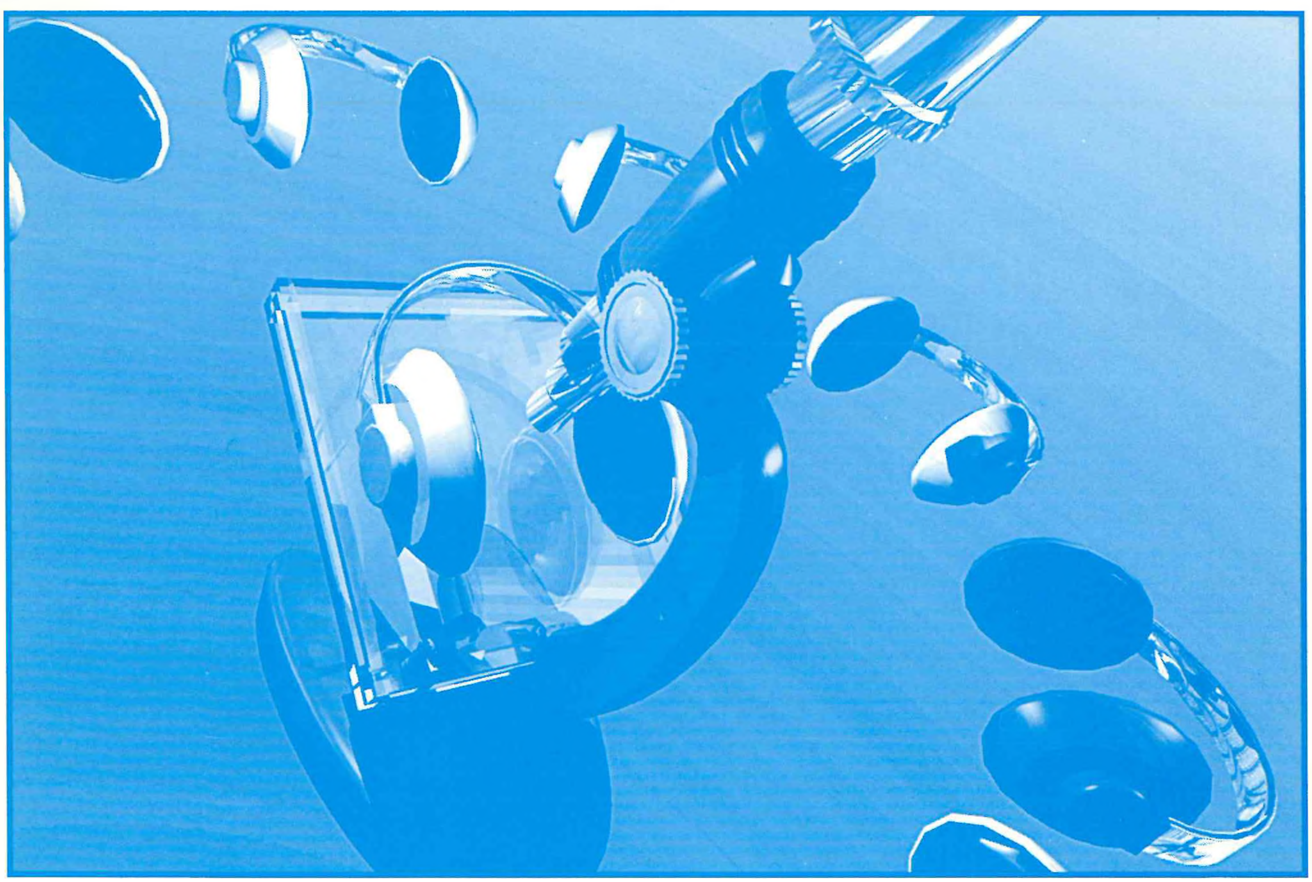
ISSN 0711-6659

canadian acoustics
acoustique canadienne

MARCH 1994 MARS 1994
Volume 22 — Number 1 Volume 22 — Numéro 1



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EDITOR-IN-CHIEF / REDACTEUR EN CHEF

Murray Hodgson
Occupational Hygiene Programme
University of British Columbia
2206 East Mall
Vancouver, BC V6T 1Z3
(604) 822-3073

EDITOR / REDACTEUR

Chantal Laroche
Département d'orthophonie et d'audiologie
Université d'Ottawa
545 King Edward
Ottawa, Ontario K1N 7N5
(613) 564-2933

ASSOCIATE EDITORS / REDACTEURS ASSOCIES

Advertising / Publicité

Chris Hugh
Ontario Hydro - H13
700 University Avenue
Toronto, Ontario M5G 1X6
(416) 592-5193

News / Informations

Jim Desormeaux
Ontario Hydro
Health and Safety Division
1549 Victoria Street East
Whitby, Ontario L1N 9E3
(905) 430-2215

EDITORIAL

As has been so well depicted by our cover illustrator, Simon Tuckett (it's about time I gave him a credit), the two technical articles in this issue put hearing-conservation programmes and hearing protection uner the microscope.

In particular, we publish a major research article by our Association's President. It presents the author's perception of how the current way of thinking about hearing conservation and noise control developed historically, and its consequences. It argues that a completely new way of thinking is required. This article is bound to be controversial and to displease some readers. I have had some taste of this in trying to have it reviewed. A number of potential reviewers declined because they felt that the article only stated an opinion; they suggested it be published as such without review and that comments be invited. Others considered the article's arguements to be biased. Another complained simply that it was not scientific.

I publish the article on the following basis. It may not be a conventional scientific article, basing its arguments on experimental observation. However, it is a logically argued treatise, basing its arguments on a reasonable interpretation of historical events and the published literature. It has been reviewed by experts in the field, and revised in response to the reviewers' comments. I publish the article as a thought-provoking piece of work, thereby opening it to public scrutiny. I invite anyone who so wishes to send me their comments on the article for publication in a future issue of this journal.

Also published in this issue is the announcement, call for papers and general information concerning Acoustics Week in Canada 1994 to be held in Ottawa. The organizers will be putting on an excellent meeting with interesting courses, exhibition and technical symposium. Get your abstracts in and reserve your flights. See you in Ottawa.

Comme le suggère l'illustrateur de notre page couverture, Simon Tuckett, (il est à peu près temps de lui donner le crédit qui lui revient), les deux articles techniques de ce numéro scrutent à la loupe les programmes de conservation de l'ouïe et la protection auditive.

Plus précisément, nous publions un article de fond écrit par le Président de l'Association. L'auteur nous présente sa perception de l'évolution historique du courant de pensée actuelle sur la conservation de l'ouïe et le contrôle du bruit, ainsi que leurs conséquences. Il insiste sur la nécessité de modifier complètement notre façon de penser. Cet article risque d'entraîner une controverse et déplaira à certains lecteurs. J'en ai eu un avant-goût en tentant de le faire réviser. Plusieurs réviseurs potentiels ont décliné l'invitation en prétendant que l'auteur exprimait uniquement une opinion; ils ont alors suggéré de le publier sans révision et de solliciter des commentaires. D'autres réviseurs ont considéreé que les arguements soulevés dans l'article étaient biaisés. Un autre a simplement rapporté qu'il n'était pas scientifique.

Ma décision de publier cet article repose sur les bases suivantes. Il ne s'agit peut-être pas d'un article scientifique conventionnel dont les arguments sont basés sur l'observation expérimentale. Cependant, il s'agit d'un traité logiquement présenté et basé sur une interprétation raisonnable des événements historiques et de la littérature publiée. Il a été révisé par des experts de la discipline et modifié en réponse aux commentaires des évaluateurs. Je publie donc cet article à titre de manuscrit qui pousse à la réflexion, le laissant ainsi subir un examen général. J'invite donc ceux et celles qui le désirent à m'envoyer leurs commentaires pour publication dans un prochain numéro du journal.

Finalement, vous trouverez dans ce numéro l'annonce, l'appel aux communications ainsi que de l'information générale sur la Semaine de l'Acoustique Canadienne 1994 qui se tiendra à Ottawa. Les organisateurs préparent un excellent congrès qui s'articulera autour de cours, d'une exposition et d'un symposium technique des plus intéressants. Préparez vos résumés et réservez vos billets d'avion. En espérant avoir le plaisir de vous rencontrer à Ottawa.

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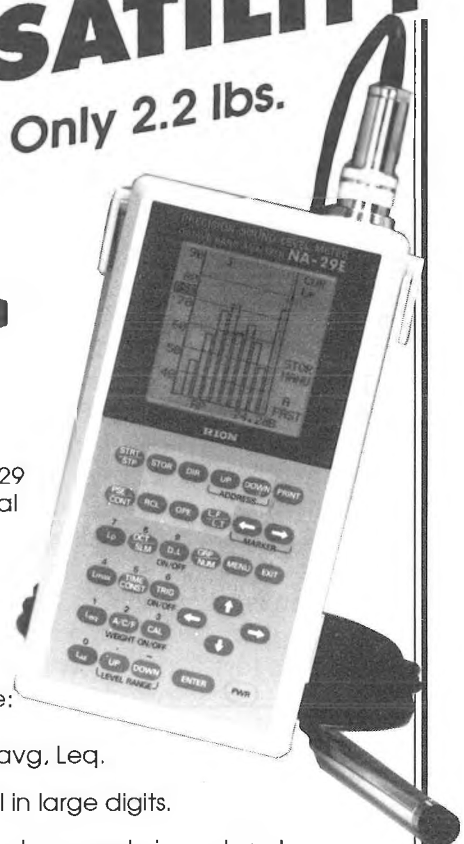

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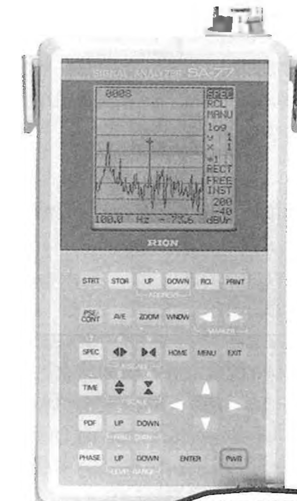

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Canadian Acoustics / Acoustique Canadienne 22(1) 3-19 (1994) **Research article / Article de recherche**

The Hearing Conservation Paradigm and the Experienced Effects of Occupational Noise Exposure

Raymond Hétu
Groupe d'acoustique de l'université de Montréal
C.P. 6128, Montréal, Québec, Canada H3C 3J7

Summary

The high prevalence of over-exposure to industrial noise is examined by means of an analysis of the paradigm of hearing conservation in noise and the characteristics of industrial workers' perceptions of the effects of noise. After considering the historical context and documents that have inspired the hearing conservation paradigm, the underlying implicit postulates and their influence on programs concerning industrial noise are examined. It is then demonstrated how the hearing conservation paradigm operates as a black box, allowing only the risk of compensable hearing loss as input and personal protection, audiometric surveillance and experts' reports on compensation claims as output. The absence of controversy around the paradigm itself is explained by the lack of awareness of the consequences of noise exposure and the fact that such consequences are not viewed as being serious. Alternative paradigms are proposed to improve the acoustic environment in industry.

Sommaire

La forte prévalence des sur-expositions au bruit en milieu industriel est examinée par le biais d'une analyse du paradigme de la préservation de l'audition dans le bruit et des caractéristiques de la perception des effets du bruit par les personnes qui travaillent en industrie. En s'appuyant sur le contexte historique et sur les écrits qui ont donné naissance au paradigme de la préservation de l'audition, les différents postulats implicites qui le sous-tendent sont examinées en montrant leur impact sur les interventions concernant le bruit industriel. Ainsi, il est démontré que la préservation de l'audition opère comme une boîte noire dont le seul intrant admissible est le risque de perte auditive indemnisable et les extrants sont la protection individuelle, la surveillance audiométrique et les expertises de réclamations. L'absence de controverse autour du paradigme lui-même est expliqué par le fait que les conséquences de l'exposition professionnelle au bruit ne sont pas connues et ne sont pas ressenties comme étant importantes. D'autres paradigmes sont proposés en vue d'assainir l'environnement sonore industriel.

1. Introduction

Noise in the workplace has been known to cause hearing impairment for more than a century [1].Yet, fifteen years ago, approximately 60 % of the total industrial workforce in the U.S.A. was known to be exposed to sound levels capable of causing damage to hearing [2]. The situation has not improved since then [3-4] despite the fact that hearing conservation programs have been instated in a large majority of industrial workplaces. Noise appears to be the most common environmental aggressor in industry [5]. A survey conducted in heavy industry across the province of Québec has shown that 56% of the workforce was exposed to daily levels of over 85 dBA-8h; in comparision, the second most prevalent environmental aggressor, ergonomic constraints, involved only 12% of the workforce. Despite the high prevalence of over-exposure, noise control is in very low demand in industry.

This was the unanimous conclusion of a seminar held recently at the Institut de recherche en santé et sécurité du travail du Québec (IRSST) where representatives of management and labor, researchers and consultants discussed research priorities in noise control [7]. Furthermore, in many workplaces affected by recent technological change, noise levels often increase with the introduction of more productive machinery [8].

In this paper, it is argued that this paradoxical situation stems from the influence of two inter-related factors: (1) the way in which the effects of occupational noise exposure have been addressed under the hearing conservation paradigm and (2) the way in which such effects are perceived and experienced by noise-exposed workers.

2. Hearing conservation: a scientific paradigm that has served to define and address the problem of industrial noise

2.1 The concepts of paradigm and black box

The concept of paradigm was introduced into the philosophy of science to account for the inevitable sharing of a certain number of presuppositions among members of a given scientific community at a given time [9]. Such presuppositions spare the latter from endless verification prior to undertaking an investigation. This process is inevitable if investigations are to be undertaken. It may, nonetheless, be enlightening to go back to the underlying presuppositions to understand how a particular demonstration of evidence is bound to a specific social context.

Parallel to this general view, the concept of black box was introduced to account for the other end of the process of constructing scientific proofs. Once a controversy is settled in favor of a given paradigm, the proposition becomes a "fact" accepted by everyone in the field [10-11]. Let us take an example: evidence of damage to hearing from occupational noise exposure can be obtained by means of an audiogram. Such a fact operates as a black box in the sense that it is referred to without any authorship and any reference to the historical or experimental context that informed its acceptance by the scientific community; it is taken for granted as being part of the nature of things by anyone involved in the field of occupational hearing loss. In order to clarify the presuppositions behind such facts, one must retrace the history of the controversies that took place before such propositions became accepted. In other words, in order to open a black box, one has to go back to the history of its construction.

In the following paragraphs, hearing conservation (HC) is examined as a black box that has served to define and address the problem of industrial noise in a particular way. Its underlying presuppositions are examined after a brief historical account of its emergence. This is followed by a short analysis of the way HC operates as a black box with predefined input and output that exclude a certain number of issues and govern the way industrial noise exposure is addressed.

2.2 Historical construction of the HC black box

Hearing loss due to prolonged exposure to industrial noise is an occupational disease that does not prevent its victims from continuing to work in the harmful industrial environment. Consistent with the fact that it did not involve wage loss, it was considered by scientists as unproblematic. A case in point is the noncommital conclusion of the following review, published in 1950, of more than 40 field studies showing a relationship between hearing loss and the working environment: "Apparently, continued repeated exposures over extended periods (years) may result in a partial but permanent deafness" [12]. The nature of the relationship changed from one of mere possibility to established fact when court rulings entitled workers to monetary compensation for partial loss of hearing even though the impairment did not prevent them from working.

A ruling was handed down on a test case for the first time in 1948 by the New York Workers' Compensation Board, and upheld by the Supreme Court of New York [13, p.64]. Another case was filed in 1951 in Wisconsin by a worker from the Ladish Forge Company, and the foundry paid the first claimant without challenge from the employer's insurance company. Strong opposition from the employer came when over 100 additional claims were filed [14]. Facing a barrage of claims, the Wisconsin Industrial Commission decided to hear a test case in an appeal. The Commission ruled that the claimant, Albert Wocjik, who was employed by Green Bay Drop Forge, was subject to compensation without suffering wage loss. This decision was overturned in an appeal to the County Circuit Court. The Commission appealed the latter decision, but in the meantime, all claims for hearing loss compensation were blocked. In 1953, the State Supreme Court upheld the original Industrial Commission ruling.

To prepare for a regulation on permanent hearing loss, the Commission appointed an Advisory Committee chaired by Meyer Fox, an otologist acting as medical consultant for Ladish Forge and the Liberty Mutual Insurance Co., a local workmen's compensation insurer. Three other otolaryngologists were involved, together with the chairman of the Wisconsin Industrial Commission, a former vice-president of the Employers Mutual Insurance [14]. Before a bill was passed in 1955, which reinstated the admissibility of claims for hearing loss, the employers represented strong arguments to the Advisory Committee, claiming that compensation would involve billions of dollars if the Commission ruled in the same way as in the first test case, and that such a ruling would lead manufacturers to move to other states. The labour movement did not raise strong objections to such contentions, nor did they voice the possibility of conflict of interest on the part of members of the Advisory Committee. The schedule proposed by Meyer Fox and his advisory committee was adopted by law, and later served as a reference for all other states and countries where occupational hearing loss became eligible for compensation. The schedule involved an intricate set of procedures that considerably limited a worker's chances of filing a claim; one of these was to require a 6-month leave of absence from noisy work in order to be eligible for a claim, ostensibly to allow for complete recovery from temporary hearing loss due to occupational noise exposure. In most instance, this meant that only unemployed or retired employees were able to file a claim.

This compensation schedule gave rise to the paradigm that later defined the problems raised by occupational noise exposure and defined their solutions accordingly. In other words, prior to the first successful claims, occupational noise exposure was a non-issue. But it then became a problem for employers and their insurers, who called for scientific and professional intervention:

> "As employers and insurance carriers were confronted with these claims, they became more conscious of the occupational hearing loss problem. Research studies indicated that as many as 25 per cent of applicants for industrial jobs had some loss of hearing. In some states, fears began to be expressed that the flood of hearing loss claims might be ruinous to insurance carriers who did not collect premiums against this kind of liability. This

situation is further complicated by the fact that the worker's hearing loss may be due only in part to occupational exposure. In many cases, there are no records by which causal relationships can be established as between present employment, past employment, and non-occupational causes..." [13, p. 685].

This type of scientific and professional intervention, that was initially sustained by Meyer Fox and three other otologists, rapidly drew in a larger circle of experts, namely the American Academy of Ophthalmology and Otolaryngology (AAOO), which in 1957 published a set of practical guidelines paradoxically labelled "Guide for Hearing Conservation in Noise" [15]. This included the defintion of hearing loss arbitrarily set by Meyer Fox. The AAOO later convinced the American Medical Association to revise its medico-legal definition of hearing loss in keeping line with the Wisconsin compensation schedule [13, p. 689]. The hearing conservation in noise approach rapidly became a black box for which input and ouptput was constantly refined, without any basic questioning of the paradigm it put forward. Since that time, it has dominated almost all scientific analysis of and professional or institutional intervention on the effects of occupational noise exposure.

Hearing conservation in noise has been designed to limit access to compensation to a minimum. It appears to have achieved its goal, considering the small number of individuals who actually benefit from compensation, compared to the very large population exposed to noise levels that have been shown to be damaging. For example, it is estimated that approximately four percent of the total number of noise-exposed retirees have benefited from a compensation in the USA [3, p. 7]. The degree of success in limiting access to compensation have inevitably varied from one country to another and, within countries, from one state or province to another. However, the object of the present analysis is not to review compensation statistics for occupational hearing loss across national administrations, but rather, to characterize how the HC black box has contributed to maintain high proportions of industrial workers being exposed to noise.

2.3 Opening the HC black box: making its underlying presuppositions explicit

The HC paradigm involves unquestioned presuppositions which in most cases are never stated explicitly. In the present analysis, five of these presuppositions hereafter called postulates and their major corollaries, listed in Table 1, are drawn from passages in the "Guide for Hearing Conservation in Noise" published by the AAOO [15; Note: The 1969 version has been used as source of reference in this paper, knowing that it had a major influence on the national regulations concerning occupational noise exposure].

Table 1. The basic preconceptions of the hearing conservation in noise paradigm formulted in terms of postulates (P.) and corollaries (C.).

P. A: Occupational noise exposure poses a health problem as long as it is proved to cause 'compensable hearing losses'
<u>C. A1</u>: Loss of hearing sensitivity is of no consequence until it reaches the specified compensable level.
<u>C. A2</u>: The only effect of noise on hearing is loss of sensitivity and its only consequence in the course of a lifetime is a loss of ability to understand speech.
<u>C. A3</u>: There are no environmental factors in the workplace other than noise that can adversely affect hearing.
<u>C. A4</u>: There are many non-occupational factors responsible for hearing loss among noise-exposed workers.
<u>C. A5</u>: Ear-nose-and-throat surgeons are the HCN experts.

P. B: Noise is there to stay

P. C: Some individuals are excessively susceptible to noise-induced hearing loss.
<u>C. C1</u>: The risk factors of NHIL are a) the level of exposure, b) the length of time an employee is exposed to noise and c) individual susceptibility to noise-induced hearing loss.
<u>C. C2</u>: The susceptible individuals need to be identified.

P. D: Hearing protective devices can always be an effective and adequate means to prevent compensable hearing los

P. E: Periodic hearing tests warrant prevention of hearing loss
<u>C. E1</u>: Early detection of hearing loss by means of audiometric monitoring leads to prevention.
<u>C. E2</u>: Audiometric monitoring can effectively detect changes in the hearing sensitivity of noise-exposed individuals before any hearing disability occurs.

Postulate A. Occupational noise exposure poses a health problem as long as it is proved to cause 'compensable hearing losses'

"By risk we mean the percentage of persons who, because of noise-exposure, may be expected to develop a significant hearing handicap during their life"[15, p. 15]. "Hearing impairment (handicap) is defined as more than 26 dB ISO for the average hearing level at 500, 1000, and 2000 Hz "[15, p22].

The definitions quoted above have many implications that may be termed implicit corollaries.

<u>Corollary A1</u>: Loss of hearing sensitivity is of no consequence until it reaches the specified compensable level.

Scientists have decided that a certain sensory capacity is superfluous. This position has since been refined in technical discussions on what is "acceptable hearing loss" [16]. It is noteworthy that, even in the narrow context of compensation for occupational diseases, the concept of an acceptable impairment is unusual in compensation schedules with respect to other diseases. The early proponents of the HC paradigm have persisted in asserting that even with a loss of 25 decibels averaged over 500, 1000 and 2000 Hz, "the large majority of listeners notice no disadvantage" [17]. Such expert assertions were made without empirical support [18]. This line of argument maintained by scientific authorities created the impression that someone with noise-induced hearing loss is only handicapped when the degree of deafness is equivalent to total loss of hearing [19], a very unlikely event. Since a compensable hearing loss, as defined above, refers to difficulties in hearing faint speech, no serious difficulties are implied and, and their is then no need for rehabilitative help. The HC paradigm has thwarted the development of rehabilitation programs specifically designed for people affected by occupational hearing loss, despite the fact that such loss is one of the most prevalent irreversible occupational diseases [20].

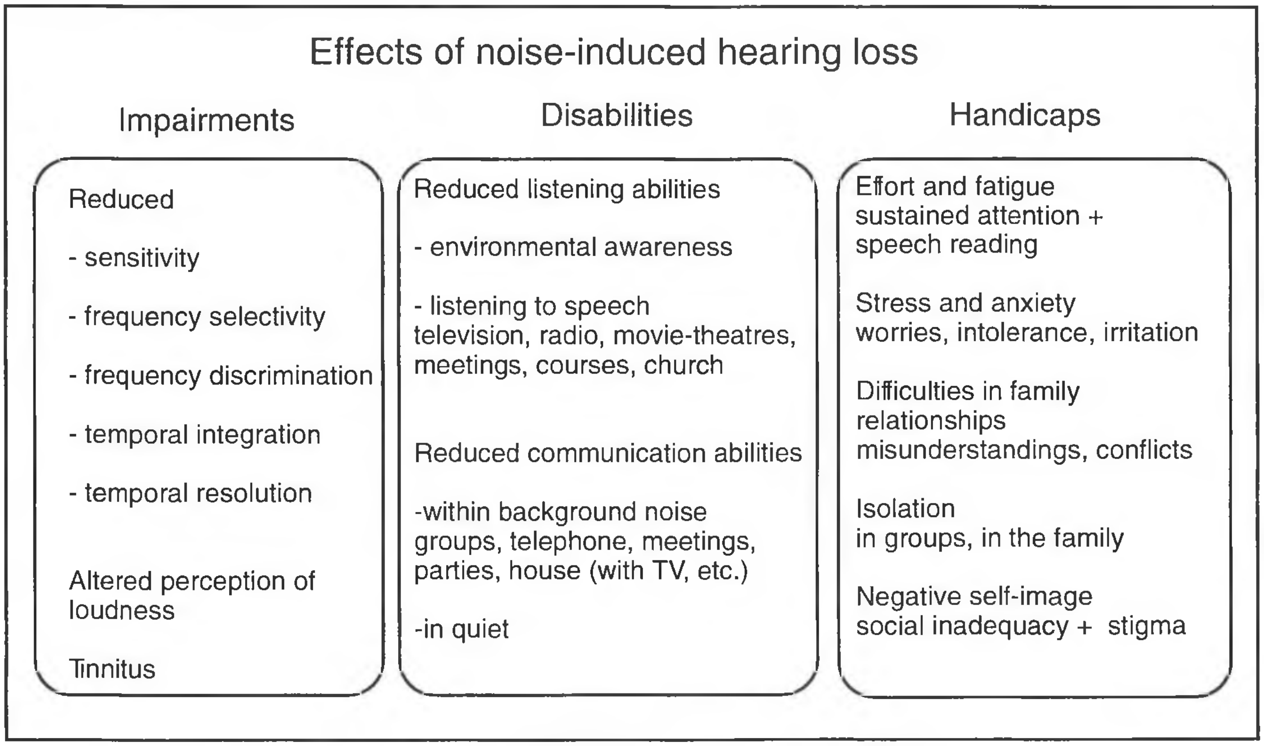

Figure 1. Classification of the various effects of noise-induced hearing loss.

Corollary A2: The only effect of noise on hearing is the loss of sensitivity, and the only consequence in the course of a lifetime is a loss of ability to understand speech.

That the effects of noise exposure are being reduced to a loss of hearing sensitivity becomes obvious when one considers the various effects of noise-induced hearing loss, as summarized in Figure 1. Impairments refer to abnormal hearing function as characterized more than 30 years ago by psychoacousticians. Disabilities refer to the hearing difficulties experienced by people suffering occupational hearing loss as reported in questionnaire surveys and interviews [20]. It can be seen that a reduced ability to communicate in quiet is only one of the many difficulties involved. Actually, this problem is reported less often by such people; the problem of understanding speech with competing background noise is much more prominent. Handicaps correspond to the psychological and social disadvantages resulting from impairment and disability. The list in Figure 1 provides only a very brief summary of the complex descriptions given by affected workers and their spouses in the context of couple and group interviews. The temporary hearing loss resulting from day-to-day noise exposure at work causes the same type of effects as permanent loss, and is experienced daily. It is nevertheless excluded from the HC paradigm; since it is reversible, it is considered not unharmful. This means that the daily experience of altered hearing ability in the hours following a workday is not seen as causing consistent difficulty and handicap.

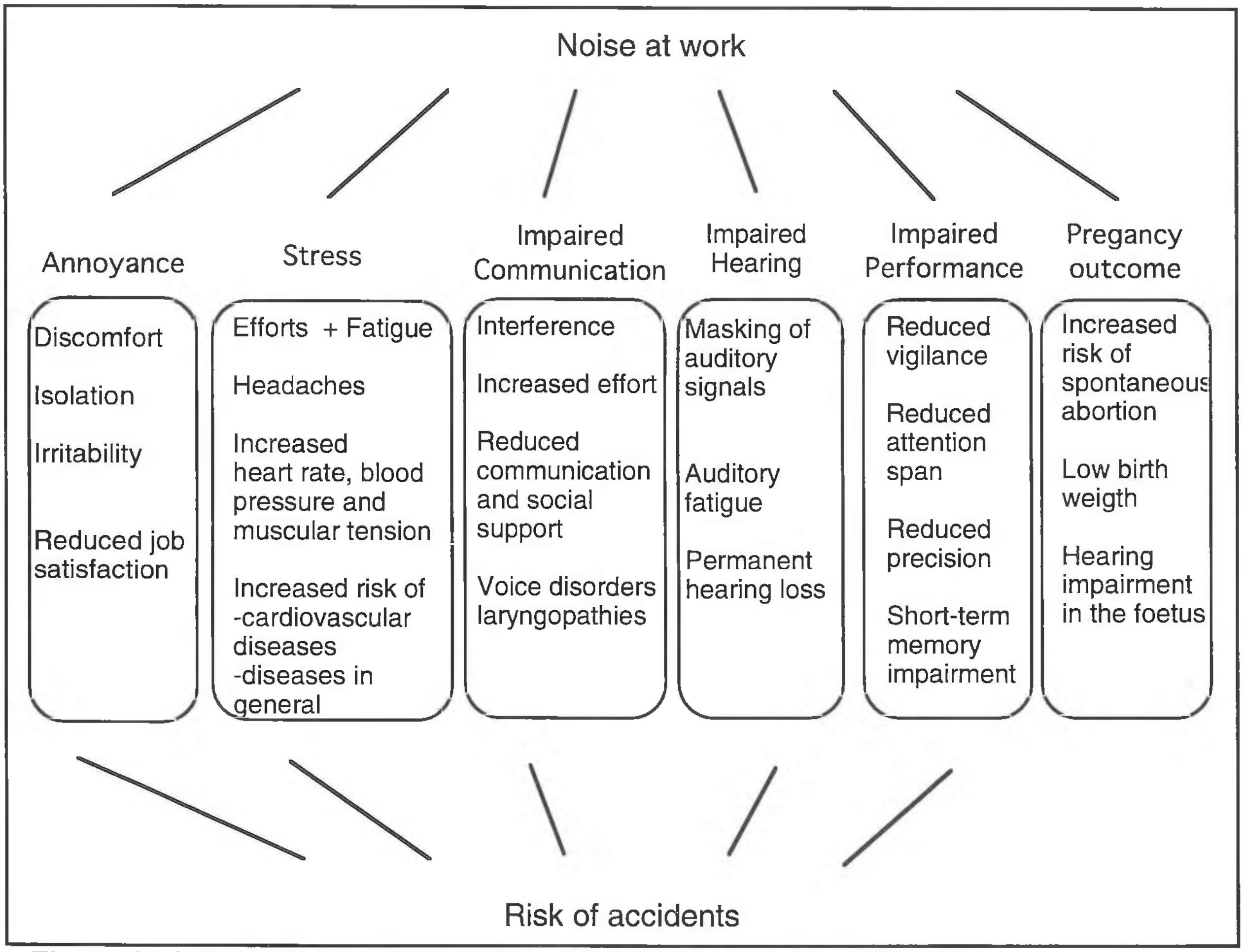

Figure 2. Outline of the various effects of occupational noise exposure.

The definition of the problem in the HC paradigm further reduces all possible effects of occupational noise exposure to its effect strictly on hearing. This oversimplification is illustrated by the brief summary of documented effects of noise [21-28] given in Figure 2. These other effects were ignored as being related to attitude, and therefore insignificant, or as not being subject to systematic and controlled measurement, or as being a mere question of habituation:

> "The annoyance caused by noise is largely a psychological response" [29].
>
> "The behavioral effects [of noise] are quite nebulous and virtually impossible to measure" [30].
>
> "Fortunately, the magnitude of these physiological responses wears off rapidly with repetition of the noise exposure"[29].
>
> "Much has been said and written concerning the effects of noise upon the behavior of man. Some of the purported effects include nervousness, fatigue, inefficiency, sterility and even death. In no case, however, is there any valid evidence to support any of these claims. As a matter of fact, previous evidence refutes any such claims except in the case of extremely loud noises such as those produced by after-burning jet engines" [31].

Otologists have taken on the role of defining the health problems that can be experienced by noise-exposed people, a common practice in the medical profession [32]. Doing so within the HC paradigm implies that the scientist cuts himself off from the experience of being exposed to and affected by noise at work, thus considering only the objective quantifiable description of an altered physical condition resulting from this experience. Treating people's health as an object by reducing it to the form of its measurement makes it possible to control those concerned [33]. It denies most of the effects of noise exposure and invalidates workers' perception of the potential harmfulness of their environment.

As health problems due to noise are reduced to audiometric records, they become computable, mobile and combinable [11, p.227] in a way that makes them manageable. HC is thus headed essentially towards management of the loss of hearing sensitivity among industrial workers.

Corollary A3: There are no environmental factors in the workplace other than noise that can adversely affect hearing.

The definition of risk stated under Postulate A refers strictly to noise exposure. This again represents a simplification that disqualifies any other environmental factor from being hazardous to the auditory system. It has had the effect of discouraging any attempt to systematically investigate such factors and consider them within the framework of regulation of the working environment. Except for whole-body and hand-arm vibration, data on the effects of other toxicants to hearing, such as toxic gases, heavy metals, organic solvants, repiratory irritants and climatic conditions, have been collected outside the framework of occupational exposure [34]. Evidence of the potentialization of noise by vibration exposure has never been considered in the adoption of exposure limits to noise. More disturbing is the fact that, when these various factors are involved in the causation of hearing loss among industrial workers, compensation is denied because their hearing loss is judged as not being typical of the effects of noise [35]. Obviously, the possibility of interaction between the effect of noise and other environmental factors is ignored as well, and hearing conservation programs in industry do not consider other occupational exposure conditions aside from noise.

Corollary A4: There are many non-occupational factors responsible for hearing loss among noise-exposed workers.

Once the health problem is defined within a compensation scheme, its occurrence is necessarily judged within an individual diagnostic perspective with the aim of retrospectively establishing its cause. The line of argument on hearing loss among industrial workers has thus been persistently governed by the supremacy of non-occupational factors. In 1955, a representative of employer insurance carriers expressed the view that still governs hearing conservationists:

> "Although no definite standards have been established, the report of the New York Committee of Consultants implies that levels above 90 decibels may be found to be harmful to certain individuals. If such a standard is adopted, it could result in holding industry responsible for hearing losses which are incurred only in part on the job. There are many sources off the job to which both industrial workers and the general population are regularly exposed where the levels are in excess of 90 decibels. For example, published reports have shown that heavy city street traffic at 95 decibels, the noise of a subway train passing a station at 100 decibels and an automobile horn or blaring radio at 120 decibels" [36].

The same argument was maintained in 1990 as the result of a symposium sponsored by the USA National Institute of Health on occupational noise-induced hearing loss [37]. Emphasis was put on such sources of noise as kitchen appliances, domestic lawn mowers, etc., as a serious threat to hearing. This gives the impression that workplace noise is not a serious problem [19]. Despite the fact that extra-occupational noise exposure has not yet been demonstrated as a significant source of hearing loss among industrial workers [35,38], it is commonly invoked as a camouflage for excessive occupational noise.

Another non-occupational factor invoked is the normal aging process of the auditory system called presbycusis. The practice of adjusting the audiometric measurements was instated in the original compensation schemes, thus substracting the portion attributed to presbycusis from the total hearing loss measured. Apart from the complex technical issues involved regarding the validity of these corrections, this procedure obviously ignores the fact that the amount of hearing loss due to noise can dramatically exacerbate the effect of the inevitable loss of hearing due to aging. In other words, the hearing disability in everyday life is related to the total loss of hearing sensitivity, not to that part that could be attributed to noise exposure alone; an older industrial worker is thus at a serious disadvantage compared to people with presbycusis alone, or to a younger worker only affected by noise.

More generally, results of periodic hearing tests performed on noise-exposed workers by hearing conservationists are interpreted as showing only medical and nonoccupational noise exposure effects [e.g. ref. 39]. The persistent background belief is that occupational hearing loss is the exception not the rule in noisy industrial settings.

Consistent with corollaries A3 and A4, ear physiolgists have systematically investigated the possible interaction between noise exposure and the consumption of various drugs [40], ignoring the possible interaction with the chemicals of the working environment that can affect the hearing of industrial workers. Thus, people who are medically treated with drugs that can be toxic to the ear are identified as unfit to work in noisy industrial environments.

Corollary A5: Ear-nose-and-throat surgeons are the HC experts.

This corollary stems implicitly from the necessity, in a hearing sensitivity management program, of attributing abnormalities to the proper causes. It is further justified by the physicians' appropriation of responsibility for people's health:

> "The conservation of any human function is primarily a medical responsibility. Hearing conservation is no exception. Prevention, diagnosis and treatment of hearing loss; validation and approval of audiometric records; and the final assessment of measurements of hearing are medical responsibilities. Any hearing conservation program without medical supervision must be considered inadequate" [15, p.12].

Indeed, the otologists have the solution to the problem that they have defined in medico-legal terms and for which they provide the means of management. Seen in a broader context, it is paradoxical that surgeons, who have no technical knowledge or skills in noise control and industrial processes, are the accepted rational authority and the most legitimate spokesmen for the problem of excessive noise in the workplace. As explained below, the otologists rapidly recruited many allies among different scientific and professional specialties in order to have them adopting the HC paradigm.

Postulate B. Noise is there to stay

Although most publications on HC since 1975 are titled "hearing conservation", omitting "in noise" in qualifying their approach, they still convey the presupposition that hearing must be conserved despite the presence of excessive noise. The rationale explicit in the original texts is that it is most often technically impossible or economically unfeasible to reduce noise in the workplace; in more recent publications, noise control is merely a possibility, in constrast to the more accessible alternative of a hearing conservation program [41, p.4; 42, pp.1-8]. Noise control is sometimes included as a component of hearing conservation; but, then, it is stated as a possibility, the management of hearing being a necessity.

Noise control engineering has grown very significantly as a science and technology over the last 30 years. While debating the feasibility of reducing the permissible exposure limit to noise, the U.S. occupational health and safety administation (OSHA) commissioned a study on the issue of noise control feasibility in industry. The report, published in 1974 [43], showed convincingly that noise control solutions were available for a very large majority of job-sites across the manufacturing industry. More recently, experts in noise control engineering have clearly stated that the available technology is not implemented because of a lack of demand [7;44].

HC promoters further invoke the constraints associated with economical feasibility of noise control. "Achievability', "practicability", "economic viability" are argued for any occupational health issue [45]. Noise, however, is never considered as such, given the value-laden postulate that industry cannot support the cost of making the sound environment acceptable and safe. This implies a societal choice, made by scientists and professionals without any explicit and public debate. The influence of values on scientific practice in general is increasingly being acknowledged [46]. In the case of HC, contextual values not only have a degree of influence, they can be said to actually govern this field.

The values in question imply that it is not possible for an industrialized society to afford various goods and services without deafening a significant segment of the workers who produce and maintain such goods. The issue of weighing the value of workers' health, safety and lives in relation to economic demands is in itself objectionable, as shown by the U.S. Supreme Court ruling concerning pneumoconiosis in the textile industry [47, p.304]. In the case of occupational hearing loss, it has not even been discussed [49]. It was settled without ever being raised in a debate, thus subjecting men and women to the machine, a legacy of the industrial revolution. In the ongoing second industrial revolution, examples of increased noise levels in the workplace abound given the faster operations of more productive machinery which relies on more powerful technologies [8]. Hearing conservation programs are introduced as soon as new plants or new departments in existing plants are opened. Once it is assumed that noise is there to stay, "hearing conservation in noise" is not a contradiction in terms.

Postulate C. Some individuals are excessively susceptible to noise-induced hearing loss

> "It is clearly not feasible in many situations to try to eliminate the possibility of causing any noise-induced hearing loss in any individual. People vary too much in their susceptibility to noise and to other factors" [15, p.23].

Another version of this postulate is as follows:

> "No noise-exposure limit can be set to protect everyone. This is not possible, let alone reasonable: there is too much individual variation in susceptibility to noise-induced hearing loss" [30].

An artificial discontinuity is created in the distribution of the effect of noise on hearing sensitivity. The results from cross-sectional studies of hearing loss among industrial workers all showed that, for a given noise dose, there is indeed a wide variation of responses, the distribution of which is accounted for by a single statistical function [49]. By creating an artificial category, such as the so-called "susceptible individuals", the HC proponents open the door to differential treatment for a subgroup presumably corresponding to the extreme end of the statistical distribution. This special treatment is made explicit in the following two corollaries.

<u>Corollary C1</u>: "The risk factors of NIHL are a) the level of exposure, b) the length of time an employee is exposed to noise and c) individual susceptibility to noise-induced hearing loss" [13, p.1] (NIHL: noise-induced hearing loss).

Individual differences in the <u>response</u> to noise, defined in two mutually exclusive categories of susceptibility and non-susceptibility, is assimilated with <u>exposure</u> descriptors. This makes it possible to define an acceptable level of risk, namely, a level of exposure to noise that creates a risk of hearing loss only among the so-called susceptible individuals:

> "In most discussions of proposed criteria it is generally agreed that 80 dBA is completely acceptable, with no clear risk at all, while 95 dBA is usually the highest that is considered as possibly acceptable. This equivalent sound level A approaches a 30 % risk at 35 years. Actually 90 dBA has been the most frequent choice, but usually with the recognition that personal protection and also careful monitoring of hearing for telltale losses of sensitivity beginning at 4000 Hz should also be employed" [17;50].

Knowing that 90 dBA impairs shouted speech at a distance of one meter, one can imagine how annoying and constraining is such an "acceptable" exposure level. The introduction of the concept of acceptable risk within this outlook has laid the foundation for the first legal limit to occupational exposure to noise ever to be passed: that is, the Walsh-Healy Act in the USA in 1969 [51], which has inspired most national regulations later adopted by industrialized countries. It was explicitly acknowledged that limiting daily exposure to 90 dBA-8h would protect only 80 to 85 percent of the population against a compensable hearing loss after a lifetime of work. In doing so, it justified the need for procedures to assist in the management of the so-called susceptible individuals.

Corollary C2: The susceptible individuals need to be identified.

The scientific literature in the fields of auditory perception, audiology and ear physiology abound with accounts of attempts to identify a predictor of susceptibility to noise-induced hearing loss. This concern has inspired many investigations of the potential relationship between sensitivity to noise-induced hearing loss and sensitivity to auditory fatigue [52-54], eye color [55], race and gender [56], cigarette smoking [57], noise regimens that could induce increased resistance of the ear [58], etc. None of these attempts has yet been successful, and audiometric monitoring, that is, periodic hearing tests with noise-exposed workers, has served as the measure of susceptibility, as explained below.

Once an individual is classified as excessively susceptible by a physician, there is no other choice given but find another job that does not involve noise exposure. It is the individual, not the noise, that is considered the problem.

Such a hearing sensitivity management approach to industrial noise opens the door to further distinctions between subgroups of individuals:

> "The percentage of an industrial population potentially compensable for hearing loss caused by on-the-job noise exposure is strongly dependent on the race and sex characteristics of the population" [56, p.565].

It has been claimed by these authors that women are less sensitive than men, and black people less sensitive than white people, to hearing loss due to occupational noise exposure. This implies that employers who wish to limit compensation costs for noise-induced hearing loss could recruit the workers to be assigned to the noisiest worksites from specific subgroups of the population defined in terms of race and sex.

Postulate D. Hearing protective devices can always be an effective and adequate means to prevent compensable hearing loss

Once it is assumed that noise is there to stay, the effectiveness of palliative means for preventing hearing loss must then be unquestionable:

> "Hearing loss varies with the type of exposure and its degree of intermittency, the individual exposed, the total duration of exposure, and the degree of consistency of use of ear protection" [29].

The use of hearing protectors is prescribed with little if any consideration given to the working conditions in which they are supposed to be used. The protector is an icon with a cult following; it needs to be respected. If, for instance, a worker modifies it for more comfort, he or she is labelled an "offending employee" which is said to "abuse" the protector [59-60], as if a transgression had been committed.

Actually, thought and practice concerning the use of hearing protectors has evolved over the past 35 years. Because the very act of trying to motivate employees to wear protectors could result in an increase of claims for compensation [8, p.38], there was originaly little insistence on their use despite their recognized status as a privileged means of preventing noise-induced hearing loss. This is demonstrated by the fact that, prior to the eighties, many surveys of occupational hearing loss (in the absence of hearing protection) were being conducted in different industrialized countries. Because of the increasing number of compensation claims [13, p.4-6], insistence on their use by the hearing conservation professionals increased markedly in the late seventies. Consideration of the potential obstacles to their use was rare [61]. More recently, the insistence on the necessity of wearing them is demonstrated in motivation programs that use the results of hearing tests as proof of the damaging power of noise exposure [62]. In this context, the difficulties arising with the use of protectors are acknowledged but considered as always surmountable. Such difficulties are examined without reference to actual and concrete work situations. Hence, hearing conservationists have not analysed the type of constraints that arise in specific industries.

Such constraints certainly exist [63]. For example, in underground mines, it can take more than half-an-hour to reach the nearest facility for washing one's hands before inserting earplugs. In foundries, the use of a hard-hat, eyeglasses, masks, and thick gloves is common for a number of job-sites; there is a problem of compatibility between this protective equipment and the use of earmuffs, particularly in high temperature areas. On production lines in the manufacturing industry, the rapid pace of repetitive gestures does not allow the workers to take the time required for proper placement and periodic re-placement of hearing protectors. Drivers of heavy and very noisy vehicles are not allowed by the road traffic regulations to wear any device that can impair sound detection. Such examples are not discussed in the HC literature; any mention of incompatibility between work requirements and the use of hearing protectors is being excluded.

Furthermore, discomfort, the most salient feature of the experience of wearing hearing protectors, is practically ignored. Feelings of isolation, insecurity and annoyance have been documented in studies of the psychosocial effects of hearing loss artificially created by the use of hearing protectors [64]; and these observations are ignored by the hearing conservation literature. The discomfort from the inevitable pressure within the ear canal or around the ear has been studied recently within laboratory conditions. But one may well question the validity of jugdements made by paid subjects who are asked to passively wear different protectors for a few seconds [65] or a few minutes [64] as predictive of the experience of real life conditions in which people have to wear them for hours and communicate verbally, localize auditory signals, etc.

Field studies of their effectiveness have consistently shown that protection is low and highly variable, so much so that it is not possible to warrant a given amount of protection for an individual wearer [4;69]. As a matter of fact, results of hearing tests conducted on workers who had been wearing protectors for the extent of their working lives indicate that they had sustained various degrees of hearing loss [67-68]. It is worth mentioning that such data were not analysed as an assessment of the success of hearing conservation programs, but rather as a comparison between the long term effectiveness of different types of hearing protectors. As it is postulated that hearing protective devices can always be an effective means of preventing compensable hearing loss, the measured ineffectiveness is attributed to intermittent use of the protectors, thus implicitly blaming the victims. The HC paradigm demands that hearing protective devices be adequate means of prevention of hearing loss. The users are at fault, not the devices. Workers' doubts as to the effectiveness or the safety of protectors are made inadmissible if not illegal:

> "Strict enforcement of the hearing protective device program is essential, and such enforcement should include a four-step procedure: a) verbal warning; b) written warning; c) brief suspension (no pay); and, finally, d) termination" [69].

The use of hearing protectors has been made a condition of employment in some plants [70]. According to compensation rules in some states of the U.S., failure to wear hearing protectors may result in reduction of the compensation award [71]. The idea of failure of the personal protective equipment is simply inadmissable to the hearing conservationists.

Postulate E. Periodic hearing tests warrant prevention of hearing loss

> "The measurement of hearing ability is the most important part of a hearing conservation program" [15, p.28].

Knowing that a test has never prevented a disease, this statement is paradoxical unless it is understood within the context of protection of employers against successful compensation claims, as some employers have actually acknowledged [72]. In fact, pre-employment and periodic examinations have been instated for this very purpose as soon as occupational diseases became compensable, that is, shortly after the first world war [73-74]. Audiometry was recommended to employers by insurers as soon as noise-induced hearing loss was formally compensable:

> "From these facts it is easy to visualize the tremendous number of these people who become eligible for compensation for hearing loss without suffering any job-connected impairment if employed by industry. A possible solution to this problem, as far as workers employed in the future are concerned, is found in the proposed new Wisconsin legislation to which reference had been made; namely, a provision that if the employer can show, through pre-employment audiometric record, that a hearing loss existed at the time of employment of the worker, he shall not be responsible for the loss which existed at that time" [36, p.344].

This proposal was further extended to periodic hearing tests within the "Guide for Hearing Conservation in Noise" as an implicit, and at times, explicit as marketing arguments for hearing conservation programs offered to the employers:

> "Historically, the market for hearing conservation services in industry is stimulated by the threat of workers compensation claims from occupationaly induced hearing loss and from federal or state regulations mandating programs to protect workers. These continue to be the moving forces behind management's consideration in developing and maintaining industrial hearing conservation programs. American business is now motivated to implement appropriate hearing conservation programs to minimize potential liabilities and protect the bottom line profits" [75, p.246].

Actually, audiometric monitoring is the corner stone of the HC paradigm, which is essentially a hearing sensitivity management protocol for industrial workers. It is formally justified by Postulates A,B and C mentioned earlier:

> "Ideally it would be desirable to reduce all existing noise doses below some acceptable value. Practically, however, noise reduction sufficient to properly protect the working population will not occur in the near future; therefore, adequate hearing test programs are essential" [56, p.551].

Audiometric monitoring further legitimizes the use of hearing protective devices despite uncertainty about their effectiveness. It also legitimizes having hearing specialists act as experts on the problem of industrial noise. It individualizes the problem of occupational hearing loss, making the worker responsible for his/her hearing loss, as it serves as evidence that the worker is not making proper use of a hearing protector or is in the "more susceptible" category. For those workers not yet showing signs of compensable losses, the results of periodic hearing tests are used to (falsely) reassure them about the potential risk of hearing damage [72, p.5].

The practice of testing hearing is in itself a means to structure the problem of occupational noise exposure within the context of hearing sensitivity management, by defining it as a loss of hearing resulting from inadequate protection or individual susceptibility. The expression "management of hearing" has been used explicitly in a Japanese paper about compensation for hearing loss [76]. But, in the usual scientific argument, audiometric monitoring is advocated as a means of secondary prevention, that is, of early detection of hearing damage in order for proper preventive measures to be implemented. Such a contention, analysed below as a corollary of Postulate E, appears to serve to camouflage the practice of hearing sensitivity management.

Corollary E.1: Early detection of hearing loss by means of audiometric monitoring leads to prevention.

> "Periodic hearing tests are conducted to identify changes in hearing level so as protective follow-up measures can be initiated before hearing loss progresses" [77].

This quotation from the recent amendment of the US federal regulation of occupational noise exposure has made audiometric monitoring part of the legal obligations of employers in noisy industries.

In more than thirty years of periodic hearing tests in the workplace, not a single documented case of noise control has been motivated by the results of such tests. In fact, apart from reassurances that the test result is "normal", there are three possible outcomes of audiometric examinations: a) workers are referred to a specialist, in which case a diagnosis is given to the employer and treatment for ear disease may be offered to the worker [78]; b) personal protection is recommended, with possible review of the fitting and placement procedure, encouraging careful and continuous use of protective devices [72, p.3]; or c) job reassignment [79]. The latter is infrequent as it is often impractical and potentially a source of economic disadvantage to the workers. But job reassignment appears nevertheless to be used in some instances. Results from a cross-sectional audiometric survey in a large steel mill where a hearing conservation program had been implemented showed that the department comprising the highest proportion of workers affected by noise-induced hearing loss was the yard, an area where the noise level was generally lower than inside the plant [80]. This was consistent with the practice of assigning hearing impaired workers to this area before their hearing loss reached a level that would have made them eligible for compensation.

Athough audiometric monitoring is formally justified as the ultimate measure of success of a hearing conservation program, a claim that has not been empirically validated [81-82], it rather appears to be a tool to collect information on the hearing status and auditory history of noise-exposed workers in order to oppose counter-arguments to compensation claims for occupational hearing loss. Many workers have reported to the present author that they had never heard about the results of their periodic hearing tests until they filed a claim for compensation [79]; at this point, the employers used the test records as evidence against the claim of the occupational origin of the hearing loss. Poor test results obtained since the earlier years of employment in the plant were used to argue that the hearing loss of the claimant was not related to the current job.

The contention that audiometric monitoring serves as a camouflage for the practice of hearing sensitivity management is further subtantiated by an analysis of the second corollary of Postulate E.

Corollary E2: Audiometric monitoring can effectively detect changes in the hearing sensitivity of noise-exposed individuals before any hearing disability occurs.

The concept of secondary prevention implies that appropriate action is taken when early signs of the presence of disease are detected. This presupposes that the health surveillance procedure is sensitive enough to detect signs of illness before any serious damage occurs. In the context of occupational hearing loss, this would mean that periodic audiometric tests can actually detect slight changes in hearing sensitivity before the listening and communication ability of noise-exposed workers becomes reduced. It also implies that the testing procedure is subjected to rigorous quality control. Actually, studies of fairly large samples of hearing test facilities in industry, from Europe as well as from the U.S.A., have shown that the great majority of these facilities did not meet the most basic requirements for a valid test [83-84]. This clearly indicates that early detection of noise-induced hearing loss is not the focus of industrial audiometry.

Even under well controlled testing conditions, the sensitivity of audiometric monitoring has been seriously challenged by the results of the most extensive and rigorous population study of noise-induced hearing loss ever conducted. This study, conducted in Great Britain was co-authored by an otologist, W. Burns, and an engineer, D.W. Robinson. It was commissioned by the Ministry of Pensions and National Insurance in 1961 for the purpose of examining the problems underlying the assessment of noise as an industrial hazard, particularly with regard to compensation. It is generally agreed among epidemiologists that a prospective study is the most powerful procedure for demonstrating a relationship between a given factor and the occurrence of a particular disease. Accordingly, this study was designed to describe the progression of noise-induced hearing loss over time among a highly selected group of industrial workers showing no signs of ear disease and having no prior record of noise exposure. The recruitment of such individuals proved to be rather difficult:

> "...the serial study ran into problems more severe than we had envisaged. One of these was the scientifically extraneous difficulty of locating enough cases of persons with little or no previous noise exposure" [85, p.21].

But the most significant finding is the actual failure to describe the progression of noise-induced hearing loss over time:

> "A second and more deep-seated problem exists, however, and would have beset our endeavours no matter how successful our quest for unexposed subjects might have been. This is the influence of random errors in the audiometry which all but swamp the noise-induced part of the threshold shifts. Even with the safeguards of precision equipment and impeccable control of the testing, these errors must be regarded as ineradicable in the practice of pure-tone audiometry as it is today... It is necessary to draw from our data some rather disquieting conclusions about the significance of apparent hearing level changes in annual serial audiometry such as might be administered routinely in industrial hearing conservation schemes. This is perhaps the most important lesson to be learnt from this part of our

investigation even though it is rather discouraging in character"[85, p.21].

In view of such a failure, the authors modified their study design to collect cross-sectional data on groups of workers with different lengths of service in noisy occupations. Their findings became the major reference to describe the dose-response relationship between noise exposure and loss of hearing sensitivity. Viewed from within the HC paradigm, the consistent practice of overlooking the most significant finging of this most frequently cited study (i.e. the failure of audiometry) is not paradoxical if one considers this paradigm as the foundation of a pratice that serves to restrict the cost of reducing noise in the workplace.

To acknowledge such a failure would be to abandon the myth of the omnipotence of scientific and technical knowledge [86]. In line with this interpretation, W. Burns and D. Robinson have continued to support audiometric surveillance as a means of preventing noise-induced hearing loss [87]. Moreover, for the numerous proponents of HC, acknowledging this failure precisely means opening the black box of HC and questioning the very foundations of its legitimacy. A cultural amnesia [88] has systematically served to protect the socially legitimate image of science entwined with the HC paradigm.

Other attempts to introduce the notion of failure of audiometric monitoring have been overlooked by the HC literature. In 1979, a paper was published in a widely-circulated journal of occupational medecine, which showed that, Burns and Robinson's cross-sectional data could actually lead to the same conclusion as the prospective study, as to the inability of audiometric monitoring to detect significant changes in hearing sensitivity due to noise [89].

Not only was it ignored as a critical analysis of HC, it was used as a reference (together with the only other study questioning the validity of audiometric monitoring that was published in scientific journals [81]) to <u>support</u> the recommendation in favour of health surveillance of noise-exposed workers, in the context of general guidelines issued by Health and Welfare Canada and published in the Canadian Journal of Public Health [90]. This procedure not only obscured the existence of disagreements among scientists, it subtly overturned the argument challenging the validity of audiometric monitoring.

In 1985, a committee of the International Standardization Organization (ISO) adopted a draft of a standard that provided a generalized dose-response relationship between occupational noise exposure and loss of hearing sensitivity. This was the synthesis of the results of previously published cross-sectional studies using a new mathematical model that was based on a number of agreed upon postulates. The consensus among the international experts on this document later allowed ISO to publish it as an international standard [91]. This provided the present author with new material for evaluating the sensitivity of periodic hearing tests for detecting changes in hearing levels among noise-exposed workers [92]. The mathematical model described in the ISO document was computerized, and the annual rate of change of hearing threshold levels was determined for different exposure levels and durations. The results were compared with the margin of error of audiometry in controlled laboratory conditions and in field testing conditions as found in hearing conservation programs. A change greater than the margin of error was defined as a significant threshold shift (STS). As expected, the annual rate of change in hearing sensitivity turned out to be always smaller than the conventional values of STS, showing once more that the likelihood of measuring a noise-induced hearing loss in its early stages is extremely small. In order to have a more concrete picture of this finding, a simulated example was presented of an industrial population with a typical range of noise exposure levels, ages, and lengths of service. The deduced likelihood of detecting a true STS was less than one in 1000, in the case of workers subjected to annual hearing tests performed in the best conditions. The conclusion was then drawn that such tests are incapable of detecting a noise-induced STS at an early stage.

HC proponents have recently proposed a procedure, in the form of a draft American national standard, for assessing the effectiveness of hearing conservation programs using audiometric monitoring data [93]. Implicitly acknowledging the impossibility of relying on an index of non-decrease in measured hearing sensitivity over time, this procedure is based on an index of statistical variability: that is, on the degree of both improvement (which is bound to be the result of measurement errors if permanent hearing loss is considered) and decline in the measured hearing sensitivity. The postulate behind this index is that a limited variability in audiometric records reflects an absence of both temporary and permanent effects of noise on hearing with the population subjected to periodic audiometric testing. It is assumed that the validity of monitoring audiometry as a procedure of secondary prevention of occupational hearing loss cannot be assessed as such. Furthermore, this procedure is founded on a tautological definition of what is an effective HC program whereby audiometric variability is to be compared with so-called control data that has been adopted "because several years of personal experience with their HCP and on-site observations indicated that the quality of HPD fitting and utilization in these programs was sufficiently strict to make them useful in control comparisons" [93, p. 11] (HCP: hearing conservation programs; HPD: hearing protective device).

2.4 The HC black box in action: input, output and exclusions

The noxiousness of occupational noise exposure became a fact as a result of a medico-legal controversy (Parag. 2.1). The nature of the solution to the problem (hearing conservation) thus created bore the stamp of the medico-legal context, whereby the risk of compensable hearing loss resulting from occupational noise exposure became the input for the HC black box.

Once the ground was set around audiometry, other manifestations of the effects of noise exposure were excluded as discussed under corollary A2. For instance, when educators in day-care centers for young children complained about stress and poor communication conditions because of excessive noise in their work environment, occupational health and safety inspectors assessed their situation as not noisy; sound levels were below the permissible level adopted for prevention of compensable hearing loss [94]. The same happened with physical education teachers complaining about sound environments in gymnasia that were inappropriate for verbal communication [95]. The inspectors' dismissal of such complaints as invalid echoes the early HC proponents' dismissal of the effects of noise on health except for hearing loss.

The output is also essentially restricted to activities that help prevent compensable hearing loss: personal protection programs, audiometric monitoring, and experts' reports on compensation claims. The focus is not on the sources of noise in the workplace (Postulate B), but on individuals' compliance with the personal protection program and on individuals' history of ear disease and extra-occupational noise exposure. Controversies have emerged over the effectiveness of personal protection, the way audiometric surveillance has been conducted, and claims adjudication, that is, within the boudaries set by the HC black box but not over the practice HC as such. One particularly disturbing exclusion from HC output is the need to adapt the workplace to accommodate those workers who have proven to have sustained compensable hearing loss. Amplified telephone receivers are very rarely found even in factories where a significant portion of the workforce has actually been compensated for occupational hearing loss. Sound warning signals are not adjusted to the residual hearing capacities of hearing-impaired workers. Meetings are held without proper speech amplification or acoustic listening devices. Problems created in the workplace by hearing impairment [96] do not appear to be an issue even when hundreds of audiograms are performed every year in noisy industrial settings to detect such impairment.

The psychosocial consequences of hearing loss are simply denied by some HC experts [17]. Others consider these effects as a matter of fact but with marginal significance. This is illustrated by the fact that, in a book recently published on occupational hearing loss by well known american experts in this field, over 350 pages are devoted to the diagnosis of the disease (that is, to expert opinion on claims), and only half of a page on its effects on family and social life [41]. Workers affected by occupational hearing loss are not perceived as people who need specific rehabilitation services by HC proponents.

2.5 Expansion of the HC black box

The HC black box has emerged in an attempt to limit compensation claims costs relative to hearing loss, with the claims subjected to the expert opinion of the otologists. As a professional group, the latter were involved in the original construction of the paradigm, and rapidly recruited allies in many areas of scientific research, a variety of professions, various governmental institutions and diverse commercial endeavours.

Among the scientists, we find not only ear physiologists and pathologists as well as psychoacousticians, as mentioned above, but also acousticians in general. The Acoustical Society of America, in its bi-annual scientific convention, systematically holds specialized sessions on 'hearing conservation'. There is also an annual meeting of the National Hearing Conservation Association in the US.

Engineers and physicists have been involved in the development of protective devices and hearing sensitivity measuring equipment. Many health professionals besides otologists also share the HC view and practice, despite some inevitable competition. They include occupational physicians and nurses, audiologists and industrial hygienists. Recruitment of these health professionals was probably facilitated due to the fact that HC opened a field of intervention, noisy industrial settings, to specialists with no specific competence in noise reduction. It is not surprising that, without such competence, these professionals "have little choice but to accept as 'reality' the existing noise situation, and hence the propriety of 'conserving hearing' within that noise" [97, p.108]. Within the claims process, there are also lawyers involved, making alliances with one or the other professions listed above.

Governmental institutions have readily adopted the HC paradigm. Most of the occupational health and safety administrations have shaped the regulations of occupational noise exposure around this paradigm [77]. This is clearly the case for the US federal regulation as it is for many European regulations. The European noise directive adopted in 1986 heavily relies on hearing protection and audiometric monitoring [98]. Hence, occupational health and safety inspectors become involved in implementing HC in industry, backed by the mandate afforded by the state laws. Their intervention is further supported by various local or national institutions that are involved in occupational health. For instance, the US National Institute for Occupational Safety and Health (NIOSH), which is basically a research institute, has recently issued a practical guide for hearing conservation [99]. The NIOSH had previously prepared, with the Association of Schools of Public Health, a national strategy for the prevention of noise-induced hearing loss that was based firmly on HC [100]. The Canadian Departement of Health and Welfare sponsored a federal-provincial committee to prepare a model regulation of occupational noise exposure [101] which, as it turned out, relied essentially on the HC paradigm. This then served as a basis for the Canadian Standards Association to adopt a series of standards on various aspects of the practice of HC [102-103].

Commercial institutions have flourished within the HC network. They include manufacturers of hearing test equipment and protective devices, private consultants who offer integrated package-deals for hearing conservation, and insurance carriers who provide support to employers in thwarting claims for occupational hearing loss.

This whole network shares a common perspective - the HC paradigm outlined above- and a common goal of minimizing claims costs associated with occupational hearing loss. It has a common stake in serving the industry by acting in ways that help limit the cost of noisy environment. All such intervention involving the legitimacy of scientific knowledge appears to be necessary to render the very high noise levels in the workplace acceptable over time. Because so many scientists, professionals and institutions share the same perspective, devoid of any trace of ownership and of the original circumstances that gave rise to it, it defined reality. Disputing HC's definition of the reality of occupational noise exposure implies challenging the view by all those who participate in the operation and expansion of this black box.

3. The effects of occupational noise exposure as experienced by industrial workers

The paradoxical concept of conservation of a function despite the presence of a deleterious environmental agent is unique to HC. Expressions such as "respiratory function conservation in dust", "attention maintenance in organic solvents", "renal function conservation in lead", "balance conservation on vibrating structures", are not found in the occupational health literature. Although personal protection and biological monitoring are advocated for these and many other toxic agents, the rationale for them does not reach the same level of conceptualization as for HC. This raises the question of the reasons for the widespread acceptance of HC (despite the contradiction that is inherent in the original concept).

The HC paradigm emerged as a response to the threat of compensation claim costs associated with occupational hearing loss. It became the frame of reference for any problem related to occupational noise exposure. This dismissal may provide a clue in explaining the widespread adoption of the HC paradigm and of the absence of controversy.

On the one hand, of all the effects of noise exposure on health, hearing loss is the only one involving a measurable alteration of a bodily function that can obviously be attributed to this specific environmental agent. As mentioned above, annoyance, stress, impaired communication or other types of performance impairment are viewed by scientists and the medical profession as inconvenience factors rather than health and safety problems per se. On the part of the exposed people, such effects are reported to be felt as inevitable drawbacks associated with the working environment, to which one must adapt [100].

On the other hand, hearing loss as such is not perceived as a serious threat to health by those at risk [20;104;105]. The physical damage is invisible. Hearing impairment due to noise develops very insidiously and its repercussions in everyday life are ambiguous. Its most characteristic manifestation is the result of a loss of frequency selectivity. This means ambiguous hearing behavior, in which the affected person's hearing capacity varies with the prevailing acoustic conditions. In addition, the major effects of OHL are experienced outside the workplace, that is, within family interactions, and these are not interpreted as a direct consequence of noise exposure and of hearing loss. Most of the time, such effects are are not discussed with co-workers.

At a later stage in the development of partial deafness, the stigmatization of deafness is such that anyone who shows signs of deafness risks being socially discredited. The implication is then that the more the workers are affected by OHL, the more they have a negative image of themselves. As a result, they are reluctant to endorse such a negative self-image and hence to acknowledge signs of hearing impairment [20]. This leads them to attribute their listening and communication difficulties to other causes, and adopt a passive attitude towards them.

When hearing difficulties are so obvious that they can no longer be denied or minimized, the affected workers try to conceal them [104]. This inevitably involves not only social withdrawal but also exclusion by others as a result of the image provided to their co-workers and significant others. The people around do not perceive the lack of communication as the result of a hearing problem. They are not solicited to help and they are not informed about the kind of behavior that might help [105]. Moreover, the lack of compassion resulting from concealment of the difficulties is such that the co-workers do not realize the offensiveness of their jokes about signs of hearing impairment. This feeds the stigmatization process with all its negative consequences.

Concealment of the effects of occupational hearing loss by those who are seriously affected underplays the risk of noise-induced hearing loss. In a group in which many people have been identified as having hearing impairment and have themselves reported some degree of hearing difficulty, a relatively small number of workers are identified by their unimpaired co-workers as being hearing impaired [105]. Furthermore, the latter's condition is often attributed to age rather than noise. In other words, if one asks workers in noisy plants about the likelihood of developing a hearing impairment because of noise exposure, the answer would most probably be, "minimal". People tend to say: "*it won't happen to me*".

Concealment of the effects of occupational hearing loss also makes it more difficult for those who are still unaffected to realize the impact of this condition in everyday life. This factor combines with occupational hearing loss sufferers' reluctance to acknowledge hearing difficulties to reinforce the misperception that hearing loss is an anomaly that is inconsequential. This is the case even in plants where the people had been subjected to mass audiometric screening and had their results explained [105]; one has to conclude that the audiogram is not a convincing means to raise awareness of the severity of the effects of occupational hearing loss, as was explicitly mentioned in group discussion among noise exposed workers. Misperception of its effects considerably delays workers' awareness. It is only when people have to ask others to repeat themselves very often that they realize they have a serious hearing impairment [106].

It is obvious, in this context, that the hearing impaired workers do not seek to convince union officials, occupational health practicioners and employers of the need to reduce noise.

The strength of the HC approach to industrial noise is thus enhanced by the absence of complaints or disputes on the part of exposed workers and their representatives. As mentioned above, disputes have occurred within the boundaries set by the HC black box, that is, over acceptable levels of hearing loss, acceptable exposure levels of noise, adequate hearing protection, and valid hearing tests. Still, these have been rather few and uncompelling. For instance, the labour movement did not challenge the definition of compensable hearing loss when it was subjected to the first compensation schedule in 1954; nor did it object to the selection of a management-oriented committee of otologists [14, p.689].

4. Conclusion

Based on the above analysis of the HC black box and the way in which occupational noise exposure is perceived and experienced, one has to conclude that very high noise levels in industrial workplaces will continue to be the rule, rather than the exception, for many years if not decades to come. Scientists and occupational health practitioners can only help improve the acoustic work environment if they recognize the ways in which the postulates behind the prevailing conception justify high noise levels in the workplace, and if they adopt new paradigms to address this longstanding problem.

As explained in section 3, concealment, reluctance to acknowledge and misperception of the effects all converge to make it difficult for noise-exposed workers to know the manifestations and consequences of occupational hearing loss. This results in their viewing hearing loss as inoffensive. A health problem associated with a perceived low level of risk and low level of impact on everyday life is not felt as a threat by those at risk. Hence, the need for prevention is not felt by most workers exposed to noise, and by their employers, unless a suitable campaign is organized to raise awareness of the extent and the severity of the consequences.

The most convincing people for raising awareness would certainly be the workers who are currently affected by OHL and bear witness to its effects. This presupposes that such workers be able to disclose their condition, and such disclosing in turn requires support, to alleviate the effects of stigmatization. In other words, rehabilitation [107] may well be the first step towards prevention [20;105].

A complementary perspective can be developed whereby noise is considered a source risk for accidents, ineffective communication and work dissatisfaction. An ecological approach has been proposed keeping in line with this perspective, in which the compatibility between auditory demands and capacities are systematically examined [108]. Within this framework, improvements in the acoustic environment are governed not so much by regulatory exposure limits but rather by the characteristics of human capacities for sound detection, discrimination, identification and localization, and by speech communication needs. This would be compatible with an ergonomic approach to auditory activities in the workplace as well as with so-called total quality management programs that include working conditions.

Where management is already open to the possibility of acknowledging the devastating consequences of over-exposure to noise, a direct approach to the problem is in order: i.e., one that explicitly focuses on noise as the target of an intervention program. Worksafe Australia has developed such a program, 'Noise management at work', with a clear focus on management issues [109]. The form and content of the program is based on (a) consultation with employers, workers and government agencies, (b) market research with key workplace groups and (c) a field trial in small factories. Industry is thereby provided with practical material for tackling the longstanding problem of noise.

When combined with the noise management approach, the international machine noise declaration system [110] can be an effective tool to reshape the industrial sound environment in the long term. Once machine manufacturers have to consider noise as a formal design constraint, quieter equipment will become increasingly available. However, availability does not in itself imply a demand. Motivation will come from increased awareness of the highly undesirable consequences of noise exposure.

The problem of industrial noise is certainly not an easy one to solve. But there is no need to wait another century for scientific research on its deleterious effects before taking steps to improve the industrial sound environment.

Acknowledgements

Valuable comments on a preliminary version of this paper were provided by Hélène David, Louise Getty, William Noble and Richard Waugh.

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NOISE AND VIBRATION CONTROL ENGINEERING, THIRD EDITION
Leo L. Beranek and Istvan L. Ver, Eds.

We are told that this book is "a completely new, single-source guide to all aspects of noise and vibration control", and that "it offers mechanical, acoustical, architectural, electrical and chemical engineers and students the engineering principles necessary for designing quiet conditions into industrial machinery, motors, power-plant equipment, air-conditioning systems, factories, buildings, and transportation systems."

One aspect of noise control that I searched for immediately on receiving this book was impulse noise from explosive sources; alas for my current community-noise problem, it was not to be found.

Other than that omission, ownership of this book is an absolute must to replace the broken-backed and dog-eared original "Noise Control Engineering" that was the first bible for practising engineers and students.

This book is mercifully brief in its treatment of the fundamentals of acoustics; i.e. the wave equation, using vector calculus and partial differential equations - mathematics that many of us with a general engineering background have allowed to sink into the dim recesses of our memories. Engineering students will find the presentation of the basics logical in its development, as well as clear and precise.

For those engineers not familiar with the units and symbols commonly used in acoustics, having to review their meanings via the index and previous chapters is somewhat reminiscent of the original bible. A fold-out page listing symbols and meanings along with values of constants such as those found in Table 1.5 would go a long way to reducing the wear and tear on the book's binding.

The later chapters, devoted to particular applications, provide much valuable insight into the practical application of the basics. Cited references are current and adequately comprehensive to allow further study in any technical or larger civic library. Chapter 7 is particularly easy to read and thorough; its inclusion of a worked example provides the uninitiated with a sense of the magnitude of the results of design calculations or problem solutions. More worked examples would be of benefit to engineers and those not currently active in the practise in acoustics. Perhaps a companion work book with worked examples and problems to be solved would be most useful to the targeted readers.

The section of Chapter 8 on resonant absorbers is a comprehensive and clear treatment of this subject and is particularly easy to use.

Chapter 9, concerning the interaction of sound waves with solid structures, is an improvement over the old bible in both content and clarity of presentation.

Chapter 12 deals with structural damping and is somewhat typical of many of the later chapters in the book in that it provides a clear overview of the subject before launching into the detail and specifics of the subject.

Readers of the portion of Chapter 17 that deals with community noise would be interested in reading the unreferenced work of Rosenblith and Stevens and their method of predicting a community's reaction to intruding noise - the results of which are very similar to those tabulated in Fig. 17.13.

[This book (ISBN 0-471-61751-2) is available from John Wiley & Sons at the price of $125.95]

Reviewed by: Kenneth E. Barron, P. Eng., Consultant in Acoustics.

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BOUNDARY ELEMENTS: AN INTRODUCTORY COURSE, SECOND EDITION

C. A. Brebbia and J. Dominguez

The first edition of this book has been a good text book suitable for an advanced undergraduate or a graduate course. The second edition is of course very welcomed because of the large number of developments in the applications in this area. The second edition has new sections added reflecting some of the recent developments. One of the new sections is on "Discontinuous Elements". While the scope is kept very small, this section has sufficient information on how to handle a singular point or a corner where a normal derivative might exhibit a jump in value. Such problems of course exist in various physical problems such as hear flow or fluid mechanics problems. Even the simple problem of potential flow bout a circular cylinder in a rectangular control volume formulated in terms of a potential function exhibits this ambiguity. The addition and the location of the material in the book is very suitable.

The second subject added in a more extensive way is the section on "Other approaches for the treatment of Domain Integrals". The section looks like a condensed form of the recent by Partridge, Brebbia and Wrobel "The Dual Reciprocity Boundary Element Method". The section gives information on the development of the Dual and Multiple reciprocity methods developed by Brebbia and his group. The section also refers to various pioneering work done by the Computational Mechanics Institute in this area.

There are also minor improvements in the presentation of the material and the terminology. The list of references is increased parallel to the addition of the two sections referred above and new publications on this subject, however, are not increased in number and scope.

The text still shares the same problems common to the text books in the area of numerical methods in engineering. The book stresses the application of the Boundary Element method FORTRAN possibly expecting the students to type the code in a suitable computer. The input and output difficulties are still left to the student. I believe that most of the students will prefer to see some of figures printed in black and white in chapter I, in color on the screen of a Personal Computer. As most campuses now have PCs based 486 chips with color monitors the book should really come with a diskette containing the sample applications and the programs in the text with a suitable input-output package. Currently available sample outputs of packages such as of BEASY by the Computational Mechanics Institute could be very beneficial.

[This book (ISBN 1-5652-087-3) is available from McGraw-Hill at the price of $60 U.S.]

Reviewed by: S. M. Calisal, Department of Mechanical Engineering, University of British Columbia.

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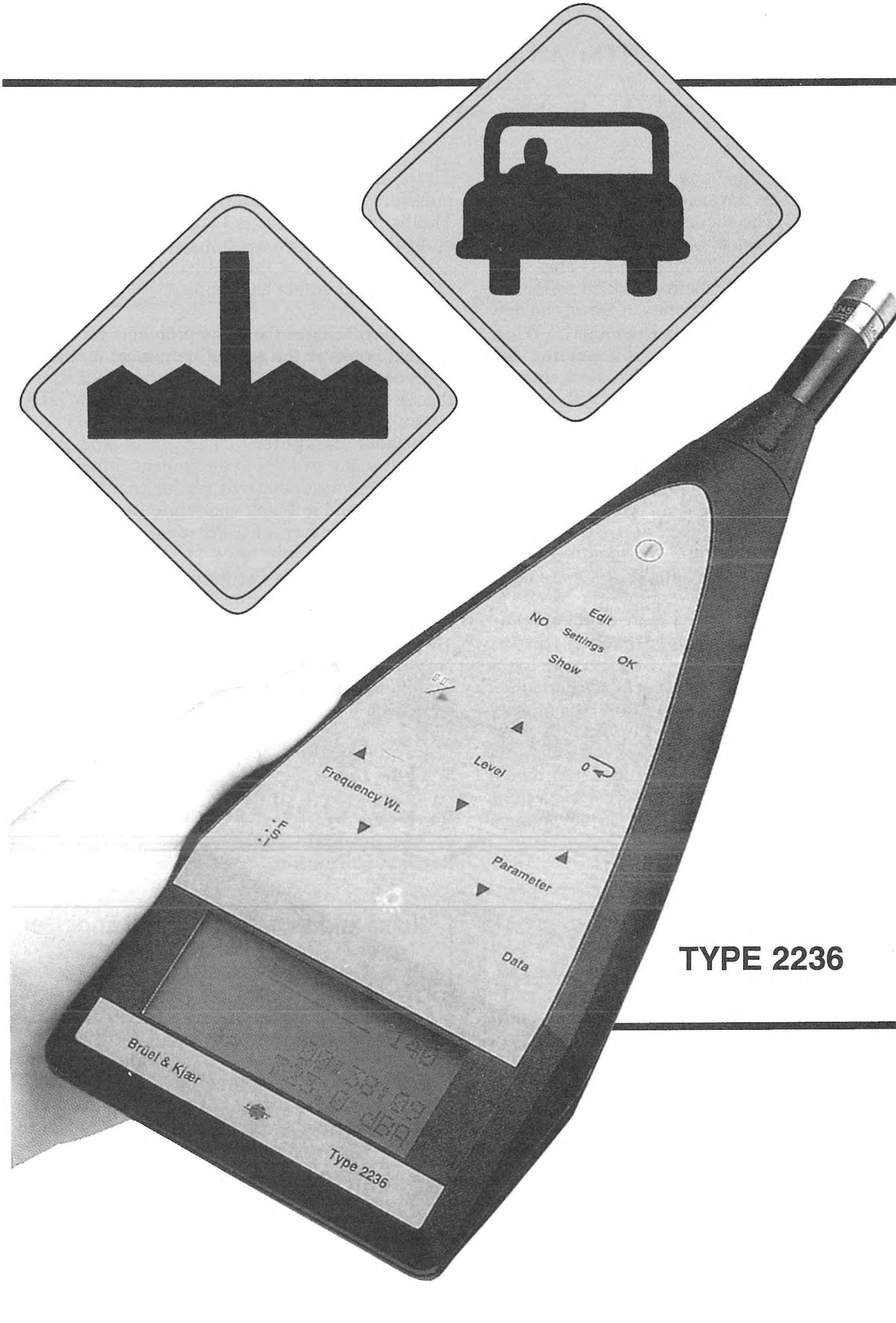
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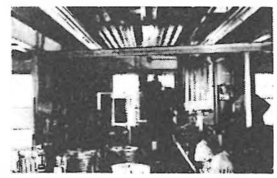

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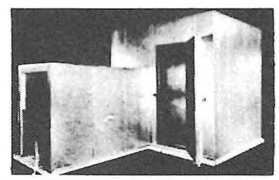

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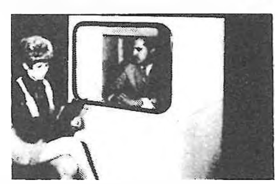

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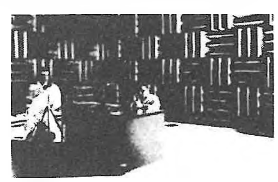

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ABSTRACT

This technical note examines the decision taken by the CSA Standard Committee on Hearing Protectors to continue with the use of the ABC system for the selection of hearing protectors. The basis for the ABC and the NRR systems are reviewed and the systems are compared. The Note provides some recommendations regarding the use of the attenuation figures for hearing conservation purposes.

SOMMAIRE

Cette note technique examine la décision du comité des normes sur les protecteurs auditifs de la CSA de continuer d'utiliser le critère ABC pour l'évaluation des protecteurs auditifs. L'auteur compare les avantages des systèmes ABC et NRR et fait des recommandations concernant l'utilisation des valeurs d'atténuation aux fins de la préservation de l'ouïe.

1. INTRODUCTION

At the last meeting of the CSA Committee on Hearing Protectors, a decision was made to continue with the use of the ABC system for the classification of hearing protectors (described in the CSA Standard Z94.2[1]). CSA standards are revised at least once every 5 years, or earlier, if there is a reason for it. Therefore, the above decision means that we will keep the ABC classification at least for the next five years.

Hearing protectors are classified according to their attenuation. There are many systems in use. However, for the purposes of this paper, we will be focusing on only two: the NRR used mainly in the USA and the ABC, included in the CSA Standard.

2. ATTENUATION OF HEARING PROTECTORS.

There are two main characteristics of interest for users of hearing protectors: one is the **comfort** experienced by the user. Its importance is obvious: an uncomfortable protector is not used so there is a real interest in having comfortable protectors. However, because of the subjectivity of this characteristic and of the difficulty of its determination, there are no known national or international standards for comfort.*

Attenuation is the second of the characteristics. It is the reduction of the sound level at the ears of a person wearing the protector ("noise level of the protected ear"). Contrary to comfort, there are standards for its measurement. The CSA Z94.2 explicitly states, that attenuation should be measured following the procedures in the ANSI Standard S3.19[2].

The result of the measurement of the attenuation of a hearing protector is a table (or graph) representing the attenuation and the standard deviation at each of the standard measurement frequencies: 125, 250, 500, 1000, 2000, 3000, 4000, 6000 and 8000 Hz. Table 1 and Figure 1 show an example of a table and the corresponding graph of the characteristics of a hearing protector.

The attenuation is measured in specialized laboratories using highly trained subjects. Results from the measurement can be qualified as being the **highest achievable attenuation**.

* Ontario Hydro has developed an internal standard for comfort.
** Now at A. Behar, Noise Control Management, 15 Meadowcliff Drive, Scarborough, Ontario M1M 2X8

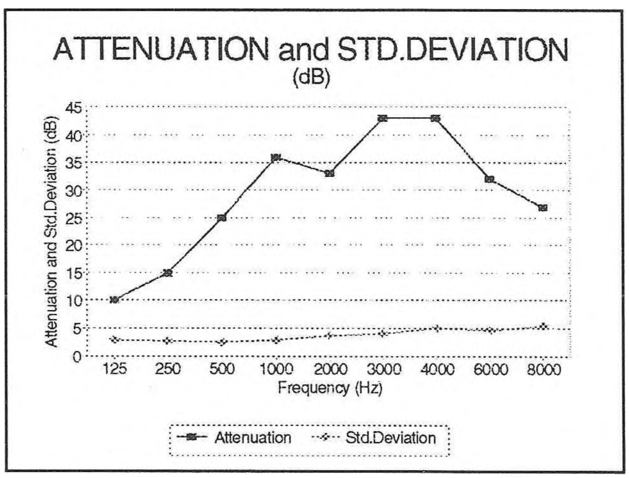
However, this attenuation could never be achieved in the real world. Many field studies have proven the above statement[(3)(4)], leading to several proposed derating schemes (e.g., how to reduce the measured attenuation so to correctly reflect what is observed in the field). Although there is no consensus on this issue, it is generally accepted that the "real" attenuation is at least 10 dB lower than the nominal.

TABLE 1

Attenuation and Standard Deviation of a Hearing Protector (see Figure 1)

Frequency (Hz)	Mean Attenuation (dB)	Standard Deviation (dB)
125	10	2.7
250	15	2.6
500	25	2.4
1000	36	2.7
2000	33	3.6
3000	43	3.9
4000	43	4.9
6000	32	4.5
8000	27	5.4

FIGURE 1



3. USE OF THE ATTENUATION

The attenuation is used to predict the noise level of the protected ear. In other words, by knowing the noise level in the workplace and the attenuation of a given protector, one should be able to determine the noise level that the wearer is effectively exposed to. If, for example, the noise level in a workplace is 105 dBA and the attenuation of the protector is 15, then the person wearing this protector will be exposed to

$$105 - 15 = 90 \text{ dBA}.$$

From the above, one would expect the issue of the use of the attenuation figure to be simple. However, this is not the case, because the attenuation of a protector changes at the different frequencies (see Figure 1) and the same occurs with the noise levels. In addition, the frequency content of the noise a worker is exposed to is constantly changing with the combined actions of different noise sources and/or the variation of worker's location with respect to these sources.

To make the situation even more complex, there is the variability of the attenuation with individuals: the way they fit their protectors, the shape of their heads, ear canals, etc., results in changes in the attenuation. [For this reason the attenuation test is taken over 10 subjects on 3 different occasions. The reported result is the mean value of all 30 measurements.]

Without entering into details, there is a method for the prediction of the noise level of the protected ear, that takes into account all of the above variables. This is the so called NIOSH "long" method. For the calculation of the predicted level, it requires the existing noise levels (measured in octave bands) and all the data (attenuation and standard deviation) of the protector. The noise level of the protected ear is then calculated in octave bands and/or dBA. [Again, for this method to work, the levels and frequency content of the noise has to be steady.]

From the above, it can be seen that the use of the NIOSH "long" method is quite cumbersome. For that reason other approaches using one number estimates have been developed. NRR and the ABC are just two of them. Neither requires noise levels of the environment to be measured in octave bands.

4. THE NRR***

The NRR (Noise Reduction Rating) is a single number, calculated using the attenuation and standard deviation data obtained from the attenuation measurement of the protector. The larger is the NRR, the higher is the attenuation of the protector. In practice NRR starts roughly at 14 and goes up to 32. It is a requirement in the USA that all hearing protectors have the NRR stamped on their envelopes. Because of the market's implications, the use of the NRR has been expanded worldwide, so that now this is the most frequently used estimate and the one most commonly found printed on hearing protector containers.

Noise level of the protected ear is calculated using the NRR as follows:

1. Measure the noise level in the workplace in dBC
2. Subtract the NRR from the above
3. The result of the calculation is the noise level of the protected ear in dBA.

Since, in many occasions, the noise level of the place is measured in dBA, NIOSH recommends that 7 dB be added to the dBA level to obtain the dBC, needed for the calculation. In practice it is equivalent to an increase of 7 dBA of the predicted noise level of the protected ear.

Example 1:	
Noise level in the workplace	
Measured (in dBA):	100 dBA
Calculated (in dBC):	100 dBA + 7 = 107 dBC
Protector:	NRR = 28
Noise level of the protected ear:	107 - 28 = 89 dBA

5. THE ABC SYSTEM

The ABC system is only used in Canada. A variation of the system (using 5 categories, A through E) has recently been adopted in Argentina.

With this system, protectors are classified in three categories: A, B and C on the basis of only their attenuations following specifications in the CSA Z94.2 Standard. As with NRR, it is manufacturers' (or suppliers') responsibility to provide the class of a given protector.

Table 2, (reproduced from Table 1.A, reference 1) indicates the Class of protector to be used for a given equivalent noise level L_{eq}. It has to be pointed out, that noise is not measured as a sound level (as with the NRR), but as L_{eq}. Therefore, not instantaneous but time weighted average is to be used.

Example 2:	
Noise exposure level in the workplace	
Measured:	L_{eq} = 100 dBA
From Table 1:	A Class A protector should be used

The values in Table 2 are calculated after derating the attenuation of the protectors, so that the recommended protectors could be effective for the indicated equivalent noise levels in real life situations.

6. ADVANTAGES AND DISADVANTAGES

Following are some of the advantages and disadvantages from the use of both estimates:

- The NRR is widely used. The International Standard Organization (ISO) has incorporated a modified version of the NRR. The ABC is used only in Canada.
- The NRR has been favourably tested against the NIOSH "long" method[(6)], the ABC has not.
- Because of its extensive use, especially in the USA the NRR is well known by the safety professionals.
- The ABC does not use the standard deviation among subjects. In doing so an important piece of information is lost.
- The NRR divides protectors into too many groups by using increments of one dB. This may lead to the wrong assumption that a difference of a few dB is important (e.g., that a protector with NRR 25 is much better than other protector with NRR 23). Having only 3 classes, the ABC system can group the protectors better. However, again, one dB at one frequency can cause a protector to change from one Class to another.
- The ABC system is procedural: one does not have to do any calculations: once the L_{eq} has been measured

*** Variations of the NRR are used in Australia, New Zealand and are also adopted by the ISO[(5)].

the appropriate Class of protector to use is found in Table 1A in the Appendix of the Standard.

- Both estimates use attenuation data that are far from the real life situations. Although the ABC system has derated somehow the system, it is still not scientifically proven and open to discussions.

7. CONCLUSIONS AND RECOMMENDATIONS

At this point some conclusions should be drawn regarding where to go. From all that was said above, the following can be concluded:

(a) The ABC system is here to stay for at least the next five years.

(b) Too many people are by now using the NRR. Therefore safety professionals should be knowledgeable of both systems

(c) Whichever system is used, it has to be kept in mind that both are using estimates that are far too "optimistic" and that in practice, attenuations are much lower (by about 10 dB in the case of the NRR).

(d) ***Most important:*** users should be trained on why, when, where and how to wear their protectors. (See appendices in the CSA Standard[1].)

REFERENCES

1. SCA Standard Z94.2 Hearing Protectors. Canadian Standard Organization, 1984.

2. ANSI Standard S3.19 Method for the Measurement of Real-Ear Protection of Hearing Protectors and Physical Attenuation of Earmuffs. American National Standard Institute, 1974.

3. Behar, A.: Field Evaluation of Hearing Protectors. Noise Control Engineering Journal, Vol. 24, No. 1, 1985.

4. Behar, A., and Desormeaux, J.: Testing of Hearing Protectors at Ontario Hydro, Sound and Vibration, October 1986.

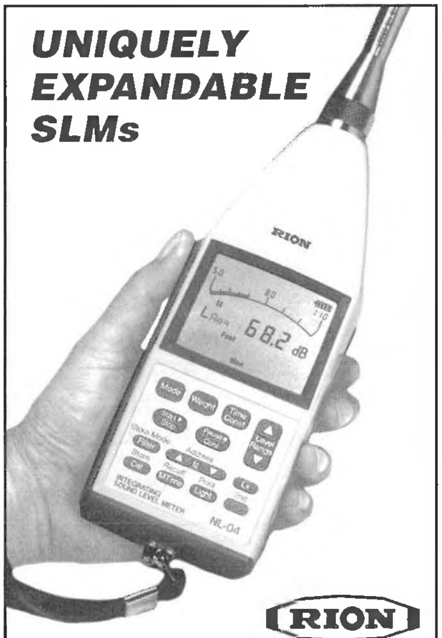
5. ISO/DIS 8353.2: Acoustics - Hearing Protectors - Part 2: Estimation of Effective A-weighted Sound Pressure Levels When Hearing Protectors Are Worn. International Standard Organization, 1991.

6. Behar, A.: Attenuation of Hearing Protectors and the NRR Factor. Am. Ind. Hyg. Assoc. (42) December 1981, 904-908.

TABLE 2

Selection of Hearing Protectors

Maximum Equivalent Noise Level, dBA	Recommended Class of Hearing Protector
L_{eq} less than 85 dBA	No protection required
L_{eq} up to 89 dBA	Class C
L_{eq} up to 95 dBA	Class B
L_{eq} up to 105 dBA	Class A
L_{eq} up to 110 dBA	Class A plug + Class A or Class B muff
L_{eq} more than 110 dBA	Class A plug + Class A or Class B muff and limited exposure



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CSA Z107 ACOUSTICS AND NOISE CONTROL MEETING 1993-10-05

At the Main Committee CSA Z107, Acoustics and Noise Control Vancouver meeting of 1992 and the Toronto meeting of 1993 considerable discussion was generated about the possibility of CSA producing a one volume document that would include the approved acoustical standards of CSA. It has been proposed that this document would divide the acoustical standards into groups with a lead CSA guideline standard (balloted according to CSA consensus procedures) for each group. This guideline would indicate how the standards in the group are to be used and how they relate to other standards in the document.

If CSA administration accepts this proposal, which is a major departure from their present procedure of selling individual standards, there will be a need to draw on the expertise of the Canadian Acoustical community to develop the guideline standards. It is thought that this one volume document might be updated every three years. Single documents would be available of any CSA approved standard during the intervening years. Comments from the Canadian Acoustical Community would be appreciated particularly in reference to the purchase of such a one volume document if it became available.

Canadian Acousticians will never be able to generate quickly enough all the acoustical standards required by Canada. For a country our size, our effectiveness is in influencing other acoustical standards writing groups. This we already do in ANSI, ASTM, ISO, SAE, and ASHRAE disproportionately to our numbers and should continue to so this in the future. Thus the route of Canadian Acoustical Standards of the future will be one of endorsement except where there is a unique need for a Canadian acoustical standard.

Cameron Sherry

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INVITATION TO PARTICIPATE

You are invited to participate in Acoustics Week In Canada 1994 to be held October 18 through 21 at the Citadel Inn Ottawa. Highlights of the week include seminars, a symposium, a laboratory tour, and entertainment. The week will begin on Tuesday, October 18 with two seminars. Bruel&Kjaer Canada will address *Sound Power: Measurement and Applicable Standards*, while the other seminar, organized by Alberto Behar, will address *Hearing Conservation and Noise control.*

The Symposium will begin Wednesday morning and will consist of two full days of organized sessions on all aspects acoustics. Each day there will be three simultaneous sessions with invited and contributed papers. Specially catered luncheons for the delegates as well as a Wednesday evening Reception and Banquet will be held in the ballroom atop the Citadel Inn which offers a beautiful panoramic view of the city. The annual general meeting and student awards will be held on Thursday after the close of the symposium. Friday, members of the IRC Acoustics Laboratory at the National Research Council Canada will provide a tour of their facilities and a seminar in which details of current work will be given. Also included in the tour is a complimentary luncheon.

The venue for Acoustics Week In Canada will be the newly renovated Citadel Inn Ottawa located in the heart of downtown, only a short walk from Parliament Hill and other attractions. A large exhibition space central to the lecture rooms has been secured in which morning and afternoon coffee will be served. Discount hotel rates of $85 Single, $90 Double which include free breakfast, are available by telephoning the hotel directly at 1-800-567-3600 and identifying yourself as a CAA conference delegate. Members are encouraged to stay at the Citadel Inn as meeting room charges are determined by the number of guest rooms occupied by our delegates.

The cost of the Symposium will be $130 per person for CAA members, $165 for non-members, $40 for student members, $50 for non-member students. This includes both luncheons and the Banquet. Symposium registration will be conducted at the door, while seminar registration will be done in advance (forms to appear in the June issue).

Conference Chair

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A Note on Air Travel

Canadian Airlines International has been appointed as the official airline for our national meeting in Ottawa. Savings of up to 50% on full fare economy are available to delegates, pending availability and restrictions. Reservations should be made by calling Canadian Airlines Conventionair at 1-800-665-5554 and quoting event number "5437 in Ottawa."

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Vous êtes invités à participer à la Semaine canadienne d'acoustique qui doit avoir lieu les 18, 19, 20 et 21 octobre 1994 à l'hôtel Citadel Inn à Ottawa. Les activités sont variées, allant des conférences, symposium, visite de laboratoires aux divertissements. Deux conférences marqueront le début de la rencontre le mardi 18 octobre; la première, par Bruel & Kjaer Canada, traitera de la puissance sonore et des mesures et normes applicables, tandis que la seconde, organisée par Alberto Behar, portera sur la protection de l'ouïe et la lutte contre le bruit.

Le symposium commencera mercredi matin et comportera deux journées complètes de séances organisées sur tous les aspects de l'acoustique. Trois séances simultanées de présentations sollicitées et offertes sont prévues chaque jour. Des repas du midi spécialement préparés par un traiteur et un banquet-réception (mercredi soir) seront servis dans la salle de bal à l'étage supérieur de l'hôtel, qui offre une vue panoramique de la ville. L'assemblée générale annuelle et la remise des prix aux étudiants auront lieu le jeudi après le symposium. Vendredi, des membres du personnel du Laboratoire d'acoustique de l'IRC au Conseil national de recherches du Canada dirigeront une visite de leurs installations et animeront une conférence portant sur les travaux en cours. Un repas du midi gratuit est prévu à cette occasion.

La Semaine canadienne d'acoustique se déroulera à Ottawa dans l'hôtel Citadel Inn récemment rénové, qui se trouve en plein centre-ville et à quelques pas seulement de la Colline du Parlement et d'autres lieux attrayants. Un grand local d'exposition tout près des salles de conférence a été réservé et c'est là qu'auront lieu les pauses du matin et de l'après-midi. Les participants pourront réserver une chambre d'hôtel à prix réduit (chambre individuelle à 85 $, chambre double à 90 $, petit déjeuner compris) en communiquant directement avec l'hôtel au 1-800-567-3600 et en mentionnant leur participation au congrès de l'Association canadienne de l'acoustique. Nous encourageons les participants à loger à l'hôtel Citadel Inn puisque le tarif des salles de réunion est fonction du nombre de participants hébergés.

Le droit de participation au symposium est de 130 $ par personne pour les membres de l'ACA, de 165 $ pour les non-membres, de 40 $ pour les membres étudiants et de 50 $ pour les étudiants qui ne sont pas membres. Ce prix englobe les repas du midi et le banquet. On pourra s'inscrire au symposium le jour même, tandis que l'inscription aux conférences se fera à l'avance (formulaires dans le numéro de juin).

Président du congrès

D^r Trevor R. Nightingale, téléphone (613) 993-0102

Voyages par avion

Les Lignes aériennes Canadien International sont le transporteur officiel pour notre rencontre nationale à Ottawa. Les délégués pourront épargner jusqu'à 50 % du plein tarif de classe économique, suivant les places disponibles et les restrictions applicables. On pourra réserver une place en communiquant avec Canadian Airlines Conventionair au 1-800-665-5554 et en mentionnant l'événement « 5437 à Ottawa ».

CALL FOR PAPERS

Acoustics Week In Canada 1994

SYMPOSIUM October 19-20

Contributions from all areas of acoustics and vibration are invited. The programme will include three parallel sessions of invited and contributed presentations. Planned sessions and their organizers are:

- Architectural Acoustics: John Swallow (416) 789-0522;
- Audio Engineering: Prof. Gilbert Soulodre (514) 398-4548 Ext. 0342;
- Hearing in the Workplace: Dr. Chantal Laroche (613) 564-2933;
- Interdisciplinary Approach to Hearing Accessibility:
  Dr. Kathy Pichora-Fuller (604) 822-4716;
- Noise in the Workplace; Prediction, Control, and Effect:
  Dr. Murray Hodgson (604) 822-3073;
- Outdoor Noise Propagation: Dr. Mike Stinson (613) 993-3729;
- Speech and Perception and Production: Prof. Ian MacKay (613) 564-3273;
- Underwater Acoustics: Dr. David Chapman (902) 426-3100.

Other sessions will be created, where necessary, to accommodate contributed papers. Persons wishing to contribute to a special session are encouraged to contact the session organizer. All presenatations require that an abstract no longer than 300 words be submitted to the technical chair on or before June 21, 1994. The abstracts will be reviewed to determine the correct session and suitability of the presentation. The technical chair will fax an acceptance by July 1, 1994. Following acceptance, a two-page camera-ready summary paper is to be submitted to the technical chair no later than July 21, 1994. Accepted papers will be published in the proceedings issue of *Canadian Acoustics*. Instructions for the preparation of abstracts and papers are provided in this issue. Completed abstracts and papers should be directed to the technical chair:

Dr. John S. Bradley
Institute for Research in Construction, Acoustics Laboratory,
National Research Council Canada,
Bldg. M-27, Montreal Road
Ottawa, Ontario. K1A 0R6
Tel: (613) 993-9747, Fax: (613) 954-1495

Summary of Dates:

- June 21, 1994: Deadline for receipt of abstracts;
- July 1, 1994: Response to abstract by technical chair;
- July 21, 1994: Deadline for receipt of camera-ready summary paper;
- October 19-20, 1994: Symposium.

Students are invited to participate. Monetary awards will be given to the three best presentations. Students must signify their intention to compete by submitting the 'Annual Student Presentation Awards' form in this issue along with an abstract.

APPEL DE COMMUNICATIONS

Semaine canadienne d'acoustique 1994

SYMPOSIUM les 19 et 20 octobre

Des présentations sont sollicitées sur tous les aspects de l'acoustique et des vibrations. Le programme englobera trois séances parallèles de présentations sollicitées et offertes. Séances prévues et personnes responsables :

- Acoustique architecturale : John Swallow (416) 789-0522;
- Techniques acoustiques : le prof. Gilbert Soulodre (514) 398-4548, poste 0342;
- Audition en milieu de travail : D^r Chantal Laroche (613) 564-2933;
- Stratégie interdisciplinaire de l'accessibilité auditive :
  D^r Kathy Pichora-Fuller (604) 822-4716;
- Bruits en milieu de travail; prévision, maîtrise et effets :
  D^r Murray Hodgson (604) 822-3073;
- Propagation du bruit extérieur : D^r Mike Stinson (613) 993-3729;
- Parole et perception et production : le prof. Ian MacKay (613) 564-3273;
- Acoustique sous-marine : D^r David Chapman (902) 426-3100.

D'autres séances seront prévues, au besoin, en fonction des communications offertes. Les personnes qui désirent présenter un exposé à une séance particulière sont priées de communiquer avec le responsable de la séance. Toute présentation doit comporter un résumé ne dépassant pas 300 mots, envoyé au responsable technique le 21 juin 1994 au plus tard. Les résumés seront examinés en fonction de la séance appropriée et du contenu, et le responsable technique transmettra les télécopies d'acceptation le 1^er juillet 1994 ou avant. À la suite d'une acceptation, un sommaire de deux pages prêtes à photographier devra être présenté au responsable technique le 21 juillet 1994 au plus tard. Les présentations acceptées seront publiées dans un numéro compte rendu de la revue Acoustique canadienne. On trouvera dans le présent numéro des instructions quant à la préparation des résumés et des communications. Prière de transmettre les résumés et les communications au responsable technique :

D^r John S. Bradley
Institut de recherche en construction, Laboratoire d'acoustique
Conseil national de recherches du Canada
Édifice M-27, chemin Montréal
Ottawa (Ontario) K1A 0R6
Téléphone (613) 993-9747, télécopieur : (613) 954-1495

Dates clés :

- 21 juin 1994 : date limite de réception des résumés;
- 1^er juillet 1994 : réponse du responsable technique;
- 21 juillet 1994 : date limite de réception du sommaire de la communication, prêt à photographier;
- 19 et 20 octobre 1994 : symposium.

Les étudiants sont invités à participer. Des prix en argent seront décernés pour les trois meilleures communications. Les étudiants doivent indiquer leur intention de participer en remplissant le formulaire « Prix annuel relatif aux communications étudiantes » qui figure dans le présent numéro, et en le retournant accompagné d'un résumé.

ACOUSTICS WEEK IN CANADA 1994
SEMAINE CANADIENNE D'ACOUSTIQUE 1994

Citadel Inn Ottawa

SEMINARS

HEARING CONSERVATION AND NOISE CONTROL

Date: Tuesday October 18, 1994.
Presented by: Alberto Behar, Winston Sydenborgh, and Bob Pemberton.
Cost: $100.

This is a practical one day course for plant personnel involved in hearing conservation programmes. This would include members of health and safety committees, safety officers, occupational nurses, and others involved in work place health and safety.

The course content will consider: how to design, implement, and assess hearing conservation programmes, including the selection of hearing protectors, as well as the measurement of noise levels and exposures. The second half of the course will consider engineering noise control issues and the selection of materials to reduce occupational noise levels.

SOUND POWER: MEASUREMENT AND APPLICABLE STANDARDS

Date: October 18, 1994.
Presented by: Bruel&Kjaer Canada.
Cost: $200.

It is becoming increasingly important to certify the sound power output of products. Equipment sold or exported to Europe must be labeled for sound power in accordance with standardized methods. With the growing importance of the European Community and the global market, the ability to provide a certificate of sound power is key to accessing these markets.

This seminar specifically addresses possible standards that can be used to obtain a recognized measure of sound power. The various accepted methods will be compared for accuracy and ease of implementation. A demonstration of sound power measurement using acoustic intensity is given and shown to be simple and accurate for most applications. Measurement technique, quality control indicators, and result interpretation will be discussed in detail.

Basic knowledge and understanding of acoustics are required.

Seminar Registration

Registration forms will be included in the next issue of *Canadian Acoustics* (June 1994). Please, note that these courses will only be offered if there is sufficient advance registration.

ACOUSTICS WEEK IN CANADA 1994

Citadel Inn Ottawa

SEMINARS

INSTITUTE FOR RESEARCH IN CONSTRUCTION, ACOUSTICS LABORATORY TECHNOLOGY UPDATE SEMINARS

Date: October 21, 1994.
Presented by: Acoustics Laboratory, Institute for Research in Construction, National Research Council Canada.
Cost: $10.
Location: National Research Council Canada, Institute for Research in Construction, Acoustics Laboratory.
Language: English.

This one day event will include both seminar presentations and laboratory tours conducted by IRC, Acoustics Laboratory researchers. The seminars will be of particular interest to practitioners of building acoustics as well as persons who design and develop and use acoustically engineered building products.

The morning will include presentations giving applied and practical information from our most recent client funded projects:

- Flanking sound transmission in wood frame constructions;
- Sound transmission through gypsum board walls;
- Degradation of sound insulation due to electrical outlets in walls;
- Sound power measurement of HVAC systems, and of low frequencies;
- Aircraft noise issues at Canadian Airports;
- Room acoustics measurement techniques and subjective testings;
- Design and commissioning of a new floor transmission test facility.

Where possible, handouts and report reprints will be made available to participants.

In the afternoon there will be guided tours of the Acoustics Laboratory facilities which include the wall and floor test suites, the anechoic room, the room acoustics test suite, and the flanking transmission test suite. The tour will provide participants with an excellent opportunity to discuss technical matters and plans for future projects with the researchers.

Buses will provide transportation to and from the Citadel Inn.

Seminar Registration

Registration forms will be included in the next issue of Canadian Acoustics (June 1994). Please, note that seminars will only be offered if there is sufficient advance registration.

SEMAINE CANADIENNE D'ACOUSTIQUE 1994

Citadel Inn Ottawa

CONFÉRENCES

INSTITUT DE RECHERCHE EN CONSTRUCTION, CONFÉRENCES SUR L'ACTUALITÉ TECHNOLOGIQUE DU LABORATOIRE D'ACOUSTIQUE

Date : le 21 octobre 1994.
Présentées par : le Laboratoire d'acoustique, Institut de recherche en construction, Conseil national de recherches du Canada.
Coût : 10 $.
Endroit : Conseil national de recherches du Canada, Institut de recherche en construction, Laboratoire d'acoustique.
Langue : l'anglais.

Cette rencontre d'une journée englobera à la fois des exposés et des visites de laboratoire dirigées par des chercheurs du Laboratoire d'acoustique de l'IRC. Les conférences intéresseront tout particulièrement les praticiens de l'acoustique architecturale et les personnes qui conçoivent, mettent au point et utilisent des matériaux de construction insonorisés.

Au cours des exposés du matin, les chercheurs de l'IRC présenteront de l'information concrète tirée de leurs plus récents projets financés par la clientèle :

- La transmission latérale du son dans les bâtiments à ossature de bois;
- La transmission du son à travers les murs de plaques de plâtre;
- La dégradation de l'insonorisation sous l'effet des prises électriques dans les murs;
- La mesure de la puissance sonore des systèmes CVC et des faibles fréquences;
- Le bruit des avions dans les aéroports canadiens;
- Les techniques de mesure et les essais subjectifs en acoustique des salles;
- La conception et la mise en service d'une nouvelle installation d'essais (transmission par les planchers).

Les participants recevront dans la mesure du possible des documents et des tirés à part.

Durant l'après-midi, on pourra visiter les installations du Laboratoire d'acoustique, y compris les locaux d'essais pour murs et planchers, la chambre anéchoïque, les locaux d'essais en acoustique des salles, ainsi que les locaux d'essais de la transmission latérale du son. Cette visite offrira aux participants une excellente occasion d'aborder des questions techniques et des projets futurs avec les chercheurs.

Des autobus feront la navette entre le CNRC et l'hôtel Citadel Inn.

Inscription aux conférences

On trouvera des formulaires d'inscription dans le prochain numéro d'Acoustique canadienne (juin 1994). À noter que les conférences ne seront organisées que si le nombre d'inscriptions préalables est suffisant.

ACOUSTICS WEEK IN CANADA 1994

SEMAINE CANADIENNE D'ACOUSTIQUE

Citadel Inn Ottawa

EXHIBITION

October 19, 20

The Organizing Committee for Acoustics Week In Canada 1994 is pleased to announce that there will be an exhibition of Instrumentation, Software, Materials, as well as Literature related to all aspects of Acoustics, and Noise and Vibration Control. A large room adjacent to the meeting rooms has been made available as an Exhibition space. Companies are invited to exhibit their products and services. The cost will be $275 for an 8-foot table. This includes a partial subsidy of the morning and afternoon conference coffee service that will be held in the exhibition room. Exhibition space will be reserved on a first come, first served basis. You are advised to reserve as soon as possible, as space is limited. A non-refundable deposit of $100 must accompany all reservations, the balance being due on or before October 1, 1994. To reserve space and/or obtain further information, please contact:

Dr. Wing T. Chu
Institute for Research in Construction, Acoustics Laboratory,
National Research Council Canada,
Building M-27, Montreal Road,
Ottawa, Ontario. K1A 0R6
Tel: (613) 993-9742, Fax: (613) 993-1495

EXPOSITION

Les 19 et 20 octobre

Le Comité organisateur de la Semaine canadienne d'acoustique 1994 est fier d'annoncer qu'une exposition sur l'instrumentation, les logiciels, le matériel et la documentation relative à tous les aspects de l'acoustique et de la lutte contre le bruit et les vibrations a été prévue dans un grand local tout près des salles de réunion. Les compagnies pourront y exposer leurs produits et leurs services au prix de 275 $ pour une table de 8 pieds, ce prix englobant une subvention partielle des pauses du matin et de l'après-midi qui auront lieu dans le local d'exposition. Puisque le nombre de places est limité, il importe de faire les réservations le plus tôt possible; ces dernières seront traitées au fur et à mesure de leur réception. Un dépôt non remboursable de 100 $ doit accompagner toute réservation, le solde devant être versé le 1er octobre 1994 au plus tard. Pour tout renseignement ou toute réservation, prière de communiquer avec :

Dr Wing T. Chu
Institut de recherche en construction, Laboratoire d'acoustique
Conseil national de recherches du Canada
Édifice M-27, chemin Montréal
Ottawa (Ontario) K1A 0R6
Téléphone (613) 993-9742, télécopieur (613) 993-1495

Instructions for the Preparation of Abstracts

1) Duplicate copies of an abstract are required for each meeting paper; one copy should be an original. Send the four copies to the Technical Program Chairperson, in time to be received by June 21. Either English or French may be used. A cover letter is not necessary. **2)** Limit the abstract to 300 words, including title and first author's name and address; names and addresses of coauthors are not counted. Display formulas set apart from the text are counted as 40 words. Do not use the forms "I" and "we"; use passive voice instead. **3)** Title of abstract and names and addresses of authors should be set apart from the abstract. Text of abstract should be one single, indented paragraph. The entire abstract should be typed double spaced on one side of 8 1/2 x 11 in. or A4 paper. **4)** Be sure that the mailing address of the author to receive the acceptance notice is complete on the abstract, to insure timely deliveries. **5)** Do not use footnotes. Use square brackets to cite references or acknowledgements. **6)** Underline nothing except what you wish to be italicized. **7)** If the letter l is used as a symbol in a formula, loop the letter l by hand and write "lc ell" in the margin of the abstract. Do not intersperse the capital letter O with numbers where it might be confused with zero, but if unavoidable, write "capital oh" in the margin. Identify phonetic symbols by appropriate marginal remarks. **8)** At the bottom of an abstract give the following information: **a)** If the paper is part of a special session, indicate the session; **b)** Name the area of acoustics most appropriate to the subject matter; **c)** Telephone and fax numbers, including area code, of the author to be contacted for information. Non-Canadian Authors should include country; **d)** If more than one author, name the one to receive the acceptance notice; **e)** Overhead projectors and 35mm slide projectors will be available at all sessions. Describe on the abstract itself any special equipment needed.

Instructions pour la Préparation des Résumés de Conférences

1) Deux copies du résumé sont requises pour chaque papier soumis; une des copies doit être un original. Envoyer les quatre copies au Président du Comité technique, suffisamment à l'avance pour qu'elles soient reçues avant le 21 juin. L'anglais ou le français peut être utilisé. Une lettre de présentation n'est pas requise. **2)** Limiter le résumé à 300 mots, incluant le titre, le nom et l'adresse du premier auteur; les noms et les adresses des co-auteurs ne sont pas comptabilisés. Les formules en retrait du texte comptent pour 40 mots. Ne pas utiliser la forme "je" ou "nous"; utiliser plutôt la forme passive. **3)** Le titre du résumé, les noms et les adresses des auteurs doivent être séparés du texte. Le texte du résumé doit être présenté en un seul paragraphe. Le résumé entier doit être dactylographié à double interlignes sur une face d'une page 8 1/2 x 11 pouce ou du papier A4. **4)** S'assurer que l'adresse postale complète de l'auteur qui doit recevoir l'avis d'acceptation est inscrite sur le résumé afin d'assurer une livraison rapide. **5)** Ne pas utiliser les notes de bas de page. Utiliser les crochets pour les références et les remerciements. **6)** Ne souligner que ce qui doit être en italique. **7)** Si la lettre l est utilisée comme symbole dans une formule, encercler la lettre l à la main et écrire "lc ell" dans la marge du résumé. Ne pas introduire la lettre majuscule O dans les chiffres lorsqu'elle peut être confondue avec zéro, mais se cela n'est pas possible, écrire "O majuscule" dans la marge. Identifier les symboles phonétiques à l'aide de remarques appropriées dans la marge. **8)** A la fin du résumé, fournir les informations suivantes: **a)** Si la communication fait partie d'une session spéciale, indiquer laquelle; **b)** Identifier le domaine de l'acoustique le plus appropié à votre sujet; **c)** Les numéros de téléphone et de télécopieur, incluant le code régional, de l'auteur avec qui l'on doit communiquer pour information. Les auteurs étrangers doivent indiquer leur pays; **d)** S'il y a plus d'un auteur, mentionner le nom de celui qui doit recevoir l'avis d'acceptation; **e)** Des projecteurs à acétates et à diapositives seront disponibles dans chaque session. Indiquer les besoins spéciaux, si nécessaire.

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

Général - Soumettre un article prêt-à-copier d'un maximum 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 21 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. Titre en 12pt, caractères gras, en simple interligne (12pt), centrés sur la page. Le reste du texte en 9pt en 0.75 (9pt) interligne, dans un format en deux colones, avec une largeur de colonnes de 3.4" et une séparation de 1/4". Noms des auteurs et adresses centrés sur la page avec les noms en caractères gras. Les titres de sections en caractères gras.

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

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

General - Submit the camera-ready article on a maximum of 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 21. The optimum format can be obtained in two ways:

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

Indirect method - Type or print as follows, reduce to three-quarters size (please ensure good copies) and assemble article on a maximum of two 8.5" x 11" pages with margins of 3.4" top and sides, and 1" minimum at the bottom. Title in 16pt bold type with 1.33 (16pt) line spacing, centred on the page. All other text in 12pt with single (12pt) line spacing. Authors' names and addresses centred on the page with the names in bold type. Section headings in bold type. Print individual text columns on four sheets of 8.5" x 14" paper with a column width of 4..5", a maximum length of 12.25", and leaving room for the title and names and addresses on the first page.

ANNUAL STUDENT PRESENTATION AWARDS

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

RULES

1. These awards are presented annually to authors of outstanding student papers that are presented during the technical sessions at Acoustics Week in Canada.

2. In total, three awards of $500.00 are presented.

3. Presentations are judged on the following merits:
   i) The way the subject is presented;
   ii) The explanation of the relevance of the subject;
   iii) The explanation of the methodology/theory;
   iv) The presentation and analysis of results;
   v) The consistency of the conclusions with theory and results.

4. Each presentation is judged independently by at least three judges.

5. The applicant must be:
   i) a full-time graduate student at the time of application;
   ii) the first author of the paper;
   iii) a member of the CAA;
   iv) registered at the meeting.

6. To apply for the award, the student must send this application simultaneously with the abstract. Multiple authors are permitted, but only the first author may receive an award.

PRIX ANNUELS RELATIFS AUX COMMUNICATIONS ETUDIANTES

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

REGLEMENTS

1. Ces prix sont decernes annuellement aux auteurs de communications exceptionelles presentées par des étudiants lors des sessions techniques de la Semaine Canadienne de l'Acoustique.

2. Au total, trois prix de 500$ sont remis.

3. Les présentations sont jugées selon les critères suivants:
   i) La facon dont le sujet est présente;
   ii) Les explications relatives à l'importance du sujet;
   iii) L'explication de la methodologie;
   iv) La présentation et l'analyse des résultats;
   v) La consistence des conclusions avec la theorie et les résultats.

4. Chaque présentation est evaluée separement par au moins trois juges.

5. Le candidat doit être:
   i) un étudiant à temps plein de niveau gradué au moment de l'inscription;
   ii) le premier auteur du papier;
   iii) un member de l'ACA;
   iv) un régistrant au congrès.

6. Afin de s'inscrire au concours, l'étudiant doit envoyer ce formulaire d'inscription en même temps que son résumé. Plusieurs auteurs sont permis, mais seul le premier auteur peut recevoir le prix.

APPLICATION FOR STUDENT PRESENTATION AWARD AT ACOUSTICS WEEK IN CANADA

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

NAME OF THE STUDENT/NOM DE L'ETUDIANT:________________________________

TITLE OF PAPER/TITRE DU PAPIER:________________________________

UNIVERSITY/COLLEGE/UNIVERSITE/COLLEGE:________________________________

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

STATEMENT BY THE SUPERVISOR/DECLARATION 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-signe affirme que l'étudiant mentionne ci-haut inscrit à temps plein et que la communication qui'il présentera est le fruit de son propre travail.

Signature:________________________________ Date:________________________________

NOISE-CON 94

THE 1994 NATIONAL CONFERENCE ON NOISE CONTROL ENGINEERING
1994 May 1–4
Fort Lauderdale, Florida

Conference Secretariat:
Susan Fish
Department of Ocean Engineering
Florida Atlantic University
500 NW 20th Street
Boca Raton, FL 33431
Telephone: (407) 367–3430
FAX: (407) 367–3885
e-mail: fish@oe.fau.edu

General Chairman:
David M. Yeager
IBM Acoustics Laboratory
IBM Corporation, M/S 5106
1000 NW 51st St.
Boca Raton, FL 33432
Telephone: (407) 982–1123
Fax: (407) 443–3241
e-mail: dyeager@bcrvm1.vnet.ibm.com

Technical Program Chairman
Joseph Cuschieri
Department of Ocean Engineering
Florida Atlantic University
500 NW 20th St.
Boca Raton, FL 33431
Telephone: (407) 367–3438
Fax: (407) 367–3885
e-mail: joe@jmc.oe.fau.edu

Exhibition Management
Philip G. Swartz
26 Vassar View Road
Poughkeepsie, NY 12603
(914) 454–7733

Sponsored by the Institute of Noise Control Engineering in cooperation with the Florida Atlantic University and the IBM Corporation

Announcement

NOISE–CON 94, the 1994 National Conference on Noise Control Engineering, will be held in Fort Lauderdale, Florida. The conference will be held at a beach–front location approximately 10 minutes by taxi from the Fort Lauderdale International Airport. NOISE–CON 94 will be held at the Bahia Mar Resort and Yachting Center on Atlantic Boulevard in Fort Lauderdale. The hotel can also be easily reached from the Palm Beach International Airport or the Miami International Airport. NOISE–CON 94 will open with an evening plenary session on 1994 May 1, and conclude on the afternoon of May 4.

NOISE–CON 94 is the 13th in a series of national conferences on noise control engineering that began in 1973. The theme of NOISE–CON 94 is *Progress in Noise Control for Industry*. The conference is being sponsored and organized by the Institute of Noise Control Engineering of the USA (INCE/USA) in cooperation with the Florida Atlantic University and the International Business Machines Corporation.

David M. Yeager of the IBM Acoustics Laboratory in Boca Raton, Florida will serve as General Chairman for NOISE–CON 94. Joseph M. Cuschieri of the Department of Ocean Engineering at Florida Atlantic University is the Technical Program Chairman.

A major instrument, equipment, and materials exhibition will be held in conjunction with NOISE–CON 94. The exhibition will include computer–based instrumentation system noise analyzers, sound level meters, sound intensity analyzers, signal processing systems, equipment for active noise control, acoustical materials, and devices for noise control.

A noise control seminar will precede NOISE–CON 94. The seminar will be held on 1994 April 29–30.

NEWS/INFORMATIONS

CONFERENCES

Third French Congress on Acoustics: Toulouse (France), May 2 - 6, 1994. Mail should be sent to: Secrétariat du Troisième C.F.A., Université Toulouse-le-Mirail, (C.P.R.S.), 5, allée Antonio Machado, 31058 Toulouse Cédex, FRANCE, Tel. (33) 61 50 44 68, Fax. (33) 61 50 42 09.

127th Meeting of the Acoustical Society of America: June 5 - 9, 1994, Cambridge, Massachusetts, USA. Contact: Elaine Moran, Acoustical Society of America, 500 Sunnyside Blvd., Woodbury, NY 11797, USA. Tel. +1 (516) 576-2360, Fax. +1 (516) 349-7669.

XXII International Congress of Audiology: July 3-7, 1994, Halifax, Nova Scotia, Canada. Secretariat, P.O. Box 2627, Station M, Halifax, Nova Scotia, Canada B3J 3P7. Tel: (902) 461-0230, Fax: (902) 465-2233.

5th Western Pacific Regional Acoustics Conference: August 23 - 25, 1994, Seoul, Korea. Contact: Conference Secretariat, Tel. +82 2 361-2783, Fax. +82 2 365-4668.

INTER-NOISE 94: 1994 International congress on Noise Control Engineering, Yokohama, Japan, August 29 to 31, 1994. Contact: Inter-Noise 94 - Congress Secretariat, Sone Lab. R.I.E.C., Tohoku University, 2-1-1 Katahira, Aoba-Ku, Sendai, 980 Japan. Fax: +81-22 263-9848, +81-22-224-7889. E-Mail: in94@riec.tohoku.ac.ip.

128th Meeting of the Acoustical Society of America: November 28 - December 2, 1994, Austin, Texas, USA. Contact: Elaine Moran, Acoustical Society of America, 500 Sunnyside Blvd., Woodbury, NY 11797, USA. Tel. +1 (516) 576-2360, Fax. +1 (516) 349-7669.

129th Meeting of the Acoustical Society of America: May 31 - June 4, 1995, Washington, DC, USA. Contact: Elaine Moran, Acoustical Society of America, 500 Sunnyside Blvd., Woodbury, NY 11797, USA. Telephone: +1 (516) 576-2360, FAX: +1 (516) 349-7669.

INTER-NOISE 95: July 10-12, 1995, Newport Beach, California, USA. Contact: Intstitute of Noise Control Engineering, P.O. Box 3206, Arlington Branch, Poughkeepsie, NY 12603, USA. Tel. (914) 462-4006, Fax. (914) 473-9325.

COURSES

Scantek, Inc. announces two new services in connection with its popular environmental noise software for the accurate modelling of noise sources in the areas of environmental impact, sound insulation, and noise quality.

The services are meant for two groups of people who need answers: those that only want results, and those who's business is sufficient to invest in software for in-house capability. Scantek can now offer a) professional consulting as a short-term solution to time-sensitive problems and, b) expert training on its popular environmental software programs so customers can get up-to-speed within hours. For further information: Richard J. Peppin, P.E,. President (301) 495-7738.

CONFERENCES

3e Congrès français d'acoustique: Toulouse, France, du 2 au 6 mai 1994. Renseignements: Secrétariat du Troisième C.F.A., Université Toulouse-le-Mirail (C.P.R.S.), 5, allée Antonio Machado, 31058 Toulouse Cédex, France. Téléphone (33) 61 50 44 68; télécopieur (33) 61 50 42 09.

127e rencontre de l'Acoustical Society of America: Cambridge, Massachusetts, du 5 au 9 juin 1994. Renseignements: Elaine Moran, Acoustical Society of America, 500 Sunnyside Boulevard, Woodbury, NY 11797, USA. Téléphone (516) 576-2360; télécopieur (516) 349-7669.

XXII conférence internationale sur l'audiologie: Halifax (Nouvelle-Écosse), du 3 au 7 juillet 1994. Renseignements: International Congress of Audiology Secretariat, C.P. 2627, Succursale M, Halifax (Nouvelle-Écosse), Canada. B3J 3P7. Téléphone (902) 461-0230; télécopieur (902) 465-2233.

5e conférence des pays du Pacifique ouest sur l'acoustique: Séoul, Corée, du 23 au 25 août 1994. Téléphone +82 2 361-2783; télécopieur +82 2 365-4668

Conférence Inter-Noise 94: Yokohama, Japon, du 29 au 31 août 1994. Renseignements: Inter-Noise 94, Congress Secretariat, Sone Lab. R.I.E.C., Tohoku University, 2-1-1 Katahira, Aoba-Ku, Sendai, 980 Japon. Télécopieur +81-22-263-9848; +81-22-224-7889; courrier électronique in94 @ riec.tohoku.ac.ip.

128e rencontre de l'Acoustical Society of America: Austin, Texas, du 28 novembre au 2 décembre 1994. Renseignements: Elaine Moran, Acoustical Society of America, 500 Sunnyside Boulevard, Woodbury NY 11797, USA. Téléphone (516) 576-2360; télécopieur (516) 349-7669.

129e rencontre de l'Acoustical Society of America: Washington, DC., du 31 mai au 4 juin 1995. Renseignements: Elaine Moran, Acoustical Society of America, 500 Sunnyside Blvd., Woodbury, NY 11797, USA. Téléphone (516) 576-2360; télécopieur (516) 349-7669.

Conférence Inter-Noise 95: Newport Beach, Californie, du 10 au 12 juillet 1995. Renseignements: Institute of Noise Control Engineering, P.O. Box 3206, Arlington Branch, Poughkeepsie, NY 12603, USA. Téléphone (914) 462-4006; télécopieur (914) 473-9325.

COURS

Scantek, Inc. annonce la création de deux nouveaux services en relation avec son logiciel de modélisation des sources de bruit de l'environnement. Ce logiciel très en demande est utilisé pour la mesure des impacts sur l'environnement, l'insonorisation et la détermination de la qualité du bruit.

Il s'agit d'un service de consultations offert par des spécialistes pour répondre aux demandes pressantes et d'un service de formation accélérée pour les utilisateurs du logiciel. Ces nouveaux services s'adressent à deux groupes de gens: ceux qui veulent des résultats à tout prix et ceux dont le volume de travail justifie l'utilisation d'un tel logiciel. Renseignements: Richard J. Peppin, président, (301) 495-7738.

NEW PRODUCTS

The Industrial Hygiene Services Section of Ontario Hydro, located in Whitby, Ontario, Canada, would like to announce that our laboratory is now offering services in Physical Agent Measurements. Sound level measurements, noise exposure measurements, audiometric calibration and sound level meter calibration are some services offered. Please contact Dr. Steve Llbich at (905) 430-2215, extension 3265 for further information.

NOUVEAUX PRODUITS

La section Hygiène du travail d'Ontario Hydro, située à Whitby (Ontario), annonce qu'elle offre désormais des services de mesure d'agents physiques dans ses laboratories, notamment la mesure du niveau sonore, la mesure de l'exposition au bruit, la calibration des audiomètres et la calibration des sonomètres. Renseignements: Steve Libich, (905) 430-2215, poste 3265.

PEOPLE IN THE NEWS

There seem to be many changes lately, so here goes.

Tony Leroux formally of Sonometric Inc. may now be reached at

Université d'Ottawa
Programme d'Audiologie
545 King-Edward
Ottawa, Ontario K1N 6N5

Alberto Behar, who recently retired from Ontario Hydro, may now be reached at his own consulting company where he provides service in the field of occupational noise management and control at (416) 268-1816 (also FAX number).

FLOWCARE Engineering Inc. would like to announce the formation of their new Acoustics and Vibration Division. Dr. Ramani Ramakrishnan, currently a Director of CAA, has joined FLOWCARE and will be responsible for the services offered by the new division. He joins FLOWCARE after brief assignments at Ontario Hydro and Barman Swallow Associates. FLOWCARE Engineering Inc. specializes in all aspects of turbomachinery such as Sound and Vibration, Energy Reduction Studies, Finite Element analsis and Design.

LES GENS QUI FONT PARLER D'EUX

Il y a du changement dans l'air depuis quelques temps. Voyez par vous-même.

Tony Leroux, anciennement chez Sonometric Inc., travaille maintenant pour le Programme d'audiologie de l'Université d'Ottawa, 545 King-Edward, Ottawa (Ontario) K1N 6N5.

Alberto Behar, ex-employé d'Ontario Hydro, a lancé sa propre entreprise de service-conseils dans le domaine de la gestion et de la réduction du bruit au travail. On peut le joindre par téléphone ou par télécopieur au (416) 268-1816.

FLOWCARE Engineering Inc. annonce la création de leur nouvelle division Acoustique et Vibrations, qui sera dirigée par Ramani Ramakrishnan qui travaillait brièvement à Ontario Hydro et à Barman Swallow Associates. Il fait également partie du conseil de direction de l'ACA. FLOWCARE Engineering Inc. se spécialise dans tous les aspects des turbomachines, notamment les sons et les vibrations, la réduction de la consommation d'énergie, l'analyse et la conception des éléments finis.

A New Dimension Noise Control
(reproduced from the Vancouver Sun newspaper)

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We regret any inconvenience this may have caused our customers.

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Audible Flatulence (Rude Gas)

We will show a silencing method you can use the rest of your life. Safe, sanitary, easy to use. Simply amazing. All inquiries strictly confidential. Send $13.95 cheque or money order to: DAISEY INFO of BC, Box 530, Surrey, B.C., V3T 5B7. Allow 4-6 weeks delivery.

ANDS

The Canadian Acoustical Association
l'Association Canadienne d'Acoustique

PRIZE ANNOUNCEMENT

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

Edgar and Millicent Shaw Postdoctoral Prize in Acoustics

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

1990	*Li Cheng*	*Université de Sherbrooke*
1993	*Roland Woodcock*	*University of British Columbia*

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

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

1990	*Bradley Frankland*	*Dalhousie University*
1991	*Steven D. Turnbull*	*University of New Brunswick*
	Fangxin Chen	*University of Alberta*
	Leonard E. Cornelisse	*University of Western Ontario*
1993	*Aloknath De*	*McGill University*

Fessenden Student Prize in Underwater Acoustics

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

1992	*Daniela Dilorio*	*University of Victoria*
1993	*Douglas J. Wilson*	*Memorial University*

Eckel Student Prize in Noise Control

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

Directors' Awards

Three awards are made annually to the authors of the best papers published in *Canadian Acoustics*. All papers reporting new results as well as review and tutorial papers are eligible; technical notes are not. The first award, for $500, is made to a graduate student author. The second and third awards, each for $250, are made to professional authors under 30 years of age and 30 years of age or older, respectively. Coordinator: position vacant.

Student Presentation Awards

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

The Canadian Acoustical Association
l'Association Canadienne d'Acoustique

ANNONCE DE PRIX

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

PRIX POST-DOCTORAL EDGAR ET MILLICENT SHAW EN ACOUSTIQUE

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

1990	*Li Cheng*	*Université de Sherbrooke*
1993	*Roland Woodcock*	*University of British Columbia*

PRIX ÉTUDIANT ALEXANDER GRAHAM BELL EN COMMUNICATION VERBALE ET ACOUSTIQUE COMPORTEMENTALE

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

1990	*Bradley Frankland*	*Dalhousie University*
1991	*Steven D. Turnbull*	*University of New Brunswick*
	Fangxin Chen	*University of Alberta*
	Leonard E. Cornelisse	*University of Western Ontario*
1993	*Aloknath De*	*McGill University*

PRIX ÉTUDIANT FESSENDEN EN ACOUSTIQUE SOUS-MARINE

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

1992	*Daniela Dilorio*	*University of Victoria*
1993	*Douglas J. Wilson*	*Memorial University*

PRIX ÉTUDIANT 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, Occupational Hygiene Programme, University of British Columbia, 2206 East Mall, Vancouver, BC V6T 1Z3.

PRIX DES DIRECTEURS

Trois prix sont décernés, à tous les ans, aux auteurs des trois meilleurs articles publiés dans l'*Acoustique Canadienne.* 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 chacun, sont décernés à des auteurs professionnels âgés de moins de 30 ans et de 30 ans et plus, respectivement. Coordonnateur: poste à combler.

PRIX DE PRESENTATION ÉTUDIANT

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, 45 Meadowcliffe Drive, Scarborough, ON M1M 2X8.

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".

Title: Bold, 14 pt with 14 pt spacing, upper case, centered.

Authors/addresses: Names and full mailing addresses, 10 pt with single (12 pt) spacing, upper and lower case, centered. Names in bold text.

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

Headings: Headings to be in 12 pt bold, Times-Roman font. Number at the left margin and indent text 0.5". Main headings, numbered as 1, 2, 3, ... to be in upper case. Sub-headings numbered as 1.1, 1.2, 1.3, ... in upper and lower case. Sub-sub-headings not numbered, in upper and lower case, underlined.

Equations: Minimize. Place in text if short. Numbered.

Figures/Tables: Keep small. Insert in text at top or bottom of page. Name as "Figure 1, 2, ..." Caption in 9 pt with single (12 pt) spacing. Leave 0.5" between text.

Photographs: Submit original glossy, black and white photograph.

References: Cite in text and list at end in any consistent format, 9 pt with single (12 pt) spacing.

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.

Marges: Dans le haut - page titre, 1.25"; autres pages, 0.75"; dans le bas, 1" minimum; aux côtés, 0.75".

Titre du manuscrit: 14 pt à 14 pt interligne, lettres majuscules, caractères gras. Centré.

Auteurs/adresses: Noms et adresses postales. Lettres majuscules et minuscules, 10 pt à simple (12 pt) interligne. Centré. Les noms doivent être en caractères gras.

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.

Titres des sections: Tous en caractères gras, 12 pt, Times-Roman. Premiers titres: numéroter 1, 2, 3, ..., en lettres majuscules; sous-titres: numéroter 1.1, 1.2, 1.3, ..., en lettres majuscules et minuscules; sous-sous-titres: ne pas numéroter, en lettres majuscules et minuscules et soulignés.

Equations: Les minimizer. Les insérer dans le texte si elles sont courtes. Les numéroter.

Figures/Tableaux: De petites tailles. Les insérer dans le texte dans le haut ou dans le bas de la page. Les nommer "Figure 1, 2, 3,..." Légende en 9 pt à simple (12 pt) interligne. Laisser un espace de 0.5" entre le texte.

Photographies: Soumettre la photographie originale sur paper glacé, noir et blanc.

Références: Les citer dans le texte et en faire la liste à la fin du document, en format uniforme, 9 pt à simple (12 pt) interligne.

Pagination: Au crayon pâle, au bas de chaque page.

Tirés-à-part: Ils peuvent être commandés au moment de l'acceptation du manuscrit.

WHAT'S NEW ??

Promotions	Retirements
Deaths	Degrees awarded
New jobs	Distinctions
Moves	Other news

Do you have any news that you would like to share with *Canadian Acoustics* readers? If so, fill in and send this form to:

QUOI DE NEUF ??

Promotions	Retraites
Décès	Obtention de diplômes
Offre d'emploi	Distinctions
Déménagements	Autres nouvelles

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

Jim Desormeaux, Ontario Hydro, 757 McKay Road, Pickering, Ontario L1W 3C8

The Canadian Acoustical Association | l'Association Canadienne d'Acoustique

SUBSCRIPTION INVOICE

Subscription for the current calendar year is due January 31. New 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.

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FACTURE D'ABONNEMENT

L'abonnement pour la présente année est dû le 31 janvier. Les nouvels 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.

Cocher la case appropriée :

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INFORMATION FOR MEMBERSHIP DIRECTORY

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Check areas of interest (max 3): / Cocher vos champs d'intérêt (max. 3):

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5.	Noise	_____	Bruit
6.	Psycho/Physiological Acoustics	_____	Physio/psychoacoustique
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Faites parvenir ce formulaire à l'adresse suivante en prenant soin d'y joindre un chèque fait au nom de L'ASSOCIATION CANADIENNE D'ACOUSTIQUE:

Make cheques payable to THE CANADIAN ACOUSTICAL ASSOCIATION. Mail this form with payment to:

J. R. Hemingway, P. Eng.
Secretary, Canadian Acoustical Association
2410 Old Pheasant Road
Mississauga, Ontario L5A 2S1

The Canadian Acoustical Association
l'Association Canadienne d'Acoustique

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TREASURER **TRÉSORIER**	**Eugene Bolstad** 5903 - 109B Avenue Edmonton, Alberta T6A 1S7	(403) 468-1872
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