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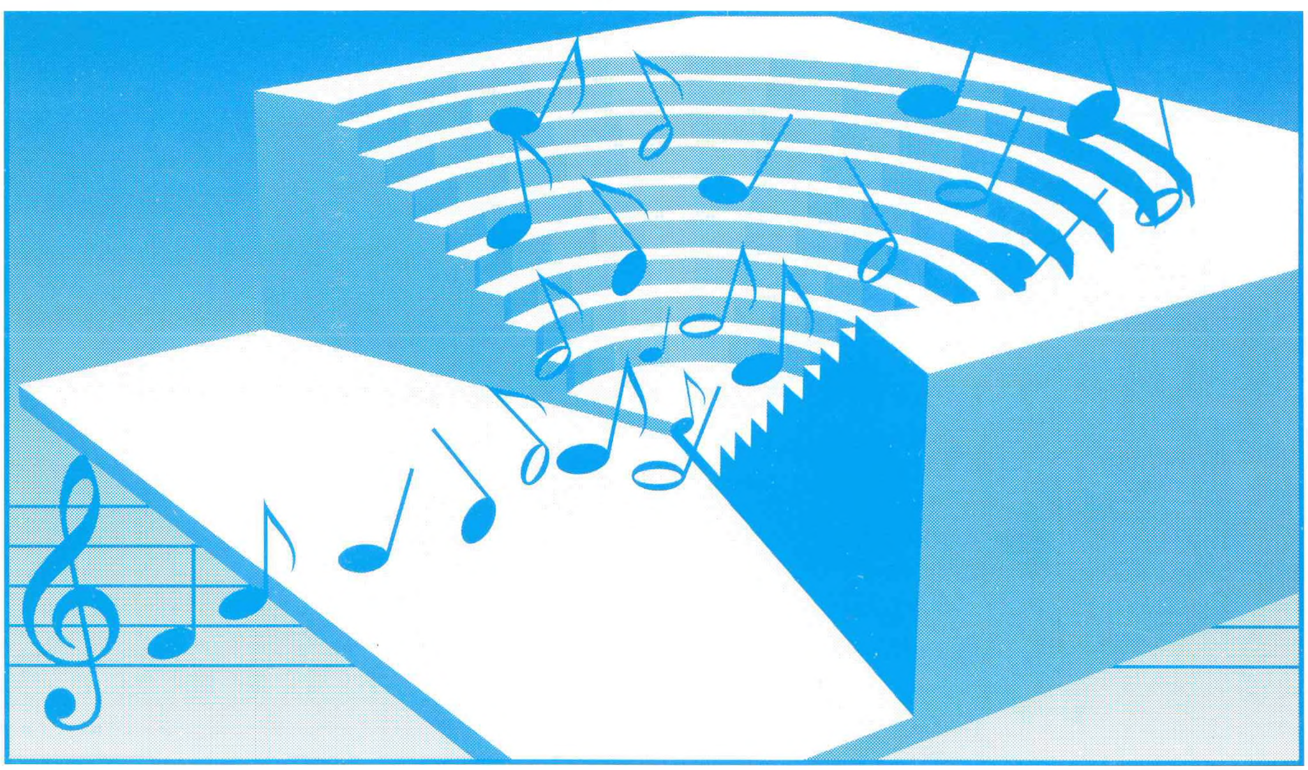

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EDITORIAL

Ce numéro est publié plus tôt afin de permettre aux membres d'avoir en main l'ordre du jour de la réunion des Directeurs et de l'Assemblée Générale Annuelle. Ces réunions auront lieu pendant la Semaine de l'Acoustique. A tous ceux qui assisteront à ces réunions, nous vous demandons d'apporter votre journal comme référence. A ceux qui ne peuvent être présents, veuillez communiquer avec un des directeurs si vous désirez commenter un des points à l'ordre du jour. Faites connaître votre opinion; essayons de mettre fin aux problèmes et mauvaises impressions reliés au fait que certains membres n'occupent pas une position qui leur permet de donner leur opinion sur d'importants dossiers à l'ACA.

Deux excellents articles portant sur l'acoustique dans les auditorium et la perception musicale, ainsi qu'une description de l'Exposition Canadienne des Sciences, sont présentés. Vous trouverez aussi, tel que promis, une analyse et discussion du questionnaire d'opinions sur l'Acoustique Canadienne, et la liste à jour des membres de l'ACA.

Récemment, nous avons travaillé à améliorer l'allure du journal. Un des problèmes concernait les articles soumis sur lesquels, même s'ils devaient être présentés dans une forme prête à reproduire, nous avons peu de contrôle. Idéalement, l'Acoustique Canadienne devrait être photocomposé, mais cela coûte cher. Heureusement, dans cette "ère du traitement de texte", plusieurs d'entre nous pouvons obtenir d'aussi bons résultats. Ce numéro modèle présente un format amélioré, uniforme et plus professionnel en particulier pour les papiers soumis - lequel nous espérons suivre dans le futur, avec votre appui. La mise à jour des instructions aux auteurs est présentée à la fin de ce numéro. Vos commentaires sur ces modifications sont les bienvenus.

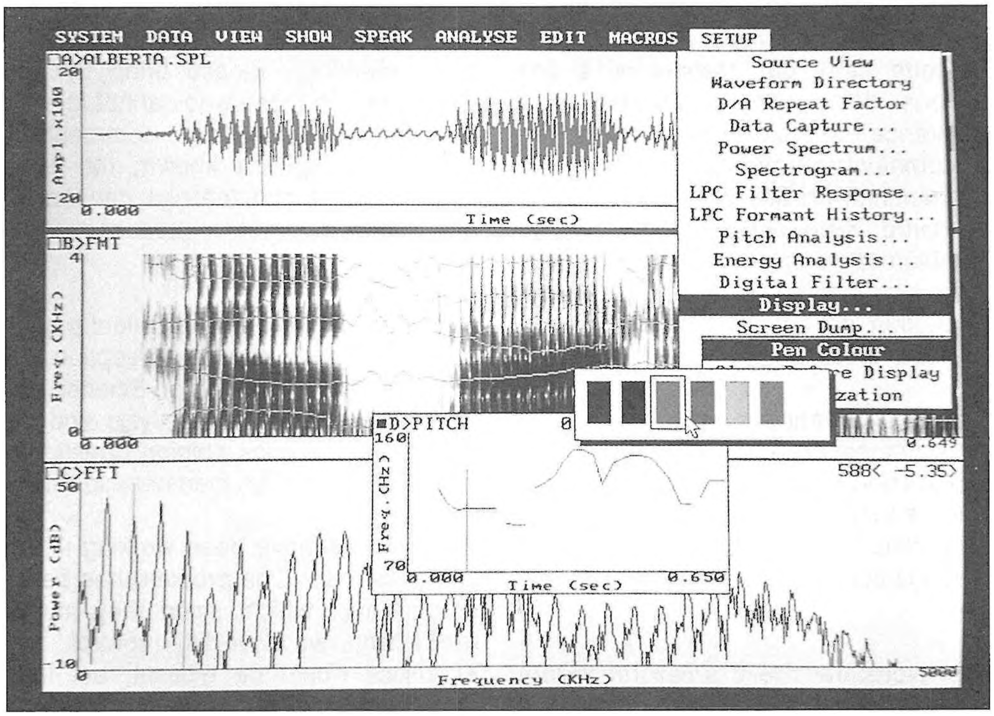
Enfin, nous continuons à solliciter des articles pour les numéros de janvier et avril. Comme nous l'avons mentionné à plusieurs reprises, toute cette planification et ces améliorations seront vaines si nous ne recevons pas suffisamment d'articles à publier.

This issue is published early in order to provide members with the agendas of the Directors' and Annual General Meetings which will take place during the Canadian Acoustics Week. To those attending these meetings, please bring the journal along for reference. To those who cannot attend, please contact any director if you wish to comment on agenda items. Make your opinion known; let us put an end to problems and bad feelings caused by members not being in a position to comment on important CAA matters.

Also published are two excellent papers on auditorium acoustics and music perception, as well as a description of the Canadian Science Fair. You will also find, as promised, an analysis and discussion of the Canadian Acoustics opinion questionnaire responses, and the current CAA membership list.

Recently, we have been working to improve the 'look' of the journal. One problem has been with submitted articles over which, since they must be in camera-ready form, we have little control. Ideally, Canadian Acoustics would be typeset, but that costs money. Fortunately, in this 'age of the word processor', many of us can do just as well ourselves. This 'model' issue presents an improved, consistent and more professional 'type-set' format - in particular for submitted papers - which we hope to follow in future, with your help. The associated up-dated Instructions to Authors are presented at the end of the issue. Your comments on these changes are welcome.

Finally, we continue to solicit articles for the January and April issues. As we have said many times before, all the planning and improvements go for nought if we don't receive enough papers to publish.



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Canadian Acoustics / Acoustique Canadienne 18(4) 3-10 (1990) ***Research article / Article de recherche***

SCALE AND SERIAL ORDER INFORMATION IN MELODIC PERCEPTION: INDEPENDENCE OR INTERINDEPENDENCE?

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ABSTRACT

Listeners indicated the temporal order of 8 tones presented in 36 different sequences representing all combinations of four 8-note scales or alphabets (chromatic, major, minor, and augmented) and nine serial orders (of varying complexity). Accuracy, as measured by ordinal position errors and by contour errors, was poorest for the chromatic alphabet and for the most irregular sequential structures. Alphabetic effects were partially accounted for by familiarity and discriminability and serial order effects were partially accounted for by rule regularity. Effects of alphabet structure and sequential structure were, however, not independent: certain combinations of alphabets and sequential orders led to error patterns that were not consistent with the main effects. The question remains whether such deviations reflect interdependent scale and order processes.

SOMMAIRE

Les auditeurs indiquerènt l'ordre temporel de 8 notes dans chaqu'un des 36 mélodies différentes qui réprèsenterent toutes les combinaisons de quatre gammes (chromatique, majeur, mineur, et augmente) et neuf ordres temporels (de compléxites divers). Le choix de la gamme et de l'ordre influa la précision de la réponse des auditeurs, mesurée par leurs erreurs d'interpretation de l'ordre des notes et du contour de la mélodie, avec le moins de précision dans le cas de la gamme chromatique et l'ordre le plus irrégulier. On explique en partie l'influence de la gamme par sa familiarité et sa facilité de discrimination, et l'influence de l'ordre par sa régularité de structure. Cependant, les influences de la gamme et de l'ordre n'étaient pas indépendantes: certaines combinaisons de gamme et d'ordre produisirent des erreurs qui n'étaient pas d'accord avec les premiers effects. Il reste de déterminer si ces écarts indiquaient une interdépendance entre la gamme et l'ordre.

1. INTRODUCTION

Recent research in music perception has revealed that sets of tones, or scales, used in Western-European music are mentally represented not as unrelated individual tones but rather as a hierarchical structure (Krumhansl, 1983; Cuddy & Badertscher, 1987). Similarly, the representation of sequential orders of tones in music is sensitive to the presence of patterns (Martin, 1972). Thus, the weight given to the representation of a particular tone of a sequence depends upon the role of that tone in both the tonal hierarchy of the scale and the sequential pattern context.

Independence of the representations of scale and sequential rules in music is implicit in many theoretical accounts of melody perception (Deutsch & Feroe, 1981; Restle, 1971; Simon & Sumner, 1968). Tests of independence of musical dimensions have been carried out by Pitt and Monahan (1987). They observed that similarity ratings of three polyrhythms were influenced by the choice of tones comprising the polyrhythms. "Pitch information had a uniform effect on polyrhythm similarity, systematically increasing or decreasing the similarity among rhythms by roughly the same amount (p. 534)." In other words, the perceived similarity of two sequences was based on additive components of the similarity of their scales and the similarity of their rhythms.

A study by Warren and Byrnes (1975) on the other hand demonstrated an interdependence of pitch alphabets and sequential information. Their stimuli were four sets of four equidistant tones separated by .3, 1, 4, or 9 semitones recycled in one of six possible orders (i.e., 1234, 1243, 1324, 1342, 1432, 1423). Naming the correct order was affected by the alphabet; in general, the smallest intervals between tones led to poorest performance. In addition, ascending (e.g., 1234) and descending (e.g., 1432) contours were less affected than complex patterns having more than one contour (i.e., up and down) change (e.g., 1324). This observation contrasts with the demonstration of independence of pitch and rhythmic information of Pitt and Monahan (1987), in the sense that both contour and rhythm are sequential variables which were applied to different tone sets or scales. The present paper addresses the fundamental question of the independence of scale and temporal order using a new melodic tracking task, by systematically varying the stimulus structure of alphabet and serial order.

2. METHOD

2.1 Task

It was the task of the subject to represent the order of an 8-tone melody on time-frequency coordinates with the x-axis representing 8 equal time units and the y-axis representing 8 positions for frequency (See Figure 1). The 8-tone melody had 8 different frequencies, that is, each of 8 frequencies was used only once. Each sequence began on the lowest frequency of its scale. Following five consecutive repetitions, the subject was to fill in the time-frequency graph represented as an 8 x 8 grid. Subjects knew *a priori* that the first note would be the lowest tone; that is, the lower left cell (1,1) was to be filled in automatically, leaving 7 additional judgments to be made.

2.2 Stimuli

Scales

As shown in Figure 2, the scales chosen were the major

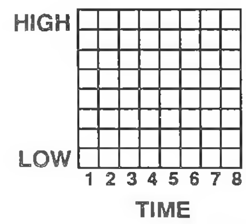

Figure 1. Matrix which was completed by the subject for each sequence.

(successive intervals 2212221), minor (2122122), and chromatic (1111111), as well as a scale of successive intervals of four semitones (4444444). They are subsequently referred to as M, m, N and W representing the Major, minor, Narrow and Wide spacing patterns. In musical terminology, the latter scale could be described as augmented triadic. The augmented triad is not found in the diatonic (major/minor) scales, is unstable (Roberts & Shaw, 1984) and is difficult to remember as compared to a diatonic sequence (Cohen, Trehub, & Thorpe, 1989). The diatonic scales (M, m) on the other hand are characteristic of most music. Scales of equal intervals such as the chromatic (N) and augmented (W) are less familiar than the diatonic scale. In addition, their higher uncertainty might lead to poorer information processing. We speak of uncertainty here in the context of classical information

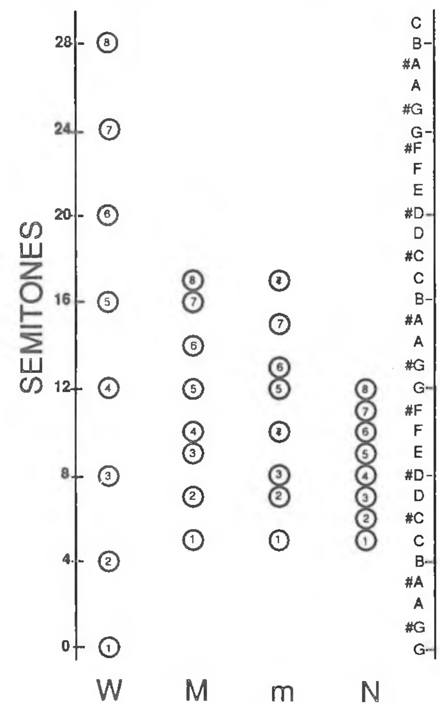

Figure 2. Spacing of the four scales in semitone units (W=wide, M=Major, m=minor and N=Narrow)

theory where highest uncertainty is associated with equiprobability of the events. In the chromatic scale, intervals of one semitone are equiprobable but in the diatonic they are not; thus, in objective terms, the diatonic scale is less uncertain than the chromatic. Reduction in objective uncertainty has been shown to increase processing efficiency in a variety of tasks (cf., Garner, 1962; 1974). Both Helmholtz (1885/1954) and Dowling (1978) noted that there are no naturally occurring musical scales of equal intervals. This rejection of equal-interval scales in music crossculturally is consistent with the processing difficulties that such scales might create as a result of their uncertainty. In the present experiment, the two interval widths (1 and 4 semitones) allowed for comparison of effects of size of the unit in the equal interval scales. The larger size would afford greater resolution, but this advantage might be counteracted by the wider frequency band over which attention must be directed.

Serial Orders

Just as sets of frequencies can differ structurally, so sequential orders can vary in degree of organization and processing difficulty (e.g., Restle, 1971; Warren & Byrnes, 1975). For example, a simple ascending sequence, such as 12345678 should be more easily remembered than an irregular sequence, such as 17264538. A set of nine different sequences were chosen to represent a range of complexity (see figure 3). This choice was made on the basis of intuition guided by past research on subjective measures of complexity for simple auditory and visual patterns (cf., Garner, 1974). Some of the patterns were easily described by a rule (e.g., order 2, start at the bottom go up 4, start at the top go down 4) but others such as order 9 were not. The description of complexity was not straightforward because of the necessity of considering more than one hierarchical level, or macrocontour (Cohen, et al., 1989). In other words, complexity was not simply a matter of counting the number of contour changes, because, in some cases the pattern of contour led to another higher level of organization. For example, the repetitious up-down pattern of order 4 produces an overall V-shape (90 degree rotation), whereas in sequence 9, the same number of contour changes produces no such obvious higher order structure. It was difficult to rank the serial rule complexity *a priori*, it was nevertheless possible to identify the simplest (1), the next simplest (2) and the most complex

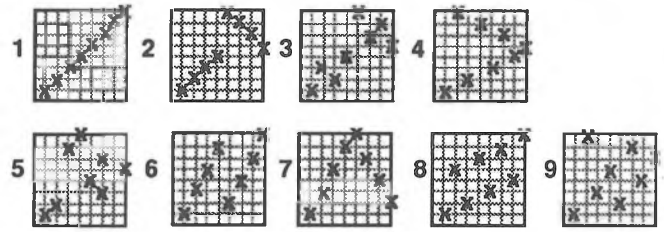

Figure 3. Representation of 9 sequential orders of 8 tones. Each matrix is a reduction of that shown in Figure 1.

pattern (9), with the remainder falling between.

2.3 Stimulus Generation

The 36 sequences produced by combining the four scales and nine serial orders were represented by sine tones generated digitally with 12-bit digital-to-analogue conversion. The 36 different melodies were recorded in random order on low noise tape using a Revox A77 reel-to-reel tape recorder. Two practice trial sequences were also recorded. Tone duration was 450 ms, intertone interval was 70 ms, and intertrial interval was 12 s. Thus, the stimulus tape was 21 min. The lowest frequency was 262 Hz (C_4) for all scales but the augmented for which the lowest frequency was 196 Hz (G_3).

2.4 Subjects

Nineteen Introductory Psychology students enrolled in a music perception seminar were tested in two groups with 11 and 8 people per group.

3. RESULTS

Two dependent measures of accuracy were considered in detail. The first, Absolute Ordinal Position Error, represented the total absolute magnitude of the ordinal errors for all 8 serial positions of the sequence. For example, if the correct order was 12345678 and the response was 14623578, the total error score would be the sum of the absolute discrepancies (i.e., 0+2 +3+2+2+1+0+0=10). The second error, Simple Contour, measured incorrect melodic contour, where contour refers to the pattern of up and down in the melody. Each incorrect change in direction within a sequence was scored 1. The correct contour always resulted in a score of 0.

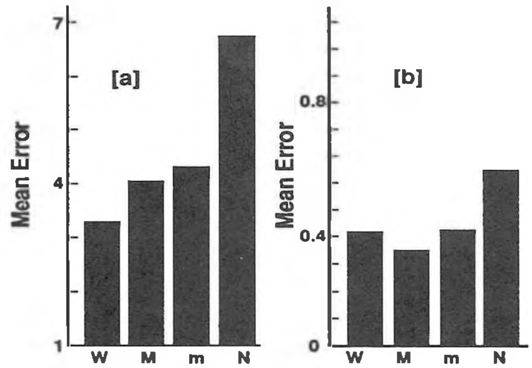

Figure 4. Mean errors as a function of scale type (a) Absolute Ordinal Position Errors (b) Simple Contour Errors

Each time a subject chose the incorrect direction, a score of 1 was added. In the previous example, the correct contour was +++++++ and the response was ++-++++ resulting in a score of 1. Since subjects were permitted to fill in the same ordinal position more than once, a contour error could be potentially created by an immediate repetition of the preceding pitch. Thus, the maximum error score per sequence was 7. Contour coding has been found to be more resilient than absolute interval information (Dowling, 1978).

For both measures, the mean error differed as a function of scale and serial order as shown respectively in Figures 4 and 5. For example, errors for the chromatic alphabet (N) were higher than those for the other three alphabets, and errors for orders 1 and 2 were lower than those for order 9. For all 36 sequences, the mean Absolute Ordinal Position Errors and mean Simple Contour Errors are shown in Figure 6(a) and (b) respectively. For each error type, the shapes of the histograms differ as a function of the nine serial orders suggesting interactions between scale and serial order. For each error type, the data were entered into an analysis of variance having two within-subjects factors of scale (4 levels) and order (9 levels). Orthogonal contrasts for scale compared the wide spacing against the other three types, the narrow spacing against the two diatonic spacings, and finally the major vs. the minor scale. Contrasts were also carried out for order pitting particular orders against each other. These sets of contrasts for main effects led to 24 contrasts for the interaction.

For each error type, the two main effects and their interaction were significant. For Absolute Ordinal Position

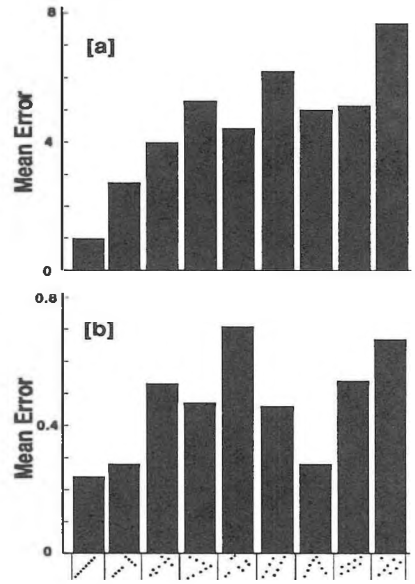

Figure 5. Mean errors as a function of sequential pattern (a) Absolute Ordinal Position Errors (b) Simple Contour Errors

Error for the main effect of scale, $F(3,54)=25.75; p<.001$, orthogonal comparisons revealed that wide spacing significantly produced the highest performance and narrow spacing the lowest. The main effect of order was also significant, $F(8,144)=11.3; p<.001$. Among a number of significant differences, the most complex pattern (9) was significantly more difficult than the simplest patterns (1 and 2) and pattern 2 was significantly more difficult than pattern 1. The interaction between scale and order was significant, $F(24,432)=2.42; p<.001$; four of the orthogonal comparisons for the interaction reached significance although no particular interaction component was pronounced.

For Simple Contour Error, the main effect of scale, $F(3,54)=4.07; p<.05$, was attributable to a difference between the narrow and diatonic spacings. For the main effect of order, $F(8,144)=2.15; p<.05$, orders 1 and 2 were significantly easier than order 9, and order 5 was significantly more difficult than order 7. For the interaction of scale and order, $F(24,432)=1.84; p<.01$, 5 of 24 orthogonal comparisons were significant (2 of which were common with the Absolute Ordinal Position Error interaction) but no interaction component was pronounced.

Considering the results for both Absolute Ordinal Position Error and Simple Contour Error measures described above,

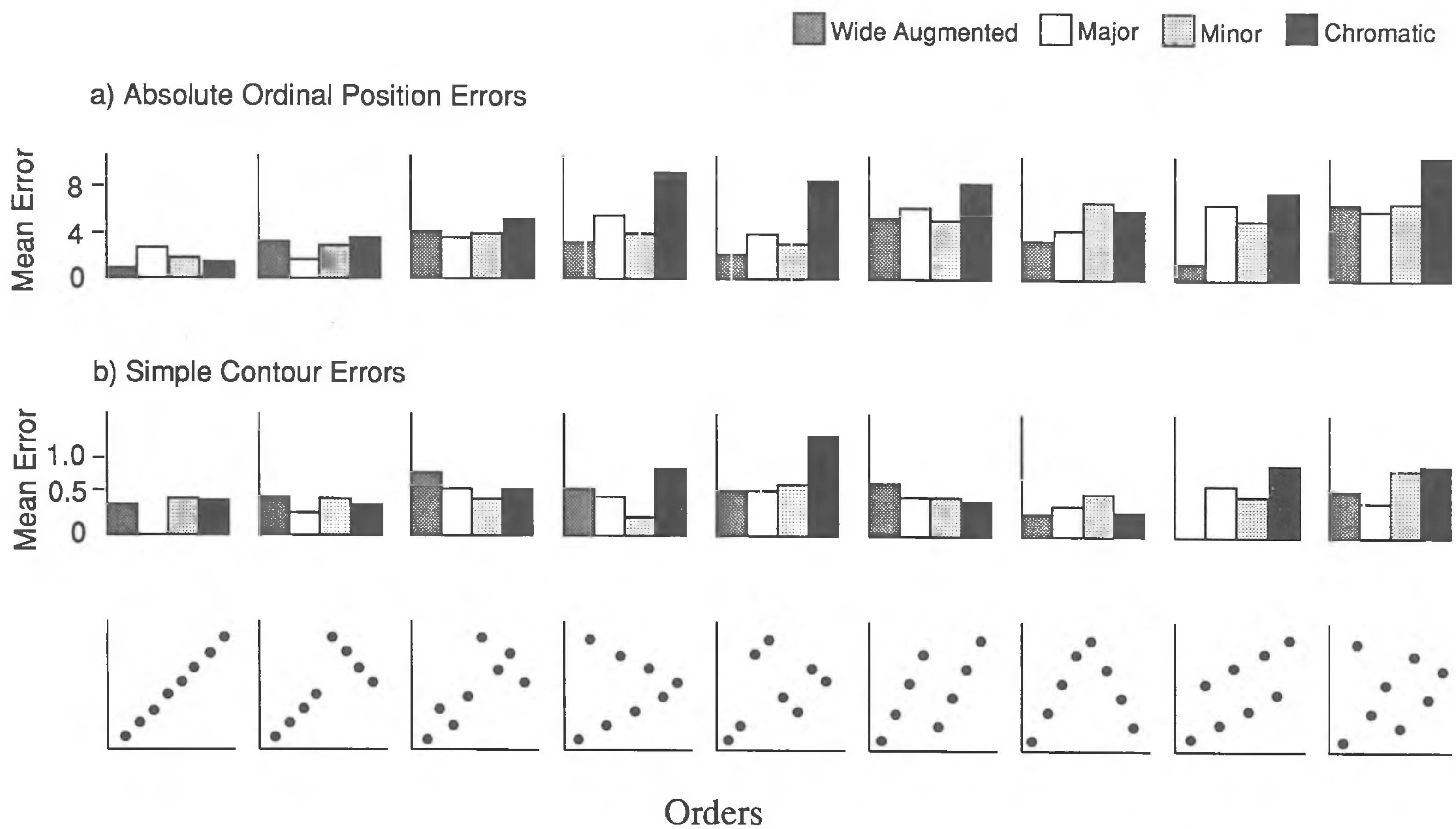

Figure 6. Mean Errors as a function of scale and order a) Absolute Ordinal Position Errors b) Simple Contour Errors

an interaction between scale and serial order clearly has been demonstrated. In order to determine whether experience in the task improved performance and therefore might account for the scale x order interaction, a correlation was computed on the 36 mean scores and their order of presentation in the session. The resulting correlation coefficients were -.25 for Absolute Ordinal Position Error and -.10 for Simple Contour Error, neither of which were significantly different from zero in a t-test. Therefore experience in the task did not account for the scale and order interaction.

Four other measures of error were also examined. The first (Binary Overall) was a binary score assigning the value of 1 for perfect performance on the sequence and 0 if any error were made. The second (Binary Serial Position) was a binary score for each serial position of the sequence; thus, a score of 1 was assigned to each position incorrect for a maximum of 8. The third measure (Complex Contour) was a variation on the previous Simple Contour error measure. In this case, the direction was measured with respect to the previous adjacent tone but the magnitude of the change was also considered. This method thus penalized the subject who lost footing at the contour change. For the final measure, the correlation was obtained between the 8 responses and the 8 correct values. Perfect performance produced a value of 1.0 and the lowest possible value was -1.0. These measures were obtained for all subjects and the means for each sequence were entered into a 6 (measures) x 36 (sequences) Spearman Rank intercorrelation matrix, the results of which are shown in Table 1.

It is noted that all correlation coefficients are statistically significant beyond the .01 level, however, the Simple Contour measure produces the lowest correlations ranging from .61 to .75. All of the other measures produce correlations greater than .84. Indeed, a crude measure of whether judgments of the sequence was completely correct or not (Binary Overall) provides roughly the same information as the more sophisticated measures such as Absolute Ordinal Position Error. This pattern of results emphasizes the robustness of the findings and suggests that a different process is tapped by the Simple Contour measure in comparsion with the remaining five.

Table 1

Spearman Rank Correlations of 6 Error Measures

Type of Measure

	Absolute Ordinal	Simple Contour	Binary Overall	Binary Ser.Pos.	Complex Contour	Corre-lation
Absolute Ordinal	1.0	.61	.93	.96	.90	.93
Simple Contour		1.00	.63	.57	.75	.73
Binary Overall			1.00	.97	.90	.84
Binary Ser. Pos.				1.00	.88	.86
Complex Contour					1.00	.94
Corre-lation						1.00

4. DISCUSSION

The main finding of the study is that accuracy of reproduction of the sequential order of a set of tones depends upon the particular serial order and the particular scale. The scale with the widest spacing, which afforded the greatest frequency resolution, led to highest performance on the Absolute Ordinal Position Error. This is consistent with Warren and Byrnes (1975); however, all of their scales were composed of equal intervals. The familiar diatonic scales in the present study did not produce an advantage over the widely spaced equal-interval scale for Absolute Ordinal Position Error but did show a large advantage over the narrow equal-interval spacing. For Simple Contour Error, there was no difference between the wide and diatonic scales. It is, thus, likely that both familiarity and discriminability had an influence. To test this assumption in the future, the diatonic scale should be compared against equal-interval scales of two semitones as well as unfamiliar scales built from one and two semitone intervals. If familiarity plays a role, the diatonic scales should lead to higher performance than the other scales mentioned. The results for serial order are consistent with the notion that sequential rule regularity played a role: the poorest performance was associated with the most complex order and the best performance with the simplest order. In future work, the orders should be selected in terms of a rule-regularity measure objectively defined. These main effects of scale and order just described do not, however, account for all aspects of the data. In addition, there was evidence for effects of the interaction of order and scale for ordinal errors summed across serial position and for errors of contour.

Theories of melodic perception have often focused on the dichotomy of a tone alphabet to be ordered sequentially and rules for ordering tone alphabets (e.g., Cohen, 1976; Deutsch & Feroe, 1981; Restle, 1971; Simon, 1971; Simon & Sumner, 1968). These models are consistent with the significant main effects of scale structure and sequential structure in the present task but do not account for interactions between alphabet and serial order. They cannot explain, for example, that when order 8 is paired with the widely spaced alphabet, performance, as measured by absolute ordinal position errors, is superior to order 3, but when paired with any of the other alphabets, the relative level of difficulty reverses.

Our observed interaction between alphabet and serial order is, however, conceptually consistent with the views of Jones (1987) and her colleagues who have investigated the effects of combining different rhythms and contours. They observed evidence of higher accuracy in notating melodies for some rhythmic/contour combinations but not others (Boltz & Jones, 1986). This violated the notion of independence, that "the temporal grouping properties of a rhythm will confer equivalently stable accentuations on a sequence... regardless of the way in which the melodic [contour] relationships fit the temporal cues" (Jones, Summerall, & Marshburn, 1987, p. 98). Jones and her colleagues did not, however, specifically address the issue of the combination of pitch alphabet and serial rules. What is novel about the present contribution is the evidence that the processing of sequential order is not independent of alphabet structure.

Lower-level variables may contribute to these interactions, for example, discriminability of tones (Warren & Byrnes, 1975) and perceptual grouping on the basis of pitch proximity (Bregman, 1978; Deutsch & Feroe, 1987). Nevertheless, the question remains as to whether performance depends upon higher level congruencies based on a shared pattern of dominance between atemporal (scale) and temporal (serial order) relations. As an example from the present study, could interdomain congruence account for the fact that wide spacing led to greater accuracy for pattern 8 (15263748) than did diatonic spacing? For wide spacing, after serial position 2, every other tone is succeeded by a tone one octave below, whereas for the diatonic sets, the relation is a fifth or a tritone. Matched hierarchies across atemporal and temporal domains could account for this interaction of scale and serial order information.

Correlations of mean performance and position in the experimental session suggested little effect of learning. It is possible that effects of immediately prior sequences may have influenced certain judgements. Since all subjects received the same order of sequences, this situation could have contributed to the observed interactions. To rule out this possibility, in future studies, different random orders of the sequences should be provided for each subject.

In the present study, sequences were presented five times in succession before the subject responded. It is possible that interdependence emerges only after a number of presentations. Thus, notions of the independence of atemporal and temporal rules must be modified to include the developing interdependence based on congruencies that emerge with repetition. But the primary point remains: although the distinction between scale and serial order information is a good starting point for some theories of melodic perception, the problem of the interaction between these two domains must be specifically addressed at perceptual and cognitive levels.

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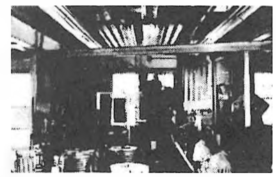

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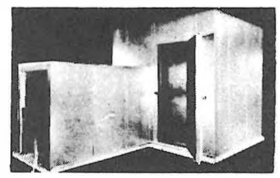

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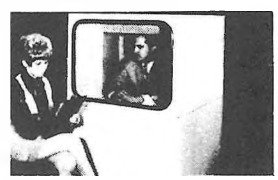

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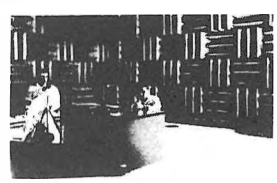

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THE EVOLUTION OF NEWER AUDITORIUM ACOUSTICS MEASURES

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ABSTRACT

This paper reviews the development of newer types of auditorium acoustics measures that go beyond the conventional reverberation time. Quantities have been developed for speech and music. Two different types of speech measures have been shown to correlate well with speech intelligibility scores. Research has led to a consensus that a small number of quantities explain almost all of the variance in subjective assessments of concert hall acoustics quality. These new quantities involve only simple energy summations over various time intervals or the decay rates of sound energy and can be readily measured in halls.

SOMMAIRE

Dans ce document, l'auteur décrit l'évolution des mesures de l'acoustique des auditoriums, qui tiennent maintenant compte d'autres critères que le temps de réverbération. On a défini des grandeurs visant la parole et la musique. Il a été démontré qu'il existe une bonne corrélation entre deux types différents de mesures de la parole et le degré d'intelligibilité de celle-ci. Les recherches accomplies ont permis de dégager un consensus concernant le fait qu'un petit nombre de grandeurs explique presque toute la variance de l'évaluation subjective de la qualité de l'acoustique des salles de concert. Ces nouvelles grandeurs, qui ne consistent qu'en simples additions d'énergie pendant divers intervalles de temps ou en indices d'affaiblissement de l'énergie sonore, peuvent être facilement mesurées dans les salles.

1. INTRODUCTION

It has long been recognized that reverberation time is inadequate as a single objective descriptor of auditorium acoustics quality[1,2]. There are clearly other dimensions to acoustic quality than reverberance, and acoustic quality often varies from seat to seat in a manner not reflected by changes in reverberation times. This paper reviews the development of newer types of objective parameters for both speech and music that go beyond reverberation time.

Large halls are extremely complicated physical systems, and to understand them in detail is a substantial challenge. We can readily devise a variety of complex physical parameters to describe conditions in such spaces, and many authors have done this. Such parameters are not of much practical value unless they relate to subjective evaluations of the same acoustical conditions. It is essential to carry out controlled subjective tests to systematically validate objective parameters in terms of subjective judgments. Because of the vagaries of subjective judgments and the physical complexity of large auditoria, large complex studies are required to make substantial progress in this field.

In spite of the complex problem, the newer parameters that will be described in this paper generally involve quite simple concepts of energy summations over various time intervals as well as the rate of decay of this energy in large rooms. In addition, these measurements have usually been made in only octave or wider frequency bands.

From a review of research in this field, this paper attempts to show how the many new parameters that have been proposed can be reduced to a small group of perhaps four or

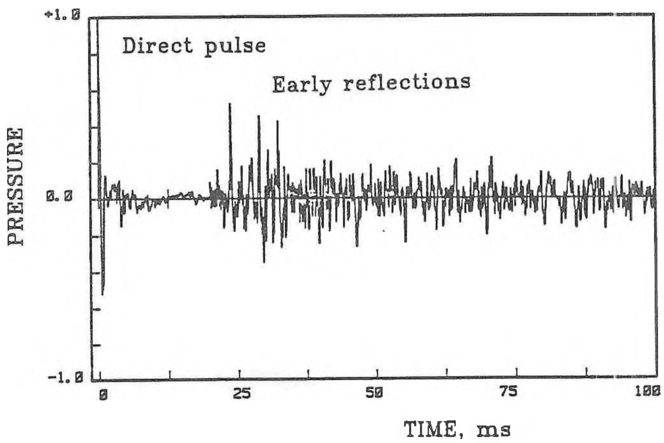

Figure 1. Example of the beginning of a pulse response in a large hall showing the direct pulse followed by several discrete early reflections, and subsequently the many reflections of the reverberant decay.

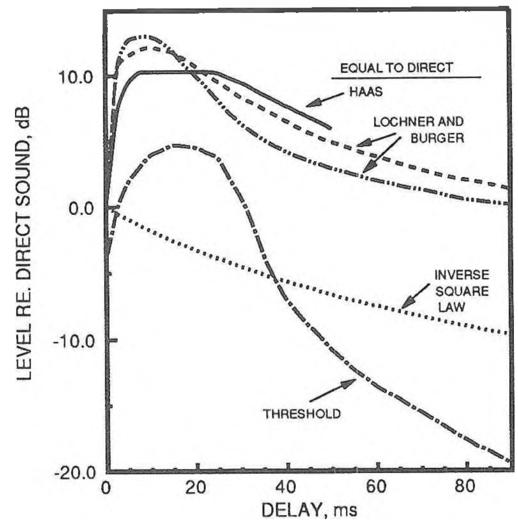

Figure 2. Curves of the subjective integration of an early reflection with the direct sound for speech. The upper curves correspond to the early reflection being judged equally loud to the direct sound, and the lowest curve is the threshold of detectability of an early reflection.

five quantities that cover the major aspects of auditorium acoustics quality. Finally, the importance of assessing halls in terms of these new objective parameters is stressed.

2. EARLY REFLECTIONS

To understand the concept of early reflections and many of the newer parameters, it is essential to appreciate the characteristics of an impulse response in an auditorium. Figure 1 illustrates such a pulse response showing the direct sound, a gap followed by several discrete early reflections, and then many overlapping reflections in the reverberant decay. Thus, early reflections are reflections that arrive very shortly after the direct sound, but before the many overlapping reflections in the reverberant decay. Frequently these early reflections represent a significant portion of the total sound energy in the pulse response.

After the pioneering work of Sabine to develop an initial understanding of reverberation, procedures were gradually developed for the design and evaluation of auditoria in terms of optimum reverberation times[3]. It was only after studies revealed the particular importance of early reflections that progress beyond reverberation time commenced. Initial investigations first demonstrated that early reflections are usually not heard as separate events, but are integrated subjectively together with the direct sound by our hearing system. Thus, early reflections can make the direct sound seem louder and hence increase the loudness and intelligibility of speech in rooms. This is often referred to as the Haas Effect[4].

Haas carried out experiments using speech in simulated sound fields with a direct sound and a single reflection. His subjects identified when the added reflection seemed equally loud to the direct sound. Figure 2 illustrates how Haas' results[5] showed that early reflections could be as much as 10 dB stronger than the direct sound or arrive as much as 50 ms after the direct sound and still be subjectively integrated together with it. Lochner and Burger[6,7] produced similar curves, that are also shown in Figure 2, and included a small dependence on speech level. Haas' and Lochner and Burger's results in Figure 2 were for judgments of the added reflection sounding equally loud to the direct sound. Also shown is a curve of the threshold of detectability of an added early reflection by Schodder[8]. Finally, there is a curve showing an expected inverse square law drop off of the level of a reflection relative to the level of the direct sound in a typical auditorium. By comparing the subjective test results to this inverse square law curve, it is seen that useful early reflections can be much stronger than would normally occur naturally in a room. This, of

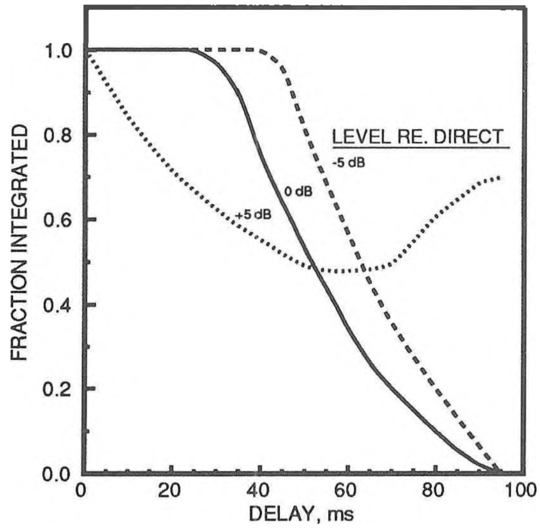

Figure 3. Lochner and Burger's weighting functions for the importance of early reflections to increased speech intelligibility.

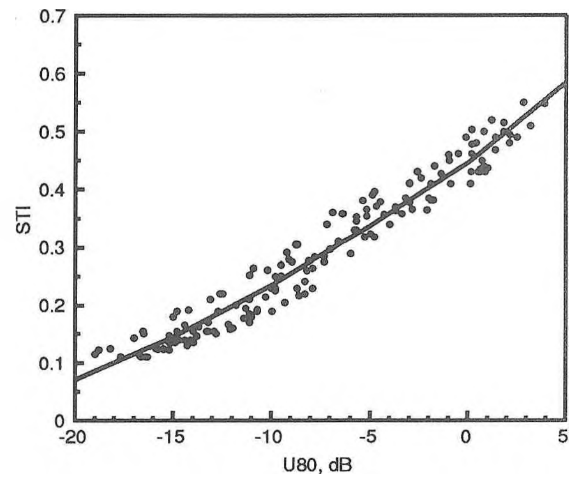

Figure 4. The relationship between STI and U80 values from measurements in a number of rooms.

course, explains why well-designed sound reinforcement systems can often produce very natural sounding increases in sound level with the illusion that there is no electro-acoustic reinforcement.

Studies with multiple early reflections[5,6,7] indicated that their combined effect was related to the sum of their energies. Accordingly, Thiele developed a parameter[9] that is the ratio of the sum of the early energy to the total energy in a pulse response. (This is later defined in Figure 5.) This parameter was called "Deutlichkeit" in German, and would translate to distinctness or definition in English. Thus, the greater the combined energy in the direct and early reflections, the greater the definition of the sound, due to the integration of the early reflections with the direct sound by our hearing system. Thiele made measurements in a number of rooms and generally showed that this was a useful new parameter nearly 40 years ago.

3. SPEECH INTELLIGIBILITY

The work of Lochner and Burger[6,7] concentrated on the influence of early reflections on speech in rooms. They developed a measure that combined early reflections by a weighting scheme derived from extensive subjective tests. Figure 3 shows their results in terms of the fraction of an early reflection that would be judged useful to improved speech intelligibility. According to this procedure, the importance of a particular reflection depends on both its amplitude and arrival time relative to the direct sound. Using this weighting procedure, they summed up the effect of direct and early reflections as the combined useful sound. They then developed a useful/detrimental sound ratio as the ratio of this useful early sound energy to the detrimental energy formed by the sum of the later arriving speech energy and the ambient noise energy. Approximately 30 years ago, they showed these useful/detrimental sound ratios to be well correlated with speech intelligibility test results.

Due to the complexity of implementing their weighting procedure, few other studies have followed this approach. More recently, work by Bradley[10,11] compared their procedure and others with speech intelligibility scores obtained in a range of rooms. This study found that a simplification of the Lochner and Burger concept, where the useful energy was a simple unweighted summation of the direct and early energy, was well correlated with speech intelligibility test scores. Thus, a simplified useful/detrimental sound ratio was derived as follows:

$$U = 10 \cdot \log\{ \text{Early}/(\text{Late} + \text{Ambient})\}, \text{dB}$$

where the early energy was summed over either 50 or 80 ms.

This measure combines both the room acoustics and signal/noise aspects of evaluating conditions for speech into

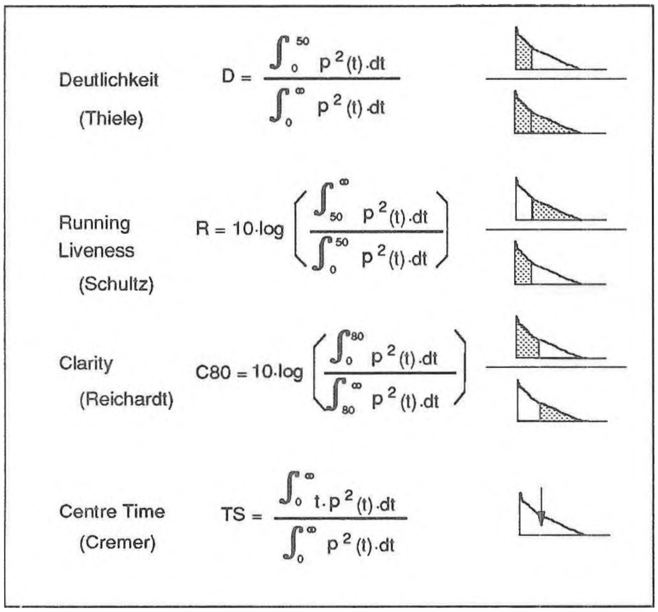

Figure 5. The names and mathematical definitions of four measures of musical clarity (or its inverse in the case of running liveness). The illustrations on the right pictorially represent the ratios of the integrated portions of the impulse responses.

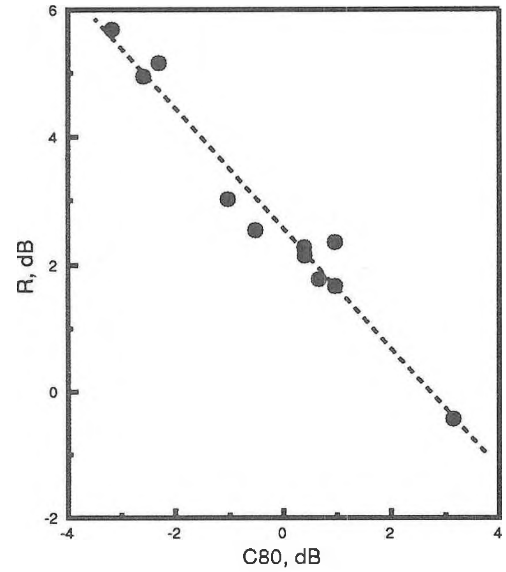

Figure 6. The relationship between running liveness, R, and clarity, C80, from hall average measurements in 11 large auditoria.

a single quantity, and includes the influence of subjectively important early reflections. (The conventional approach would be to separately measure reverberation times and background noise levels.)

More recently, another speech measure has been produced that again combines both aspects into a single quantity. Work in The Netherlands by Steeneken and Houtgast[12] produced the speech transmission index, STI, and a simplification of it, the rapid speech transmission index, RASTI. It was reasoned that speech intelligibility in rooms is degraded because the acoustical properties of the room and existing ambient noise diminish the natural amplitude modulations of speech. Accordingly, the STI measure assesses modulation transfer functions for the 96 combinations of 6 speech frequency bands and 16 modulation frequency bands. From this matrix of values, the single STI value is derived as a number between 0 and 1.0 similar to the articulation index. Houtgast and Steeneken have published many papers on their work and have shown the STI measure to be well correlated with speech intelligibility scores for a wide range of conditions.

Bradley[10] calculated STI values from impulse responses by a procedure proposed by Schroeder[13]. It was found that STI values and useful/detrimental sound ratios were quite strongly correlated with each other (see Figure 4). Thus, in spite of their quite different derivation, the two quantities are apparently assessing essentially the same physical aspects in the rooms that were studied.

4. MEASURES OF MUSICAL CLARITY

Thiele's Deutlichkeit parameter (see Figure 5) was the first of a number of parameters based on ratios of energy sums from various parts of an impulse response. While such quantities have been developed as measures of speech intelligibility, they have also been used to assess conditions for music. They are usually thought to relate to clarity, definition or distinctness in the sound quality. Four of these quantities are compared in Figure 5, and these are: Thiele's Deutlichkeit, Schultz's running liveness, Reichardt's clarity measure, and Cremer's centre time. This figure includes the defining equations of each measure as well as a pictorial representation of the intervals over which energies are integrated in calculating each quantity.

While Thiele's Deutlichkeit is an early/total sound ratio, Schroeder[14] somewhat later published results of measurements using an early/late arriving sound energy ratio. At about the same time, Schult[15] proposed his running liveness measure that is the ratio of the late/early

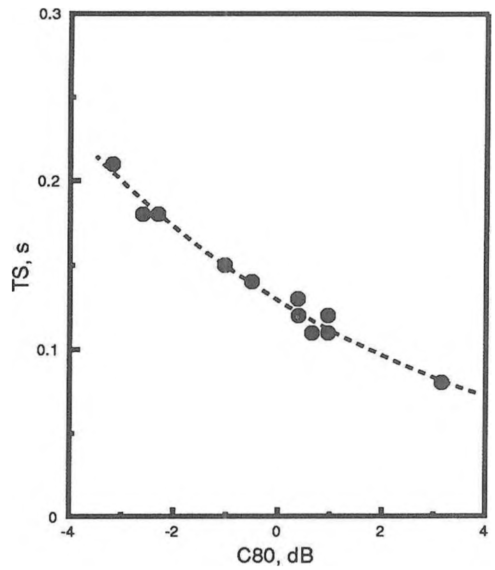

Figure 7. The relationship between centre time, TS, and clarity, C80, from hall average measurements in 11 large auditoria.

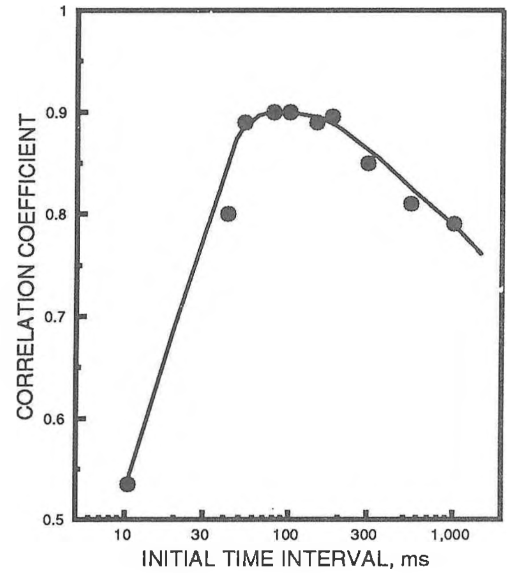

Figure 8. The influence of the early time interval on correlations with subjective judgments from Eysholdt.

arriving sound. Although the ratio is inverted, because it uses the same 50 ms early time interval, it would be exactly related to Deutlichkeit.

The use of a 50 ms early time interval seems to be a result of earlier studies concerning speech. Reichardt[16] developed a clarity measure for music with an 80 ms early time interval from subjective tests in simulated sound fields. His clarity measure is a simple early/late arriving sound energy ratio and is included in Figure 5. Because the early time interval is different than the earlier measures, there will not be an exact relationship among these quantities, but measurements in halls have shown that C80 values are typically 2 to 3 dB greater than C50 values (where C80 and C50 are early/late arriving sound energy ratios with 80 and 50 ms early time intervals respectively).

Clearly, many different early time intervals could be proposed or a weighting scheme similar to that of Lochner and Burger could be used to blur the boundary between early and late energy. Cremer[17] proposed that this problem could be solved by using the centre time as a clarity related measure.

Measurements in halls indicate that these quantities are usually highly correlated with each other and it is difficult to discriminate among them. Figure 6 plots hall mean values of Schultz's running liveness, R, versus Reichardt's clarity measure, C80, showing how these two quantities are related to each other. Figure 7 plots values of the centre time versus C80 values. Because the centre time is a linear quantity and C80 ia a logarithmic quantity, the relationship is not linear, but the two measures are clearly closely related.

Eysholdt[18] considered this same question by comparing correlations between subjective judgments using music signals and early/late ratios with varied early time interval. His results, shown in Figure 8, show a broad maximum in the range from 50 to 180 ms early time intervals. Again, it is not possible to find large differences among the various parameters. They all seem to asses the balance between clarity and reverberance in a more or less similar manner.

5. LATERAL REFLECTIONS

After it was established that early reflections are subjectively important, the direction of arrival of these reflections was next found to be important. Marshall[19] and West[20] both suggested that strong early lateral reflections were particularly important. Pioneering work by Barron[21,22] showed that the sense of spatial impression or envelopment was determined by having adequate strong early lateral reflections. Figure 9 taken from Barron's work shows the region of delays and amplitudes of lateral reflections that lead to spatial impression. It is seen that early lateral reflections as much as 20 dB below the level of the direct sound contribute to perceived spatial impression. Very early reflections, arriving within less than 10 ms after the direct sound, lead to colouration of the perceived sound.

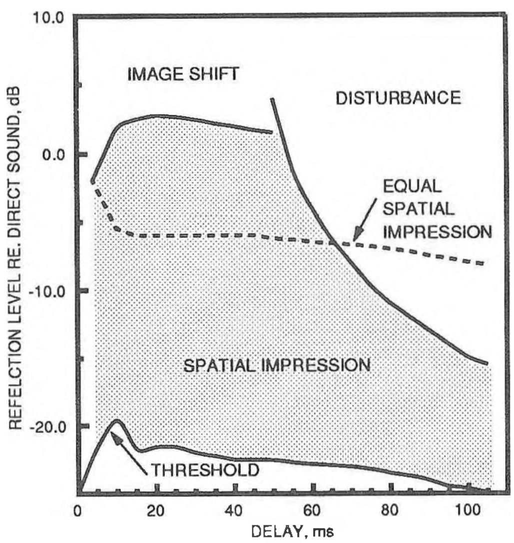

Figure 9. Barron's region of spatial impression as a function of the amplitude and delay time of early lateral reflections. The dashed curve shows values of subjectively equal spatial impression as a function of the arrival time after the direct sound.

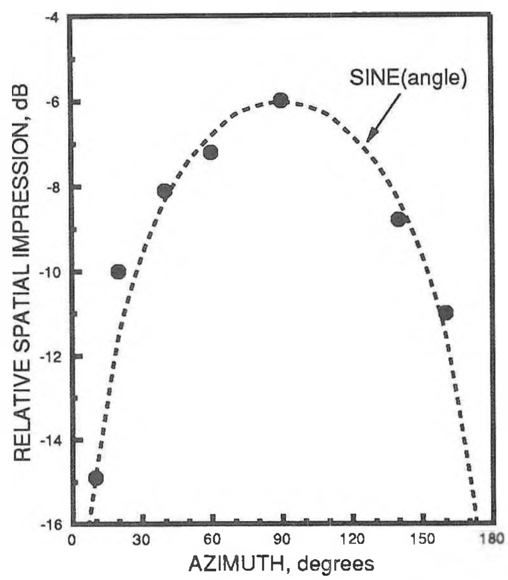

Figure 10. The variation of spatial impression with horizontal angle of incidence from work by Barron and Marshall. Straight ahead corresponds to 0 degrees.

Longer delayed reflections, that fall to the right of the shaded area on Figure 9, are detected as discrete echoes and lead to disturbance rather than ideal spatial impression. If the amplitude of early reflections is too great, then there is a perceived image shift.

As shown in Figure 9, Barron also found that the degree of spatial impression was relatively independent of time delay. He also showed that spatial impression was greatest for reflections arriving at listeners' ears in the horizontal plane at 90 degrees to straight ahead (see Figure 10).

Ando[23] has published many papers on subjective preference tests using simulated concert hall sound fields. His work also includes the effect of angle of incidence of early lateral reflections, and his results are reproduced here in Figure 11. Again, early reflections from straight ahead have the least effect, but for one of Ando's music motifs, preference was less at 90 degrees than at lower angles, leading Ando to conclude that there is a preferred angle of about 55 degrees to straight ahead. This conclusion would conflict with Barron's results in Figure 10 and depends on only one data point in Figure 11.

Barron's work led to the derivation of the lateral energy fraction, LF, as an objective parameter related to subjective spatial impression. It is simply the ratio of the early arriving energy from lateral directions to the total early arriving energy from all directions. The early time interval is taken as 80 ms. Ando has used the inter-aural cross correlation coefficient, IACC, as an objective correlate of spatial impression. Ando uses the maximum of the short-term cross correlation of the A-weighted signals obtained from a dummy head. Both the LF and the IACC have been shown to relate to subjective judgments of spatial impression and some authors[22] have suggested that the two quantities are related to each other. However, measurements in real rooms[24] shown in Figure 12 show no correlation at all between the two measures.

6. MULTI-DIMENSIONAL SUBJECTIVE STUDIES

Focussed laboratory studies can explore the importance of particular aspects of early reflections, but broad comprehensive studies are necessary to appreciate the overall picture. Two such major studies were undertaken in the early 1970's by research groups in Berlin and Göttingen in Germany. These studies looked at the overall multi-dimensional subjective evaluation of concert hall acoustics in combination with a large number of objective acoustical parameters. Figure 13 summarizes some details of these studies.

The Berlin group[25,26] used dummy head recordings of a live orchestra in six different halls as their source of test sounds.

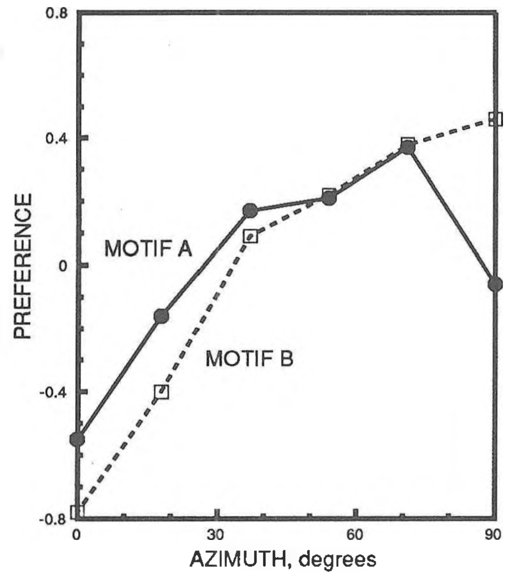

Figure 11. The variation of preference judgments with horizontal angle of incidence of an early reflection for two different musical motifs from work by Ando.

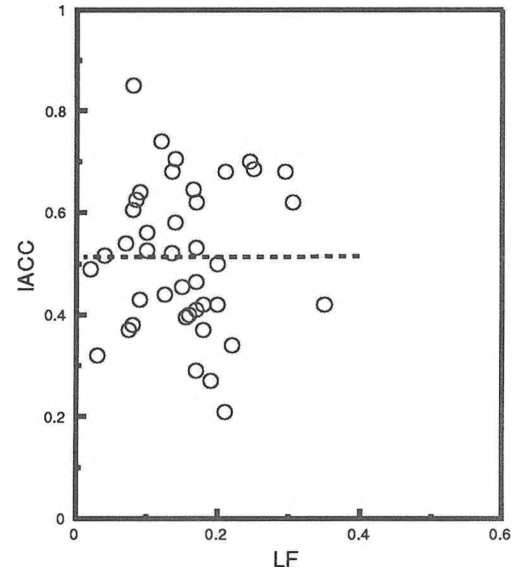

Figure 12. Comparison of measurements of inter-aural correlation coefficient, IACC, and lateral energy fraction values from 500 Hz octave band measurements.

These recordings were played back to subjects via headphones. Subjects judged the sound fields by responding to 19 bipolar response scales. The overall strength or relative sound level, G, of the sound fields was found to correlate best with the major subjective response factor. The centre time, TS, and the slope of the early decay time versus frequency, EDT(f), were also found to be important correlates of subjective judgments.

In the Göttingen study[27,28], 25 halls were included by playing anechoic music recordings into the halls via two loudspeakers. The sounds were again recorded using a dummy head, but were played back to subjects using loudspeakers in an anechoic room. Cross talk filters were developed so that the sound recorded at one ear of the dummy head was only heard at one ear of the listener in the tests. Subjective judgments were of the overall preference of pairs of sound fields. Because the overall level or loudness was assumed to be of dominant importance, test sounds were adjusted so that they were all heard at the same loudness. Thus, there were no observed effects of the loudness or strength of the sounds. Deutlichkeit, D, reverberation time, RT, (or early decay time, EDT), and the inter-aural cross correlation coefficient, IACC, were found to be the strongest correlates of principal subjective dimensions. Because RT and EDT values were strongly correlated with each other for these halls, either was said to be an equivalent predictor of subjective preference.

Although the importance of D in the Göttingen study might seem to parallel the importance of TS in the Berlin research, the sign of the correlation was reversed between the two groups. Thus, the subjects in the Berlin study preferred more clarity, but the Göttingen subjects preferred less clarity. Subsequent investigations have attempted to explain this difference as due to a less reverberant character of the recorded sounds when the source was two loudspeakers and not a real orchestra. There can be many other criticisms of the details of these studies which just reflect how difficult it is to carry out this type of research as an ideal controlled experiment. Together they have given a much better picture of the overall problem. They have revealed that a relatively small number of subjective dimensions explain almost all of the variance in subjective assessments of concert hall sound and that only a relatively small number of objective parameters are necessary to describe acoustical conditions in concert halls.

A more recent study has been published by Barron[29] based on subjective assessments of conditions in 11 British concert halls during regular performances. His subjects filled in a short questionnaire after each concert and the responses were correlated with objective measurements at the same locations in these halls. Figure 14 summarizes how subjects' responses were inter-related, including the correlation coefficients between pairs of subjective responses. When all subjects were included in the analyses,

	GOTTINGEN	BERLIN
SOURCE	2 loudspeakers	orchestra
RECEIVER	dummy head	dummy head
PLAYBACK	2 loudspeakers, + cross talk correction	head phones
N. HALLS	25	6
JUDGEMENTS	preference	19 bipolar scales
OBJECTIVE PARAMETERS	D RT (EDT) IACC	G TS EDT(f)
PROBLEMS	- equal loudness presentation -loudspeaker source less reverberant	-in head localisation -front/back confusion -limited data range

Figure 13. Summary of selected details of the two major German subjective studies.

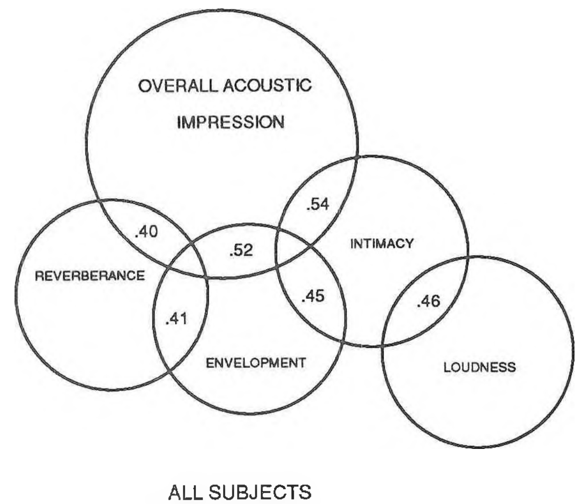

Figure 14. Interdependence of Barron's subjective response data29 for all of his subjects showing overall acoustic impression to be directly dependent on reverberance, envelopment, and intimacy, but only indirectly on loudness.

overall impression was found to be determined by perceived reverberance, envelopment, and intimacy. Perceived loudness appeared to influence overall impression via its effect on intimacy.

Barron found that his subjects could be grouped into two groups. One group seemed to prefer reverberance while the other preferred intimacy. Figure 15 shows that for the first group, judgments of reverberance and envelopment seemed to influence overall impression. For the second group, intimacy and envelopment judgments were most strongly correlated with overall impression.

Barron concluded that overall sound level or strength, early decay time, and lateral energy fraction values correlated with the principal dimensions of his subjects' responses. He also found that the perceived bass balance was related to either the ratio of low frequency to mid frequency EDT or TS values. His results were in reasonable agreement with those of the earlier German studies and his survey was an improvement over the German studies because of the more realistic presentation of the sounds. Thus, his subjects' evaluations of intimacy were influenced by both acoustical and non-acoustical factors present in actual halls. This complete concert experience is not entirely reproduced in laborotory studies. However, his survey was not as controlled an experiment as the German studies. His expert listeners were well aware that they were in a hall with a possibly good or bad reputation and their judgments could have been influenced accordingly.

7. A CURRENT CONSENSUS

Barron's British results combined with the earlier German studies lead to a reasonable consensus as to which objective parameters are most important. All studies agree that the overall sound level or strength, is important. A measure of clarity or definition is found to be important in each of these studies as is a measure of reverberance. Both Barron and the Göttingen study found a measure of spatial impression to be important. It is arguable that this parameter is absent from the Berlin results because its influence was masked by the larger effect of changing sound levels which is also known to influence spatial impression. Finally, both Barron and the Berlin group found that the variation of early decay time with frequency influences the timbre of the perceived sound.

One can thus draw up a list of subjectively important acoustical parameters for evaluating conditions in concert halls and auditoria. These are listed in Figure 16. There are five different categories of parameters given but there is clearly some overlap between measures of clarity and measures of reverberance. At this point, it seems desirable

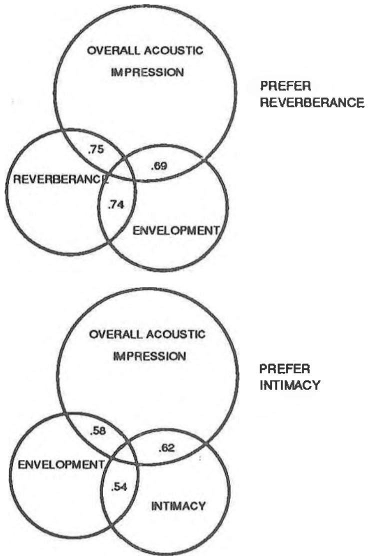

Figure 15. Interdependence of Barron's subjective response data29 separately for his two subject groups: those preferring reverberance and those preferring intimacy.

SUBJECTIVE ATTRIBUTE	PARAMETER
Strength or loudness	G, strength or relative level
Reverberance or liveness	EDT, early decay time
Clarity or definition	C80, clarity TS, centre time
Spatial impression or envelopment	LF, lateral energy fraction IACC, inter-aural correlation coefficient
Timbre	EDT(f), variation of EDT with frequency

Figure 16. Summary of the five most important subjective attributes of auditorium acoustics quality and related objective parameters.

to include both and to assume that they relate to different but related aspects of subjective impressions. Although reverberation time is not included, it is certainly an important quantity related to the physical parameters of the room and the statistical behaviour of sound in the room.

8. THE VALUE OF OBJECTIVE MEASUREMENTS

Thorough objective assessments are essential to evaluations of acoustical conditions in auditoria. Informal individual subjective assessments are not reliable and there is much evidence that such evaluations can be more influenced by obvious visual changes than by the often quite subtle acoustical changes. Small adjustments to halls may initially be thought to produce marked improvements to halls, but careful measurements usually reveal that small physical changes produce only small acoustical effects. In such cases, the initial perception of improvements usually soon leads to a sense of disappointment as the initial euphoria diminishes.

The newer parameters are expected to vary from seat to seat within a hall so that measurements must be made for a number of source-receiver combinations. This spatial sampling problem[30], combined with the often short time available in halls, demands a measurement system that is not only comprehensive and precise, but also fast and efficient.

We have gradually developed improved measurement techniques to evaluate these newer parameters in auditoria. Recently, we have been using our RAMSoft measurement program[31,32] that runs on an IBM PC computer interfaced to a Norwegian Electronics real time analyser. The program calculates 12 different acoustical parameters in a matter of seconds at each position in an auditorium. This system was a development from an earlier system[33], and has been shown to produce results in close agreement with the quite different measurement systems of Gade[34], and Barron[35]. Our measurements have been used to evaluate conditions in particular halls with acoustical problems and have been most useful in evaluating changes to halls. We are also accumulating data from a range of different halls[36] so that we can learn what conditions exist in better halls and how the various acoustical parameters relate to the geometry and materials of the halls.

9. CONCLUSIONS

There is a reasonable consensus that a small number of objective parameters are required to explain the major portion of subjective assessments of auditorium acoustics quality. A list of five different parameters can be produced, and all are based on quite simple energy summations or decay rates of sound energy. These five parameters have been shown to be correlated with different but perhaps partially overlapping subjective attributes of the acoustical quality of auditoria.

Efficient procedures exist to routinely obtain values of these parameters in halls, and studies in several countries have reported such measurements. These measurements can provide a clear objective assessment of acoustical conditions in an auditorium, and are certainly vastly superior to informal individual subjective judgments. By the systematic use of these newer parameters, we can gradually learn to better interpret their values and to make auditorium acoustics a more quantitative science. The addition of these newer quantities to more conventional considerations such as reverberation times and background noise levels, should help to make future consulting in this area a more robust and reliable business.

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REVIEW OF "SOUND INTENSITY" BY F.J. FAHY

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In the last two decades, the advent of instruments capable of measuring sound intensity, which represents the flow of energy in sound fields, has revolutionized audio-frequency acoustical metrology. It is now possible to measure the sound power output of individual noise sources even when perturbing sources are in operation.

There was a great need for a global treatise on sound intensity and its measurement. This is the challenge taken up by F. Fahy. The author of this first book on "Sound Intensity" has been one of the pioneers of the development of sound intensity techniques and also, for six years, the chairman of the ISO/TC43/SC1 working group on the determination of sound power levels of sources using sound intensity measurement at discrete points.

In general, when reading the book, the reader must keep in mind the statement made by the author in the preface: *my principal purpose in writing this book has been to compile information about sound intensity and its measurement.* This means that the main objective is to collect in one document the partial information contained in the wide range of publications that have appeared on this subject in the last 15 years. It is more a compilation of knowledge than a synthesis.

The first two chapters (introduction and history) are really very pleasant to read. The history is done in a thorough way, bringing to light the difficulties that have been overcome since the beginning. It sets the scene for the key ideas that will be developed in other chapters.

The third chapter is dedicated to sound and sound fields. The merit of this part lies in its comprehensive presentation of the physical bases for what made acoustics a special branch of physics. It also introduces the reader to the concepts of vector, phase, amplitude and interference, which are so important for sound intensity. A particular attention is paid to the time evolution of an acoustic field.

Sound energy and sound intensity are tackled in the fourth chapter. The instantaneous sound intensity is defined as a *vector quantity* $P \bullet U$. One would have preferred a more general development, in which the term $P \bullet U$ appears naturally in the classical balance of energy derived from Euler's equation. For non-specialists, this would have helped in the understanding where this famous $P \bullet U$ term came from. Active and reactive intensity are then described mathematically as well as graphically, this helping to explain their physical meanings. The cases of the distribution of intensity vectors from interfering monopoles, of intensity in ducts and of the intensity field above a structure or in front of a Helmholtz resonator are very useful to beginners in this field.

The next two chapters address the principles of sound intensity measurement and its electronic implementation. The author has chosen to present separately the systematic errors involved in the process of measurement. In this way, the reader may pinpoint a specific question of interest to him or her. In parentheses, perhaps, specialists of sound intensity should try to use words such as "imperfections" rather than "errors" when describing the tolerances related to sound intensity. The term "error" very often frightens engineers and technicians and tends to make them skeptical of this wonderful and powerful technique. The author explains well the effect of the finite approximation involved when measuring sound intensity in a free field with the so called P-P principle (pressure and pressure gradient). According to our experience, the difficulties which occur in the presence of extraneous noise sources deserved more detailed analytical derivations and explanations in order to introduce the key idea that a sound intensity apparatus is nothing other than a special phase meter. Examples of sound pressure and sound intensity spectra presented simultaneously for some meaningful cases would have perhaps helped provide a better understanding of the importance and the usefulness of the *sound intensity component level* (Pressure/Intensity).

Chapters 7 and 8 describe the main applications of sound intensity for engineering purposes: sound power measurement, source location, impedance and absorption, transmission loss, radiation efficiency. The determination of the sound power of a source by discrete-point measurement is based on the ISO provisional standard and is described in detail. Examples of source location are presented vectorially. The measurement of sound absorption and impedance is described qualitatively. Since the equations and calibration are now well known and used, this subject deserved a more complete treatment so that the reader would not be obliged to refer to other publications on the subject. The same remark pertains to sound transmission and radiation efficiency.

The last chapter concerns sound intensity in ducts with flow. The author uses his strong experience in this subject to expose how and to what extent one can measure sound intensity in the presence of flow.

In summary, this book is effectively a compilation of information about sound intensity and the first document on this subject. Non-specialists will appreciate finding all the basic principles and applications, described in a way that they can understand. The very complete bibliography (148 references) is there for the reader who wants more details. It is a shame that the two chapters dedicated to engineering applications are more an introduction, referring to other publications, than a ready-to-use presentation (except in the case of sound power measurement, for which it may be used as such). Specialists would have appreciated a source of reference for a better understanding of specific points.

In a next edition, it would be an interesting idea to introduce a summary at the end of each chapter. The summaries would include the key equations, the physics behind them, warnings about limitations, and key references.

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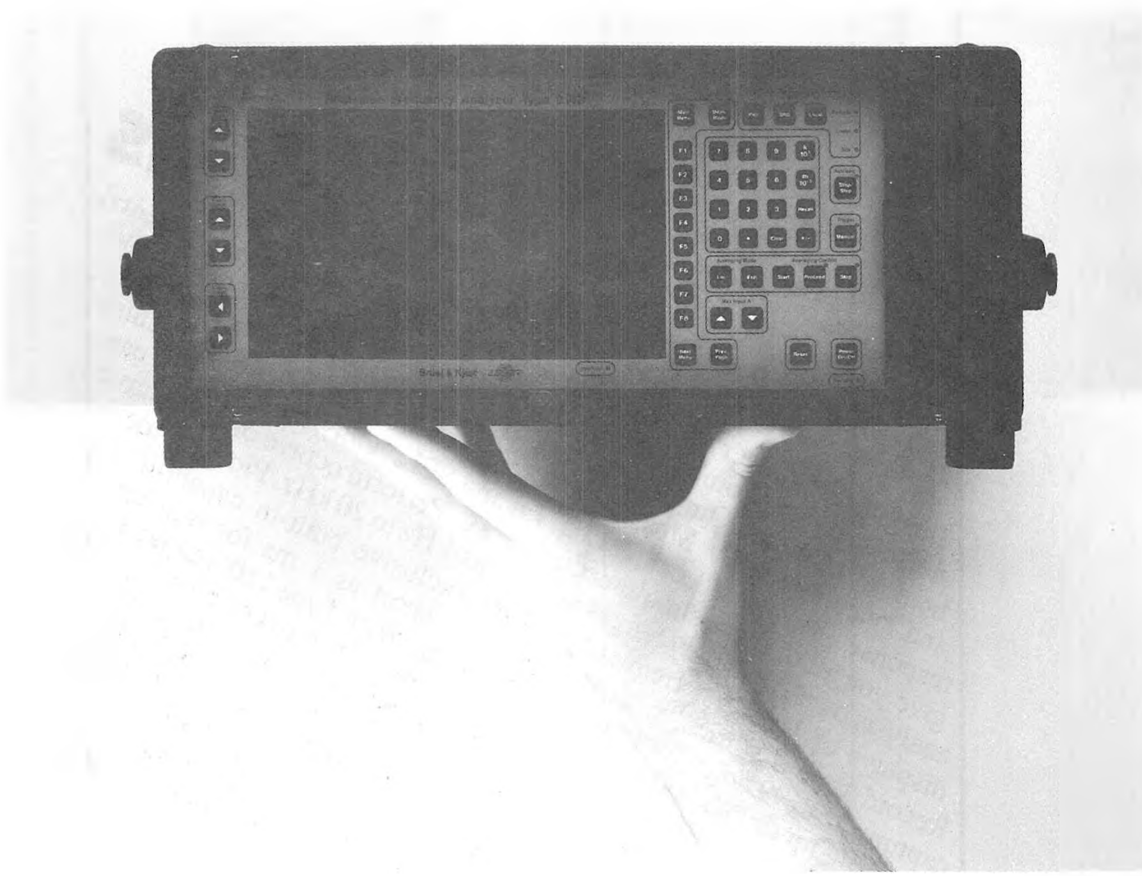

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ANALYSE DES REPONSES AU QUESTIONNAIRE D'OPINIONS SUR L'ACOUSTIQUE CANADIENNE

Murray Hodgson, Rédacteur en chef

Au total, 24 questionnaires, représentant moins de 5% des membres de l'ACA, ont été retournés. Même si deux membres enthousiastes ont retourné deux copies, il semble que le sentiment principal à l'égard de l'Acoustique Canadienne soit de l'apathie. A la lumière du faible taux de réponses et de la pauvre fidélité statistique, il n'y a pas de raison de faire une analyse détaillée des résultats. Je vais tenter de les résumer qualitativement et de tirer certaines conclusions.

Les questionnaires ont été complétés par des membres oeuvrant dans tous les milieux de travail et représentant tous les intérêts professionels. En général, toutes les rubriques du journal sont lues.

Les répondants apprécient les aspects suivants de l'Acoustique Canadienne: la qualité et la diversité des articles, sa présentation générale, le format bilingue et le style "amical"; il véhicule des informations qui "unissent" les membres. Un répondant aimait "tout".

Les répondants n'apprécient pas le manque d'articles, leur pauvre qualité scientifique, et les articles trop spécialisés. Ils n'aiment pas la couverture limitée des disciplines, que le journal soit peu connu en dehors du Canada, et les publications tardives.

Tous les répondants ont l'impression que l'Acoustique Canadienne satisfait leurs besoins en tant que francophoes.

La réponse à la question-clé à savoir si l'Acoustique Canadienne devrait être un journal scientifique ou un bulletin de nouvelles est concluante. La majorité désire qu'il soit les deux. Un petit nombre rapporte qu'il devrait être un journal scientifique exclusivement. Encore moins de répondants veulent qu'il soit seulement un bulletin de nouvelles.

Diverses suggestions ont été formulées pour améliorer le journal. Il s'agirait de publier le journal deux fois par année, solliciter plus d'articles (principalement, des articles à portée pratique), inviter des auteurs à soumettre des articles, publier des articles de revues, créer un comité de rédaction, et viser une meilleure qualité scientifique. D'autres suggestions seraient de publier des résumés de journaux, brevets, prix accordés, résumés de travaux en cours, biographies de membres. Enfin, d'autres suggestions seraient d'établir un format de journal uniforme et de solliciter une subvention pour défrayer la composition.

ANALYSIS OF THE CANADIAN ACOUSTICS OPINION QUESTIONNAIRE RESPONSES

Murray Hodgson, Editor in Chief

In total, 24 questionnaires, representing less than 5% of CAA members, were returned. Although two enthusiastic members returned two forms, it seems that the main sentiment felt about Canadian Acoustics is apathy. In the light of the low response and associated poor statistical accuracy, there seems no point in doing a detailed analysis of the results. I will try to summarize them qualitatively and to draw some conclusions.

Questionnaires were returned by members in all work environments and with all professional interests. As a rule, all of the journal's features are read.

Respondants liked the following aspects of Canadian Acoustics: the quality and diversity of its articles; its general presentation, bilingual format and 'friendly style'; that it conveys information that 'links' members. One respondant liked 'everything'.

Respondants disliked the lack of articles, their low scientific quality and too specialized articles. They disliked the limited coverage of disciplines, that the journal is little known outside Canada, and late publication.

The response to the key question as to whether Canadian Acoustics should be a scientific journal or a newsletter was conclusive. The majority want it to be both. A small number said it should be only a scientific journal. Even fewer want it to be only a newsletter.

Various suggestions were made as to how to improve the journal. These included publishing only two issues a year, soliciting more papers (especially practical ones), inviting papers, publishing review/tutorial articles, creating an editorial board, and aiming for higher scientific quality. Other suggestions included publishing journal abstracts, patents, degrees awarded, summaries of work in progress, and members' biographies. Further suggestions were to establish a more consistent journal format and to apply for a grant to fund type-setting.

As to why respondants have never published in Canadian Acoustics, most didn't reply. Those that did cited lack of time, classified work, that it's more interesting to publish in better-known journals, and laziness. Several stated that they are considering publishing soon.

A la question pourquoi les répondants n'ont jamais publié dans l'Acoustique Canadienne, la plupart n'ont pas répondu. Ceux qui ont répondu ont mentionné le manque de temps, le travail confidentiel, qu'il est plus intéressant de publier dans un journal plus connu, et la paresse. Plusieurs ont rapporté qu'ils considèrent publier bientôt.

La plupart des répondants considéreraient publier un article scientifique ou une description de leurs activités. Certains considéreraient publier leur point de vue. La plupart ne soumettraient pas leur point de vue mais publieraient un article scientifique ou portant sur leurs activités.

Qu'est-ce que tout cela évoque chez moi? Je conclus que la plupart des gens apprécient l'Acoustique Canadienne, ce qu'il essaie d'être et comment il y parvient. Le consensus est qu'il devrait tendre à être à la fois un journal scientifique et un bulletin de nouvelles. Comme journal scientifique, il devrait attirer des articles de meilleure qualité. Les papiers invités et de revue représentent une bonne idée. Comme bulletin de nouvelles, il devrait être un moyen pour la communauté canadienne oeuvrant dans le domaine de l'acoustique et des vibrations de communiquer et devrait être plus informatif.

L'idée de créer un comité de rédaction regroupant des membres de diverses disciplines et sollicitant activement des articles et des nouvelles est excellente. En général, la qualité de rédaction devrait être améliorée et le journal devrait être publié à temps.

Nous pouvons améliorer l'Acoustique Canadienne. Le questionnaire représente un point de départ pour agir. Merci à tous ceux qui ont répondu. De mon côté, je m'engage à:

- introduire un nouveau format de journal, plus professionnel et plus uniforme. En fait, ceci se réalise dans ce numéro-ci;

- encourager et solliciter des articles scientifiques, de revues et portant sur les activités;

- mettre sur pied un comité de rédaction;

- investiguer la possibilité de solliciter une subvention afin de défrayer les coûts de la composition du journal, ainsi que de voir l'Acoustique Canadienne listé dans les index de citations;

- essayer de publier à temps (ce numéro est publié plus tôt afin de rattraper le retard accumulé).

Most respondants would consider publishing a scientific article or a description of their activities. Some would consider publishing a viewpoint. Most would not submit a viewpoint, but would publish a scientific or 'activities' article.

So what does all this tell me? I conclude that most people like Canadian Acoustics, what it is trying to be and how it does it. The consensus is that it should aim to be both a scientific journal and a newsletter. As a scientific journal it should attract more high quality papers. Invited and review/tutorial articles are a good idea. As a newsletter, it should be a means for the Canadian acoustics/vibration community to communicate, and it should be more informative. The idea of an editorial board with members in various disciplines actively soliciting articles and news is excellent. In general, the editorial quality should be improved and the journal should be published on time.

That is, WE can improve Canadian Acoustics. This questionnaire is a starting point for action. Thanks to all who completed it. For my part, I commit myself to the following action:

- to introduce a new, more professional and consistent journal format. In fact, here it is in this issue!;

- to encourage and invite scientific, review/tutorial, and 'activities' articles;

- to establish an editorial board;

- to investigate applying for a grant to fund journal type-setting, as well as having Canadian Acoustics listed in citation indices;

- to try to keep publication on schedule (this issue is published early to make up for past tardiness).

Your part is to USE the journal - to publish articles, your latest news, and your opinions. Why not start writing a paper, a description of your own, your group's or your student's activities, or your thoughts on this analysis and the journal format TODAY?

Votre contribution consiste à UTILISER le journal pour publier des articles, vos nouvelles récentes et vos opinions. Pourquoi ne pas commencer à écrire un article, une description de vos activités, des activités de votre groupe ou de celles de vos étudiants, vos réflexions sur cette analyse et le format du journal, et ce dès aujourd'hui?

ACOUSTICS AND THE CANADA-WIDE SCIENCE FAIR

Annabel J. Cohen
Department of Psychology, Dalhousie University

For almost three decades the Youth Science Foundation/Fondation Sciences Jeunesse has offered challenges and opportunities in science to young Canadians. Its central program involves the encouragement, support and development of science fairs. Over 500,000 students participate annually in such fairs, which take place at individual high school, city-wide, regional and national levels. There are 95 regions organized in six zones comprising all of Canada: British Columbia/Yukon, Prairies, Ontario (south), Ontario (North and East), Quebec, and Atlantic. Winners of the regional competitions enter the final Canada-Wide Science Fair. (Incidentally, two of these students, sponsored by NSERC, are invited to participate in the Stockholm International Youth Science Symposium held each December during the week of the Nobel Prize ceremonies.) For the majority of the students, benefits of participation in these fairs goes far beyond any particular award obtained. The students meet talented peers, and get a chance to talk to professional scientists and educators (there are over 200 judges at the Canada-Wide Fair as well as many members of the public who visit the exhibits). The participants are exposed to a wide range of cultural and scientific activities. They can acquire a vast amount of new information, some of which might not have been covered in their school curriculum or some of which suddenly "makes sense" in a new context. The experience does much to enhance the view that a career in science can be exciting and worthwhile. Participation in the science fairs thus indirectly could lead to a productive career and also to a positive appreciation of science.

In 1989, The Canadian Acoustical Association joined with over 60 other scientific, educational, industrial and political organizations in the sponsorship of an award at the Canada-Wide Science Fair held in St. John's, Newfoundland. Specifically, the CAA had decided to offer one award at the senior level. Of the 200 projects, approximately 5% directly related to the science of sound, as such titles as the following suggest: "Voice recognition", "Artificial melodically correct answers", "Noise-induced deafness", "Light wave voice transmitter", "Musical physics", "Boom box builder", and "To see or to hear: An investigation into learning channels". Each project was represented by an exhibit with working experiments and demonstrations. In addition, a short written summary of the project was provided.

Dr. Michael Zagorski of Memorial University and Dr. Annabel Cohen of Dalhousie University volunteered as judges for this special CAA award and interviewed the young investigators whose work related to acoustics. The projects were judged on the basis of scientific thought, originality, skill or workmanship, practical value, and written summary. Kevin Greer and Suresh Pereira, two Grade 13 students from Brockville, received the CAA Senior award for their fine project on automatic word recognition. They each were presented a bronze medal, a certificate, and $150 by Dr. Zagorski at the awards ceremony. In addition, although the CAA had no official award for more junior candidates, it was felt by the judges that honourable mention was well deserved by Rachel Zimmerman at the Intermediate level and by Thomas Zajac at the Junior level. The short reports of some of these projects will appear in upcoming issues.

Although in 1988 the CAA Board of Directors and Executive had voted to award the Science Fair prize for three consecutive years, a revision in the awards program by the Youth Science Foundation forced the Board to reconsider involvement after 1989. In particular, the Youth Science Foundation required that organizations participating in the Canada-Wide Science Fair pay a new annual membership fee of $200 in addition to the minimum $250 prize. It was decided not to participate in the 1990 Fair but to consider at the next Director's meeting in October 1990 whether to participate at the 1991 Science Fair to be held in Vancouver. Whereas there is general endorsement of the Science Fair and support of young scientists through the Youth Science Foundation, there is a question of priorities for the CAA given budget constraints. The CAA currently offers prizes for graduate students, postdoctoral students and full CAA members, in all cases at levels beyond what is required for participation in the Canada-Wide Science Fair. Nevertheless, there may be more practical means for the CAA to encourage public school education in acoustics than participation in the Canada-Wide Science Fair. For example, taking part in regional fairs might be effective and this could allow for more involvement from CAA volunteers than participation that the national level. Any views on this matter from the CAA membership would be appreciated (preferably prior to the October Director's meeting) and can be directed to CAA President Bruce Dunn or to CAA Director Annabel Cohen.

NOTE FROM THE PRESIDENT

Last year, the CAA raised its dues to $35. As professional organizations go, $35 is not a great deal. However, the dues are now high enough that members have asked questions about what the organization does for them. This is a good question and perhaps it is time for us all to really ask what the CAA should be doing for all of us. This issue will be on the agenda of the Annual General Meeting.

At the present moment, our three major services are "Canadian Acoustics", the papers at the convention, and monetary prizes. These are all valuable functions. All have been questioned in one form or another. Some have requested that more unreviewed articles such as progress reports be included in "Canadian Acoustics". The editor and myself have appealed to researchers to risk a little and publish more of their good stuff in the journal. Only by doing this will it gain the status to become a major journal in the eyes of those who make salary decisions. The conventions produce excellent opportunities for communication, but they cost extra and are really not paid for out of dues. In the case of the prizes, there have been complaints that the eligibility requirements are too narrow and favour graduate students and other academics as opposed to those out in the field.

All of these are legitimate issues to be discussed. There may be many more functions to which our attention should be directed. If you feel strongly about any of these, please let us know. One of the best ways is to come to the Annual General Meeting and make your views known. If enough of us do that, good ideas may surface; at the very least, the function of enhanced communication will have been achieved.

As you read in the minutes of the board meeting, the acceptance of the invitation to hold Inter-Noise 92 was unanimous. This is another value of an organization such as ours. We attract interesting meetings (recall the 12th ICA). This is further enhanced if we participate strongly. So, start thinking about presenting in 1992.

Bruce Dunn, CAA President

ACOUSTICS AND NOISE CONTROL COMMITTEE Z107 MEETING

On Friday afternoon, October 5, at 13:00 hours at the Holiday Inn Crowne Plaza, Montreal, the Canadian Standards Association Acoustics and Noise Control Committee Z107 will meet to review the activities of the past year. The meeting is open to all who are interested. Only members will be allowed to participate in any formal votes. Visitors, upon recognition from the chair, will be allowed to make comments.

Reports will be received from all active subcommittees. Some of the areas of discussion will be activities of the Canadian Standards Association Hearing Protector Committee Z94.2, sale of packaged acoustics standards, status of federal occupational noise legislation, ground vibration measurement standard, and reports on ISO activities since last fall.

Z107 INDUSTRIAL NOISE SUBCOMMITTEE MEETING

Wednesday, October 3, at 10:00 hours in the Holiday Inn Crown Plaza, Montreal, the Canadian Standards Association Z107 Industrial Noise Subcommittee will meet. Visitors are welcome.

MOT DU PRESIDENT

L'an dernier, l'ACA a haussé ses cotisations à $35.00. Pour ce type d'organisation, $35.00 ne représente pas un montant excessif. Cependant, les cotisations sont maintenant assez élevées pour que les membres s'interrogent sur ce que l'organisation leur apporte. Il s'agit là d'une bonne question et il est peut-être temps de nous questionner sur ce que l'ACA doit faire pour nous. Cet item sera à l'agenda de l'assemblée générale annuelle.

En ce moment, nos trois services majeurs sont l'Acoustique Canadienne, les présentations au congrès, et les prix en argent. Ce sont toutes des fonctions valables. Toutes ont été remises en question d'une façon ou d'une autre. Certains membres ont demandé que plus d'articles non-révisés tels que des rapports d'avancement de travaux soient publiés dans l'Acoustique Canadienne. Le rédacteur en chef et moi-même avons lancé un appel aux chercheurs pour qu'ils risquent un peu et qu'ils publient davantage leurs bonnes réalisations dans le journal. C'est seulement en agissant ainsi que le journal gagnera un meilleur statut aux yeux de ceux qui prennent les décisions à l'égard des salaires. Les congrès représentent une excellente occasion pour présenter des communications, mais ils représentent un surplus et ne sont pas payés à même les cotisations. En ce qui a trait aux prix en argent, il y a eu des plaintes à l'effet que les critères d'admissibilité sont trop restrictifs et favorisent les étudiants gradués et autres universitaires au détriment de ceux qui oeuvrent hors de ce circuit.

Tous ces points méritent d'être discutés. Il pourrait y avoir plusieurs autres activités vers lesquelles notre attention devrait se tourner. Si vous avez des suggestions, faites nous le savoir. Une des meilleures façons est de venir à l'assemblée générale annuelle et de faire connaître votre point de vue. Si plusieurs d'entre nous le font, de bonnes idées pourraient surgir; à tout le moins, l'objectif d'accroître la communication aura été atteint.

Comme vous aurez constaté en le lisant le procès verbal de la rencontre du conseil d'administration, l'approbation à l'invitation de tenir Inter-Noise 92 a été unanime. Ceci représente un autre mérite d'une organisation comme la nôtre. Nous attirons d'intéressants congrès (souvenez-vous du 12e ICA). Ceci sera d'avantage mis en valeur si nous participons en force. Ainsi, commencez à penser à présenter une communication en 1992.

Bruce Dunn, Président de l'ACA

REUNION DU COMITE Z107 SUR L'ACOUSTIQUE ET LE CONTROLE DU BRUIT

Vendredi après-midi, 5 octobre, 13h00 au Holiday Inn Crowne Plaza, Montréal, l'Association canadienne de normalisation Comité Z107 sur l'acoustique et le contrôle du bruit tiendra une rencontre pour discuter des activités de l'année qui vient de s'écouler. Tous les gens intéressés sont bienvenus à cette rencontre. Seuls les membres seront invités à voter. Les visiteurs reconnus par le comité pourront faire des commentaires.

Des compte-rendus de tous les sous-comités seront acceptés. Parmi les points à l'ordre du jour, il y aura les activités de l'Association canadienne de normalisation Comité Z94.2 sur les protecteurs auditifs, la vente de normes en acoustique prix forfaitaire, l'état de la réglementation fédérale en ce qui a trait à l'exposition professionnelle au bruit, une norme sur la mesure des vibrations dans le sol, et les compte-rendus des activités de l'ISO depuis l'automne dernier.

REUNION DU SOUS-COMITE Z107 SUR LE BRUIT INDUSTRIEL

Mercredi, 3 octobre, à 10h00 au Holiday Inn Crowne Plaza, Montréal, l'Association canadienne de normalization, Sous-comité Z107 sur le bruit industriel tiendra une rencontre. Les visiteurs sont bienvenus.

BOARD OF DIRECTORS MEETING / REUNION DES DIRECTEURS

Date/Date:	October 3 octobre, 1990
Time/Heure:	2:00 p.m. / 14h00
Place/Endroit:	Executif Holiday Inn Crown Plaza Montreal

AGENDA / ORDRE DU JOUR

1. Report of the President (B. Dunn)

2. Report of the Executive Secretary (W. Sydenborgh)

3. Report of the Treasurer (C. Andrew)*

4. Report of the Editor of "Canadian Acoustics" (M. Hodgson)

5. Report of the Membership Chairperson (M. Zagorski)

6. Prizes:

   Directors Awards - C. Laroche
   Postdoctoral Prize - S. Abel
   Bell Speech Prize - L. Brewster
   Underwater Acoustics Prize - D. Chapman
   Student Presentations - A. Behar

7. Canada Wide Science Fair (A. Cohen)
8. Internoise '92 (T. Embleton)
9. International Congress of Audiology in 1994 (B. Dunn)
   (Invitation to hold joint meeting in Halifax)
10. Annual Meeting in Edmonton (B. Dunn)
11. 1992 Annual Meeting
12. Report of Education Committee (S. Abel)
13. Other Business

    Student and other Prizes (S. Abel and D. Chapman)
    Acoustics Centre of Excellence in Halifax (D. Chapman)
    New business

* See preliminary financial statement on page 38.

ANNUAL GENERAL MEETING / ASSEMBLEE GENERALE ANNUELLE

Date/Date:	October 4 octobre, 1990
Time/Heure:	5:00 p.m. / 17h00
Place/Endroit:	Gouverneur I and II Holiday Inn Crown Plaza Montreal

AGENDA / ORDRE DU JOUR

1. Welcome

2. Presentation of the Minutes

3. Report of the President (B. Dunn)

4. Report of the Treasurer (C. Andrew)*

5. Report of the Executive Secretary (W. Sydenborgh)

6. Report of the Editor of "Canadian Acoustics" (M. Hodgson)

7. Report of the Membership Chairperson (M. Zagorski)

8. Prizes:

   Directors Awards - C. Laroche
   Postdoctoral Prize - S. Abel
   Bell Speech Prize - L. Brewster
   Underwater Acoustics Prize - D. Chapman
   Student Presentations - A. Behar

9. Canada Wide Science Fair (A. Cohen)

10. Internoise '92 (T. Embleton)

11. Annual Meetings:

Halifax	'89	(B. Cyr)
Montreal	'90	(H. Forester)
Edmonton	'91	(G. Bolstad)
??	'92	(?)

12. Report of Education Committee (S. Abel)

13. Other Business

   Student and other Prizes (S. Abel and D. Chapman)
   Acoustics Centre of Excellence in Halifax (D. Chapman)
   Service of CAA to Members (B. Dunn; see "Note from the President" in this "Canadian Acoustics")
   Business Arising from Board Meeting
   International Congress of Audiology in 1994
   New Business from the Floor

14. Elections

* See preliminary financial statement on page 38

CANADIAN ACOUSTICAL ASSOCIATION

PRELIMINARY FINANCIAL STATEMENT FOR THE PERIOD 1/9/89 - 31/8/90

Receipts:

Membership	15100
Advertisements	3720
Reprints	1215
Profit from CAA '89[1]	2895
ICA Proceedings	419
Royalties (Harold Merklinger)	351
Interest[2]	6300
	30000

Disbursements:

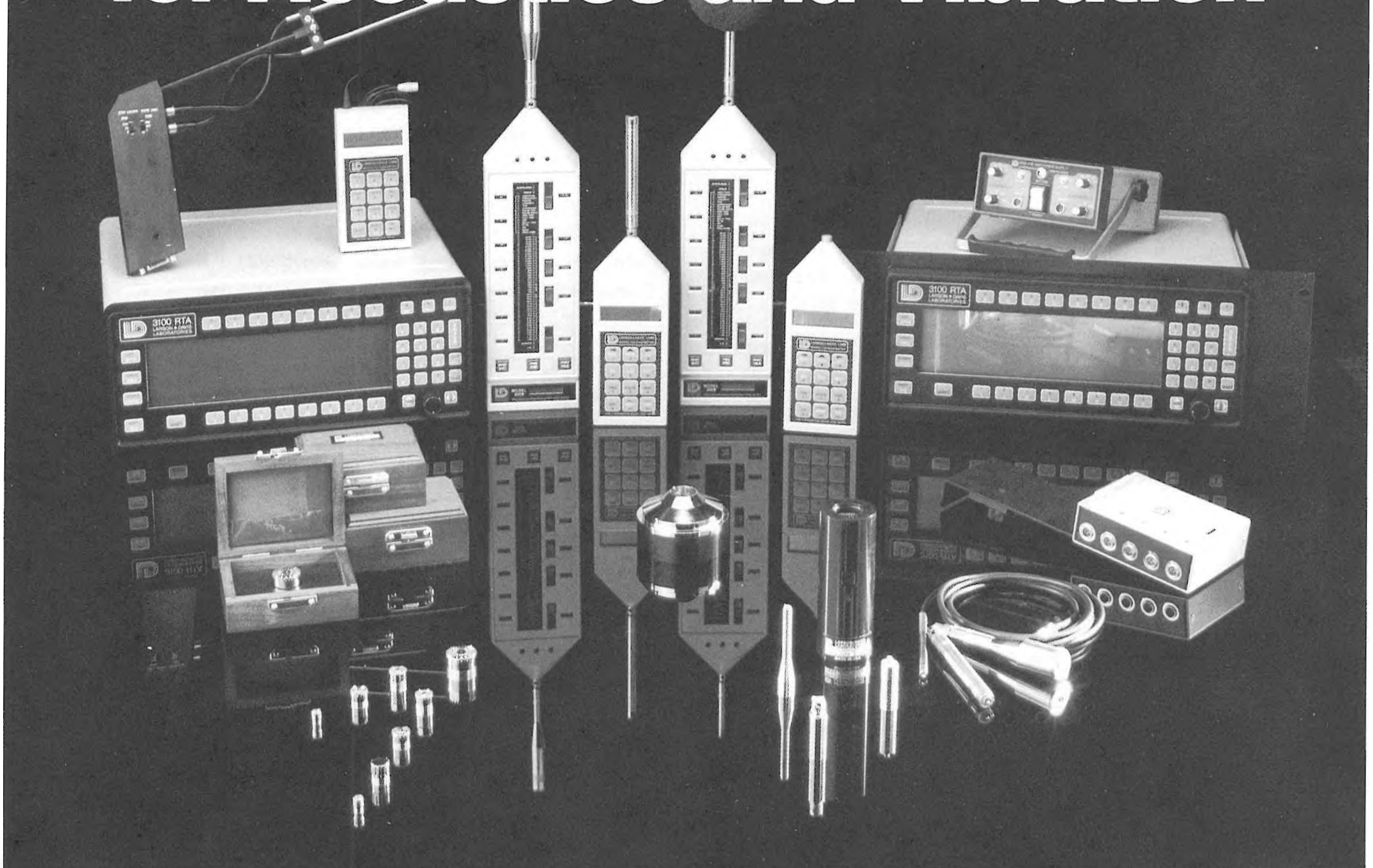
Journal	9600
CAA '90 advance	3000
Secretarial	1700
Audit 1989	1500
Awards, prizes	6300
Miscellaneous	600
	22700

Excess of receipts over disbursements	7300

1 From preliminary statement.

2 Interest from investments covering prizes and awards.

Superior Instrumentation for Acoustics and Vibration



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We have become a new technology leader in acoustics and vibration measuring instruments. Our goal is to provide advanced, precise, high-quality products at very reasonable prices. As the result of a substantial ongoing research program, Larson-Davis products provide versatility and automation untouched by *any* competitive offerings. Our growing product family includes:

- Portable multichannel Real-Time analyzers delivering 1/1, 1/3 and 1/12 octave bands to 125 KHz with future plug-in modules for FFT, acoustic intensity, memory expansion, etc.
- Underwater acoustic analysis equipment.
- Precision sound level meters with computer interfaces and automated control of 1/1 and 1/3 octave filters.
- Data logging noise dosimeters and hand-held sound level meters.
- Environmental and industrial noise monitoring systems.
- Building and architectural acoustics analyzers.
- Vibration measuring and monitoring instruments.
- Audiometric calibration instruments for speech and hearing.
- Network airport noise monitoring systems, with management planning software.
- Precision measuring microphones, preamplifiers, power supplies, instrumentation amplifiers, acoustic intensity probes, calibrators and accessories.

For more information contact the factory.

LARSON • DAVIS
LABORATORIES

280 South Main
Pleasant Grove, UT 84062
801-785-6352 TELEX 705560

Dalimar Instruments Inc.

C.P. 110
Ste-Anne de Bellevue
(Québec) Canada H9X 3L4
(514) 453-0033
TELEX: 05-560592 - TO: 23218

Yvon J. B. Larose
Directeur général
FAX:
(514)453-0554

NEWS / INFORMATIONS

CONFERENCES

Eleventh NRCC Machinery Dynamics Seminar: The Westbury Hotel, Toronto, Ontario, October 1-2, 1990. Contact: Nicole Leger at (613) 993-9009.

29th Conference on Acoustics: Building Acoustics, Room Acoustics, Urban Acoustics: Strbske Pleso - High Tatras Czechoslovakia, October 2-5, 1990. Contact: House of Technology, Ing. 1, Goralikova, Skultetyho ul. 1 832 27 Bratislava, Czechoslovakia.

Noise-Con 90: The 1990 National Conference on Noise Control Engineering, Austin, TX, October 15-17. Contact: Professor Elmer Hixson, Department of Electrical and Computer Engineering, University of Texas at Austin, Austin, TX 78712.

The International Environment and Ecology Exhibition Crossroads: Place Bonaventure, Montreal, Quebec, October 31 to November 2, 1990. Contact: C.I.E.E. Carex Ltd. at (514) 922-2545 or Fax (514) 649-8719.

Annual Conference of the Australian Society: Ballarat, Victoria, Australia. Contact: Mr. S.E. Samuels, Australian Road Research Board, P.O. Box 156 (Bag 4), Nunawading, Victoria 3131, Australia.

Autumn Conference 90 - Speech and Hearing, British Institute of Acoustics: Windermere, U.K., November 22-25, 1990. Contact: Institute of Acoustics, P.O. Box 320, St. Albans, Herts. AL1 1PZ or Tel. 0727 48195.

Noise and Vibration Control in Industry: in the High Tatras, Tatranska Lomnica, Czechoslovakia, on November 26-30, 1990. Contact: Dom Techniky Csvts, Nadja Bajova, Casta Miery 4, CS-011 32 Zilina, Czechoslovakia.

12th Meeting of the Acoustical Society of America: San Diego, CA, November 26-30, 1990. Contact: Frederick H. Fisher, Marine Physical Lab., P-001, Scripps Institute of Oceanography, University of California, San Diego, La Jolla, CA 92093-0701.

22nd Annual Scientific Meeting of the British Medical Ultrasound Society: Harrogate, U.K., December 4-6, 1990. Contact: BMUS, 36 Portland Place, London, W1N 3DG.

1990 IEEE Ultrasonics Symposium: Honolulu, HI, December 4-7, 1990. Contact: Dr. Harry Salvo (301) 765-4290.

Effects and Control of Transportation Noise: Lyon, France, 4-7 December 1990. Contact: Claude Girard, Quebec Ministry of Transport (514) 873-3443.

Institute of Acoustics - Sonar Transducers for the Nineties: Birmingham, U.K., December 17-18, 1990. Contact: Institute of Acoustics at 0727 48195.

CONFERENCES

11e séminaire du CNRC sur la dynamique des équipements: Hôtel Westbury, Toronto (Ontario), les 1 et 2 octobre 1990. Contacter: Nicole Léger, (613) 993-9009.

29e conférence sur l'acoustique: acoustique urbaine et acoustiques des bâtiments et des salles: Strbske Pleso - Haute Tatra, Tchécoslovaquie, du 2 au 5 octobre 1990. Contacter: House of Technology, Ing. 1. Goralikova, Skultetyho ul. 1 832 27 Bratislava, Tchécoslovaquie.

Noise-Con 90: Conférence nationale de 1990 sur les techniques d'insonorisation, Austin (TX), du 15 au 17 octobre 1990. Contacter: Professor Elmer Hixson, Department of Electrical and Computer Engineering, University of Texas at Austin, Austin, TX 78712.

Le carrefour - exposition internationale de l'environnement et de l'écologie: Place Bonaventure, Montréal (Québec), du 31 octobre au 2 novembre 1990. Contacter: C.I.E.E. Carex Inc., (514) 922-2545; télécopieur (514) 649-8719.

Conférence annuelle de l'Australian Society: Ballarat, Victoria, Australie. Contacter: Monsieur S.E. Samuels, Australian Road Research Board, P.O. Box 156 (Bag 4), Nunawading, Victoria 3131, Australie.

Conférence automnale 1990 - Speech and Hearing, British Institute of Acoustics: Windermere, U.K., du 22 au 25 novembre 1990. Contacter: Institute of Acoustics, P.O. Box 320, St. Albans, Herts, AL1 1PZ; téléphone 0727-48195.

Insonorisation et contrôle des vibrations dans l'industrie: Haute Tatra, Tatranska Lomnica, Tchécoslovaquie, du 26 au 30 novembre 1990. Contacter: Dom Techniky Csvts, Nadja Bajova, Casta Miery 4, CS-011 32 Zilina, Tchécoslovaquie.

120e réunion de l'Acoustical Society of America: San Diego (CA), du 26 au 30 novembre 1990. Contacter: Frederick H. Fisher, Marine Physical Lab., P-001, Scripps Institute of Oceanography, University of California, San Diego, La Jolla, CA 92093-0701.

22e réunion scientifique annuelle de la British Medical Ultrasound Society: Harrogate, R.-U., du 4 au 6 décembre 1990. Contacter: BMUS, 36 Portland Place, London, W1N 3DG.

Symposium de 1990 de l'IEEE sur l'ultrasonique: Honolulu, Hawaï, du 4 au 7 décembre 1990. Contacter: Dr. Harry Salvo, (310) 7865-4290.

Effet et traitement du bruit du transport: Lyon, France, du 4 au 7 décembre 1990. Contacter: Claude Girard, Ministère des Transports du Québec, (514) 873-3443.

Institute of Acoustics - Sonar Transducers for the Nineties: Birmingham, R.-U., les 17 et 18 décembre 1990. Contacter: Institute of Acoustics, Téléphone 0727-48195.

COURSES

Occupational Noise Dosimetry and Sound Measurement Techniques: Sscan-Grodyne Controls and Quest Electronics, Toronto, Ontario, September 18, 1990. Contact: Sscan-Grodyne Controls, Richmond Hill, Ontario

Occupational Noise Dosimetry and Sound Measurement Techniques: Sscan-Grodyne Controls and Quest Electronics, Cambridge, Ontario, Spetember 19, 1990. Contact: Sscan-Grodyne Controls, Richmond Hill, Ontario

Occupational Noise Dosimetry and Sound Measurement Techniques: Sscan-Grodyne Controls and Quest Electronics, Ottawa, Ontario, September 21, 1990. Contact: Sscan-Grodyne Controls, Richmind Hill, Ontario.

International Industrial Hygiene Workshop: The Pillar and the Post Inn, Niagara-on-the-Lake, October 1-3, 1990. Contact: (416) 978-3069.

Audiology or Speech-Language, Graduate Level: University of Western Ontario, Fall 1990. Contact: Donald G. Jamieson, Faculty of Applied Health Sciences, Department of Communicative Disorders, Elborn College, London, Ontario. Tel.: (519) 679-2111.

Acoustics and Noise Control: Seven Springs Mountain Resort, Seven Springs, PA. One week seminar, October 8-12, 1990. Contact: Jean at AVNC at (412) 265-4444. Fax No. (412) 367-9233; for technical details, call Bill Thornton at (412) 265-2000.

Signal Processing: Seven Springs Mountain Resort, Seven Springs, PA. One week seminar, October 8-12, 1990. Contact: Jean at AVNC at (412) 265-4444. Fax No. (412) 367-9233; for technical details, call Bill Thornton at (412) 265-2000.

Pressure Measurement: Endevco Corporation, October, 1990. Contact: Colette Landerville at (714) 493-8181.

Training Course in Noise Control: Orlando, FL, November 12-16, 1990. Contact: Hoover and Keith Inc., 11381 Meadowglen, Suite I, Houston, TX 77082 or call (713) 496-9876.

Shock and Vibration Measurement: Endevco Corporation, December, 1990. Contact: Colette Landerville at (714) 493-8181.

Vibration Technology II - Machinery Vibration Analysis: IRD Mechanalysis, Inc. Contact: Andrea Applegate at (614) 885-5376.

NEW PRODUCTS

Solutions to OHS Problems Found

The Canadian Centre for Occupational Health and Safety (CCOHS) is working on a database to put you in the know about the many OHS problems out there and the many solutions that have been found for them ... usually by people on the shop floor - workers, supervisors, members of joint health and safety committees. The database is called SOLUTIONS. They'll become part of CCINFO, CCOH's national electronic information service, and thus available on the compact disc series CCINFOdisc.

COURS

Occupational Noise Dosimetry and Sound Measurement Techniques: Sscan-Grodyne Controls and Quest Electronics, Toronto (Ontario), le 18 septembre 1990. Contacter: Sscan-Grodyne Controls, Richmond Hill (Ontario).

Occupational Noise Dosimetry and Sound Measurement Techniques: Sscan-Grodyne Controls and Quest Electronics, Cambridge (Ontario), le 19 septembre 1990. Contacter: Sscan-Grodyne Controls, Richmond Hill (Ontario).

Occupational Noise Dosimetry and Sound Measurement Techniques: Sscan-Grodyne Controls and Quest Electronics, Ottawa (Ontario), le 21 septembre 1990. Contacter: Sscan-Grodyne Controls, Richmond Hill (Ontario).

International Industrial Hygiene Workshop: The Pillar and the Post Inn, Niagara-on-the-Lake, du 1 au 3 octobre 1990. Téléphone (416) 978-3069.

Audiology of Speech-Language, Graduate Level: University of Western Ontario, automne 1990. Contacter: Donald G. Jamieson, Faculty of Applied Health Sciences, Department of Communicative Disorders, Elborn College, London (Ontario). Téléphone (519) 679-2111.

Acoustics and Noise Control: Seven Springs Mountain Resort, Seven Springs, PA. Semaine du 8 au 12 octobre 1990. Contacter: Jean au AVNC, (412) 265-444; télécopieur (412) 367-9233; pour des renseignements techniques, contacter Bill Thornton, (412) 265-2000.

Signal Processing: Seven Springs Mountain Resort, Seven Springs, PA. Semaine du 8 au 12 octobre 1990. Contacter: Jean au AVNC, (412) 265-4444; télécopieur (412) 367-9233; pour des renseignements techniques, contacter Bill Thornton, (412) 265-2000.

Pressure Measurement: Endevco Corporation, octobre 1990. Contacter: Colette Landerville, (714) 493-8181.

Noise Control: Orlando, FL, du 12 au 16 novembre 1990. Contacter: Hoover and Keith Inc., 11381 Meadowglen, Suite I, Houston, TX 77082. Téléphone (713) 496-9876.

Shock and Vibration Measurement: Endevco Corporation, décembre 1990. Contacter: Colette Landerville, (714) 493-8181.

Vibration Technology II - Machinery Vibration Analysis: IRD Mechanalysis, Inc. Contacter: Andrea Applegate, (614) 885-5376.

NOUVEAUX PRODUITS

Le Centre canadien d'hygiène et de sécurité au travail (CCHST) élabore actuellement une base de données qui vous informera des solutions trouvées à plusieurs problèmes d'HST ... ordinairement sur les lieux de travail mêmes, par des ouvriers, des superviseurs ou des memberes du comité mixte d'hygiène et de sécurité. Cette base de données s'appelle SOLUTIONS. Il les incorpore à son système national de documentation électronique, CCINFO, et à sa série de disques compacts, disqueCCINFO.

CANADIAN ACOUSTICAL ASSOCIATION - MEMBERSHIP DIRECTORY 1990
ASSOCIATION CANADIENNE D'ACOUSTIQUE - ANNUAIRE DES MEMBRES 1990

Dr. Sharon M. Abel
Mount Sinai Hospital
600 University Ave., Suite 843
Toronto, Ontario
M5G 1X5
(416) 586-8278
1990
Member 5, 6, 8

ACOUSTEC INC.
Dr. J.G. Migneron
106 Chaudiere
St. Nicolas, Quebec
G0S 2Z0
(418) 839-0101
1990
Sustaining 1,6

Acoutherm Insulation Ltd.
19 Passmore Ave., Unit 18,
Scarborough, ON.
M1V 4T5
(416) 299-7852 Fax: (416) 299-7783
1990
Corp.Subscription 1, 5, 7

Ms. M.P.B. Adams
Safety Dept.
INCO Ltd.
Thompson, Manitoba
R8N 0W9
(204) 778-2605
1990
Member 5, 6, 8

Dr.P.W.Albert,
200 Elizabeth St.,
7th Floor North,
TORONTO, ON
M5G 2C4
1990
Member 5

Dr. D.L. Allen
Vibron Limited
1720 Meyerside Drive
Mississauga, Ontario
L5T 1A3
(416) 670-4922
1989
Member 1, 5, 7

Ms. Denise Barbiero
Audiology
Mount Sinai Hospital
600 University Ave., #201
Toronto, Ontario
M56 1X5
(416) 586-5018
1990
Member 2, 5,

Mr. Simon Bargetzi
Bargmes Ent. Canada Ltd.
P.O.Box 704
Golden, British Columbia
V0A 1H0
(604) 344-5344
1990
Member 1, 5, 7

Barman Swallow Associates
1 Greensboro Dr., Suite 401
Rexdale, Ontario
M9W 1C8
(416) 245-7501
1990
Sustaining 1, 5, 7

Barron Kennedy Lyzun & Associates Ltd.,
Att: Mr. Kenneth E. Barron, P.Eng.,
#250-145 West 17th Street
North Vancouver, British Columbia
V7M 3G4
(604) 988-2508
1990
Sustaining 1, 2, 5,

Dr.W.E.Bayliss,
Dept.of Physics
University of Windsor
Windsor, Ontario
N9B 3P4
(519) 253-4232, ext 2653
1990
Member 1, 4,

B.C. Inst. of Technology
Library - Serial Dept.
3700 Willingdon Avenue
Burnaby, British Columbia
V5G 3H2
1990
Subscription

Mr. Maurice Amram
Ecole Polytechnique
de Montreal
Departement de Genie Physique,
C.P. 6079, Succursale A
Montreal, Quebec
H3C 3A7
(514) 340-4572
1990
Member 1, 5

Mr.Chris Andrew
DPW, Noise Control Office,
433 Eastern Avenue,
Toronto Ont.
M4M 1B7
(416) 392-0791
1990
Member 1, 5, 7

Mr. Graham Andrews
Boeing Canada, Dehavilland
Flight Test Building
Garratt Blvd.
Mailstop N70-01,
Downsview, Ontario
M3K 1Y5
1990
Member 2, 5

Ms. Jean Andruski
#40, 4007-108 St.
Edmonton, Alberta
T6J 2L5
(403) 437-6647
1990
Student 6, 8

Mr.Donald B. Archer,
156 Lloyd Manor Road,
Islington, Ontario
M9B 5K3
(416) 239-2837
1990
Member 1, 2, 4, 5

Mr. Tom Beardall, Manager,
Occupational Hygiene Services,
Occupational Health Centre,
Abramsky Hall - 2nd Floor,
Queen's University,
Kingston ON
K7L 3N6
(613) 545-2909
1990
Member 5,7

Mr. Alberto Behar
Safety Services Dept.
Ontario Hydro
757 McKay Road
Pickering, Ontario
L1W 3C8
(416) 683-7516
1990
Member 1, 2, 5

Mr. S. Benner,
Ministry Of the Environment
250 Davisville Ave., 3rd Floor,
Toronto, Ontario
M4S 1H2
(416) 440-3549
1990
Member 1, 5

Ms. Barbara Bentley
14 Archer Cres.
London, Ontario
N6E 2A5
(519) 668-0635
1990
Student 5, 6,8

Mr. Elliott M. Berger
E-A-R Div., Cabot Corp.
P.O. Box 68898
Indianapolis, Ind.
U.S.A. 46268-0898
(317) 872-1111
1990
Member 5, 6, 10

Mr. Alain Berry
GAUS - Genie Mecanique
Universite de Sherbrooke
Sherbrooke, Quebec
J1K 2R1
(819) 821-7102
1990
Student 5, 7, 9

Mr. Jim Armstrong,
Industrial Hygiene Specialist,
Mines Accident Prevention Association of Ontari
P.O. Box 1468
North Bay, Ontario
P1B 8K6
(705) 472-4140
1990
Member 5, 7, 8

Mr. Horst Arndt
Unitron Industries Ltd.
20 Beasley Drive
P.O. Box 9017
Kitchener, Ontario
N2G 4J3
(519) 895-0100
1990
Member 2, 6, 8

Mr.A.F.Atamanchuk
Health Environmentalist
City of Winnipeg, Health Dept.,
280 William Avenue
Winnipeg, Manitoba
R3B 0R1
(204) 986-2388
1990
Member 1, 5, 10

Mr. B.W. Bailey
c/o Bruel & Kjaer Canada Ltd.
116 Russ Rd.
Grimbsby, Ontario
L3M 4E7
(416) 945-1900
1990
Member 1, 2, 3

Mr. Rick Barber,
33 School Ave.,
Halifax, N.S.
B3N 2E1
(902) 443-3155
1990
Member 5,7

P. Bhatt
Experimental Phonetics Lab.
Dept. of French, New College
University of Toronto
300 Huron Street
Toronto, Ontario M5S 2X6
(416) 978-8281
1990
Member 8

Mr. Ugis Bickis
Occupational Health Ctr.
Abramsky Hall, Queen's University
Kingston, Ontario K7l 3N6
(613) 545-2909
1990
Member 1, 5, 7

Mr. David G. Billard
NFLD. & LABRADOR HYDRO
P.O. Box 12400
St. John's, Newfoundland
A1B 4K7
(709) 737-1404
1990
Member 2, 5, 7

Bilsom International Ltd.
60 St. Clair Ave. E.
Suite 1002
Toronto, Ontario
M4T 1N5
(416) 922-7807
1990
Sustaining 10

Mr.Kenneth G.Bilyk
Bilyk Technologies
27 Park Terrace Drive
Winnipeg, Manitoba
R2J 3C6
(204) 255-0620
1989
Member 1, 2, 5

Mr. John Binek
SPL CONTROL
1400 Bishop St.
P.O. Box 2252
Cambridge, Ontario
N1R 6V8
(519) 623-6100
1990
Member 5

H.L. Blachford, Ltd.
c/o Mr. D.E. Watson
2323 Royal Windsor Dr.
Mississauga, Ontario L5J 1K5
(416) 823-3200
1990
Sustaining 5,10

Mr. J. Blachford,
H.L. Blachford Ltee
977 Lucien l'Allier
Montreal, Quebec H3G 2C3
(514) 866-9775
1990
Member

Mr. Richard Blackman,
175 Dowling Ave.,
Toronto ONt.
M6K 3B1
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