	*Queen's University*
	Fangxin Chen	*University of Alberta*	*1995*	*Kristina Greenwood*	*University of Western Ontario*
	Leonard E. Cornelisse	*University of Western Ontario*	*1996*	*Mark Pell*	*McGill University*

Fessenden Student Prize in Underwater Acoustics

The prize is made to a graduate student enrolled at a Canadian university and conducting research in underwater acoustics or in a branch of science closely connected to underwater acoustics. It consists of $500 cash prize to be awarded annually. Coordinator: David Chapman, DREA, PO Box 1012, Dartmouth, NS B2Y 3Z7.

1992	*Daniela Dilorio*	*University of Victoria*	*1994*	*Craig L. McNeil*	*University of Victoria*
1993	*Douglas J. Wilson*	*Memorial University*	*1996*	*Dean Addison*	*University of Victoria*

Eckel Student Prize in Noise Control

The prize is made to a graduate student enrolled at a Canadian academic institution pursuing studies in any discipline of acoustics and conducting research related to the advancement of the practice of noise control. It consists of a $500 cash prize to be awarded annually. The prize was inaugurated in 1991. Coordinator: Murray Hodgson, Occupational Hygiene Programme, University of British Columbia, 2206 East Mall, Vancouver, BC V6T 1Z3.

1994	*Todd Busch*	*University of British Columbia*	*1996*	*Nelson Heerema*	*University of British Columbia*
1995	*Raymond Panneton*	*Université de Sherbrooke*			

Directors' Awards

Three awards are made annually to the authors of the best papers published in *Canadian Acoustics*. All papers reporting new results as well as review and tutorial papers are eligible; technical notes are not. The first award, for $500, is made to a graduate student author. The second and third awards, each for $250, are made to professional authors under 30 years of age and 30 years of age or older, respectively. Coordinator: Blaise Gosselin, Hydro Québec, 16e étage, 75 boul. René Lévesque ouest, Montréal, QC H2Z 1A4.

Student Presentation Awards

Three awards of $500 each are made annually to the undergraduate or graduate students making the best presentations during the technical sessions of Acoustics Week in Canada. Application must be made at the time of submission of the abstract. Coordinator: Alberto Behar, 45 Meadowcliffe Drive, Scarborough, ON M1M 2X8.

The Canadian Acoustical Association
l'Association Canadienne d'Acoustique

ANNONCE DE PRIX

Plusieurs prix, dont les objectifs généraux sont décrits ci-dessous, sont décernés par l'Association Canadienne d'Acoustique. Pour les quatre premiers prix, les candidats doivent soumettre un formulaire de demande ainsi que la documentation associée au coordonnateur de prix avant le dernier jour de février de l'année durant laquelle le prix sera décerné. Toutes les demandes seront analysées par des sous-comités nommés par le président et la chambre des directeurs de l'Association. Les décisions seront finales et sans appel. L'Association se réserve le droit de ne pas décerner les prix une année donnée. Les candidats doivent être membres de l'Association. La préférence sera donnée aux citoyens et aux résidents permanents du Canada. Les candidats potentiels peuvent se procurer de plus amples détails sur les prix, leurs conditions d'éligibilité, ainsi que des formulaires de demande auprès du coordonnateur de prix.

Prix Post-Doctoral Edgar et Millicent Shaw en Acoustique

Ce prix est attribué à un(e) candidat(e) hautement qualifié(e) et détenteur(rice) d'un doctorat ou l'équivalent, qui a complèté(e) ses études et sa formation de chercheur, et qui désire acquérir jusqu'à deux années de formation supervisée de recherche dans un établissement reconnu. Le thème de recherche proposée doit être relié à un domaine de l'acoustique, de la psycho-acoustique, de la communication verbale ou du bruit. La recherche doit être menée dans un autre milieu que celui où le candidat a obtenu son doctorat. Le prix est de $3000 pour une recherche plein temps de 12 mois avec possibilité de renouvellement pour une deuxième année. Coordonnatrice: Sharon Abel, Mount Sinai Hospital, 600 University Avenue, Toronto, ON M5G 1X6. Les récipiendaires antérieur(e)s sont:

1990	*Li Cheng*	*Université de Sherbrooke*	*1995*	*Jing-Fang Li*	*University of British Columbia*
1993	*Roland Woodcock*	*University of British Columbia*	*1996*	*Vijay Parsa*	*University of Western Ontario*
1994	*John Osler*	*Defense Research Estab. Atlantic*			

Prix Étudiant Alexander Graham Bell en Communication Verbale et Acoustique Comportementale

Ce prix sera décerné à un(e) étudiant(e) inscrit(e) dans une institution académique canadienne et menant un projet de recherche en communication verbale ou acoustique comportementale. Il consiste en un montant en argent de $800 qui sera décerné annuellement. Coordonnateur: Don Jamieson, Department of Communicative Disorders, University of Western Ontario, London, ON N6G 1H1. Les récipiendaires antérieur(e)s sont:

1990	*Bradley Frankland*	*Dalhousie University*	*1993*	*Aloknath De*	*McGill University*
1991	*Steven D. Turnbull*	*University of New Brunswick*	*1994*	*Michael Lantz*	*Queen's University*
	Fangxin Chen	*University of Alberta*	*1995*	*Kristina Greenwood*	*University of Western Ontario*
	Leonard E. Cornelisse	*University of Western Ontario*	*1996*	*Mark Pell*	*McGill University*

Prix Étudiant Fessenden en Acoustique Sous-marine

Ce prix sera décerné à un(e) étudiant(e) inscrit(e) dans une institution académique canadienne et menant un projet de recherche en acoustique sous-marine ou dans une discipline scientifique reliée à l'acoustique sous-marine. Il consiste en un montant en argent de $500 qui sera décerné annuellement. Coordonnateur: David Chapman, DREA, PO Box 1012, Dartmouth, NS B2Y 3Z7.

1992	*Daniela Dilorio*	*University of Victoria*	*1994*	*Craig L. McNeil*	*University of Victoria*
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