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EDITORIAL

Right! The publication of *Canadian Acoustics* has been successfully transferred to Vancouver. In fact, we have decided to continue to have the journal printed in Ottawa; it's much cheaper than in Vancouver for some reason. Thus publication is pretty well back on schedule. May I remind you that, from now on, your journal will be published in March, June September and December of each year. The September issue will be the Proceedings Issue.

In this issue are published technical articles on the modelling of the vibro-acoustic behaviour of aircraft structures, the effect of gas inhalation on TTS in humans and on the design of auditoria. Who says that acoustical work in Canada is not diverse in nature?

Also found in this issue are the full details of Acoustics Week in Canada 1992, to be held in Vancouver in October. It promises to be an interesting conference; the deadline for abstract submission is April 15. I can speak from my new perspective of total immersion that Vancouver is a beautiful city. For those of you that are so inclined, the city and region offer unequalled vacation opportunities (no, I don't get a commission from the Tourism Board).

Further to my recent report regarding abstracting services that will cite *Canadian Acoustics*, Cambridge Scientific Abstracts, has now been added to the list.

While I was in Ottawa last week, a major 'acoustical' news story broke. Two heavy-metal bands, wishing to hold an open-air concert near a residential neighbourhood, had applied for an exemption to the new city noise bylaw, so that they could play past 11 pm. The city refused; it had requested the bands to reschedule their concerts to finish by 11, but this was not accepted. The next day, the city council was inundated with over 700 calls from irate rock fans demanding that the council change its decision. So the next day it did. This seems to be another demonstration of the ineffectiveness of legislative noise control measures. Was it really unacceptable for the bands to end their concert by 11 pm? Should the council have 'given in'? What do you think?

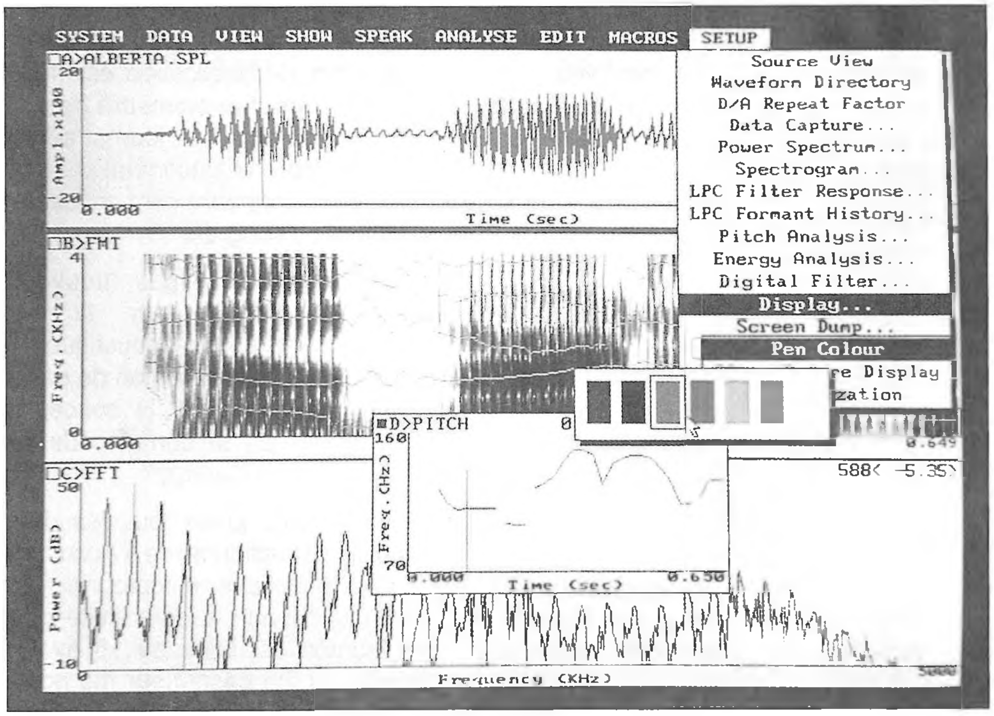
C'est fait! La publication de l'*Acoustique Canadienne* a été transférée à Vancouver avec succès. En fait, le journal continuera d'être imprimé à Ottawa; cela s'avère moins onéreux qu'à Vancouver pour certaines raisons. Ainsi, l'échéancier de publication est maintenant presque rétabli. Puis-je me permettre de vous rappeler qu'à partir de maintenant le journal sera publié en mars, juin, septembre et décembre de chaque année. Le numéro de septembre sera consacré à la publication des Actes du congrés.

Dans ce numéro, vous trouverez des articles techniques portant sur la modélisation du comportement vibro-acoustique de structures d'avion, l'effet de l'inhalation de gas sur le DTS chez l'humain ainsi que sur la conception d'auditorium. Qui prétend que le domaine de l'acoustique n'est pas diversifié au Canada?

Vous trouverez aussi tous les détails relatifs à la Semaine Canadienne de l'Acoustique 1992 qui se tiendra à Vancouver en octobre. Ce congrés promet d'être intéressant; la date limite pour la soumission de résumés est fixée au 15 avril. Je peux vous affirmer, en me basant sur ma nouvelle perspective d'immersion totale, que Vancouver est une très belle ville. Pour tous ceux qui en ont envie, la ville et la région offrent des occasions de vacances inégalées (non, je ne reçois pas de redevances du Bureau de Tourisme).

Pour faire suite à mon récent rapport relatif aux services de résumés quie citent l'*Acoustique Canadienne*, le Cambridge Scientific Abstracts, qui publie différents résumés reliés à "l'environnement", s'ajoute à la liste.

Alors que j'étais à Ottawa la semaine dernière, une manchette majeure concernant l'acoustique a retenu l'attention. Deux groupes d'"heavy metal" qui souhaitaient tenir un concert en plein air près d'un quartier résidentiel ont demandé une exemption au règlement municipal relatif au bruit, de sorte qu'ils puissent terminer leur spectacle après 23 heures. La ville a refusé; elle a demandé aux groupes de revoir leur horaire afin de terminer avant 23 heures, ce qui n'a pas été accueilli favorablement. Le lendemain, le conseil de ville a été inondé de plus de 700 appels de fans du rock en colère qui demandaient au conseil de ville de modifier sa décision. Le jour suivant, il le faisait. Il s'agit là d'une autre démonstration de l'inefficacité des règlements portant sur le contrôle du bruit. qu'est-ce qui était vraiment problématique à l'effet de terminer le concert avant 23 heures? Le conseil aurait-il dû se soumettre? Qu'en pensez-vous?



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Canadian Acoustics / Acoustique Canadienne 20(1) 3-11 (1992) ***Research article / Article de recherche***

ON THE MODELLING AND THE PREDICTION OF THE VIBROACOUSTIC BEHAVIOUR OF AN AIRCRAFT STRUCTURE

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ABSTRACT

This paper summarizes the first step of a long-term research program focusing on the modeling and prediction of the vibrational and acoustical behavior of an aircraft structure. The final goal pursued is to provide the aeronautical industry with guidance for cabin sound-proofing with the help of a versatile, physical and easy-to-use model. Two main subjects tackled in this paper are: ① The free vibrational behavior of the aircraft structure. ② Effects of the rear pressure bulkhead on the cabin noise.

SOMMAIRE

Ce papier résume la première étape d'une série de programme de recherche portant sur la modélisation et la prédiction du comportement vibratoire et acoustique de structure d'avion. L'objectif final est de fournir à l'industrie aéronautique, à l'aide d'un modèle qui est à la fois physique et propice à l'analyse paramétrique, des directives en vue de l'amélioration de la discrétion acoustique dans la cabine. Deux sujets principaux traités sont les suivants: ① Comportement de vibration libre de la structure d'avion. ② Effets de la cloison arrière sur le bruit interne de la cabine.

1. INTRODUCTION

Noise inside the aircraft cabin affects passenger speech communication, comfort, composure and sleep. Consequently, control of interior noise is required as one of the key elements in enhancing the competitiveness of new-generation aircraft in the commercial markets. Unremitting efforts to increase aircraft performance and to reduce weight and fuel consumption present new challenges for noise control technology. To meet these challenges, substantial research and development have been carried out. But much research is still needed in this field. In this paper, we present some preliminary results regarding the modeling and the prediction of the vibrational and acoustical behavior of an aircraft structure.

1.1 Noise sources

It is beyond the scope of this paper to review all of the past theoretical and experimental work on interior noise. Readers are referred to references [1-2] for classical work and [3] for more recent development in the field. It is generally admitted that aircraft noise prediction and control are very complex subjects. First of all, the noise sources have to be identified before a representative model is established. Usually, cabin noise sources include propellers, exhaust from reciprocating or turbofan engines, turbomachinery, turbulent flow over the aircraft structure and engine vibrations [3]. Noise from internal sources, such as air-conditioning systems, may also be important in some situations. Secondly, noise transmission involves very complicated mechanisms, whose understanding is indispensable to the choice of any noise control measures. Generally speaking, noise is transmitted to the cabin along airborne paths through the fuselage sidewall and along structure borne paths, through mechanical connections such as engine mounts. In both cases, structural vibration and the acoustical field inside the cabin form a complicated coupled system. The coupling process is illustrated schematically in Fig. 1. It shows clearly that three physical mechanisms (structural vibration, radiation and fluid-structure interaction) have to be accounted for jointly. This statement is also confirmed by a common observation, which may appear striking to those who are not familiar with the problems: the decrease in vibration level can not always guarantee the same trend for sound levels. Therefore, a throughout understanding of the "why" and the "how" of this fluid-structure interaction is fundamental.

(*) **This paper reports the research activities carried out by the first author during his tenure as the first holder of the CAA Edgar and Millicent Shaw Postdoctoral Prize in Acoustics , 1990 and 1991.**

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1.2 Simulation models

Faced with such problems, several approaches are available. The first involves numerical procedures, such as Finite Element Method (FEM) and Boundary Element Method (BEM) [4]. A particular advantage of these methods is that they can deal with mathematical models representing very detailed idealizations of the physical structures. However, they depend heavily on large, fast computational facilities. The computational demands increase dramatically with the structural size and frequency range of interest. Even today, when computational methods are highly developed and optimized, it is only practicable to predict the aircraft's behavior at very low frequencies[5]. Most importantly, the methods do not allow easy parametric studies and offer little physical insight into the physical phenomena. Another applicable method is referred to as Statistical Energy Analysis (SEA)[6]. This method involves a lot of hypotheses and gives only rough estimates in relatively broad frequency bands at higher frequencies. Up to now, it is still not a predictive method since some of the important parameters must be obtained by experiment[7]. The third category involves analytical methods for the simple reason that discretization is not applied to the governing equations, as in the case of FEM, but to the solutions at a later stage. This method overcomes the shortcomings of the two forementioned methods, though the method is up to now applicable only to structures of simple geometry. The philosophy of using this method is to reveal the main physical processes without considering the details of the structures. This is believed, in some circumstances, to be sufficient to guide noise control actions.

1.3 New models

In this paper, we present a new model for airplane cabin noise prediction. This model is based essentially on the work done by Cheng *et al.;* detailed development of the model is given in references [8-9]. The approach can be classified as an analytical one, but further development is made to extend the existing models to a more general context in order to address more complicated fuselage structure. The study is part of a program of work undertaken on an aircraft "Challenger 601-3A" (Canadair) by the authors in order to investigate the noise and vibration produced by the engines. Preliminary testing on real aircraft has identified significant sources of mechanical excitation transmitted from the engines. The engines are attached directly to the aircraft body through beams in the rear part where a Rear Pressure Bulkhead (RPB) is fixed (Fig.2). Therefore, the aircraft fuselage and the RPB are considered as the main components affecting the cabin noise. In the light of these observations, a model, consisting of a circular cylindrical shell and an end panel is used to simulate the aircraft structure. Elastic coupling is permitted between these two substructures. This point, together with the consideration of the end plate, constitutes a novel element with respect to existing models in the

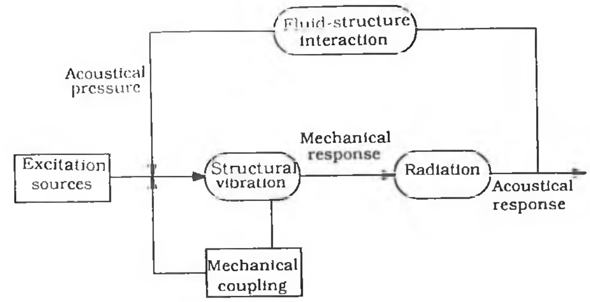

Fig.1 Schematic diagram of the coupling process

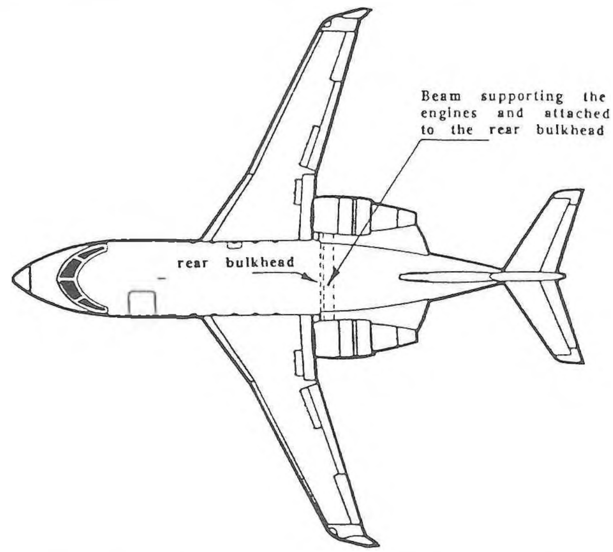

Fig.2. Schematic drawing of the airplane and the location of the Rear Pressure Bulkhead

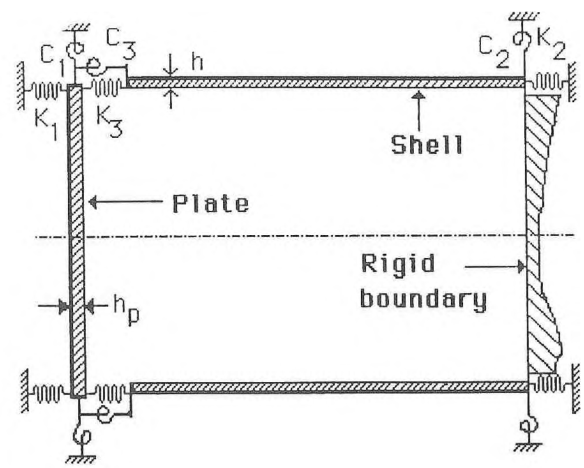

Fig.3. Model investigated

literature [10-12]. It permits varing the type of junction from free to rigid. Starting with a brief review of the formulation, we outline the basic steps. The paper is not intended to make a lengthy presentation of the formulation;

instead, emphasis is placed on phenomenal interpretations. First, numerical results are presented and interpreted in terms of the free vibration of the structure, illustrating the main coupling phenomena between the shell and the plate. Comparisons are also made with finite element analysis to show the convenience, efficiency and accuracy of our model. Second, emphasis is placed on the fixing condition of the Rear Pressure Bulkhead to the fuselage. This section ends with some discussion of the possibility of sound-proofing by choosing appropriately the fixation of the RPB.

2. MODEL INVESTIGATED

Fig. 3 shows the cross section of the model investigated. It consists of a finite, circular, thin, cylindrical shell with a circular plate at the left end. An acoustically rigid wall (with infinite impedance) is placed at the right end of the structure to form an acoustic cabin. The origin of the coordinate system is set at the geometrical center of the plate and, consequently, each point of the structure is located by x,q,r which correspond respectively to the longitudinal, tangential and radial directions. u,v and w are the displacements of the shell along these three directions. The shell is initially assumed to be supported by shear diaphragms at each end so that the v and w components are restrained at the boundary. For the plate, only the normal displacement w_p of the plate is taken into account and it is assumed positive along the positive x-axis. The plate has a thickness h_p and is elastically supported by translational springs and rotational springs having, respectively, distributed stiffness K_1 (N/m^2) and C_1 (Nm/m) along its edge. Similar spring systems are introduced between the plate and the shell (K_3, C_3) and at the right end of the shell (K_2, C_2). All the spring constants are defined in the appropriate units of stiffness per unit length on the contour and are assumed to be constant along the edges. Point forces may be applied to the structure. In what follows, the sound field within the cavity, as well as the vibration of the structure, will be calculated. The effect of the fluid loading from the outside of the cavity on the structure's vibration will be neglected.

3. THEORY

3.1 Basic Equations:

Structural vibration:

$$dH = 0 \quad . \tag{1}$$

$$H = \int_{t_0}^{t_1} (T_c - E_c + T_p - E_p - E_k - E_F)dt \tag{2}$$

where T_c and T_p are, respectively, the kinetic energies of the cylindrical shell and the plate, E_c and E_p are their potential energies, E_k represents the potential energy stored in the springs, and E_F the work done by external driving forces and by internal acoustic pressure.

Acoustical field:

$$\nabla^2 P_c + (\omega / c)^2 P_c = 0 \tag{3}$$

in which P_c is the sound pressure inside the cavity, ω is the excitation angular frequency and c is speed of sound.

Fluid-structure interface condition:

$$\begin{cases} \dfrac{\partial P_c}{\partial \xi} = \rho\ \omega^2 w_p & \text{on } A_p \\ \dfrac{\partial P_c}{\partial \xi} = -\rho\ \omega^2 w & \text{on } A_c \\ \dfrac{\partial P_c}{\partial \xi} = 0 & \text{on } A_R \end{cases} \tag{4}$$

where ρ is the fluid density, A_c and A_p are, respectively, the surface of the shell and the plate, A_R is the rigid portion of the cavity wall surface, and ξ is the unit normal to the corresponding surface (positive towards the outside).

Remarks:

1) Eq. (1) is the mathematical expression of the well known Hamilton's principle, which states that the displacement of a system adjusts itself in shape and velocity so that the Hamilton's function H is minimized.

2). Eq. (3) is the classical Helmholtz equation that governs the acoustical field inside the cavity.

3). Structure-cavity coupling in the system is characterized by the term E_F in Eq. (2) and by the fluid-structure interface condition.

3.2 Solution Discretization and Coupling Equations

Solution discretization

The whole set of equations given above can be resolved by discretizing different unknowns on the basis of appropriately chosen series. The appropriate choice of these series is a crucial factor on which the accuracy of the prediction depends. This is not an easy task, especially when the structure is complex and when different movements are involved. The difficulty is also increased by the fact that unsuitable choices may make numerical treatment very lengthy and heavy.

For the shell:

The eigenfunctions of the "shear-diaphragm-supported" shell are used as admissible functions and expansion of the displacement components is expressed as:

$$\begin{Bmatrix} u \\ v \\ w \end{Bmatrix} = \sum_{\alpha=0}^{1} \sum_{n=0}^{\infty} \sum_{m=1}^{\infty} \sum_{j=1}^{3} A^{\alpha}_{nmj}(t)\Gamma^{\alpha}_{nmj}$$

$$\Gamma^{\alpha}_{nmj} = \begin{Bmatrix} D_{nmj} \sin(n\theta + \alpha\,\pi/2)\cos(m\pi x/L) \\ E_{nmj} \cos(n\theta + \alpha\,\pi/2)\sin(m\pi x/L) \\ \sin(n\theta + \alpha\,\pi/2)\sin(m\pi x/L) \end{Bmatrix} \tag{5}$$

where (D_{nmj}, E_{nmj},1) are the components of the eigenvector; n and m are, respectively, the circumferential and longitudinal order; α denotes symmetric (α=1) or antisymmetric (α=0) modes and j denotes the type of modes (bending, twisting, extension-compression). $A^{\alpha}_{nmj}(t)$ are the coefficients to be determined.

For the plate:

The expansion of the plate's displacement is expressed as:

$$w_p(t) = \sum_{\alpha=0}^{1} \sum_{n=0}^{\infty} \sum_{m_p=0}^{\infty} B^{\alpha}_{nm_p}(t)\,\Lambda^{\alpha}_{nm_p}$$

$$\Lambda^{\alpha}_{nm_p} = \sin(n\theta + \alpha.\pi/2)\left(\frac{r}{a}\right)^{m_p} \tag{6}$$

with n, m_p and α being, respectively, the circumferential order, the radial order and the symmetry index. $B^{\alpha}_{nm_p}(t)$ are coefficients to be determined.

For the cavity:

For the cylindrical cavity considered here, the normal modes for the case of acoustically hard walls are known analytically. The pressure inside the cavity can thus be expanded in terms of these cavity modes as:

$$P_c = \sum_{\alpha=0}^{1} \sum_{n=0}^{\infty} \sum_{p=1}^{\infty} \sum_{q=1}^{\infty} P^{\alpha}_{npq}(t)\Phi^{\alpha}_{npq}$$

$$\Phi^{\alpha}_{npq} = \sin\left(n\theta + \alpha.\frac{\pi}{2}\right) J_n(\lambda_{np} r)\cos\left(\frac{q\pi}{l}x\right) \tag{7}$$

where α is the symmetry index, n is the circumferential order, J_n is the nth order Bessel function, q is the longitudinal order and l_{np} is the p_{th} root of the following equation:

$$J'_n(\lambda_{np} a) = 0 \tag{8}$$

Coupling equations

For structure vibration:

Using expressions (5) and (6) to calculate different energy terms involved in Eq. (2), one expresses the Hamilton's function H in terms of two sets of unknowns, $A^{\alpha}_{nmj}(t)$ and $B^{\alpha}_{nm_p}(t)$.

The minimization of H with respect to these unknowns according to Lagrange equation yields a set of ordinary differential equations. It should be noted at this stage that these structural unknowns are coupled to the acoustical pressure P_c, whose determination , in turn, depends on the structural vibration.

For acoustic field:

The sound pressure P_c inside the cavity can be calculated by means of the cavity Green's function G with Neumman boundary conditions [9] as follows:

$$P_c = -\int_{A_p} G\rho\omega^2 w_p\, dA_p + \int_{A_c} G\rho\omega^2 w\, dA_c \tag{9}$$

The Green's function G in the cylindrical cavity is known analytically. It is expressed in the form of cavity mode decomposition.

Inserting Eq. (7) into (9) yields another set of ordinary differential equations describing the interior sound pressure.

Coupling equations:

The equations obtained above may be summarized schematically as follows:

$$\begin{bmatrix} & & \\ & S & \\ & & \end{bmatrix} \begin{Bmatrix} A^{\alpha}_{nmj} \\ B^{\alpha}_{nm_p} \\ P^{\alpha}_{npq} \end{Bmatrix} = \begin{Bmatrix} F^{\alpha(shell)}_{nmj} \\ F^{\alpha(plate)}_{nm_p} \\ 0 \end{Bmatrix} \tag{10}$$

in which matrix S is the system matrix. The three sets of unknowns are related, respectively, to the shell, plate vibration and cavity sound pressures. The three terms of the right hand side are generalized forces corresponding to the decomposition terms of the shell and the plate.

Remarks:

1) The system should be resolved as a whole.
2) Two types of problem can be solved by using the established model: free vibrational analysis of the structure in vacuum, and structure-cavity coupling. The free vibrational study of the structure is done by neglecting the terms in the system (10) corresponding to the excitation and cavity. The solution of this eigenvalue equation yields the natural frequencies together with the coefficients for constituting the mode shapes. The structure-cavity coupling analysis, is done by solving system(10) . Two main parameters which will be used in the analysis are the average quadratic velocity $<V^2>$ of the structure and the average sound pressure level L_p inside the cavity.
3) The size of the system depends on the truncation of the series (5),(6), and (7). For the structure, the number of terms used in the series is increased until a relatively stable solution is achieved. It has been observed during numerical calculations that the solution converges rather rapidly for free vibration problems. For response prediction, the decomposition term is increased until all resonance modes in the frequency range of interest are reasonably well predicted. As far as the cavity is concerned, all cavity modes whose natural frequencies are included in the frequency band considered have been taken in the expansion (7) for each calculation.

4. RESULTS AND DISCUSSION

4.1 Free vibration of the structure

The versatility of this model has been demonstrated in the previous work [8]. In fact, this model can be used to investigate the vibrational behavior of a single plate, a single shell or their combination. The characterization of structural coupling and boundary conditions by means of continuous distributions of springs along the shell and the plate interface allows a wide spectrum of boundary conditions and coupling conditions between the shell and the plate. In that paper, very good precision of the method has been demonstrated by solving test problems for lower-order modes of the plate and the shell for which some results are available in the literature. Here, we perform a supplementary comparison with Finite Element Analysis of a plate-ended shell. The objective is to compare two methods with respect to precision and CPU time, and to illustrate the physical process by which two sub-structures are coupled.

The shell and plate considered are assumed to have the same thicknesses and material properties. The geometrical parameters used are a/h = 30, L/a = 3 (a being the radius, h the thickness and L the length). The shell is "shear diaphragm supported" at the right end (X = L) and rigidly connected to the plate at the left end (X = 0). With this structure, the lower-order modes are calculated by both methods and the comparisons are made in terms of frequency parameters, CPU time, memory space required and mode shapes. The so-called frequency parameter Ω, which is a dimensionless quantity, is the ratio between the natural frequency and the ring frequency, the latter being defined as:

$$f_r = 1/(2\pi a)\sqrt{E/\rho_s(1-\nu^2)} \qquad (11)$$

where E and ρ_s are, respectively, the Young's modulus and the density of the material.

The finite element software used is available commercially (ANSYS 4.4A). A 19 x 20 finite element mesh (in the circumferential and longitudinal directions respectively) is used for the shell and a 20 x 20 mesh (in the circumferential and radial directions respectively) for the plate. This meshing is illustrated in Fig.4. All calculations are carried out with the computer IRIS-4D.

The frequency parameters are compared in Table I. It can be seen that the two sets of results agree within 5% and that most of modes are predicted with a better precision. As far as CPU time is concerned, our method is far more rapid than FEM. It should be noted that our calculation was carried out for every given circumferential order n and each calculation was completed within 20.6 second. This calculation speed will be the same even if the higher order n is pursued. As for FEM, the CPU time and memory space required increase dramatically with n, for the simple reason that more finite elements are needed at that time.

Figure 4 compares the first three modes shapes for n = 2 calculated by our model and by FEM. The three pictures in the left column are the results given by our calculation. These figures show the normal displacement of the plate (w_p) and the radial displacement of the shell (w) in the cross section with $\theta = 0$ and $\theta = \pi$. Pictures in the next two columns are FEM results for the same modes. Two observations can be made: 1). The agreement between the two sets of results is excellent. The two approaches give exactly the same description of the structural motion and even the very detailed deformation around the shell-plate junction is precisely predicted. 2). These pictures show the two types of modes of the combined structure: the first is dominated by shell vibration; the second is essentially a plate mode. The third possible type is a well-coupled mode,

Table I. Comparison of frequency parameters between the present study and Finite Element Method in the case of a plate-ended shell (L/a = 3, a/h = 30)*

Mode Order n	q	Our study	FEM	Deviation ξ in %
3	1	0.1566	0.15026	4.0%
4	1	0.1728	0.1738	0.58%
1	1	0.1866	0.1801	3.4%
2	1	0.2258	0.2201	2.5%
5	1	0.2443	0.2499	-2.2%
4	2	0.2856	0.2861	0.2%
2	2	0.3078	0.3028	1.6%
5	2	0.3128	0.3142	-0.4%
3	2	0.3344	0.3350	-0.18%
1	2	0.3998	0.3813	4.6%
3	3	0.4480	0.4433	1.0%
4	3	0.4338	0.4415	-1.8%
2	3	0.4742	0.4745	-0.07%
1	3	0.5579	0.5224	2.8%
CPU time		103 sec.	5751 sec.	ratio: 56
Mem. space		2 meg	20 meg	ratio: 10

* q : mode rank

ζ : (present study-FEM)/present study

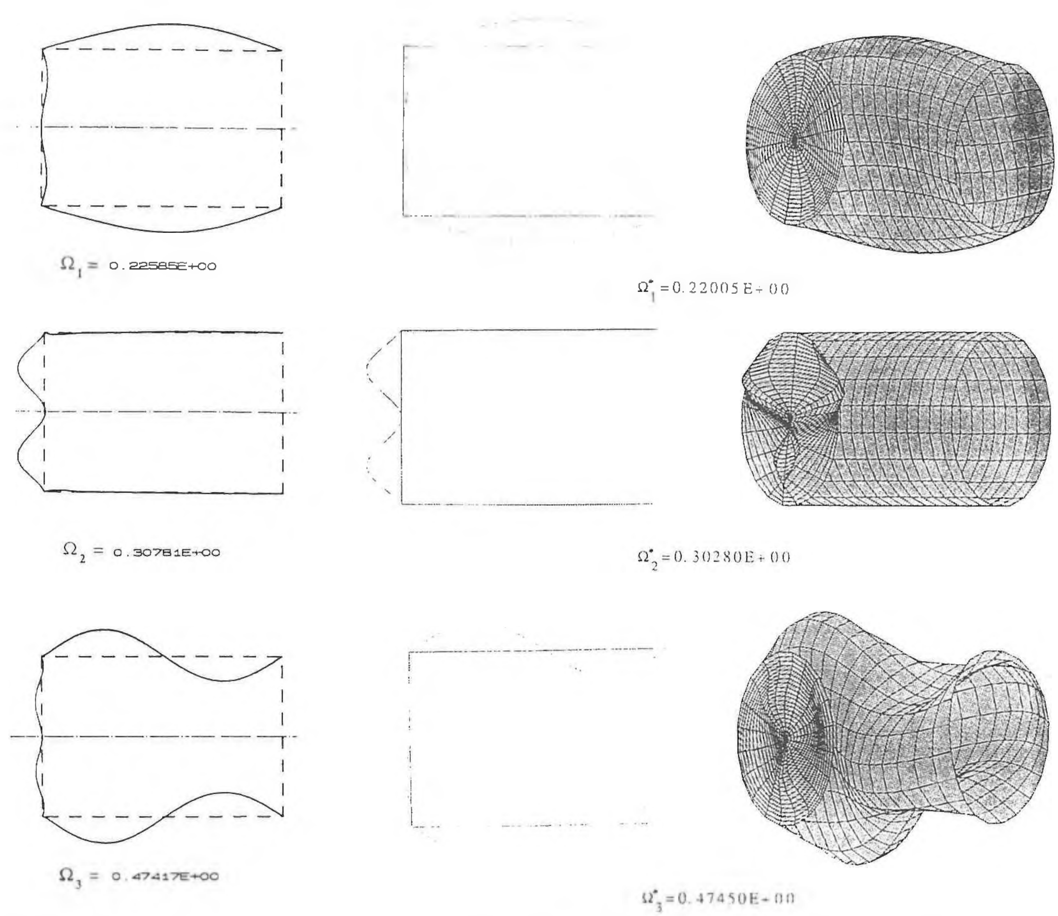

Fig.4. Comparison of the present approach with Finite element analysis in terms of mode shapes of the combined structure.

corresponding to the case in which the shell and plate displacements are of the same order of magnitude.

Concerning the second point mentioned above, it can be shown that a well-coupled mode occurs when there is a mechanical impedance match of the uncoupled structures, whereas panel-like or shell-like modes correspond to the case where the mechanical impedances of the uncoupled components are quite different.

4.2 Effect of bulkhead on the cabin noise

The information concerning the mechanical vibration of the structure is essential, but still not sufficient for noise control problems. Generally speaking, the understanding of vibrational phenomena is easier than that of the structural radiation, whereas without the latter, the structural quietening can hardly be achieved. In fact, the physical process by which the vibrating energy is converted to acoustical energy is rather complex. As a direct application of the established model, this section will concentrate on the cabin noise radiated by the end bulkhead. In order to simplify the discussion, the cylindrical shell is considered purely as an acoustically rigid wall, so that its vibration is not under consideration here. This analysis, neglecting obviously the effects of the cylinder, is the first step toward a more complete model. Particular effort is made to give a thorough understanding of the fixing conditions of this plate, which can hopefully help engineers to reduce the cabin noise. The model we have developed offers great advantages for investigating this problem, since different fixing conditions can be easily simulated by adjusting the elastic stiffness of the springs.

Numerical results are presented in the following order: First, a typical calculated vibration spectrum is presented and compared to experimental results. Then, two plates with two limiting fixing conditions are considered, illustrating the importance of certain parameters. It should be pointed out that one of the plates used in the discussion is a free plate. Although free supports can hardly be justified in practical circumstances for cavity configurations, this represents as a very informative reference case for understanding the phenomena. Meanwhile, as will be illustrated later, with decreasing support stiffness, the phenomena observed in the free case becomes rather representative of more realistic cases. Finally, calculations are made with a scaled down aircraft model. In this case, more realistic support cases are investigated.

Mechanical response of the plate

The study of the end plate which simulates the rear pressure bulkhead is of particular importance to our problem. One may hope to improve the internal sound field by modifying its designing. Fig.5 shows a comparison between our calculation and experimental measurement in terms of the average quadratic velocity of a plate. The plate is an

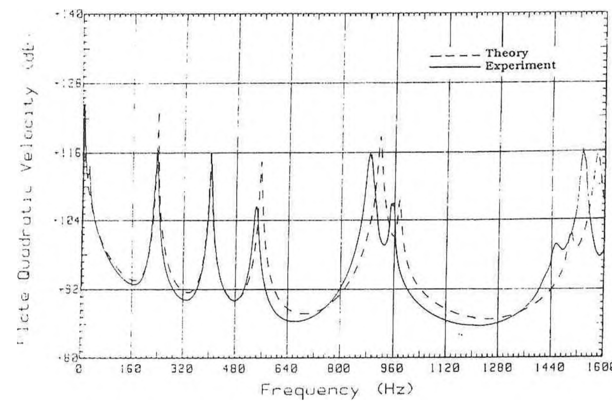

Fig.5. Comparison of the theory with experiment in terms of the plate's vibration

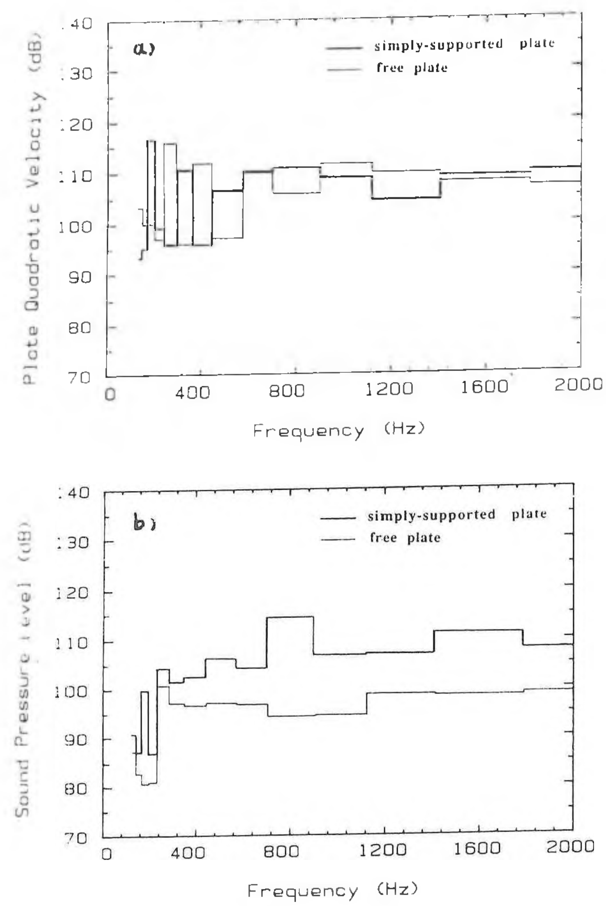

Fig.6. System response in one-third octave bands for plates with two limiting fixing conditions. a). average quadratic velocity of the plate. b). overall sound pressure level inside the cavity

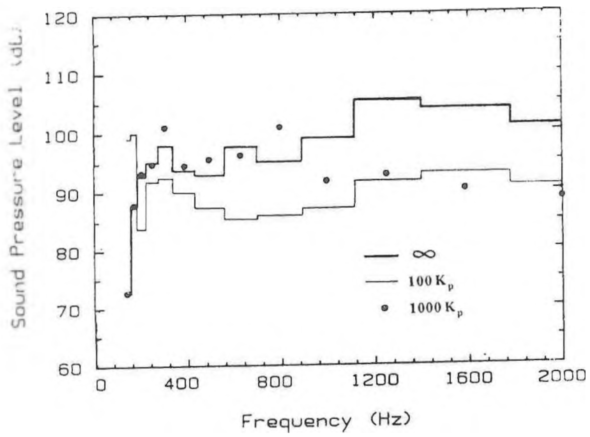

Fig. 7. Sound pressure level inside the cabin of a 1/4 scaled airplane model. Three fixing conditions of the RPB are considered

aluminium one of 0.132 m radius and 3.2 mm thickness. Although our model allows investigating plates with different boundary conditions, only a free plate, which is the most simple to realize experimentally, is chosen. To this end, the plate is suspended at three points along the boundary by elastical strings with small elastic constant.The comparison is made for a frequency range up to 1.6 kHz and good agreement exists between two sets of results. The differences in peak level comes from rough estimations of the structural damping. In fact, no damping measurement is made for the plate and the loss factor of the plate is set to be of 0.01 in the calculation.

Plates with two limiting fixings

The following configuration will be used for numerical investigations: it is a steel plate of 0.25m radius and 0.003 m thickness. backed by an air-contained cylindrical cavity of 0.6m thickness. The plate is driven by a unit point-force at $r_F = 0.1$ m and $\theta_F = 0$. The loss factors of the plate and the cavity are assumed to be constant: $\eta_v = \eta_p = 0.01$.

Fig.6(a-b) present the average quadratic velocity of the plates $<V^2>$ and the corresponding sound pressure level inside the cavity L_p for two limiting fixing cases: plates with simple supports and free supports. All spectra are presented in one-third octave band. $<V^2>$ is also given in dB with a reference of 2.5e-15(m^2/s^2). Fig.6a indicates that in terms of the quadratic velocity of the plate $<V^2>$, the overall level of the plate vibration is comparable. The difference can be shown to be caused basically by the different positions of the plate-controlled resonances. However, Fig.6b, comparing the corresponding average sound pressure level within the cavity clearly shows that the free plate radiates much less than a simply supported one. In fact, the sound pressure level induced by the free plate is 10-20 dB lower than the one radiated by a simply-supported plate for almost the whole frequency range considered in the present case. Hence, it seems that the translational stiffness of the contour supports is a key factor in the radiation behavior of the plates into the cavity.

Plates with elastical supports (1/4 aircraft model)

Using this model, a prediction is made for a 1/4 scale model of the aircraft mentioned at the beginning of the paper. The cabin is faithfully scaled in every respects, Whereas the rear pressure bulkhead is simulated by a 3 mm thick plate. Fig.7 illustrates the cabin noise level in one-third octave band radiated by bulkheads with three different supports in translation. Three stiffnesses chosen are respectively infinite, $100K_p$ and $1000K_p$. Compared with the simply-supported plate case (with infinite stiffness), a limiting frequency seems to exist for each elastical support, above which we notice a significant reduction in induced sound pressure, but below which, a softer support does not always guarantee a sound reduction. The reason is that different supporting conditions modify the structural modes, the consequence of which can further change the modal structural-cavity coupling. As a result, in these frequency ranges, the cavity sound pressure may be amplified. Furthermore, the stiffer the support is, the higher is this limiting frequency and, consequently, the higher is the frequency range where the beneficial effect is expected. This phenomena has been found and analysed in detail in an other work [7]. In conclusion, a softer translational support of this bulkhead can improve significantly the cabin noise. In practical, the flexible mounting of the bulkhead should be designed by considering the axial pressure loading it withstands. Consequently, a compromise existes between the mechanical preformance and the noise attenuation.

5. CONCLUDING REMARKS

We have presented an analytical model aiming to investigate the vibroacoustic behavior of an aircraft structure. Important phenomena have been revealed through numerical investigations. The originalities of the findings are summarized as follows:

1).The proposed approach offers a new way of addressing mechanically coupled structures. In fact, The idea of using dynamic distribution of springs offers a new possibility of handling structural complexities at substructure junctions and at boundaries.

2).This method offers an alternative to purely numerical methods such as FEM usually used to address this kind of problem. As has been shown by the comparisons with FEM, our method is physical, convenient, and efficient in terms of computation time. However, it should be mentioned that this method and FEM are complementary in the sense that FEM is surely more capable of tackling complex structures. Consequently, an analysis with the present model may serve as a preliminary step to later finite element analyses.

3).It opens a new and promising door to the vibroacoustic study of the plate-ended shell structure in which the fluid loading is included.

4). Numerical study of the effect of the bulkhead fixing furnishes useful sound-proofing guidance.

Of course, the established model is still a preliminary one, in which many complicating elements of a real aircraft are not taken into account. In fact, the modeling process is rather useful in the initial stage of aircraft conceptualization, when major components and their coupling mechanisms are being defined. It may provide designers with the major trends of the vibroacoustic performance of their products and guide soundproofing measures. The framework established in this paper allows an extension to include further complexities such as stringers and frames. What is required in this case is to include the energy terms for these elements into the functional expression. This constitutes a major advantage of the method used. The improvement of the model in this direction is the current work of the authors.

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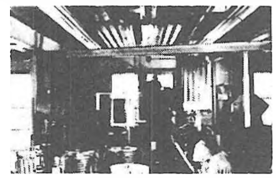

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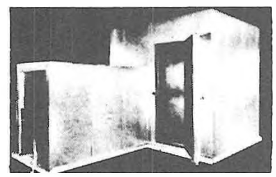

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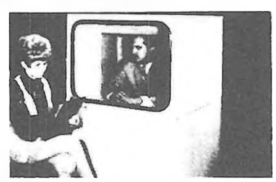

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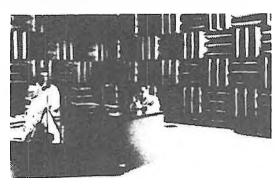

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APPLICATION OF MODERN ROOM ACOUSTICAL TECHNIQUES TO THE DESIGN OF TWO AUDITORIA

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ABSTRACT

Recent advances in the study of room acoustics are formidable. The modern understanding of the behaviour of sound in rooms now allows for much more freedom and confidence in design. The design of two new rooms will be presented. The first is a 3500 seat Assembly Hall of Jehovah's Witnesses to be used primarily for speech. It features a terraced floor plan to provide early reflected sound throughout the audience. The second room is a 300 seat recital hall at Conrad Grebel College in Waterloo, Ontario. In this room, special attention has been given to platform acoustics using the recent findings of Gade and Naylor. Both designs demonstrate the practical application of modern acoustical research.

SOMMAIRE

D'importants progrès ont récemment été réalisés dans le domaine de l'acoustique des salles. Une meilleure compréhension du comportement du son dans les salles permet d'avoir plus de latitude et un meilleur degré de confiance au niveau de la conception. Le design de deux nouvelles salles est présenté. La première est une salle d'assemblée des Têmoins de Jéhovah de 3500 sièges utilisée principalement pour des discours et des allocutions. Elle est formée en terrasses de façon à réfléchir promptement le son d'un bout à l'autre de la salle. La deuxième est une salle de récitals de 300 sièges au Collège Conrad Grebel à Waterloo en Ontario. Dans cette salle, une attention spéciale à été donnée à l'acoustique du théâtre, sur la base des récents résultats de recherche de Gade et Naylor. Ces deux modèles démontrent le potential d'application pratique de la recherche moderne en acoustique des salles.

1. INTRODUCTION

Since Haas' seminal study on the effects of early reflected sound on speech intelligibility,[1] nearly forty years ago, a new understanding of the behaviour of sound in theatres and concert halls has emerged. Subsequent studies in the 1950's and 1960's confirmed that the time of arrival of early reflected sound at the listener is critical. For good speech intelligibility, at least half of the acoustic energy must arrive at the listener within 50 ms of the direct sound. Musical clarity is analogous to speech intelligibility except the threshold between useful and detrimental sound is slightly longer at 80 ms.[2]

Work in the late sixties and early seventies established that the spatial aspects of early reflections are also important.[3] It was found that reflected sound arriving at the listener from the sides within 10 to 80 ms of the direct sound promotes a feeling of spatial impression or envelopment.

Multi-dimensional studies of existing concert halls in the 1970's and 1980's[4,5] have brought about a general consensus on the desired subjective and objective attributes of a hall. The subjective qualities are: overall loudness, clarity, reverberance, spatial impression, timbre and intimacy. Most of these attributes are inter-related and there is no single parameter that will, in the absence of the others, guarantee good listening conditions.

2. COMPUTER TECHNIQUES

The findings described above indicate quite clearly that the appreciation of a room's acoustic is determined primarily by the sequence of early reflections arriving at a listener location. In room acoustics design therefore, computer techniques to predict individual reflections are indispensable

Two methods of tracing sound paths in a room are available. The method of images generates a lattice of virtual sources much like a room full of mirrors. The path between a virtual source and the point receiver is the temporal and spatial equivalent of the real reflection path. The other method is often referred to as ray tracing but is perhaps more accurately described as particle tracing. A single source is used to radiate "particles" of sound which reflect about the room until they are intercepted by a receiver volume or until their energy has decayed to an insignificant level.

Both methods have their advantages and disadvantages and some recent algorithms have combined the two.[6] The method of images cannot account for diffusion or diffraction and execution times increase exponentially with the complexity of the room and the number of reflections. Vorlander estimates that to generate the first 400 ms of decay in a typical 15,000 m^3 concert hall, modelled with thirty surfaces, the execution time on a AT compatible personal computer will be in the range of 10,000 years.[6] Because the method of images employs a point receiver it can produce extremely accurate spatial resolution, accurate enough to generate binaural computer simulations of sound fields in a room before it is built. For this same reason, it is also a useful predictor of stage acoustics parameters, some of which are measured as close as 0.5 m from the source.

Particle tracing can model acoustic diffusion and for complex rooms its execution time is much shorter than the method of images. It also lends itself well to multiple receivers, which can be used to create maps of the acoustical conditions in the seating area of the room.

Both methods produce reasonably accurate representations of the important early reflected sound. For later sound, e.g. the reverberant decay beyond 200 ms, the precision is less accurate. Legrand & Sornette point out that two rays, starting out with an apparently insignificant difference in direction (10^{-14} radians), can propagate at right angles to each other after only 20 reflections.[7] It is apparent therefore that the reverberant field is, like many other natural phenomena, chaotic. Just as Lorenz has established that the prediction of weather beyond a few days is intrinsically inaccurate[8], it would appear that algorithms such as the method of images and particle tracing are not and perhaps cannot be accurate beyond the first few reflections.

Hodgson's studies seem to support this thesis[9]. He has found significant differences between conventional computer predictions of sound fields and the actual measurements. He demonstrated that particle tracing predictions correspond better with measurements if the calculations implement a compensation corresponding to random Lambertian diffusion. Diffusion is inherently chaotic so it would appear that his findings confirm what we are beginning to understand as the chaotic nature of (late) reverberant sound.

The computer software we have developed to predict reflection sequences in a room is called TRACES. Two algorithms are implemented: the method of images, based on Borish[10] and particle tracing based on Krokstad et al.[11] The two algorithms are independent, no attempt is made to blend early reflections from the method of images with the late reflections generated by particle tracing. Data is entered using a three dimensional (3D) graphics interface. Results can be viewed as sound energy impulse responses, either as function of time or angle of incidence. 3D "wire diagram" representations of the room show the path of sound rays as they reflect about the room. It is also possible to view the range of reflections cast by a given reflector. This module of the program, again using 3D graphics, is extremely useful especially in the early design phase of a project.

TRACES is still in development and has not as yet been calibrated. For this reason, it is used only for comparative studies of various design alternatives.

3. 3500 SEAT ASSEMBLY HALL

The 3500 seat Assembly Hall for Jehovah's Witnesses in Norval, Ontario will replace the existing hall for 1812. Like the present hall, it will be used primarily for speech with the aid of electro-acoustic reinforcement. The hall has been specifically designed to optimise listening conditions, using a central loudspeaker cluster located above the stage and appropriate early reflected sound. To do this and still accommodate the design requirement of 3500 seats, with at least 2300 on the ground floor, it was decided to use a terraced floor plan based, loosely, on rooms such as Berliner Philharmonie, the 2500 seat concert/congress hall in Las Palmas, Canary Islands[12] and the Sapporo Cultural Centre in Sapporo, Japan.[13] The design has been greeted with excitement by the both the architect and the owner because, in addition to solving the obvious acoustic problems, it opens up new architectural

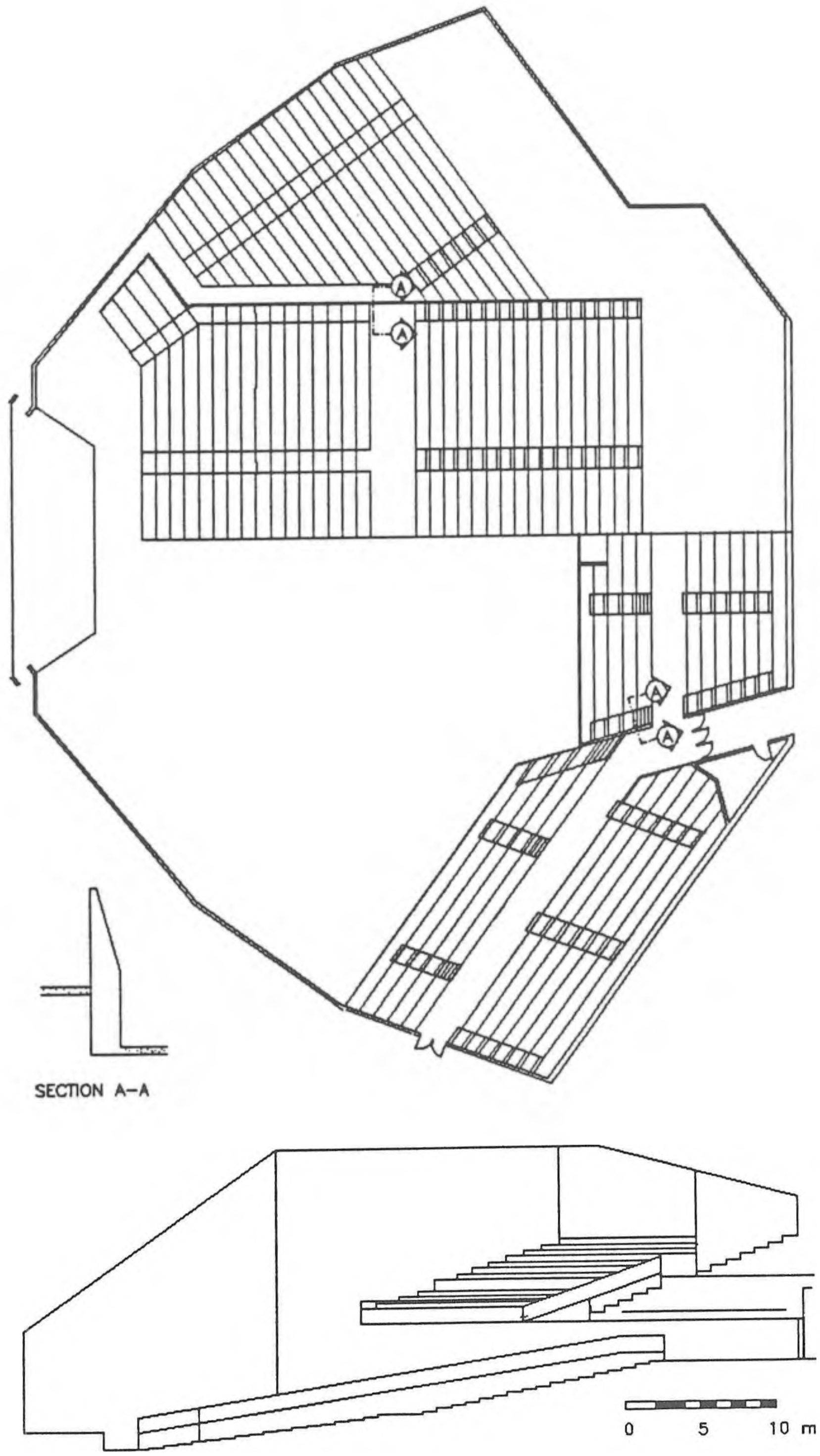

Figure 1 Plan and Centre Line Section of the Jehovah's Witnesses Assembly Hall in Norval, Ontario.

possibilities giving a large scale room a better sense of intimacy. The new hall will accommodate almost twice as many people as the existing room yet no one will be seated any further from the stage.

A plan and section of the room are shown in Figure 1. The central portion of the ground floor seating area is approximately 1 m below the two side areas. The same is true in the balcony. The wall separating the central and side portions is 2 m high, the top half of which is inclined upwards at a 1 in 6 slope. The orientation of this sloped wall is based on the loudspeaker location, approximately 7 m above the front of the stage. Using a sloped surface provides (loudspeaker) reflections throughout the central seating area whilst maintaining a low dividing wall. The reduced height of the wall translates into a lower overall building height.

The critical elements of the acoustic design are the dividing walls and the ceiling, both of which provide the requisite early reflections for good speech intelligibility. The sloped dividing walls provide first and sometimes second order reflections to listeners, both within 50 ms of the direct sound.

The ceiling was designed in the light of recent findings by Barron and Lee[14] and Bradley.[15] These studies of existing halls found that rooms with diffusing or backscattering elements in the ceiling consistently demonstrated lower Total Sound Levels and shorter Reverberation Times near the back. For this reason the ceiling is simple, without ornamentation or major openings for lighting or ventilation.

4. PLATFORM ACOUSTICS

It has long been accepted that the acoustical requirements of listeners and performers are not the same. Research in the past decade has begun to establish relationships between the subjective judgements of musicians and the measurable objective acoustic properties on an orchestra stage. Work by Marshall et. al.,[16] Meyer[17] and most notably by Gade[18] and Naylor[19] has extended our understanding significantly beyond the previous common sense observations.

Meyer has studied the masked thresholds of audibility for instrumental musicians. He found that for reciprocal hearing, "reflections falling vertically from above may be more prominent in the acoustic perspective of most instrumental players than wall reflections or sound reaching the player diagonally from above".[17] He proposed a ceiling design, shown in Figure 2, that takes advantage of the directional characteristics of the musicians' hearing and the radiation patterns of the instruments they are playing.

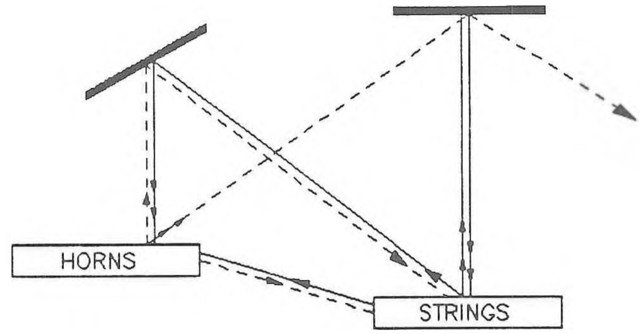

Figure 2 Schematic stage ceiling proposed by Meyer. The solid lines indicate the intensity of sound radiation and the open lines demonstrate the aural sensitivity to indirect sound.

Early reflections also influence the perception of the performer's own instrument or voice. Gade has established that the threshold of perception for a single reflection by a musician playing an instrument is much higher than the amplitude of the reflection off a plane surface, assuming normal spherical attenuation[19,20]. This is illustrated in Figure 3. In other words, a single reflection cannot, on its own, contribute to a soloist's acoustic impression of his performance. Therefore, to ensure adequate Support for a soloist, a stage enclosure must provide a series of early reflections, one or two will not suffice. The term subjective term "Support" has been defined by Gade as "the property which makes the musician feel that he can hear himself and that it is not necessary to force the instrument to develop the tone"[20]. He proposed the following parameter to quantify Support:[21]

$$ST2 = 10\log\frac{\int_{20}^{200} p^2(t)dt}{\int_{0}^{20} p^2(t)dt}$$

He found that on stages were ST1 was less than the thresholds of perception described in Figure 3, the halls were found to be lacking in Support.

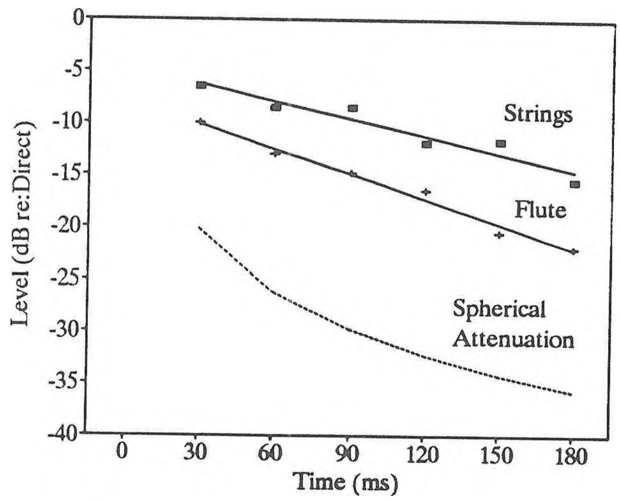

Figure 3 Threshold of perception of a single reflection for soloist, after Gade. The thresholds for strings (violins and celli) and flutes are significantly above the level of a single reflection, shown with the broken line.

Naylor expanded on the musical and acoustical influences on ensemble[19,22]. He found that the Modulation Transfer Function (MTF), previously used by Houtgast and Steeneken to model speech intelligibility,[23] was also a good model for what he called Hearing of Other.

The MTF treats the propagation of sound in a room much like an Amplitude Modulated (AM) radio signal. The sound is characterized by two components, a carrier signal in the audio frequency range and modulating signal that shapes the envelope of the carrier signal. The carrier represents the musical note, for example A-440 Hz, and the modulation signal corresponds to the rhythm at which it is played, typically between .5 and 5 Hz. At higher frequencies, between 5 and 20 Hz, the modulation signal contains information about dynamic transients (i.e attack and release). Figure 4 shows a music/acoustic interpretation of the information content of a modulation signal. The MTF is a ratio between the input and output modulation depth which indicates how much the signal modulation has been degraded by the transmission path and noise. The MTF ranges from 0 to 1, the latter indicating perfect transmission.

Naylor found that in the presence of noise only, there was a linear relation between the MTF and musicians' judgement of Hearing of Other. When reverberation was added the relation became non-linear, quite similar to the speech intelligibility curves developed by Houtgast and Steeneken.

As in previous studies, Naylor found that a balance must

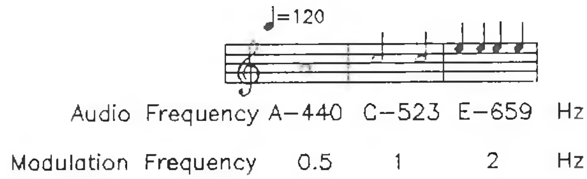

Figure 4 A music/acoustic representation of the information content in a modulation signal.

be struck between Hearing of Self and Hearing of Other. He points out that the simple doctrine of "more energy returned to the orchestra is better" is "clearly not tenable".[19]

5. 300 SEAT RECITAL HALL

The new recital hall for Conrad Grebel College at the University of Waterloo, Ontario will seat 300 in a volume of approximately 2700 m^3. The room is based on a classic shoe box shape, although the side walls are in fact non-parallel, forming a slight reverse fan. This was done to avoid flutter echo or the tonal colouration which precedes flutter echo. Because the room will be used as teaching

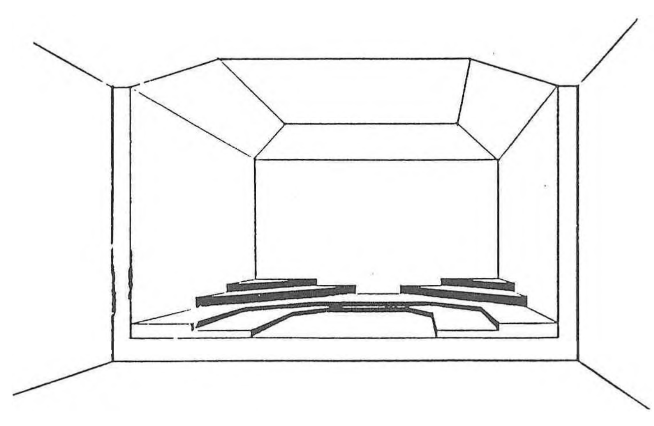

Figure 5 Perspective drawing of the proposed stage for the recital hall at Conrad Grebel College, University of Waterloo, Ontario.

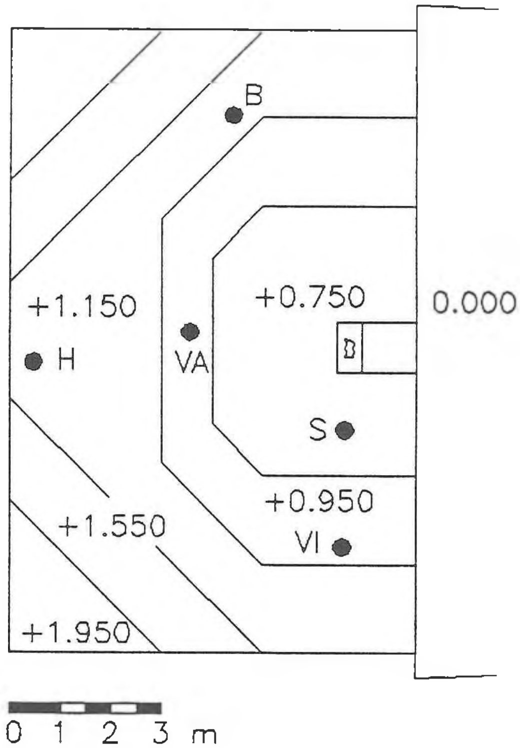

Figure 6 Source and receiver for locations of the analysis of the Conrad Grebel Recital Hall stage (Plan).

facility, special attention was given to the performing conditions on stage.

Using the method of images module of TRACES, we have analyzed four stage configurations, implementing some of the parameters described by Gade and Naylor. The first configuration has a flat floor and a nominally flat ceiling 8.25 m high. The second has a tiered floor with the same ceiling as the first. The third stage, shown in Figure 5 has a tiered floor and a shaped ceiling, 8.25 m high. The ceiling design is based on Meyer's proposal, cognizant of Gade's observations on reflection thresholds (Figures 2 and 3 respectively). The forth configuration is similar to the third except the ceiling is lower, at 6.25 m. Calculations were performed for 5 locations on the stage, as shown in Figure 6. The positions correspond roughly to: Violins (VI), Bass (B), Violas (VA), Horns (H) and Soloist or First Violin (S).

Figure 7 compares the change in MTF when the shaped ceiling is lowered from 8.5 m to 6.5 m (i.e. the third and fourth configurations). MTFs are seen to improve above 1.6 Hz when the shaped ceiling is lowered. Roughly

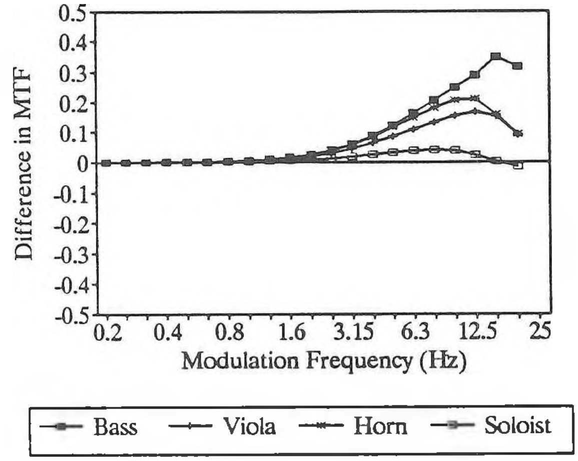

Figure 7 Change in the MTF re: location VI comparing a stage with a 8.5 m high shaped ceiling to one with a similar ceiling 6.5 m high.

speaking, the improvement is proportional to the distance, i.e. the positions furthest from the violinist see a greater improvement. At the closest position, the change is minimal, less than 0.1. Although MTF difference limens have not as yet been established, Naylor has advised that a change in MTF of 0.1, such as that shown in Figure 7, is "likely to lie around the limit of what is noticeable".[24] One would expect therefore that the violinists' Hearing of Other would improve for some sections on the stage when the ceiling is lowered from 8.5 to 6.5 m. The improvement will be most significant for the furthest section (Bass) and will not be noticeable for the closest section (Soloist).

Although the MTF model would suggest that the lower ceiling is better, experience with existing halls suggests otherwise. The accepted wisdom is that stage reflectors work best at heights of 8 to 10 m. Why then the discrepancy? The answer lies in the fundamental dilemma of stage acoustics design - the conflicting needs of a performer to hear both himself and his associates and the listeners' desire to hear the music as a whole, embellished with reverberation.

Although MTFs and ST1 increase as the ceiling is lowered, a balance must be struck between the two. That is, Hearing of Other must not be sacrificed for Hearing of Self or vice versa. To date, a method of quantifying that balance does not exist. Furthermore, as the ceiling is lowered, Early Decay Times will decrease. This will result in a reduced sense of reverberance. In a recent survey of existing auditoria,[25] we found that, where the orchestra had the option of adjusting the height of the stage reflector,(at the Centre in the Square, Kitchener, Ontario) it was set at 11 m. That is, above what is thought to be the optimum height. When the reflector was lowered from 11 m to 8.5 m, both the MTFs and the ST1 ratios improved. The Early Decay Times however decreased significantly, from approximately 2.2 to 1.7 seconds. It would appear that the conductor, given the choice of reflector height, decided in favour of the listener.

Now that we have decided on the reflector height, let us consider the effect of the shaped ceiling versus the nominally flat ceiling. Predicted ST1 values showed little or no change between the two ceilings. Using predicted MTFs, there were some quantifiable differences between the two ceilings but the difference was in the range of ± 0.1 or less. As we pointed out before, Naylor's experience is that performers will probably not notice a change in MTF of this magnitude.

This is not to say that the shaped ceiling is without merit. The TRACES study of early reflections revealed that the horn section receives more overhead reflections from the violin section with the shaped ceiling than it does with the flat one. This, according to Meyer, suggests increased audibility of the string section in the horn section.

The successful ceiling design therefore was the third configuration, i.e. a shaped ceiling 8.5 m above a tiered stage as shown in Figure 5.

6. CONCLUSIONS

Some of the many new developments in rooms acoustics have been reviewed. The advances in audience and platform acoustics as well as computer techniques are formidable. Perhaps the most significant of these developments is the realization that reverberant sound is a chaotic phenomenon.

The acoustic design of two halls has been described. The two rooms presented different acoustical challenges. The Jehovah's Witnesses Assembly Hall in Norval, Ontario will be a very large room, used primarily for speech. The recital hall at Conrad Grebel College, Waterloo Ontario will be used for music with an emphasis on teaching. The method of images/particle tracing software, TRACES, was used to analyze various room configurations in an attempt to optimise the acoustic design.

For the Assembly Hall, the design uses a terraced layout to provide reflected sound to all the listeners within 50 ms. The Conrad Grebel recital hall design is based on a classic "shoe box" configuration. Special attention was given to the acoustical conditions on the stage using some of the recent findings of Gade, Naylor and Meyer.

Because room acoustics research cannot always provide foolproof recommendations, the design of both rooms was based, as much as possible on existing successful halls. This was particularly true for the stage design of the Conrad Grebel recital hall.

ACKNOWLEDGEMENTS

I would like to thank Drs. Murray Hodgson and John Bradley who helped with the ceiling design of the Jehovah's Witnesses Assembly Hall. Ms. Rose Tardao provided the perspective drawing of the Conrad Grebel Recital Hall stage. Much of what is shown here was developed without financial remuneration, costs that were inevitably borne by my family. I would like to thank my wife Jacqueline Hayden for her infinite patience.

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Canadian Acoustics / Acoustique Canadienne 20(1) 21-25 (1992) ***Research article / Article de recherche***

THE EFFECTS OF INHALATION OF OXYGEN AND CARBON DIOXIDE MIXTURES ON NOISE-INDUCED TEMPORARY THRESHOLD SHIFT IN HUMANS

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ABSTRACT

Sixteen subjects breathed either oxygen, carbogen, air with 5% carbon dioxide or air while subjected to 10 min of 100dB noise and for a further 10 min in order to explore the effect of the various gasses on the establishment and recovery of noise-induced temporary hearing threshold shift. Oxygen and carbogen were found to be effective but not different in effectiveness in reducing the establishment of temporary threshold shift suggesting that the role of carbon dioxide in the process is minimal. No evidence was found to suggest that oxygen or carbogen inhalation assists in recovery from temporary threshold shift.

SOMMAIRE

Seize sujets ont respiré soit de l'oxygène, du carbogène, de l'air avec 5% de dioxyde de carbone ou de l'air pendant 10 min alors qu'ils étaient exposés à un bruit de 100 dB, et pendant les 10 min subséquentes, afin d'explorer l'effet des différents gaz sur la manifestation des troubles temporaires du seuil de l'ouïe, et sur le rétablissement consécutif. L'oxygène et le carbogène sont également efficaces mais non-différents pour réduire l'apparition à la fatigue auditive de l'ouïe ce qui suggère que le rôle du dioxyde de carbogène est minime dans ce processus. Les résultats ne permettent pas de suggérer que l'inhalation d'oxygène ou de carbogène aiderait au rétablissement suite à la fatigue auditive.

1. INTRODUCTION

Inhalation of either a high concentration of oxygen or a 95% oxygen 5% carbon dioxide mixture (carbogen) has been shown to reduce hearing threshold shift due to intense noise in various animal studies (Joglekar, Lipscomb, & Shambaugh, 1977; Witter, Deka, Lipscomb, & Shambaugh, 1980; Brown, Vernon, & Fenwick, 1982); Brown, Meikle, & Lee, 1985) and also with humans (Joglekar et al., 1977; Patchett, 1980; Witter et al., 1980; Joyce & Patchett, 1982; Lindgren, Dengerink, & Axelsson, 1989).

Since Joglekar et al. (1977) considered that a more substantial diminution of temporary threshold shift (TTS) from noise exposure was shown when their subjects breathed carbogen rather than pure oxygen, most researchers have used this gas to explore the parameters of the effect. Since an increase in arterial carbon dioxide tension (PCO_2)is known to cause some cerebral vasodilation (Comroe, 1974), various investigators (e.g., Brown et al., 1985) have suggested that the carbon dioxide component of the carbogen may be the main element in the mechanism by which carbogen reduces noise induced TTS. This suggestion follows the proposition of Lawrence, Gonzales and Hawkins (1967) and Hawkins (1971) that noise induced threshold shift could be caused by vascular insufficiency in the inner ear possibly as a result of intense noise stimulation. Thus raised PCO_2 in the blood could counteract noise induced cochlear capillary constriction allowing greater passage of oxygen and other nutrients to inner ear areas being depleted in the course of high metabolism.

It is not yet clear what effect sound has on the cochlear vasculature, the evidence is conflicting. As a result of noise exposure, Lipscomb and Roettger (1973) found evidence suggesting constriction of cochlear capillaries and Dengerink, Axelsson, Miller, and Wright (1984) found a reduced blood supply to the cochlea in guinea pigs. However, Perlman and Kimura (1962) and Prazma, Rogers, and Pillsbury (1983) noted an increase of cochlear blood flow after noise exposure. Oxygen tension (PO_2) in both endolymph (Misrahy, Shinabarger, & Arnold, 1958) and perilymph (Nuttall, Hultcrantz, & Lawrence, 1981) have been reported to be diminished under noise exposure suggesting a lessened supply. On the other hand, a reduced oxygen presence in cochlear fluids could be the likely result of heightened metabolism at the level of the organ of Corti (Ward, 1970) rather than an indication of reduction of supply.

The question as to whether artificially increased carbon dioxide in the blood has an effect of dilating cochlear blood vessels, or mediating a cochlear blood flow increase by some other means in the process whereby carbogen reduces noise induced TTS is also still open. Miles and Nuttall (1988) found a small dilation in stria vascularis capillaries of guinea pigs breathing carbogen. However, they found no dilation changes in animals breathing carbon dioxide in air but measured a 50% cochlear blood flow increase in these subjects. Similarly, Hultcrantz, Larsen, and Angelborg (1980) found a considerably greater cochlear blood flow with rabbits inhaling 7% carbon dioxide in air than carbogen. Cochlear blood flow increases with carbogen have been reported by Dengerink et al. (1984) with guinea pigs in a post-mortem histological study, but in a recent study by Miller, Bredsberg, Grenman, Suonpaa, Lindstrom, and Didier (1991) using a laser-Doppler flow meter found that as far as they could ascertain, carbogen inhalation had little if any influence on human cochlear blood flow.

From evidence such as the above, it does seem that carbon dioxide might alter cochlear blood flow but the studies on blood flow with carbogen rather suggest that this mechanism may not be the primary one to affect noise induced TTS. Carbogen clearly has an effect, possibly not as an agent in altering blood transport rate, but principally for its oxygen content.

The following study was mounted to compare the effects of the inhalation of oxygen, carbogen and carbon dioxide on noise induced TTS in order to attempt to assess the relative contribution that these gasses might make in reduction of TTS and in its recovery.

2. METHOD

Subjects

Twenty-four paid male college student volunteers, all with hearing threshold levels (HTLs) better than 20dB at 4kHz served as subjects.

Procedure

Subjects located in an I.A.C. sound attenuated chamber completed four sessions, each separated by at least 24hrs. At each session, HTLs at 4kHz of the subjects' previously established better ears were measured with pulsed tones beginning at 40dB HL on a Grason-Stadler E-800 Bekesy audiometer. The mean of the six-pen excursions following 1 min of recording was calculated as HTL.

Sixteen subjects were then exposed for 10 min to 100dB SPL of narrow band noise centred at 3kHz generated by an Alison Model 22 audiometer and narrow band filter Model 26, produced binaurally through TDH39 ear-phones. The noise was expected to produce a TTS 2 min after noise cessation (TTS_2) of approximately 15 dB at 4kHz (Ward, Glorig, & Sklar, 1958). The traditional test frequency for TTS studies of 4kHz, expected to show the greatest shift with noise (Ward et al. 1958) was chosen. TTS was measured with the Bekesy audiometer at 2 min, 5 min and 10 min after cessation of the noise using the same procedure as for the pre-test. The audiometer began at 40 dB HL 1 min after the noise cessation and six pen excursions, three each side of the 2 min point, were used to calculate TTS_2. The audiometer was then turned off and restarted at the 4 min point and again at the 9 min point to measure TTS_5 and TTS_{10}.

At each of the four sessions, subjects breathed a different gas either medical grade air, 100% oxygen, 95% oxygen with 5% carbon dioxide (carbogen) or 95% medical air with 5% carbon dioxide. The gas was delivered at a flow rate of 12 l/min through an Ohio Medical Products respiratory therapy nebulizer to provide humidity into a disposable plastic respiratory mask which the subject wore from the beginning of the pre-test until TTS_{10} had been measured. Presentation of gasses across subjects was organized in a Latin square design to control for order effects. Subjects were not made aware of which gas they breathed at any session and subsequent questioning indicated that they were not able to guess successfully.

To establish whether inhalation of the gasses used affected TTS rather than altered basic HTLs, the remaining eight subjects underwent the same procedures except that they were not subjected to the 100dB noise nor was their hearing retested 15 min or 20 min after the pre-test. They attended four sessions, each time breathing a different gas, were pre-tested at 4kHz in the manner described above then tested again 12 min after the pre-test.

Calculation of HTLs and TTSs were performed by an independent observer not aware of the experimental conditions under which the hearing test records were obtained.

3. RESULTS

TABLE 1
Average Threshold Shift in dB at 4kHZ
After 10 min Gas and Noise Exposure (N=16)

Gas	Mean TTS_2	SD	Mean TTS_5	SD	Mean TTS_{10}	SD
Air	13.27	4.53	10.75	4.14	7.43	3.62
Oxygen	9.97	4.45	6.94	5.14	4.80	4.23
Carbogen	8.94	5.78	6.90	3.94	5.22	4.60
Air+5% CO_2	10.89	4.94	8.31	4.46	5.91	4.20

The results for the subjects exposed to noise while breathing the various gasses are summarized in Table 1. A one-way repeated measures ANOVA revealed that at the 2 min point after noise exposure, average threshold shifts differed according to the gasses inhaled [$F(3,45) = 5.094$, $p < .05$]. Tukey post-hoc comparisons to reveal which avage threshold shifts were different from others indicated a significant difference between the average TTS_2 after air inhalation and both carbogen inhalation ($p < .01$) and oxygen inhalation ($p < .05$). None of the other comparisons showed significant differences. Inhalation of either 100% oxygen or carbogen, then, produced the least amount of threshold shift to the noise compared with inhalation of air. Although the difference did not reach an acceptable level of significance, compared with air inhalation, inhalation of 5% CO_2 and air, may also have shown a reduced threshold shift ($t = 1.37$, $p < .10$).

Table 2 shows averaged threshold shifts after 10 min of gas inhalation but no noise.

TABLE 2
Average Threshold Shift in dB at 4kHz
After 10min Gas Inhalation (N=8)

Gas	Mean	SD
Air	-3.66	5.17
Oxygen	0.80	5.27
Carbogen	1.08	3.27
Air + 5% CO_2	2.67	2.96

One sample *t* tests indicated that none of the mean threshold shift measurements differed significantly from zero. The apparent differences were no more than expected by measurement error, given this number of subjects. Thus no evidence was found that gas inhalation alters auditory thresholds.

On Figure 1 are plotted the TTS recovery curves following the cessation of the noise exposure. If inhalation of a particular gas resulted in a more rapid recovery than others, the curve for that gas would be expected to descend more steeply. The recovery curves in the figure appear to follow a parallel course with no indication that inhalation of a particular gas before and during recovery altered the rate of TTS recovery.

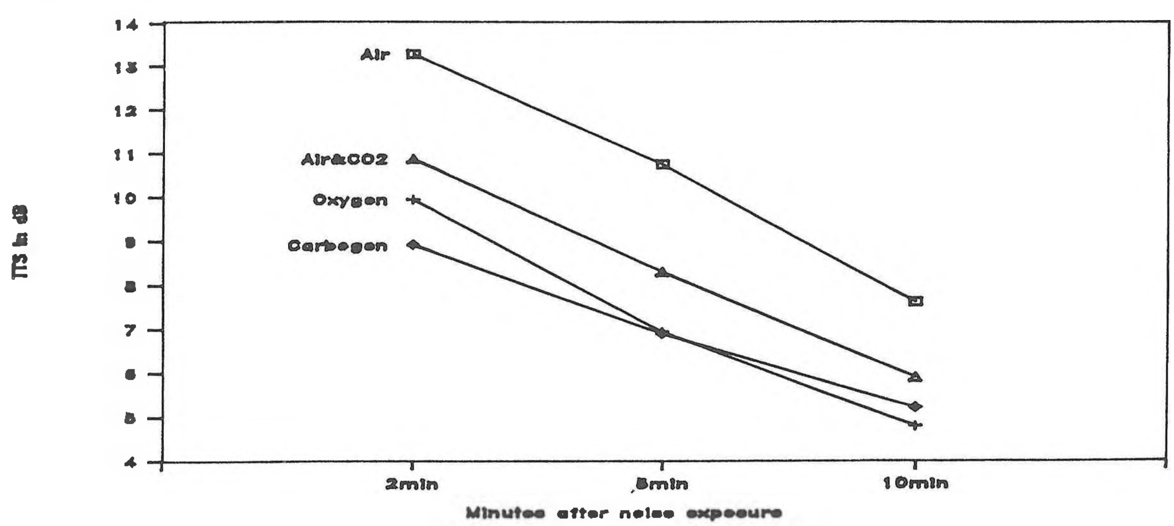

FIGURE 1: Average threshold shift recovery in dB for 16 subjects after exposure to 100dB of noise for 10 min with gas inhalation.

4. DISCUSSION

Inhalation of oxygen or carbogen reduced noise induced threshold shift, according to the results. Since oxygen and carbogen had no apparent effect on HTLs, it is reasonable to conclude that the effect of gas inhalation was to reduce noise induced threshold shift rather than to raise basic auditory acuity. The addition of carbon dioxide to the inhaled oxygen did not seem to make a difference. These findings coincide generally with those of Joglekar et al. (1977) who observed a beneficial effect of inhalation of both oxygen and carbogen on sound induced TTS, but do not agree with their observation that the effect of carbogen was superior. However, Joglekar et al. reached their conclusion about the superiority of carbogen from a consideration of a graphical representation of their results rather than from a statistical analysis.

Although strong efforts were made in this study to control sources of measurement error inherent in any research involving auditory threshold measurements, the influence of such error on the results cannot be discounted. Thus it is difficult to draw conclusions from the finding that there was no significant difference between TTS with carbogen inhalation as against oxygen inhalation. The data from the subjects exposed to the noise while breathing a mixture of air and carbon dioxide does suggest that carbon dioxide could possibly have some beneficial effect on TTS. However, it is clear that since TTS results with carbogen and oxygen were very similar, the added carbon dioxide played a minor rather than a dominant role in the TTS reduction. This conclusion does not agree with those of Joglekar et al.(1977), Degerink et al.(1984) nor that of Brown et al.(1985) all of whom ascribe a major role to the carbon dioxide in carbogen in the reduction of TTS. They propose that carbon dioxide dilates cochlear blood vessels allowing more blood and thus more oxygen to reach depleted areas in the cochlea during intense stimulation. The conclusion is consistent, however, with a more parsimonious explanation that raised blood PO_2 allows for more oxygen than usual to reach areas in the cochlea depleted in the course of intense metabolic activity.

There was no evidence that recovery from TTS was assisted differentially by the inhalation of the gasses. The rate of recovery appeared to be related to the magnitude of the original TTS_2, an observation which coincided closely with that of Ward, Glorig, and Sklar (1959) in their examination of TTS recovery. The finding that TTS recovery rate did not appear to depend on gas inhaled did not agree with the interpretation that Joglekar et al. (1977) made of their data. Those investigators considered that carbogen inhaled during recovery had a beneficial effect on recovery since their carbogen treated subjects recovered more rapidly than those inhaling air. However, an examination of the graphs provided by Joglekar et al. suggests that it is possible that they did not take into account the different levels of TTS at the beginning of the recovery period. Their graphs appear to show parallel recovery. Also, rather in contradiction to their interpretation that carbogen assists TTS recovery, Joglekar et al. did point out that recovery rate appeared to be similar whether carbogen was administered during recovery or only while the subject was exposed to the noise suggesting, as does the present study, that enhanced oxygen inhalation can reduce the level of TTS due to noise but may not assist in the recovery process. In a follow-up study of the Joglekar group's work in the same laboratory with human and chinchilla subjects, Witter et al. (1980) also considered that they had evidence that recovery from TTS was faster after inhalation of carbogen than after inhalation of air. In their case, the carbogen was administered for various periods 30 min before noise exposure. Again, it would seem possible that in their interpretation of results, they neglected to take into account the original TTS magnitudes when they compared rates of recovery. Their graphs also show parallel TTS recovery curves. It would seem, then, that although oxygen or carbogen inhalation can reduce TTS in the first place, resulting in faster recovery, breathing such gasses while recovering may have little effect. It is possible that recovery from TTS depends on processes other than oxygen dependent ones. The suggestion of Ylikoski and Lehtosalo (1985) that recovery from auditory fatigue may depend on replenishment of neuropeptides in the area of outer hair cells before these cells can regain functioning capacity after intense stimulation, a process not involving a direct supply of oxygen, is interesting.

The findings of this study suggest that some of the hearing loss effects from loud sound can be offset by inhalation of either oxygen or carbogen at the time of noise exposure but gas administration after the noise in an effort to speed recovery may not be effective. Since Fisch, Marata and Hossli (1976) have indicated that 30 min of oxygen inhalation increases the oxygen tension of human perilymph to its maximum extent, studies are needed to explore the possible prophylactic effect of longer periods of oxygen administration on the development of TTS. Information about a relationship between oxygen supply and TTS has practical implications. For instance, by monitoring and regulating oxygen levels in noisy industrial situations and even augmenting oxygen supplies for individuals, perhaps some of the effects of such noise on hearing could be ameliorated.

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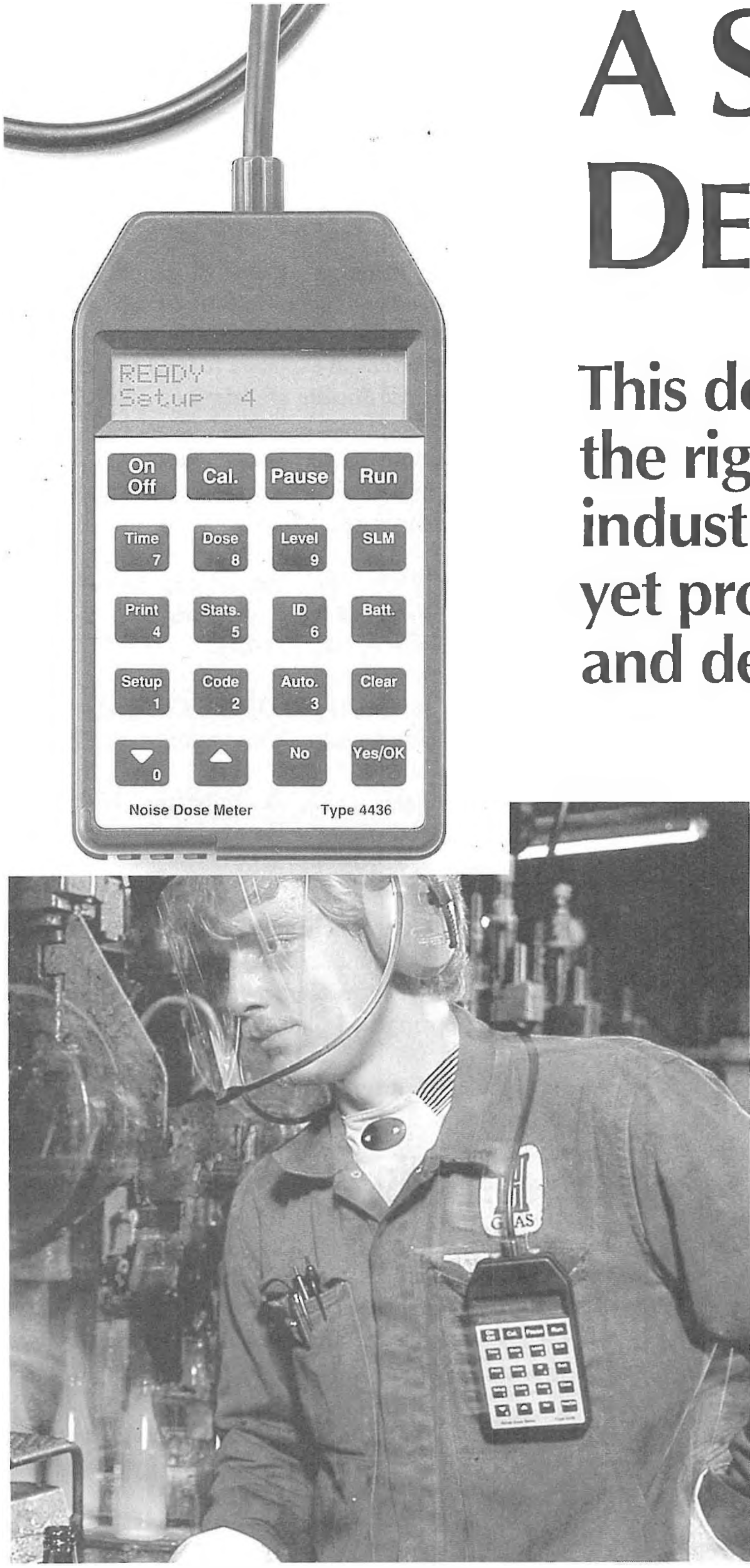

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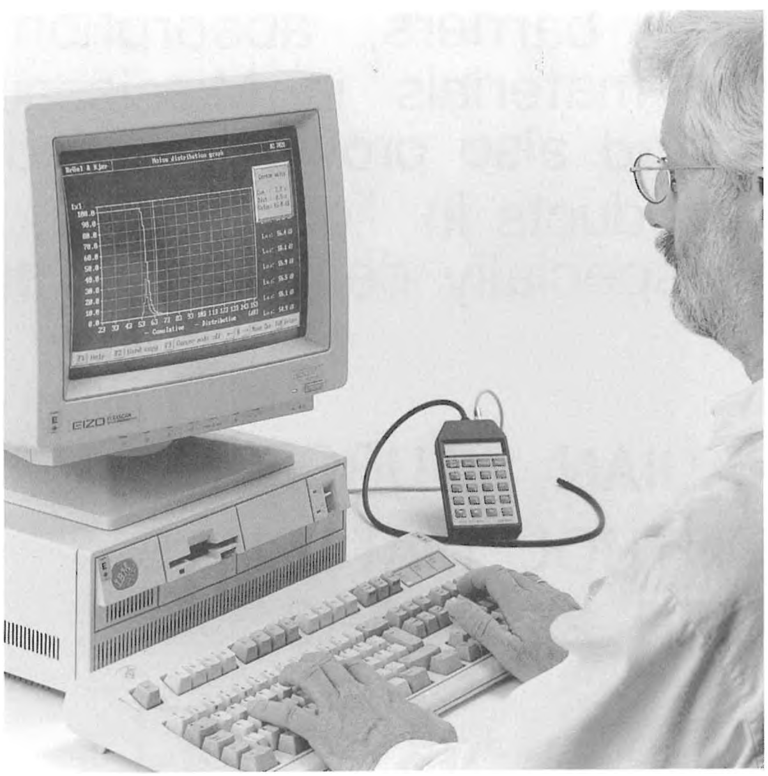

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ASSESSING HEARING CONSERVATION PROGRAMS: THE NEW ANSI STANDARD

Alberto, Behar, P.Eng.
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Pickering, Ontario L1W 3C8

SUMMARY

A new draft ANSI Standard S12.13-1991 "Evaluating the Effectiveness of Hearing Conservation Programs" has been published for trial use, comments, and criticism. It presents a statistical method to calculate three indices using audiometric tests results. A hearing conservation program is then assessed as "acceptable", "marginal", or "unacceptable", by comparing these indices to limits given in the Standard.

SOMMAIRE

Une nouvelle version preliminaire d'une norme a été publié par l'Institute Nationale Americain des Normes. C'est le ANSI Standard S12.13-1991 "Evaluating the Effectiveness of Hearing Conservation Programs". Cette norme a été publié pour une periode d'essai, de commentaires et de critique. Elle utilise une méthode statistique pour calculer trois index en utilisant les resultats des measures audiometrique des employées. Une programme de conservation de l'ouie est ensuite evalué comme " acceptable", "marginal" ou "inacceptable" en comparant ces index avec des limites contenues dans la Norme.

1.0 INTRODUCTION

It is generally accepted that Hearing Conservation Programs (HCP) are the best tool for reducing the risk of hearing loss in the workplace. As with all other control programs, a HCP is a comprehensive set of steps to be followed to control the hazard in an efficient manner. To do so, they deal with the assessment of the problem and its management. Issues such as use of hearing protectors, posting of noisy areas are included, as is the use of engineering noise controls. Also, a comprehensive HCP lists the responsibilities for the implementation of the different stages of the Program.

The audiometric surveillance, used to control that all workers are properly protected from the hazard, is a very important component of the HCP. In a very simplistic approach, the effectiveness of the entire HCP can be easily assessed using the results of hearing tests. If there are no hearing losses, the program works. If there are, then, something has to be improved.

To everyone experienced in dealing with noise in the workplace, this is a very unreliable way for such an assessment. A range of causes, other than the noise in the workplace can cause large variations in the audiogram. On a particular day, a person may not hear that well because of common cold. He may be apprehensive during his initial test. Also, the calibration of the audiometer may have changed because of an electronic fault. Besides, screening audiometry is done in 5 dB steps making possible an error of up to 10 dB.

To follow the evolution of the hearing threshold of a single person requires a great deal of attention and analysis before concluding that the person is loosing his hearing due to occupational noise. To follow a group of workers is even more difficult task. Unless noise levels are very high or if the hearing protection does not exist, changes in hearing threshold are slow and small. Today, in most workplaces some controls are instituted. They may be more or less efficient, but they preclude a collective loss of hearing, large enough as to be detected by simply looking at the audiometric results.

Therefore, using audiometric data to assess the effectiveness of HCP is not a simple task. This is a fact already found by many professionals in the field. The new Draft Standard intend to provide an answer to the problem using statistical methods. It provides a tool simple enough and yet reliable that can be used provided some criteria are met.

This paper reviews the bases for the Draft Standard and describes the procedures included in the document. Readers are encouraged to use it in their workplaces, to test it and to send their comments, critics and observations to the Working Group.

2.O THE NEW ANSI DRAFT STANDARD S12.13-1991 (1)

2.1 The Audiometric Data Base Analysis (ADBA)

The ADBA process was originally devised by L.H. Royster and J.D.Royster (2). The objective was to have a tool, where by statistically treating audiometric results from a group of workers exposed to the same noise environment, one could determine the effectiveness of the HCP.

It is based on analysis of sequential audiometric data, each subtracted from the previous one. Following given procedures several numerical indices were calculated. Compared to some limits they allowed for the classification of a given HCP as acceptable, marginal or unacceptable.

The ANSI Working Group S12/WG12 was created following an initiative by Royster and Royster, with the objective of improving the original ADBA and preparing a Draft Standard. Once tested in the field it will become a Standard. To do this work, the Working Group compiled the largest known industrial audiometric database ever assembled in the United States. It took seven years to complete the Draft, trying different approaches and methods. The Draft now published for trial use, comments and criticism contains three of the original indices devised by Royster and Royster.

2.2 Data Requirements

Before performing the analysis, data have to be scrutinized to meet the following requirements:

i) There should be at least four consecutive annual audiometries for all workers included in the database. Tests should have been taken during the same year (i.e., every one of the workers should have been tested during the same year, during each of these consecutive four years).

ii) There should be a minimum of workers in the database. The number suggested is of 30.

iii) Hearing tests should be performed during working hours. In doing so, measurement results will include temporary threshold shifts (TTS), if they are present.

iv) Changes in hearing are considered as significant if equal or larger than 15 dB. Since screening audiometry is done in 5 dB steps, up to two steps (10 dB) may be due to reasons other than noise induced hearing loss.

v) Database should include results from testing at the audiometric frequencies from 0.5 to 6KHz.

2.2 The Indices

Data are entered in the database as hearing thresholds for each person, each ear, frequency and test number. To eliminate the need for age corrections, data are subtracted sequentially: each threshold from the corresponding one, measured on the previous year. Only differences (=/>15 dB) are used for calculating the indices.

The following three indices are calculated and used for the assessment of the effectiveness of a HCP:

2.2.1 Percent Worse Sequential (%W_s)

This is the percent of the population which shows a significant decrease in hearing threshold in any ear, at any testing frequency between two sequential audiograms.

2.2.2 Percent better or worse sequential (%BW_s)

This is the percent of the population which shows a significant increase or decrease in hearing threshold in any ear, at any testing frequency between two sequential audiograms.

2.2.3 Standard Deviation of Differences in Hearing Threshold Levels

This is the standard deviation of the differences between binaurally averaged sequential hearing thresholds, for each testing frequency.

Standard deviations are calculated at each test frequency and at three frequency averages: 0.5, 1,2 and 3 kHz, at 2,3 and 4 kHz and at 3,4 and 6 kHz.

Different limits are set for the indices if databases contain data from up to, or more than 4 consecutive years.

NOISE CONTROL IN THE INDUSTRY, 3rd ed.

by Sound Research Laboratories

After a preliminary review of **Noise Control in Industry**, it becomes evident that the book is aimed primarily at health and safety personnel, plant engineers, or plant managers who require a basic text or reference book in order to assist them in solving noise problems which may occur in practice. That being said, it is evident that there is little of value for engineers practising in the field of industrial noise control. On the other hand, however, although there are some weaknesses, the book is an excellent overall reference for it's target audience.

The book is roughly divided into three sections, with the first several chapters outlining the basics of noise and its measurement, the middle section dealing with techniques for noise control, and the last few chapters providing case studies in Industrial Noise Control.

The first chapter deals with the basic physics of sound, and goes through the basic definitions of the sound wave length, sound power, and sound pressure level. In general, only the reference equations showing the relation of decibels to the actual sound pressure or power given, with no derivation from the fundamental principles. This comment is generally true throughout the book, as very few derivations of any equations are given, the authors preferring to give only equations which are absolutely necessary. The basics are generally clearly presented, although some information presented such as the equal loudness contours relating phones to sound pressure level are irrelevant, and may confuse the target audience for which the book has been written.

The second chapter, Physiology and Psychology of Hearing, generally follows the same pattern as the first chapter, with the basics of hearing physiology and hearing loss being presented, along with some useful explanations on the energy equivalent noise level (Leq) and hearing protection. Once again the same equal loudness contours relating phones to sound pressure level are presented as the author seemed determined to get the most out of this one figure.

The third chapter discusses the noise regulations primarily in the United Kingdom, and is of little relevance to readers in Canada and the United States, say for the Lep, the daily personal noise exposure level which is used to assess acceptability of noise levels in the United Kingdom.

The Fourth and Fifth chapters outline the basics of room acoustics, and sound insulation. Such concepts as the sound absorption coefficient, sound dispersion in a reverberant field, and the standard equations describing sound in large rooms are introduced. The chapter on sound insulation is one of the better chapters in the book, and gives a good basic description of the mass law, and the response of partitions at the critical bending frequency. the concepts of stiffness controlled, mass controlled and coincidence regions of typical partitions as well described. The book uses nomograms extensively throughout it, especially in these two chapters. As is usually the case with this type diagrams, they are more useful in illustrating the principles which are being outlined in the text of the book, rather than provide useful practical information.

Chapter Six attempts to give the very and non-mathematical introduction to vibration theory, introducing the concepts of natural frequency, transmissibility, isolation efficiency and damping. In general although the chapter provides some useful rules of thumb, the lack of any mathematical background limits the usefulness of this section. Again, however, for the target audience the information provided is quite practical.

Chapter Seven gives the basics of sound and vibration measuring equipment and briefly just gives an overview of the basic equipment available. the equipment outlined in this chapter is generally fairly basic, and no descriptions as such instruments as dosimeters are given, while some dated equipment such as statistical distribution analyzers have been included.

Chapter Eight continues on to describe measurement techniques for sound and vibration period. Some useful information for those not familiar with acoustic measurements are given in terms of determination of sound power from sources by the area method. No mention however, is made so sound intensity measurements, or correlation of vibration measurements to sound power radiated, both of these methods are currently in common use to determine sound power of various sources.

The next several chapters, Nine through Fifteen describe techniques for noise control, starting with general planning in terms of source, transmission path and receiver to specific noise control problem. In general, however not enough information is given for a plant engineer to adequately design his own noise control measures. Again the book seems to be more geared towards delivering an overall picture which it does quite well.

The final chapters are case studies in the noise control of various types of equipment and machinery found commonly in an industrial setting. in general, all f these chapters give very useful information on common techniques to control noise and vibration from such items as compressors and pumps, diesel generators, air handling systems, gas turbines, etc. While some of the information in these chapters is excellent, such as the electric noise control for common industrial motors, the section on air handling equipment is dealt with only in a cursory fashion, and the reader would be much better off to reference the ASHRAE handbook chapters on the subject.

Overall, while the book would be of little interest to the acoustician working in the field, it would be an excellent reference for people working in the plant and others with little ex pereince in the control of noise or vibration period. The reviewer gave the book to an industrial client for a period of several days to get his comments. The plant engineer in question found the book highly informative, and easy to read. Thus while the book contains little new information, or anything on the recent advances in the study of industrial noise control, it could be considered and excellent reference for plant engineers.

Even so, there are several items which could have provided for a more complete reference:

1. The section of the book on acoustic enclosures around equipment should have touched on the effect of the mass air gap mass resonance on amplifying certain frequencies of sound from a machine. In the reviewer's experience, he has seen several installations which have actually made noise admissions from machines higher, rather than effectively silencing them.
2. Plant engineers are commonly concerned about the pressure drop of mufflers and silencers attached to their processing or air handling equipment. A short section on the pressure drops expected from various such noise control measures might be useful.
3. A short introduction to the radiation of sound via vibrating structures, much of the work for which has been done at ISVR in England could have been included. Plant engineers often do not understand the relevance of a large vibrating surface in terms of sound power vs a smaller louder source.
4. Some information on the modern "Coanda" type air nozzles would be useful, as air blow-off noise is a major noise source in many plants.

[This book (ISBN 0-442-31341-1) is available from Van Nostrand Reinhold at a price of $69.95.]

Reviewed by Marc Bracken, Barman, Swallow Associates.

MESSAGE DU PRÉSIDENT

Pourquoi devrais-je participer à la Semaine Canadienne de l'Acoustique? Un collègue de travail m'a posée cette question la semaine dernière alors que nous discutions des budgets de déplacements pour l'année à venir. Il désirait savoir pourquoi il devait "gaspiller" un voyage à la SCA '92 alors qu'il pourrait utiliser cet argent pour participer à un congrès plus prestigieux. Je pense que nous avons tous eu des interrogations similaires même si la SCA semble toujours attirer un nombre relativement important de participants. Pourquoi est-ce ainsi?

Les scientifiques ambitieux parmi nous ressentent le besoin de présenter un papier dans les congrès de grande visibilité où ils peuvent se frotter aux chercheurs de renommée mondiale et demeurer à la fine pointe des développements dans leur domaine. Je suis d'accord avec ce principe: communiquer nos résultats à nos confrères représente une part importante du cycle de la recherche. Une autre raison de participer à des congrès est de s'exposer aux développements récents dans des disciplines connexes qui se trouvent hors de nos intérêts directs. A mon avis, la SCA représente une bonne occasion pour atteindre cet objectif.

Je réalise que lorsque je participe à des congrès "importants" - dans mon cas, les congrès de l'ASA - j'ai tout juste le temps d'assister aux présentations relatives à mon domaine et je dois faire un effort important pour profitter des autres sessions. D'autre part, je trouve que le plus petit et plus intime groupe que l'on retrouve à la SCA permet de s'intéresser aux autres sessions. Par example, je crois que si j'avais participé à un congrès du genre de l'ASA au lieu de celui de la SCA '91 en octobre dernier, j'aurais manqué l'excellente présentation de Daryl Caswell portant sur les cloches symphoniques (qui a d'ailleurs reçu un des Prix pour les Étudiants).

A la SCA '89 à Halifax, j'ai rencontré un océanographe du Bedford Institute of Oceanography - qui se trouve à quelques milles de mon labo - qui était intéressé à l'effet de la "réflexibilité" des fonds marins sur les niveaux de bruit dans l'océan, un sujet sur lequel je venais tout juste de publier. Nous ne nous étions jamais rencontrés auparavant et ne nous connaîtrons peut-être pas aujourd'hui si nous nous étions confinés à nos conférences spécialisées respectives.

Il faut certainement participer à vos congrès "importants" si vous le devez. Mais pourquoi ne pas envoyer aussi un résumé pour la Semaine Canadienne de l'Acoustique? Vous constaterez peut-être que certains des scientifiques de renommée mondiale y seront (Au cas où vous n'auriez pas entendu parler de la SCA '92, elle se tiendra à Vancouver du 6 au 9 octobre et les résumés sont attendus au plus tard le 15 avril 1992).

PRESIDENT'S MESSAGE

Why should I go to Acoustics Week in Canada? This is a question that a colleague posed to me only last week, when we were discussing next year's travel budget. He wanted to know why he should "waste" a trip on AWC '92 when he could use the opportunity to go to a more "important" conference. I think we all have had similar thoughts, yet AWC always seems to attract a fair-sized crowd. Why ?

The ambitious scientists among us presumably feel the need to present papers at visible conferences where they rub shoulders with other world-class researchers and keep abreast of developments in their specialty. I agree with that goal: communicating our results to our peer group is an important part of the research cycle. Another reason for attending conferences is to expose oneself to current developments in related disciplines that are outside of one's own direct interest. In my opinion, AWC is a very good opportunity for this.

I find that when I go to a big "important" conference - in my case, the ASA meetings - I barely have time to take in the sessions in my own specialty and I really have to try hard to attend other sessions. On the other hand, I find that the smaller, more intimate group at AWC makes it more possible to "cross-train" by attending talks in other areas. For example, I suspect that if I had been at an ASA-type meeting instead of AWC '92 last October, I would have missed a paper such as the excellent presentation by Daryl Caswell on symphonic bells (which received a Student Award, by the way).

At AWC '89 in Halifax, I met an oceanographer from the Bedford Institute of Oceanography - which is just a couple of miles down the road from my lab - who was interested in the effect of seabed reflectivity on underwater noise levels, a subject upon which I had just published a paper. We had never met before and probably wouldn't know each other today if we had restricted ourselves to our respective specialist conferences.

Sure, go to your "importrant" conference, if you must. But why not send in an abstract for Acoustics Week in Canada as well? You will probably find that some of those world-class scientists will be there with you. (In case you hadn't heard, ACW '92 will be held October 6 - 9 in Vancouver and abstracts are due April 15, 1992).

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Canadian Acoustical Association

Acoustics Week in Canada 1992

Sheraton Plaza 500, Vancouver, B.C.

SEMINARS

ARCHITECTURAL ACOUSTICS (October 7)

This one day seminar is aimed towards architects, engineers and project planners interested in incorporating noise control into buildings. Topics covered include airborne, structure-borne, mechanical services and site noise control. Discussions will also encompass the subjects of architectural acoustics and acoustical problems. This seminar is sponsored by Western Noise Control Ltd. and will be presented by **Mr. Mike Noble**, a senior consultant specializing in industrial, architectural, environmental and marine acoustics with Barron Kennedy Lyzun & Associates Ltd., and **Mr. Ken Barron**, P.Eng., president of Barron Kennedy Lyzun & Associates Ltd. Course fee is $150.00 Canadian. There is a discount for early registration.

UNDERWATER ACOUSTICS (October 6 - 7)

This two day seminar is directed towards those in need of a basic understanding of the principles of underwater sound and will be of interest to engineers and scientists entering the field and will serve as a concise review for those already carrying out research. It will be also useful for students in related fields such as oceanography and geophysics and those who make use of underwater sound in their research. Topics to be discussed include: description of the ocean as an acoustic medium, sources of sound, transducers and arrays, the sonar equation, propagation of sound in the deep ocean, geoacoustics, propagation of sound in shallow water, matched field processing in ocean acoustics, sea surface scattering, ambient noise in the ocean and arctic acoustics. Discussions will include examples from current research in ocean acoustics. The lecturer for this seminar will be **Dr. Ross Chapman**, who is a research scientist in ocean acoustics at Defence Research Establishment Pacific. He is also an adjunct professor in Physics at the University of Victoria and a Fellow of the Acoustical Society of America. Course fee is $345.00 Canadian. There is a discount for early registration.

OCCUPATIONAL NOISE AND VIBRATION (October 6 - 7)

This two day seminar is designed to meet the needs of engineers and hygienists wishing to increase their comprehension of occupational noise and vibration problems and their understanding of how to solve them. Topics to be discussed include: acoustics and vibrations concepts and variables, characteristics of sound waves, effects of noise on health, effects of occupational hearing loss, occupational hearing loss risk appraisal and prevention, effects of noise on safety and comfort, human response to vibration, vibration damage-risk criteria, standards, control of hand/arm vibration, measurement instrumentation and techniques, design and efficiency of noise control measures, noise prediction methods and vibration control. The lecturers for this seminar will be **Dr. Murray Hodgson** of the University of British Columbia, **Dr. Raymond Hétu** of the University of Montreal and **Dr. Tony Brammer** of the National Research Council Canada. Course fee is $450.00 Canadian. There is a discount for early registration.

DEADLINE FOR REGISTRATION IS SEPTEMBER 10, 1992

SYMPOSIUM (October 8 - 9)

The program for the 1992 Symposium commences with special plenary sessions on each of the two days. Each plenary session will be followed by several parallel sessions of technical papers on all aspects of acoustics. Included in the parallel sessions will be theme sessions on underwater acoustics and on occupational noise control. As well, manufacturer's of noise control products, testing instrumentation, and related equipment will be exhibiting these items throughout the symposium. A Thursday evening banquet for the participants and their guests will be the highlight of the week's formal events and will include presentation of CAA awards. The sessions contemplated to date include:

- Underwater Acoustics
- Occupational Noise and Vibration
- Acoustic Sources
- Performance Acoustics
- Electroacoustics
- Speech, Hearing and Communications
- Architectural Acoustics
- Acoustic Measurements

CAA ANNUAL GENERAL MEETING

The meeting will be held on Thursday, October 8, 1992 at the hotel. All CAA members are urged to attend.

HOTEL INFORMATION

All meeting activities are to be held in the Sheraton Plaza 500 Hotel, 500 West 12th Avenue, Vancouver, B.C., Canada, V5Z 1M2 (Phone (604) 873-1811, Fax (604) 873-5103). A block of rooms has been reserved at a reduced room rate of $86.00 for single/double occupancy (GST and PST extra). The reduced rate release date is September 6, 1992. Late reservation will be made on a space available basis.

All reservations are to be made directly with the hotel. To reserve a room, complete and mail or fax the registration card contained in the information package which you will receive on submission of your completed CAA registration form, or call the hotel directly and identify yourself as attending the CAA 1992 Symposium.

Ground transportation from the Vancouver International Airport to the Sheraton Plaza 500 Hotel will cost approximately $20.00 by taxi.

For a complete information package on the entire Acoustics Week in Canada program, write, phone, or fax to:

Canadian Acoustical Association
1992 Symposium Committee
c/o Barron Kennedy Lyzun & Associates Ltd.
Suite 250, 145 West 17th Street
North Vancouver, B.C. V7M 3G4
Phone: (604) 988-2508; Fax: (604) 988-7457

L'Association Canadienne d'Acoustique

Semaine de i'Acoustique Canadienne 1992

Sheraton Plaza 500, Vancouver, C.-B.

COURS (6 - 7 octobre)

Trois cours sont offerts en anglais. On vous prie de voir le côté anglais pour les descriptions et de vous inscrire avant le 10 septembre 1992.

SYMPOSIUM (8 - 9 octobre)

Le programme pour le symposium de 1992 commence avec une plénière chaque jour. Ces sessions seront suivies de sessions parallèles de communications couvrant tous les aspects de l'acoustique. Les sessions parallèles inclueront des sessions spéciales sur l'acoustique sous-marine et le contrôle du bruit et des vibrations en milieu de travail. De plus, il y aura une exposition de manufacturiers de produits de contrôle du bruit, d'instrumentation et d'autre équipement ayant rapport à l'acoustique, qui durera tout le long du symposium. Le banquet jeudi soir pour les participants et leurs invités couronnera le congrès avec la remise de prix. A date, voici les sessions prévues:

- L'acoustique sous-marine
- Bruit et vibrations en milieu de travail
- Sources acoustiques
- L'acoustique de spectacles
- L'électro-acoustique
- La parole, l'ouïe et la communication
- L'acoustique architecturale
- Le mesurage acoustique

L'ASSEMBLÉE ANNUELLE DE L'ACA

L'assemblée annuelle aura lieu le jeudi, 8 octobre 1992 à l'hotel. Tous les membres de l'ACA sont priés de s'y rendre.

INFORMATION SUR L'HOTEL

Toutes les activitées de la semaine se dérouleront à l'hotel Sheraton Plaza 500, 500 12ième Avenue ouest, Vancouver, B.C., Canada, V5Z 1M2 (Tél (604) 873-1811, Télécopieur (604) 873-5103). Un bloc de chambres a été réservé à des taux préférentiels de $86.00 pour occupation simple or double (TPS et taxe provincialle en sus). Ces taux réduits sont valables jusqu'au 6 septembre 1992. Après cette date les réservations seront faites si l'espace le permet. Toutes les réservations doivent être faites directement avec l'hotel. Afin de réserver une chambre, remplissez et retournez par la poste ou par télécopieur la carte d'enregistrement incluse dans le paquet d'information, ou appelez l'hotel directement en vous identifiant comme un participant au symposium de 1992 de l'ACA.

Les coûts de taxi de l'aéroport international de Vancouver à l'hotel Sheraton Plaza 500 sont environs $20.00.

Pour de plus amples renseignements et le paquet d'information complète de la Semaine de l'Acoustique Canadienne 1992 écrivez, appelez ou contactez par télécopieur:

L'Association Canadienne d'Acoustique
COMITÉ DE LA CONVENTION DE 1992
a/s Barron Kennedy Lyzun & Associates Ltd.
250, 145 17th Street West
North Vancouver, C.-B. V7M 3G4
Tel. (604) 988-2508; Télécopieur. (604) 988-7457

APPEL DE COMMUNICATIONS

Semaine Canadienne de l'Acoustique
6 - 9 octobre 1992

La Semaine Canadienne de l'Acoustique 1992 aura lieu à l'hôtel Sheraton Plaza 500 de Vancouver, Colombie-Britannique. La semaine débutera avec deux jours de séminaires techniques, portant sur l'acoustique architecturale, l'acoustique sous-marine, et l'évaluation et le contrôle du bruit et des vibrations en milieu de travail. Les détails spécifiques et les modalités d'inscription à ces cours sont publiés dans ce numéro. Le congrès de l'Association Canadienne d'Acoustique se tiendra les 8 et 9 octobre, suite aux séminaires. L'Assemblée générale annuelle et le banquet de l'ACA auront lieu mardi, le 8 octobre.

CONGRES

8 - 9 octobre 1992

Le programme du congrès sera composé des conférences d'invités spéciaux regroupés à l'intérieur des sessions plénières qui seront suivies par des sessions génerales parallèles. Les auteurs sont invités à soumettre leur résumés pour ces sessions générales qui porteront sur tous les aspects de l'acoustique. Cependant, les communications relatives à des thêmes spécifiques sont fortement encouragés. Il s'agit de:

- L'acoustique sous-marine
- La parole, l'audition et la communication
- L'acoustique architecturale
- Les mesures acoustiques
- L'électro-acoustique
- Les sources acoustiques
- L'acoustique des salles de spectacle
- Le bruit et les vibrations en milieu de travail

Les organisateurs désirent planifier plusieurs sessions structurées autour d'un thème particulier et invitent les auteurs potentiels à soumettre leurs idées. Les soumissions de groupe seront révisées en tant qu'ensemble complet. Les papiers soumis individuellement seront classés dans une catégorie appropriée.

Tous les résumés seront révisés afin de vérifier leur pertinence et les résumés acceptés seront publiés dans un document qui sera disponible au congrés ainsi que dans l'*Acoustique Canadienne.* Les résumés doivent être limités à 300 mots et doivent être reçus avant le 15 avril 1992. Les résumés soumis doivent être préparés selon les instructions contenues dans la préparation des résumés inclus dans ce numéro de l'*Acoustique Canadienne.* Chaque auteur de sommaires acceptés devrait soumettre, avant le 31 juillet 1992, une version écrite de sa communication, se conformant avec les directives publiées dans ce numéro et à paraître sans arbitrage dans le cahier des actes (numéro de septembre) de l'*Acoustique Canadienne.* Les résumés complets et les demandes d'informations concernant les sessions techniques doivent être envoyés à:

Dr. Pierre Zakarauskas
DREP FMO Victoria
Victoria, B.C., V0S 1B0
Tel: (604) 363-2879
FAX: (604) 363-2856

PRIX AUX ETUDIANTS

Les étudiants sont particulièrement invités à participer. Les étudiants doivent s'inscrire au concours et envoyer leur résumés en utilisant le formulaire joint à ce numéro. En plus des prix aux étudiants décernés par l'ACA, il y aura un nombre limité de bourses pour couvrir les frais de déplacement et de logement.

CALL FOR PAPERS

Acoustics Week in Canada
October 6 - 9, 1992

Acoustics Week in Canada 1992, will be held at the Sheraton Plaza 500 Hotel in Vancouver, British Columbia. The week will begin with two days of technical seminars on architectural acoustics, underwater acoustics, and occupational noise and vibration evaluation and control. Specific details and registration for these courses are published elsewhere in this issue. The symposium of the Canadian Acoustical Association will take place on October 8th and 9th following the seminars. The annual meeting and banquet of the CAA will be held on Thursday, October 8th.

SYMPOSIA

October 8 & 9, 1992

The symposia programme will include keynote speakers in special plenary sessions which will be followed by parallel general sessions. Authors are invited to submit abstracts for presentation in these general sessions on all aspects of acoustics; however, papers in specific areas are especially encouraged. These include:

- Underwater Acoustics
- Speech, Hearing and Communications
- Architectural Acoustics
- Acoustic Measurements
- Electroacoustics
- Acoustic Sources
- Performance Acoustics
- Occupational Noise and Vibration

The organizers intend to develop several structured sessions around a particular theme and invite ideas from potential authors. Group submissions will be reviewed as a complete package. Papers submitted independently will be placed into appropriate categories for presentation.

All submissions will be reviewed to ensure suitability, and accepted abstracts will be published in a booklet available at the conference as well as in *Canadian Acoustics.* Abstracts should be limited to 300 words and must be received by April 15th, 1992. Submitted abstracts must be prepared in accordance with the Instructions for the Preparation of Abstracts as directed in this issue of *Canadian Acoustics*. Authors of accepted abstracts will be expected to submit, before July 31, 1992, a 2-page written summary of their paper, prepared in strict accordance with the instructions in this issue and to be published in the Proceedings (September) Issue of *Canadian Acoustics* (without review). Completed abstracts and proceedings articles and requests for information on technical sessions should be directed to:

Dr. Pierre Zakarauskas
DREP FMO Victoria
Victoria, B.C., V0S 1B0
Tel: (604) 363-2879
FAX: (604) 363-2856

STUDENT AWARDS

Students are particularly invited to participate. Students must apply for these awards with their abstract submission using the application form printed in this issue. In addition to the student awards for papers, available from the CAA, a limited number of assistance grants for student travel and housing will be available.

Instructions for the Preparation of Abstracts

1) Quadruplicate copies of an abstract are required for each meeting paper; one copy should be an original. Send the four copies to the Technical Program Chairperson, in time to be received by April 15th. 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 number, 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) Quatre copies du résumé sont requises pour chaque papier soumis; une des copies doit être un original. Envoyer les quatre copies au Président du Comité technique, suffisamment à l'avance pour qu'elles soient reçues avant le 15 avril. 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 approprié à votre sujet; c) Le numéro de téléphone, 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 for Preparation of Articles to be Published in the Conference Proceedings Issue

General - Submit the camera-ready article on a maximum of two pages 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 July 31. 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.

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 de deux pages 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 le 31 juillet. 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. Tître 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.

ANNUAL STUDENT PRESENTATION AWARDS

The Canadian Acoustical Association makes awards to students whose papers are presented at the CAA Annual Symposium. Students contemplating papers for the 1992 Symposium should apply for consideration 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. An award can be divided in case of a tie.
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 post-secondary student at the time of application (undergraduate or graduate);
   ii) the first author of the paper;
   iii) a member of the Canadian Acoustical Association.
6. To apply for the award, the student must send the application simultaneously with the abstract of his or her paper. Multiple authors are permitted, but only the first author may receive an award.

PRIX ANNUELS RELATIFS AUX COMMUNICATIONS ÉTUDIANTES

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

REGLEMENTS

1. Ces prix sont décernés annuellement aux auteurs de communications exceptionnelles présentées par des étudiants lors des sessions techniques de la Semaine Canadienne de l'Acoustique.
2. Au total, trois prix de 500$ sont remis. Un prix peut être partagé en cas d'égalité.
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 évaluée séparément par au moins trois juges.
5. Le candidat doit être:
   i) un étudiant à temps plein de niveau post-secondaire au moment de l'inscription (de niveau sous-gradué ou gradué);
   ii) le premier auteur du papier;
   iii) un member de l'Association Canadienne d'Acoustique.
6. Afin de s'inscrire au concours, l'étudiant doit envoyer le 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 DE L'ACOUSTIQUE

NAME OF THE STUDENT/NOM DE L'ÉTUDIANT:____________________

TITLE OF PAPER/TITRE DU PAPIER:____________________

UNIVERSITY/COLLEGE//UNIVERSITÉ/COLLEGE:____________________

NAME, TITLE OF SUPERVISOR/NOM ET TITRE DU SUPERVISEUR:____________________

STATEMENT BY THE SUPERVISOR/DÉCLARATION DU SUPERVISEUR:

The undersigned affirms that the student mentioned above is a full-time student and the paper to be presented is the student's original work. Le sous-signé affirme que l'étudiant mentionné ci-haut inscrit à temps plein et que la communication qui'il présentera est le fruit de son propre travail.

Signed/Signature:____________________ Date:____________________

Acoustics Week in Canada 1992
Sheraton Plaza 500, Vancouver, B.C.
October 6-9, 1992

Travel Subsidy for Students

The Canadian Acoustical Association (CAA) annually hosts a four-to-five day conference, dealing with a wide variety of topics related to acoustics. This year the week will begin with the following seminars held concurrently:

ARCHITECTURAL ACOUSTICS (October 7 - 1 day)
UNDERWATER ACOUSTICS (October 6 - 2 days)
OCCUPATIONAL NOISE AND VIBRATION (October 6 - 2 days)

The seminars will be followed by a symposium on October 8-9, where technical papers are presented. Some of the structured session include:

- Underwater Acoustics
- Electroacoustics
- Occupational Noise and Vibration
- Speech, Hearing and Communications
- Acoustic Sources
- Architectural Acoustics
- Performance Acoustics
- Acoustic Measurements

If you are a student involved in acoustical study or research, we invite you to attend this year's conference in Vancouver, British Columbia. Students that present a technical paper are eligible to receive an award for their contribution.

To encourage student participation, a travel fund has been established to partially defray transportation and housing expenses. The amount granted to each student will depend on the number of requests received. To apply for a travel subsidy, students should submit, to be received by July 31, 1992, a brief informal written proposal to:

Canadian Acoustical Association
1992 Symposium Committee
c/o Barron Kennedy Lyzun & Associates Ltd.
Suite 250, 145 West 17th Street
North Vancouver, B.C. V7M 3G4
Phone: (604) 988-2508; Fax: (604) 988-7457

The proposal should indicate your status as a student, whether or not you have submitted an abstract to present a paper at the conference, whether you are a member of the CAA, your travel plans (i.e., whether you will be travelling alone or with other students), and any other information which you consider relevant. Preference will be given to full-time students at a University or post-secondary institution using the most economical mode of transportation.

Semaine de l'Acoustique au Canada 1992
Sheraton Plaza 500, Vancouver, C.-B.
6 au 9 october 1992

Subside de Voyage pour Etudiants

Le congrès annuel de l'Association Canadienne d'Acoustique (ACA) couvre une variété de sujets qui se rattachent à l'acoustique. Cette anneé, la semaine débuttera avec trois cours présentés simultanément (en anglais):

ARCHITECTURAL ACOUSTICS (7 octobre - 1 jour)
UNDERWATER ACOUSTICS (6 octobre - 2 jours)
OCCUPATIONAL NOISE AND VIBRATION (6 octobre - 2 jours)

Les deux derniers jours du congrès seront consacrés à un symposium de communications techniques. Parmi les sessions structurées, l'on propose les thèmes suivants:

- L'acoustique sous-marine
- L'électro-acoustique
- Le bruit et les vibrations de travail
- La parole, l'audition et la communication
- Les sources acoustiques
- L'acoustique architecturale
- L'acoustique de grandes salles
- Les mesures acoustiques

Si vous êtes étudiant(e) en acoustique nous vous invitons à participer à notre congrès à Vancouver, Colombie Britannique. Il y a des prix pour les meilleures présentations étudiantes.

Afin d'encourager la participation étudiante, un fonds a été établi pour aider à défrayer les coûts de transport et de logement. Le montant octroyé à chaque étudiant(e) dépend du nombre de demandes reçues. Une soumission écrite doit être reçue par le comité organisateur avant le 15 juillet, à l'adresse suivante:

Association Canadienne d'Acoustique
Comité de la Convention 1992
a/s Barron Kennedy Lyzun & Associates Ltd.
Bureau 250, 145 - 17th Street West
North Vancouver, C.-B. V7M 3G4
Téléphone: (604) 988-2508; FAX: (604) 988-7457

Votre soumission doit indiquer votre situation en tant qu'étudiant(e), si vous avez soumis un résumé afin de présenter une communication, si vous êtes membre de l'ACA, vos plans de voyage (i.e. si vous voyagez seul(e) ou avec d'autres participants) et toute autre information que vous jugez utile. La préférance sera donnée aux étudiant(e)s qui fréquentent une université ou autre institution post-secondaire à plein temps et à ceux qui choisiront le moyen de transport le plus économique.

REGISTRATION FORM
(FORMULAIRE D'INSCRIPTION)
1992 Acoustics Week in Canada
Sheraton Plaza 500 Hotel, Vancouver, B.C.

Surname(Nom):_______________ First Name(Prénom): _______________

Representing (représentant): _______________

Address (adresse): _______________

____

____

Postal Code (Code Postal):_______________ Telephone: ( ) _______________

Companion Name (Nom de Personnes qui accompagnent) _______________

SEMINARS (SÉMINAIRES en anglais)
October 6-7 (Octobre) 1992

Registration Received: (Inscription reçu)	before (avant) Sept.10	after (aprés) Sept.10	Amount (Montant)
Architectural Acoustics (Oct. 7 - 1 day)	$125.00	($150.00)	$________
Underwater Acoustics (Oct. 6-7 - 2 days)	$295.00	($345.00)	$________
Occupational Noise and Vibration (Oct. 6-7 - 2 days)	$395.00	($450.00)	$________

SYMPOSIUM
October 8-9, 1992

Registration received: (Inscription reçu)	before (avant) Sept.10	after (aprés) Sept.10	
Registration (Inscription) (Includes 1 banquet ticket; inclut un billet de banquet)	$125.00	($150.00)	$________
Student registration (Inscription d'etudiant)	$25.00	($35.00)	$________
Additional Banquet Tickets (Billets)_____	$40.00ea	($40.00ea)	$________
	TOTAL		$________

PLEASE make cheques payable in Canadian funds to CAA 1992 Symposium and mail to
S.V.P. Faites vos chèques à l'ordre de CAA 1992 Symposium en fonds Canadiens et postes à

Canadian Acoustical Association
c/o Barron Kennedy Lyzun & Associates Ltd.
Suite 250, 145 West 17th Street
North Vancouver, B.C. V7M 3G4

NEWS/INFORMATIONS

CONFERENCES

XIIIth World Congress on Occupational Safety and Health: New Delhi, India, April 4 - 8, 1993. Contact: National Safety Council, P.O. Box 26754, Sion, Bombay, 400 022, India. Tel: 407-3285; 407-3694; 409-1285 FAX: +91-22-525-657, Telex: 011-74577 CLI-IN, Cable: NASACIL.

14th Inernational Congress on Acoustics: Beijing, China September 3 - 19, 1992. Contact: ICA SEcretairat, Institute of Acoustics, P.O. Box 2712, Beijing 100080m, China or FAX at 256-1457.

World Building Congress: Montreal, Canada, May 18 - 22, 1992. Contact: Congress Secretariat, CIB '92 World Building Congress, National Research Council Canada, Ottawa, Canada K1A 0R6.

17th International Association Against Noise, AICB - The Aims for Noise Control in Europe of the Future: Cvut, Prague - Czechoslovakia, June 23 - 25, 1992. Contact: Czech Technical University in Prague, Faculty of Civil Engineering, Thákurova 7, Mrs. Alena Náprstková, CS-166 29 PRAGUE - Czechoslovakia. Tel: +42 2 332 4887, FAX: +42 2 311 7368.

1992 International Congress on Noise Control Engineering: Toronto, Ontario, July 20 - 22, 1992. A four-page Announcement and Call for Papers is now available from the Congress Secretariat. Contact: Congress Secretariat, P.O. Box 2469 Arlington Branch, Poughkeepsie, NY 12603, USA. Tel: (914) 462-4006, FAX: (914) 473-9325.

6th International FASE - CONGRESS 1992: Zürich, Switzerland, July 29 - 31, 1992. Contact: FASE Congress 1992, Swiss Acoustical Society, P.O. Box 251, 8600 Dübendorf, Switzerland. Tel: 0041-1-954 06 05 (Mrs. E. Rathe) FAX: 0041-1-954 33 48.

Acoustical Society of America: Memphis, Tennessee, October 19-23, 1992. Contact: Acoustical Society of America, 500 Sunnyside Blvd., Woodbury, NY 11797. Tel: (516) 349-7800 ext. 481.

IEEE Ultrasonics Symposium: Tucson, Arizona, USA, October 1992. Contact: Motorola Government Electronics Group, Attn: F.S. Hickernell, 8201 E. McDowell Rd. Scottsdale, AZ 85252.

VDE - Kongress '92: Köln, FGR, October 12 - 14, 1992. Contact: VDE-Zentralstelle, Tagungen und Seminare, Stresemannallee 15, D-6000 Frankfurt, 70, FGR.

Tonmeistertagung 1992: Bergheim, FGR, November 18 - 21, 1992. Contact: Bildungswerk des Verbandes Deutscher Tonmeister, Honiggasse 16, D-5010, Bergheim 12, FGR.

COURSES

Acoustics & Noise Control: Cheswick, PA, May 18 - 22, 1992. Contact: AVNC, Continuing Education Division, 250 Shagbark Drive, R.D. #1, Cheswick, PA 16094.

Signal Processing: Cheswick, PA, May 18 - 22, 1992. Contact AVNC, Continuing Education Division, 250 Shagbark Drive, R.D. #1, Cheswick, PA 16094.

CONFÉRENCES

XIII^e congrès mondial sur la santé et la sécurité du travail: New Delhi, Inde, du 4 au 8 avril 1993. Contacter: National Safety Council, P.O. Box 26754, Sion, Bombay 400 022, Inde. Téléphone 407-3285; 407-3694; 409-1285, Télécopieur +91-22-525-657, Télex 011-74577 CLI-IN, câble NASACIL.

14^e Congrès international sur l'acoustique: Beiijing, Chine, du 3 au 19 septembre 1992. contacter: ICA Secretariat, Institute of Acoustics, P.O. Box 2712, Beijing 100080, Chine. Télécopieur 256-1457.

Congrès mondial du bâtiment: Montréal, Canada, du 18 au 22 mai 1992. Contacter: Secrétariat du Congrès mondial du bâtiment, Conseil national de recherches du Canada, Ottawa, Canada, K1A 0R6.

17^e congrès de l'Association internationale contre le bruit, AICB - La maîtrise du bruit dans l'Europe de demain: Cvut, Prague, Tchécoslovaquie, du 23 au 25 juin 1992. Contacter: Czech Technical University in Prague, Faculty of Civil Engineering, Thakurova 7, Mrs. Alena Naprstkova, CS-166 29 Prague, Tchécoslovaquie, Téléphone +42 2 332 4887, Télécopieur, +42 2 311 7368.

Conférence Inter-Noise 92: Toronto, Canada, du 20 au 22 juillet 1992. L'annonce de la conférence et l'ppel aux auteurs sont maintenant disponible auprès du secrétariat de la conférence. Contacter: Congress Secretariat, P.O. Box 2469, Arlington Branch, Poughkeepsie, NY 12603, USA. Téléphone (914) 462-4006, Télécopieur (914) 473-9325.

Congrès 1992 de la fédération européenne des sociétés d'acoustique (FASE): Zürich, Suisse, du 29 au 31 juillet 1992. Contacter: FASE Congress 1992, Swiss Acoustical Society, P.O. Box 251, 8600 Dübendorf, Suisse. Téléphone 0041-1-954 06 05 (Mme E. Rathe), Télécopieur 0041-1-954 33 48.

Acoustical Society of America: Memphis, Tennessee, du 19 au 23 octobre 1992. Contacter: Acoustical Society of America, 500 Sunnyside Blvd., Woodbury, NY 11797. Téléphone (516) 349-7800, poste 481.

Symposium de l'IEEE sur les ultrasons: Tucson, Arizona, octobre 1992. Contacter: Motorola Government Electronics Group, attention F.S. Hickernell, 8201 E. McDowell Rd., Scottsdale, AZ 85252, USA.

VDE - Kongress '92: Köln, Allemagne, du 12 au 14 octobre 1992. Contacter: VDE-Zentralstelle, Tagungen und Seminare, Stresemannallee 15, D-6000 Frankfurt, 70, Allemagne.

Tonmeistertagung 1992: Bergheim, Allemagne, **du** 18 au 21 novembre 1992. Contacter: Bildungswerk des Verbandes Deutscher Tonmeister, Honiggasse 16, D-5010 Bergheim 12, Allemagne.

COURS

Acoustics and Noise Control: Cheswick, Pennsylvanie, du 18 au 22 mai 1992. Contacter: AVNC, Continuing Education Division, 250 Shagbark Drive, R.D. #1, Cheswick, PA 16094.

Signal Processing: Cheswick, Pennsylvanie, du 18 au 22 mai 1992. Contacter: AVNC, Continuing Education Division, 250 Shagbark Drive, R.D. #1, Cheswick, PA 16094.

Program in Acoustics and Signal Processing: State College, PA, June, 1992. A unique four-week program, comprised of ten accredited graduate level courses in acoustics and signal processing, will be offered in June, 1992 by Penn State's Graduate Program in Acoustics in cooperation with the University's Applied Research Laboratory (ARL). Contact: Dr. Alan D. Stuart, Summer Program Coordinator, the Penn State Graduate Program in Acoustics, P.O. Box 30, State College, PA, 16804. Telephone (814) 863-4128 or FAX (814) 865-3119.

Modal Analysis: San Diego, California, USA,June 9 - 11, 1992. Contact: Scientific-Atlanta, Spectral Dynamics Products, 13112;.Evening Creek Drive South, San Diego, CA 92128, USA. For further information or to register, Telephone Bob Keifer at (619) 679-6351.

Sound Intensity: Cheswick, Pennsylvania, June 22 - 26, 1992. AVNC, Continuing Education Division, 250 Shagbark Drive, R.D. #1, Cheswick, PA 16094.

ISVR - Short Courses 1992: The University, Southampton, UK.

Technical Audiology	Sept. 7 - 11
21st Advanced Course in Noise & Vibration	Sept. 14 - 18
11th Annual Engine Noise & Vibration Control Course	September

Further information regarding the above courses may be obtained from: ISVR Conference Secretary, Institute of Sound and Vibration Research, The University, SOUTHAMPTON, SO9 5NH, UK/ Tel: 0703 0592310; FAX: 0703 593033.

Certificate in Competence in Work Place Noise Assessment: London. UK. October 12 - 15, 1992. Contact: Centre for Continuing Professional Education, Room n201, IoEE, South Bank Polytechnic, Borough Road, London SE1 0AA, UK.

NEW PRODUCTS

Audio Manufacturers Directory Available : The Schafer Library has announced the publication of the second annual edition of the audio manufacturers' address book. Each of the more than 1,500 alphabetical manufacturers' listings include name, address, zip, phone, FAX, WATTS, contact person and type of product.

This master listing for audio equipment manufacturers has gone to a three-ring binder format. Regular updates will assist in keeping information current. The subscription price is $65 per year plus $3.50 shipping and handling. Contact the Schafer Library at P.O.Box 1241, Concord, NC 28026. Tel: (704) 786-3009.

ASTM offers "A Guide to Standards", a clearly-written introduction to voluntary consensus standards, for the individual as well as the organization that puts standards in its agenda.

The "Standards Developers" chapters provides addresses and brief descriptions for a wide range of national and international standards development organizations. Other chapters include: *The History of Standards, Development of Standards, Importance and Appiciation of Standards, Problems in Using Standards, Correcting Standards Problems, Involvement in Standard and Critical Source Information.*

This 129-page, soft-cover publication is available for $12 ($10 for members) from ASTM, 1916 Race Street, Philadelphia, PA 19103.

Program in Acoustics and Signal Processing: State College, Pennsylvanie, juin 1992. Programme d'une durée de quatre semaines comprenant dix cours de 2e cycle en acoustique et en traitement des signaux, offert par le programme de 2e cycle en acoustique du Penn State College en collaboration avec le laboratoire de recherche appliquée (ARL). contacter: Dr. Alan D. Stuart, Summer Program coordinator, the Penn State Graduate Program in Acoustics, P.O. Box 30, State College, PA 16804, USA. Téléphone (814) 863-4128, Télécopieur (814) 865-3119.

Modal Analysis: San Diego, Californie, du 9 au 11 juin 1992. Contacter: Scientific-Atlanta, Spectral Dynamics Products, 13112;. Evening Creek Drive South, San Diego, CA 92128, USA. Téléphone (619) 679-6351 (Bob Keifer).

Sound Intensity: Cheswick, Pennsylvanie, du 22 au 26 juin 1992. Contacter: AVNC, Continuing Education Division, 250 Shagbark Drive, R.D. #1, Cheswick, PA 16094.

ISVR - Short Courses 1992: The University, Southampton, Grande-Bretagne. Technical Audiology, du 7 au 11 septembre; 21st Advanced Course in Noise & Vibration, du 14 au 18 septembre; 11th Annual Engine Noise & Vibration Control Course, septembre. Contacter: ISVR Conference Secretary, Institute of Sound and Vibration Research, The University, Southampton, S09 5NH, Grande-Bretagne. Téléphone 0703 592310, Télécopieur 0703 593033.

Certificate in Competence in Work Place Noise Assessment: Londres, Grande-Bretagne, du 12 au 16 octobre 1992. Contacter: Centre for Continuing Professional Education, Room n2102, IoEE, South Bank Polytechnic, Borough Road, Londres SE1 0AA, Grande-Bretagne.

NOUVEAUX PRODUITS

Audio Manufacturers Directory: Schafer Library vient de publier la deuxième édition annuelle du répertoire d'addresses des fabricants de matériel audio. Ce répertoire alphabétique, qui est contenu dans une reliure à trois anneaux, comprend plus de 1 500 noms de fabricants, avec adresses, numéros de téléphone/télécopieur/ligne watts, le nom d'une personne-ressource et le type de matériel fabriqué.

Il en coûte 65$ US par an, plus 3,50$ pour les frais d'expédition et de manutention, pour obtenir le répertoire et les mises à jour régulières. contacter: Schafer Library, P.O. Box 1241, Concord, NC 28026, USA. Téléphone (704) 786-3009.

A Guide to Standards: Ce guide s'adresse aux personnes et aux organismes qui oeuvrent dans le domaine de la normalisation et qui désirent avoir une vue d'ensemble du sujet.

Il explique en termes clairs l'historique des normes, leur création, ainsi que les problèmes d'utilisation rencontrés et les solutions possibles. Il contient aussi une longue liste d'organismes nationaux et internationaux de normalisation, avec leur adresse et une brève description.

Ce guide broché de 129 pages et disponible au coût de 12 $ US (10 $ US pour les membres) auprès de l'ASTM, 1916 Race Street, Philadelphia, PA 19103, USA.

PEOPLE IN THE NEWS

GUPTILL CONSULTING SERVICES has been engaged by the newly-formed Institute of Acoustics of Atlantic Canada (IAAC) to create an inventory of people and resources in the field of acoustics. The inventory includes keywords describing each person's area of interest, and a list of any special equipment or facilities to which he or she has access - along with the usual name, address, company, phone number, etc.

The inventory will be available in hard copy as well as soft copy formats. Soft copy formats are intended for use with IBM PC database management software and incorporate features such as auto-dial, mailing label generation, mail merge and the ability to search on any data field, to a professional contact management database, to a telemarketing tool.

A limited number of copies of the inventory are being distributed free of charge; after that they will be available on a cost recovery basis. To obtain a copy of the inventory, or to get yourself or your company listed in the inventory,contact:

Institute of Acoustics of Atlantic Canada
c/o Fred Guptill
Guptil Consulting Services
Box 213, Site 16, RR 2,
Armdale, Nova Scotia
Canada B3L 4J2
Phone/Facsimile: (902) 852-3878

LES GENS QUI FONT PARLER D'EUX

Guptill Consulting Services à été mandatée par le nouvel Institute of Acoustics of Atlantic Canada (IAAC) pour inventorier les personnes-ressource et entreprises du domaine de l'acoustique, avec mention de leur champ d'intérêt, des équipments et installations à leur disposition, en plus de leur adresse et de leur numéro de télephone.

Ce répertoire sera également disponible sur disquette pour utilisation avec les logiciels de gestion de base de données fonctionnant sur ordinaterus IBM. Parmi les fonctions qui seront possibles, notons l'appel automatique, la production d'étiquettes d'adresse, la fusion de fichiers et la recherche à partir de n'importe quel champ de données.

Un certain nombre d'exemplaires sont distribués gratuitement; les autres seront vendus à prix coûtant. Pour recevoir un épertoire ou pour y faire inscrire le nom de votre entreprise, contactez:

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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 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 year. For some awards 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 of the prizes and their eligibility conditions, as well as application forms and procedures from: The Secretary, Canadian Acoustical Association, P.O. Box 1351, Station F, Toronto, Ontario M4Y 2V9.

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. Past recipients are:

1990 Dr. Li Cheng, Université de Sherbrooke

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: Lynne Brewster. Past recipients are:

1990 Bradley Frankland, Dalhousie University
1991 Steven Donald Turnbull, University of New Brunswick
Fangxin Chen, University of Alberta
Leonard E. Cornelisse, University of Western Ontario

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 an approximately $400 cash prize to be awarded every two years. The prize was inaugurated in 1991. Coordinator: David Chapman.

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.

Directors' Awards

Three awards are made annually to the authors of the best papers published in *Canadian Acoustics*. The first author must study or work in Canada. 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: Chantal Laroche.

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.

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. Quant aux quatre premiers prix, les candidats doivent soumettre un formulaire de demande ainsi que la documentation associée 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. Pour certains des prix, 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 de: Le Secretaire, Association Canadienne d'Acoustique, C.P. 1351, Station F, Toronto, Ontario M4Y 2V9.

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 complété(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. Les récipiendaires antérieur(e)s sont:

1990 Dr. Li Cheng, Université de Sherbrooke

PRIX ETUDIANT 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. Coordonnatrice: Lynne Brewster. Les récipiendaires antérieur(e)s sont:

1990 Bradley Frankland, Dalhousie University
1991 Steven Donald Turnbull, University of New Brunswick
Fangxin Chen, University of Alberta
Leonard E. Cornelisse, University of Western Ontario

PRIX ETUDIANT 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 d'environ $400 qui sera décerné tous les deux ans. Ce prix a été inauguré en 1991. Coordonnateur: David Chapman.

PRIX ETUDIANT ECKEL EN CONTROLE DU BRUIT

Ce prix sera décerné à un(e) étudiant(e) inscrit(e) dans une institution académique canadienne dans n'importe quelle discipline de l'acoustique et menant un projet de recherche relié à l'avancement de la pratique en contrôle du bruit. Il consiste en un montant en argent de $500 qui sera décerné annuellement. Ce prix a été inauguré en 1991. Coordonnateur: Murray Hodgson.

PRIX DES DIRECTEURS

Trois prix sont décernés, à tous les ans, aux auteurs des trois meilleurs articles publiés dans l'*Acoustique Canadienne*. Le premier auteur doit étudier ou travailler au Canada. Tout manuscrit rapportant des résultats originaux ou faisant le point sur l'état des connaissances dans un domaine particulier sont éligibles; les notes techniques ne le sont pas. Le premier prix, de $500, est décerné à un(e) étudiant(e) gradué(e). Le deuxième et le troisième prix, de $250 chaqun, sont décernés à des auteurs professionnels âgés de moins de 30 ans et de 30 ans et plus, respectivement. Coordonnatrice: Chantal Laroche.

PRIX DE PRESENTATION ETUDIANT

Trois prix, de $500 chaqun, sont décernés annuellement aux étudiant(e)s sous-gradué(e)s ou gradué(e)s présentant les meilleures communications lors de la Semaine de l'Acoustique Canadienne. La demande doit se faire lors de la soumission du résumé. Coordonnateur: Alberto Behar.

INSTRUCTIONS TO AUTHORS PREPARATION OF MANUSCRIPT

Submissions: The original manuscript and two copies should be sent to the Editor-in-Chief.

General Presentation: Papers should be submitted in camera-ready format. Paper size 8.5" x 11". If you have access to a word processor, copy as closely as possible the format of the articles in Canadian Acoustics 18(4) 1990. All text in Times-Roman 10 pt font, with single (12 pt) spacing. Main body of text in two columns separated by 0.25". One line space between paragraphs.

Margins: Top - title page: 1.25"; other pages, 0.75"; bottom, 1" minimum; sides, 0.75".

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Abstracts: English and French versions. Headings, 12 pt bold, upper case, centered. Indent text 0.5" on both sides.

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Page numbers: In light pencil at the bottom of each page.

Reprints: Can be ordered at time of acceptance of paper.

DIRECTIVES A L'INTENTION DES AUTEURS PREPARATION DES MANUSCRITS

Soumissions: Le manuscrit original ainsi que deux copies doivent être soumis au rédacteur-en-chef.

Présentation générale: Le manuscript doit comprendre le collage. Dimensions des pages, 8.5" x 11". Si vous avez accès à un système de traitement de texte, dans la mesure du possible, suivre le format des articles dans l'Acoustique Canadienne 18(4) 1990. Tout le texte doit être en caractères Times-Roman, 10 pt et à simple (12 pt) interligne. Le texte principal doit être en deux colonnes séparées d'un espace de 0.25". Les paragraphes sont séparés d'un espace d'une ligne.

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Sommaire: En versions anglaise et française. Titre en 12 pt, lettres majuscules, caractères gras, centré. Paragraphe 0.5" en alinéa de la marge, des 2 cotés.

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Avez-vous des nouvelles que vous aimeriez partager avec les lecteurs de l'*Acoustique Canadienne*? Si oui, écrivez-les et envoyer le formulaire à:

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Subscription for the current calendar year is due January 31. Subscriptions received before July 1 will be applied to the current year and include that year's back issues of Canadian Acoustics, if available. Subscriptions received from July 1 will be applied to the next year.

L'abonnement pour la présente année est dû le 31 janvier. Les abonnements reçus avant le 1 juillet s'appliquent à l'année courante et incluent les ancient numéros (non-épuisés) de l'Acoustique Canadienne de cette année. Les abonnements reçus à partir du 1 juillet s'appliquent à l'année suivante.

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L'Association Canadienne d'Acoustique tient à témoigner sa reconnaissance à l'égard de ses Abonnés de Soutien en publiant ci-dessous leur nom et leur adresse. En amortissant les coûts de publication et de distribution, les dons annuels (de $150.00 et plus) rendent le journal accessible à tous nos membres. Les Abonnés de Soutien reçoivent le journal gratuitement. Pour devenir un Abonné de Soutien, faites parvenir vos dons (chèque ou mandat-poste fait ou nom de l'Association Canadienne d'Acoustique) au rédacteur associé (publicité).

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