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Advertising:
Keith Rose FIOA
Brook Cottage, Royston Lane,
Comberton, Cambs. CB3 7EE
Tel 01223 263800 Fax 01223 264827

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The Institute of Acoustics, 5 Holywell Hill, St Albans, Herts. AL1 1EU
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R Lawrence FIOA

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contents

The Institute of Acoustics was formed in 1974 through the amalgamation of the Acoustics Group of the Institute of Physics and the British Acoustical Society and is the premier organisation in the United Kingdom concerned with acoustics. The present membership is in excess of two thousand and since 1977 it has been a fully professional Institute. The Institute has representation in many major research, educational, planning and industrial establishments covering all aspects of acoustics including aerodynamic noise, environmental, industrial and architectural acoustics, audiology, building acoustics, hearing, electroacoustics, infrasonics, ultrasonics, noise, physical acoustics, speech, transportation noise, underwater acoustics and vibration. The Institute is a Registered Charity no. 267026.

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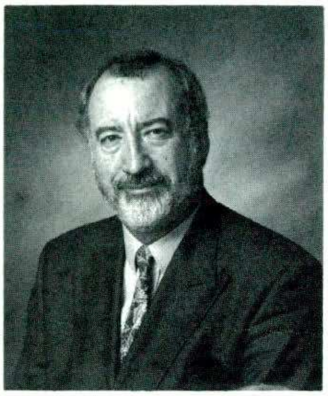

Dear Fellow Member

For the last few months, the Executive Committee of the Institute have been working hard to finalise arrangements for the future Secretariat of the Institute, to take effect on 1 January 1997. A statement appears on the next page and I would like to take this opportunity to thank in particular the President-Elect, Ian Campbell, who has had the task of setting up the contracts of employment for the existing staff at Agriculture House and the Honorary Secretary, Tony Jones, who has been involved in discussions with staff and drafting a new agreement with Cathy Mackenzie Management Services.

I am pleased that Cathy will continue as Executive Secretary for a period of up to12 months and that she will be able to assist the new Deputy Secretary, whom we hope to appoint soon, in the process of re-structuring the Institute's Secretariat. I am also pleased to welcome Linda, Anne, Joanne, Sue, Alison, Diane and Lukman as either full-time or part-time employees of the Institute. Dennis Playle will continue his important Engineering Council activities, in a self-employed capacity.

Another matter also likely to be of great importance to the future of the Institute is the Brussels Green Paper on 'Future Noise Policy' – COM(96) 540 Final dated 4 November 1996. It is intended that an article on this document will be published in the January/February 1997 issue of Acoustics Bulletin. This executive summary of the Green Paper charts the way ahead:

> ***'Environmental noise, caused by traffic, industrial and recreational activities is one of the main local environmental problems in Europe and the source of an increasing number of complaints from the public. Generally however action to reduce environmental noise has had a lower priority than that taken to address other environmental problems such as air and water pollution.***
>
> ***The 1993 Fifth Environmental Action Programme started to remedy this and included a number of basic targets for noise exposure to be reached by the year 2000, while the recent proposal on the review of the Fifth Action Programme (COM(95)647) announces the development of a noise abatement programme for action to meet these targets.***
>
> ***This Green Paper is the first step in the development of such a programme and aims to stimulate public discussion on the future approach to noise policy. It reviews the overall noise situation and Community and national action taken to date followed by the outline of a framework for action covering the improvement of information and its comparability and future options for the reduction of noise from different sources'.***

I would like to would like to take this opportunity to wish you all a happy and peaceful Christmas and a prosperous New Year.

Sincerely yours

Bernard Berry

Bernard Berry

The future of the Institute Secretariat

Cathy Mackenzie advised the Institute's Executive Committee at its May 1996 meeting that she did not wish to seek a renewal in December 1996 of the contract under which for the past seventeen years Cathy Mackenzie Management Services has provided the Institute's Secretariat. Since then, the Executive Committee has carefully and extensively explored a variety of possible arrangements for the future. At its meeting on 5th December, Council approved the following recommendation of the Executive Committee.

(i) From 1st January 1997 Cathy Mackenzie will continue as Executive Secretary for an interim period of no longer than twelve months, as part of a new contract with Cathy Mackenzie Management Services.

(ii) The Institute would directly employ the staff of Cathy Mackenzie Management Services who have worked hitherto on Institute affairs.

(iii) As of 31 December 1996 Dr Roy Lawrence will resign as Deputy Secretary of the Institute and, as part of the contract with Cathy Mackenzie Management Services, take up a post as Special Projects Co-ordinator. His remit will be to explore ways in which the Institute can enhance the services offered to the membership and the wider public.

(iv) A Deputy Secretary will be appointed as soon as possible, directly responsible under the Executive Secretary for specific areas of the Institute's activities.

(v) Dr Roy Lawrence and Cathy Mackenzie, as Cathy Mackenzie Management Services, will undertake all aspects of the publication of Acoustics Bulletin, for an initial period of one year.

Deputy Secretary

The Council of the Institute wishes to employ a Deputy Secretary, working in the Institute office in St Albans, with certain specific responsibilities. Applications for this post are invited from suitably qualified individuals.

Experience in education, science or engineering, preferably in acoustics, noise and vibration, along with administrative and financial management experience and some knowledge of computer systems would be a particular recommendation.

The intention is for the appointee to take up the post as soon as possible in January 1997. The terms of employment would be a matter of negotiation. For the right candidate, there is scope for promotion in due course to the post of Executive Secretary.

Applications should be sent as soon as possible, and not later than 17 January 1997, enclosing a current CV, to *Dr Tony Jones FIOA, Institute Hon Secretary, Institute of Acoustics, 5 Holywell Hill, St Albans, Herts AL1 1EU,* marking the envelope Private and Confidential. Anyone who wishes to know more about the post before submitting an application may contact Cathy Mackenzie on 01727 848195 to arrange an informal meeting.

THE DIDJERIDU (DIDGERIDOO)

Neville Fletcher

Introduction

The didjeridu (commonly spelt didgeridoo) or yiraki of the Australian aboriginal people is a very ancient instrument with considerable acoustic interest, despite its extremely simple construction. It consists of a more-or-less straight piece of tree trunk or branch, hollowed out by the successive action of fire and termites to produce a gently flaring tube. Didjeridus from Central Australia are typically about one metre in length, while those from Arnhem Land are usually about 1.5 metres long. The longer didjeridus are now generally preferred because they allow a greater range of musical effects. In each case the blowing end is about 30 mm in internal diameter and the free end about 50 mm, though all these dimensions vary significantly from one instrument to another, even among those by the same maker. The average wall thickness is usually 5 to 10 mm. At the blowing end, the walls are coated with a rim of resinous gum, to improve playing comfort, and the free end is often given a slight extra flare by internal scraping. The outside of the instrument is smoothed and painted in geometrical totemic designs, usually in black, white and orange.

To play the didjeridu, the musician seals the narrow end of the tube around his mouth, blows, and vibrates his lips under muscular tension in very much the same way as used in playing a brass instrument such as the tuba. The didjeridu uses air at rather a high rate so that, to play a sustained tone, the player adopts the technique of 'circular breathing'. After playing normally for a few seconds, he expands his cheeks with air, seals off his mouth from his throat with the back of the tongue and, while using the stored air to maintain the tone, takes a quick breath through his nose. This technique is common on certain other instruments, such as Indonesian flutes, and is now used routinely by oboists and even flute players to play without breath breaks for as long as several minutes. In these instruments, with their much smaller breath demand, the objective is to maintain an even tone and cover up any effect of the breathing. With the didjeridu, however, the player makes a virtue of necessity and emphasises the rhythmic breathing cycle to produce a pulsating drone. The pulsations are usually further decorated by tongue vibrations, so that the player effectively says unvoiced words such as 'ritoru' or even 'didjeridu', with the final 'u' sound prolonged. The westernised name 'didjeridu' for the instrument perhaps arises from this circumstance, though it may perhaps be a word from some aboriginal language, now extinct.

There has been only a little written about the acoustics of the didjeridu [1,2] or about its playing techniques [3,4]. The instrument itself, however, has become increasingly used in popular music by groups such as Gondwanaland, and was earlier made widely known on television through the efforts of Rolf Harris. A few simple calculations and measurements, however, allow us to understand a good deal about this interesting instrument.

Passive Acoustics

It is a good approximation to treat the didjeridu as a truncated conical horn of length L. Suppose that the diameter of the smaller end is d_1 and that of the larger end d_2. Then if we imagine the cone to be continued to its apex, the distance from this apex to the smaller blowing end of the instrument will be $x_1 = d_1 L / (d_2 - d_1)$. Since the players' lips form a pressure-controlled valve, the preferred sounding frequencies are those at which the acoustic pressure at this end, and thus the acoustic impedance, is a maximum. These frequencies f_n can be shown [5] to be the roots of the equation

$$k_n L' = n\pi - \tan^{-1} k_n x_1 \qquad (1)$$

where $k_n = 2\pi f_n / c$, c is the speed of sound in air, and the acoustic length $L' = L + 0.3 d_2$ includes the end-correction at the open end.

If the flare is extremely small so that the horn is nearly cylindrical, then x_1 becomes very large and $\tan^{-1} k_n \pi$ approaches $\pi/2$. The resonance frequencies are then $f_n = (n - {}^1/_2)\, c/2L'$ which form the series of odd harmonics that we expect, for example as the playing frequencies of a clarinet, starting with a quarter of a wavelength equal to the tube length. More generally, if the flare is fairly small, we can expand the result (1) to arrive at the approximate expression

$$f_n = \left(n - \tfrac{1}{2}\right)\frac{c}{4L'}\left\{1 + \left[1 + \frac{4(d_2 - d_1)}{\pi^2 d_1 \left(n - \tfrac{1}{2}\right)^2}\right]^{1/2}\right\} \qquad (2)$$

We can see that the frequencies of the lower modes, and particularly that of the fundamental, are raised relatively more than those of the higher partials, so that all the mode intervals are compressed. For moderate flare, only the lowest mode frequency is significantly affected. For the range of end diameters found in the typical didjeridus of Table 1, this fundamental-mode frequency is raised by a factor between about 1.06 and 1.38 relative to a cylindrical tube of the same length. The ratio of second to first mode frequencies, which would be a perfect twelfth (1.50) for a cylindrical pipe, ranges from about 1.30 (about a tone flat of a perfect twelfth) to about 1.43 (a little less than a semitone flat). The greater the flare, the flatter the second mode appears relative to the drone fundamental.

Length L (cm)	159	144	149
Diameter d_1 (mm)	31	26	30
Diameter d_2 (mm)	36	60	40
Frequency f_1 (Hz)	60	80	64
Drone pitch	B_1	E_2	C_2

Table 1. Typical didjeridus [1]

These mode-frequency predictions are confirmed by the measured drone frequencies of three typical didjeridus from Arnhem Land as listed in Table 1. The effect of flare is easily seen in the case of the second and third instruments – the second is only 3 percent shorter than the third, but its fundamental frequency is 25 percent higher because of its large flare. Unfortunately the second-mode frequencies were not recorded, but the pitches agree qualitatively with the theoretical predictions [1].

It is interesting to note that traditional makers and players seem to have little concern with either the drone frequency or the interval to the second mode – the first two instruments in the table are actually by the same maker. Indeed, a good player can produce most of the nuances of traditional performances on a piece of plastic pipe of appropriate diameter and length! When used in popular Western music, however, it is necessary to select a didjeridu of appropriate pitch to match the keyboard instruments, though in some multi-track recordings the didjeridu is actually recorded first and then pitch-shifted, the player having made some adjustment for the associated change in tempo. Breaking with tradition, Graham Wiggins has made the perhaps obvious extension of building a didjeridu with keys to open one or more holes near the foot and so allow the drone pitch to be changed.

Sounding Mechanism

While much of our understanding of the sounding mechanism of wind instruments dates back to the time of Helmholtz a hundred years ago [6], it is only recently that these mechanisms have been studied in detail. There is a clear distinction between three types of pressure-controlled valves, as illustrated in Figure 1. In the first two types, air pressures acting on the two faces of the valve have opposite effects, tending to either open or close the valve, while in the third type excess pressure on either face tends to open the valve. If we represent a closing action of excess pressure by the symbol '–' and an opening action by '+', then the first two valves have classification (–,+) and (+,–) respectively, and the third has classification (+,+).

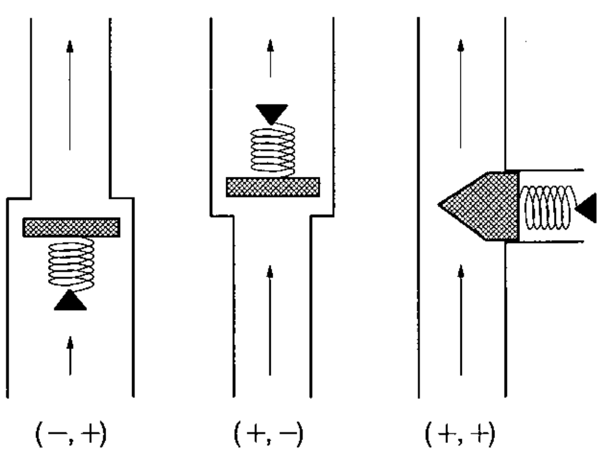

Fig. 1. The three types of simple pressure-controlled valve. Air flow direction is shown with an arrow.

The familiar reed valves of oboes and clarinets are of the (–,+) type, as also are the metal reeds used in organ reed-pipes. The human vocal folds are usually modelled as having the configuration (+,+), as are the vocal organs of birds (the syrinx), though the models used are generally more complex than this. The lips of players of brass instruments, such as the trumpet or tuba, and of the didjeridu, are either of configuration (+,–) or (+,+), and possibly change character between different playing regimes [7]. It is probably necessary to use a rather complex model for the vibrating lip valve, such as has been developed for the human vocal folds [8], but this has not yet been attempted. We must therefore be satisfied for the present with simpler models.

If we define the acoustic admittance of a pressure-controlled valve under blowing pressure, as viewed from the instrument, to be the ratio of the small-signal acoustic flow out of the instrument to the small-signal acoustic pressure in the instrument mouthpiece, then there is the possibility of self-sustained oscillation if the resistive part of this impedance (the acoustic conductance) is negative, to overcome the losses in the system, and if the reactive part can be balanced by the reactive admittance of the instrument tube and the player's mouth, taken together. In all cases, the first condition requires that the blowing pressure should be greater than some threshold value determined by the tension of the lip muscles, which itself depends on the pitch of the note being played [9,10].

Provided a blowing pressure greater than this minimum is used, then the acoustic admittance of a lip-valve generator can be shown [9] to have a form like one of those shown in Figure 2. For such a (+,–) or a (+,+) valve, the acoustic conductance – the real part of the admittance – is large and negative at a frequency either just above or just below the resonance frequency of the lip-valve, which is determined by lip mass and muscular tension. At other frequencies the conductance is relatively small and may be either positive or negative. The magnitude of this peak negative conductance is sufficiently large that it is able to overcome the positive conductance losses in the rest of the system and force it into oscillation. While this can happen over a considerable frequency range if the lip resonance frequency is adjusted – a skilled trombone player can play a glissando without moving the instrument slide – the oscillation is most easily sustained near an impedance maximum of the tube, where its positive conductance is least. The acoustic impedance of the player's mouth also plays an important role in sustaining the lip oscillation – a role

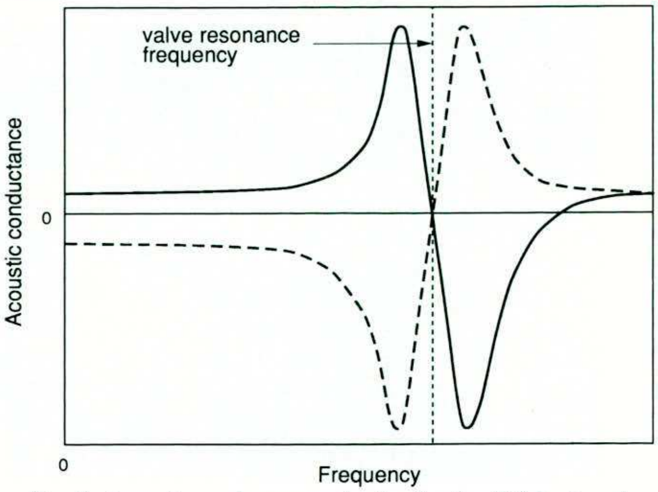

Fig. 2. Acoustic conductance of a (+,–) valve (full line) and of a (+, +) valve (broken line). The resonance frequency for free vibration of the valve is shown.

that can be appreciated when we realise that it is possible to buzz the lips at their resonance frequency even in the absence of any instrument tube [10].

This is the operating regime for a didjeridu – the player adjusts lip tension so that the lip resonance is close to the first tube resonance. To produce the second mode, the player must use a much higher lip tension to raise the lip resonance frequency, and this requires, in turn, a greater threshold blowing pressure. The actual pressures used are, of course, well above the threshold value. Measurements [1] show that a didjeridu player typically uses a pressure of about 1 – 2 kPa (10 – 20 cm water gauge pressure) for the drone note and about 4 – 5 kPa to produce the second mode. Some players can produce the third mode and even higher modes, but they are rarely used. Indeed, even the second mode is only employed for brief accents, and not as a sustained tone.

Sound Quality

The discussion above is essentially linear and expressed in terms of linear quantities such as acoustic admittances. Sound production in wind instruments, however, is a nonlinear process [5,11], and this nonlinearity is responsible for generating the upper partials of the tone. The process has been examined for brass instruments such as the trumpet [12] and trombone [13] and much of this discussion can be applied to the didjeridu.

Because, unlike the reed valve in a clarinet, the lip valve operates at very nearly its resonance frequency [7,9,10], the motion of the player's lips is nearly sinusoidal. The average lip opening is determined by the blowing pressure, and the amplitude of the lip vibration is such that the lips just about close once in each cycle. If p_0 is the steady blowing pressure, p the pressure just inside the mouthpiece of the instrument, and $x = a_0 + a \sin 2\pi ft$ the lip opening, then the volume flow U through the lip valve is

$$U \approx \gamma x (p_0 - p)^{1/2} \qquad (3)$$

where γ is a constant. The pressure p inside the instrument mouthpiece is approximately RU, where R is the acoustic resistance of the instrument tube at the resonance frequency f_1, and we can substitute this back into (3), along with the expression for x, to find, after a little algebra, that if $a < a_0$ the flow has the form

$$U \approx \frac{p_0}{R} - \frac{p_0^2 / R^3}{(a_0 + a \sin 2\pi ft)^2} \qquad (4)$$

This expression cannot be taken too literally in the limit as $a \to a_0$, but the shape of the flow waveform is essentially as shown in Figure 3.

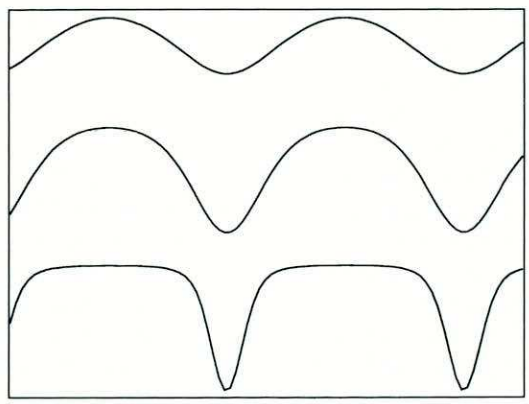

Fig. 3. The flow waveform through a lip-valve at several amplitude levels, as given by Equation (4).

Clearly such a waveform has many harmonics, and this accounts for the rich sound of the didjeridu, and of lip-excited instruments in general. The relative strengths of the upper harmonics are not well predicted by this simple flow waveform, however, for several reasons. The flow waveform gives a spectral envelope which is initially nearly constant and then declines at about 12 dB/octave. The assumption that R is constant, however, is not very good, and this resistance is less for the upper harmonics than for the resonant fundamental, except for accidental near-coincidences with higher horn resonances. Finally, the transfer function between flow spectrum and acoustic radiation rises at 6 dB/octave at low frequencies and is then flat above about 3 kHz for the didjeridu horn. Despite these reservations, however, this simple treatment does give a fair idea of spectral behaviour.

Note that the sound spectrum of the didjeridu, as for all sustained-tone instruments (except when playing 'multiphonics' or other special effects), is strictly harmonic. The fact that the upper modes of the pipe are not in harmonic relation to the fundamental affects only the strength of certain harmonics. If one of the upper pipe modes is sounded instead of the fundamental, then this sound will itself be accompanied by its own set of harmonics.

We should now consider the effect of the player's mouth cavity on sound quality. The player's lip opening varies nearly sinusoidally with time, as we have seen. The time spent at each opening is inversely proportional to the lip speed at that opening. If the lips just close each cycle so that $a = a_0$, the fraction of time spent at opening x can then be shown to be proportional to $[x(2a_0 - x)]^{-1}$ which is sharply peaked at $x = 0$ and $2a_0$, so that the lips spend most of their time either nearly fully open or nearly closed. Seen from the instrument tube, therefore, the player's mouth is mostly either blocked off by the closed lips or else forms a Helmholtz resonator consisting of a closed volume vented by the lip opening. The resonance frequency of this resonator can be estimated from our experience with whistling, in which the whistle frequency is the resonance frequency of the same Helmholtz resonator. Since the lip opening is similar, within a factor of less than ten, in the two cases, the attainable resonance frequencies should be the same within about a factor three. We therefore expect that it should be possible to vary the resonator frequency over a range from about 500 Hz to about 3 kHz by changing the mouth volume with the tongue.

It is fairly easy to understand the effect of such a resonator on the lip-valve flow and hence on the radiated sound spectrum. The resonator is rather highly damped by the flow resistance through the lip valve so that its bandwidth encompasses the frequencies of several harmonics of the drone frequency. The acoustic flow through the lip valve will be enhanced for these harmonics, so that the acoustic spectrum will exhibit a 'formant band' rather like those of the human voice and, indeed, arising from similar causes. Details are more complicated than this, of course, because the opening from the mouth to the instrument is changing with time.

While the didjeridu can be played with a dull drone, lacking obvious formants, this is not usual for good players. Figure 4 shows two examples of such formants, which play an important role in producing the characteristic sound of the didjeridu. In the first example, there is a pronounced formant band at about 1500 Hz, while in the second example the player has reduced the volume of his mouth so as to raise formant frequency to about 2.2 kHz. In each case there is some evidence for a lower vocal-tract formant at about 500 Hz. Because the frequency range of these formants is similar to that of human vowel formants, they have a similar aural effect. In normal playing, using circular breathing, these formants are produced in a rhythmic manner as the mouth volume changes, but they are often made a tonal feature of the performance.

These formant phenomena are much more pronounced in the didjeridu than in Western brass instruments, principally because trumpets, tubas and the like have a cup-shaped mouthpiece with a narrow constriction between it and the main bore of the instrument. This mouthpiece, as well as providing a comfortable support for the lips, functions as a Helmholtz resonator in its own right, and its resonance produces a broad formant band, typically with a centre frequency around 500 Hz for a trumpet [5]. The mouthpiece cavity also functions as a filter which reduces any influence that mouth resonances might have on upper partials of the sound.

There is one other aspect of performance technique that deserves detailed acoustic comment. This is the use of vocal sounds to augment the drone of the didjeridu.

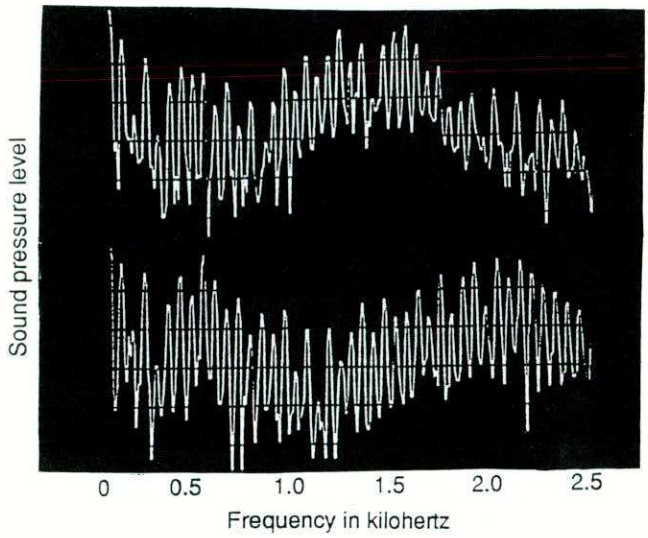

Fig. 4. Formant bands in the didjeridu sound. In the upper trace, there is a mouth-cavity formant at about 1.5 kHz, while in the lower trace this has been shifted to about 2.2 kHz by constricting the mouth.

Because of the acoustic coupling between the vocal folds in the throat and the player's vibrating lips, the interaction is quite complex. Suppose that the player's vocal folds vibrate at a frequency f_v. Then this produces pulses of flow in the same way as described for the lip valve and illustrated in Figure 3. The flow entering the mouth, and therefore the mouth pressure p_0 of (4), thus contains all harmonics nf_v of the vocal-fold frequency. When this flow is convolved with the nonlinear flow through the lips, which are vibrating with frequency f_L, as in (4), the result is the production of all frequencies $nf_v \pm mf_L$, those with greatest amplitude having small integer values (1 or 2) for m and n.

The simplest example of this frequency mixing occurs when the player sings a steady tone at a frequency simply related to the drone frequency. A typical example is the singing of a note that is a just major tenth (frequency ratio $5/2$) above the drone fundamental. The cross term $f_v - 2f_L$ then has a frequency $f_L/2$ and this is accompanied by all its harmonics from the other cross terms. The sound is therefore an octave below the original drone frequency. There is not much radiated energy in this sub-octave fundamental, but the subjective pitch is generated strongly from the sequence of harmonics. Because of the low pitch and the strength of the higher harmonics, the sound has a rough rasping quality which is very effective. A rather similar result can be obtained by singing a note a perfect fifth (frequency ratio $3/2$) above the drone fundamental.

Finally, we should remark that players of the instrument often use it to accompany traditional songs or stories and, to this end, embellish their playing by adding the sung sounds of barking dingos, brolgas and other animals. The pitch of these vocal sounds is rather high so that frequency mixing does not have such a pronounced effect, and the sounds can be made easily recognisable.

Figure 5 shows a spectral display of a short passage of didjeridu playing. In this representation, time is along the horizontal axis and frequency on the vertical axis, with the

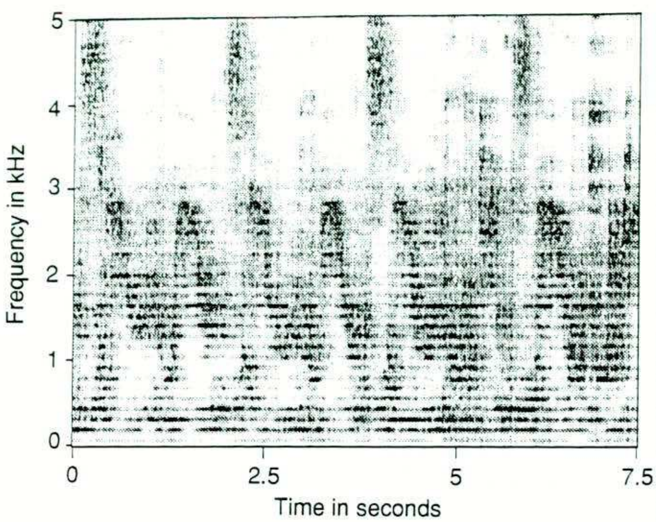

Fig. 5. Time-frequency display of the sound of a didjeridu during a typical playing sequence. Note the harmonics of the drone frequency, the shifting formant bands, and the articulation noise.

density of shading indicating the sound pressure level. Two things are immediately obvious. The first is that the harmonic structure of the sound is clearly evident in the closely spaced dark bands running horizontally in the figure. The second feature is the formant bands, which show up as darker regions on the plot and vary with time. Articulation and circular breathing divide the time record into repeating segments. Features of this type will be familiar to anyone involved with human speech analysis.

Conclusion

Although the didjeridu is physically a simple instrument and its makers appear to accept wide variations in its physical dimensions and therefore in its tuning, it supports a wide variety of subtle performance techniques. We have considered here the acoustics of only the most important of these, but it is clear that there is a great deal of interesting understanding to be derived. I hope that this article may serve as an example of the sort of results that can come from cooperation between acousticians and musicologists.

Acknowledgments

The work on which this paper is based was completed a long time ago and has, for the most part, already been published elsewhere [1]. It is a pleasure to acknowledge the help I have received from conversations with Trevor Jones, a distinguished musicologist and expert didjeridu player, and with Graham Wiggins, a physicist turned didjeridu virtuoso. Some of the analysed examples were played by Trevor and some were collected in the field by linguist Bill Hoddinott. I would also like to thank Suszanne Thwaites for assistance with the measurements.

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Neville Fletcher is at the Research School of Physical Sciences, Australian National University, Canberra ❖

THE CONCAWE SCHEME FOR OUTDOOR NOISE PREDICTION

Keith Attenborough FIOA

Introduction

ISO 9613-2 'General method for predicting noise outdoors' [1,2], which is about to be published, is unlikely to be implemented as a British Standard for outdoor noise prediction, so it seems timely to give a brief review of the nearest UK equivalent and to compare it with the ISO scheme. Essentially, like the ISO scheme, the CONCAWE scheme [3] is empirical. It was derived over fifteen years ago specifically for use by the petro-chemical industry, however it contains generic material which could permit its wider use for predicting outdoor noise from fixed sources including industrial and construction plant. In some ways the CONCAWE scheme does not contain as many provisions as the ISO scheme. For example, the CONCAWE scheme does not provide for screening by vertical edges, and while acknowledging the possibility, does not contain specific provision for attenuation during propagation through buildings. In two ways it is more sophisticated than the ISO scheme. First the CONCAWE scheme permits predictions for a wide range of meteorological conditions rather than being confined to 'moderate downwind'. Secondly, it allows for calculation of the reduction of ground effect in octave bands due to the presence of a (horizontal edge) barrier, rather than assuming simply, like the ISO scheme, that the ground effect is lost if a barrier is present.

The purpose of this article is to provide a survey of important elements of the scheme and comment on its applicability in the light of current knowledge. This cannot replace a thorough reading of the source report [3] and the details in the background references that it cites.

Basis and Provisions of the Scheme

The scheme is based on a survey of literature that was available prior to 1980, field data collected at ranges up to 1300 m around three complex sources ranging from a small process site to a major petroleum and petrochemical industry complex and a series of measurements using octave band filtered white noise at source heights between 3 m and 9 m and ranges between 100 m and 1000 m over flat grassland. The component sources for the three industrial sites were between 0 m and 25 m above ground level. The scheme allows for spherical spreading and corrections for atmospheric absorption, ground effect (including propagation path height influence), barrier effect and meteorological (refraction) effects. The corresponding calculations are in octave bands and require an octave band source power spectrum. Meteorological conditions are described in terms of six categories defined in terms of the Pasquill classification system used when predicting air quality and vector wind speed between source and receiver. The Pasquill stability classifications are based on incoming solar radiation, time of day and wind speed. There are six classes, A – F. Class A represents a very unstable atmosphere with strong vertical air transport and mixing. Class F represents a very stable atmosphere, with weak vertical air transport. Class D represents a meteorologically-neutral atmosphere with a logarithmic wind speed profile and a zero temperature profile. Note that this is not the same as an acoustically-neutral atmosphere since it includes a wind velocity gradient. In a stable atmosphere, the temperature increases with height and the wind-speed gradients are larger than is usual for a meteorologically-neutral atmosphere. In an unstable atmosphere, the temperature decreases with height and wind-speed gradients are smaller than usual for a meteorologically-neutral atmosphere. Usually, the atmosphere is unstable (classes A, B, C and D) by day and stable (classes D, E and F) by night. Acoustically-neutral conditions are assumed to correspond to CONCAWE meteorological category 4 and strong downwind conditions to meteorological category 6.

The basic octave band ground effect corrections for acoustically-neutral and various vector wind conditions are derived from the classical data obtained by Parkin & Scholes [4,5] for a fixed jet engine source at a height of 1.85 m and for ranges to 1097 m over a grass covered airfield. To extrapolate from these data obtained with a single source height to any source height, the CONCAWE scheme assumes that the ground effect diminishes nonlinearly to zero at a grazing angle of 5°. The validation experiments with filtered octave band white noise were restricted to grazing angles up to 2° and so were unable to verify this assumption or the exact form of the variation of ground effect with source height. As in the ISO scheme, CONCAWE allows for the simultaneous presence of acoustically-hard and acoustically-soft ground along the propagation paths. However it suggests that only the distance travelled over the soft ground is used when calculating the ground effect correction in octave bands, rather than defining proportions of source, middle and receiver ground regions as required by the ISO scheme.

Separate corrections for wind and ground are given in the CONCAWE scheme, so it is tempting to think of them as separate effects. However, the presence of wind and temperature gradients influence propagation by altering the ground effect, so it is more accurate to regard the *combination* of ground and wind corrections as the excess attenuation due to ground in the presence of wind.

In the CONCAWE scheme, the calculation of barrier effects is based on the widely accepted and extensively used formula due to Maekawa [6]. For a barrier of negligible thickness, the formula gives a relationship between the barrier-induced attenuation, the wavelength of the sound and the difference between the length of the path from source to receiver diffracted around the top of the barrier and that travelling directly from source to receiver. To predict propagation in the presence of a barrier close to the source, the CONCAWE scheme applies a correction (reduction) to the ground effect term based on a change in the effective source height to coincide with the top of the barrier. In common with the ISO scheme, no explicit guidance for calculation is given for situations where a barrier is placed at a distance from the source that is an appreciable fraction of the source-receiver distance. Although the scheme does not give an explicit method, it recommends the use of a ray-tracing method by De Jong and Susnik [7] for calculating meteorological influences on barrier performance. This method, particularly important for downwind receivers, involves calculation of the ray path curvature (assumed circular) from the sound speed gradient. The barrier effect is calculated subsequently by using the curvature to define the locations of a virtual source and receiver corresponding to positions where an equal barrier effect would be produced under no-wind conditions.

The 95% confidence limits for predictions using the scheme based on comparison with validation measurements vary between 6.9 dB(A) for meteorological category 3 (slight upwind) and 4.5 dB(A) for meteorological category 6 (strong downwind). The limits in individual octave bands are consistently higher for the 250 Hz octave band where ground effects may be expected to be important and in the 4 kHz octave band where signal-to-noise is often a problem.

A Few Criticisms

Since some of the largest discrepancies between measurement and prediction and variations between measurements are to be found in octave bands where ground effects are dominant, it seems that progress could be made by allowing for more classes of ground condition than simply acoustically-hard or -soft. This would mirror more closely the number of classes used to describe meteorological conditions.

The meteorological categories in CONCAWE are based, in part, on the observed wind speed. However there is no indication, within the part of the scheme in which the meteorological categories are defined, of the height at which this wind speed is to be measured. This is a vital omission since the wind's influence on propagation depends on wind speed *gradient* rather than wind speed alone. It is reported elsewhere in the report proposing the scheme [3] that wind speeds for the Parkin and Scholes measurements and the measurements carried out to validate the CONCAWE scheme were obtained at 11 m (33 feet) height. If a linear wind speed profile is assumed, this implies a positive gradient of greater than 0.27 s^{-1} for meteorological category 6. Use of the recommended method for calculating downwind effects on barrier performance [7] requires knowledge of the wind speed *gradient*. If the input gradient exceeds the implied value for meteorological category 6 to a significant extent then calculations may lead to anomalous results for barrier effect whereby the total attenuation during downwind conditions with a barrier present is predicted to be less than that without a barrier.

A high degree of turbulence can have a devastating influence on ground effect at long ranges even under otherwise acoustically-neutral conditions, since it destroys the coherence and hence possibility of interference between direct and ground-reflected sound. Destruction of coherence between various sound paths by turbulence together with scattering into the shadow zone will influence barrier performance also. Consequently it is important to define the turbulence values implied by each of the meteorological categories. Probably because the effect of turbulence was not realised at the time that Parkin and Scholes took their data, it was not monitored by them. Neither was it deduced, in terms of the variation statistics, from the continuous monitoring of wind speed fluctuations during the validating measurements for the CONCAWE scheme.

Concluding Remarks

The BS5228 method for predicting noise from construction and demolition operations is being revised. Moreover it is possible that a British Standard alternative to IS09613-2 might be formulated some day. In either case the CONCAWE scheme represents important background. Its provisons for differing meteorological conditions and for interactions between barrier, ground and meteorological effects represent more sophisticated treatments than those in IS09613-2. The CONCAWE report acknowledges that, for its intended use by the petrochemical industry, improvements could follow from better allowance for the variation in ground effect with source height, consideration of partial barrier effects and a more definitive allowance for in-plant screening. Additional directions for improvement with regard to specification of meteorological and ground conditions have been pointed out here. As a final note, it might not be necessary to rely on such empirical schemes for much longer. The theory for propagation of sound over an impedance plane in the presence of atmospheric absorption, turbulence and refraction has developed considerably in recent years and should provide a useful alternative to relationships derived empirically.

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Professor Keith Attenborough is in the Faculty of Technology, The Open University

ACOUSTICAL RENOVATION OF THE ORPHEUM, VANCOUVER, CANADA

John O'Keefe MIOA

Vancouver's much loved Orpheum Theatre is the home of the Vancouver Symphony. It was saved from the wrecker's ball in the 1970s, brought up to date and given a permanent orchestra shell. It remained however more of a vaudeville house than a concert hall – at least in terms of acoustics. A long term renovation project has been initiated by the Vancouver Civic Theatres to address these problems and others like it in The Orpheum, Queen Elizabeth and Playhouse Theatres. Financing for the project is generated through parking and seat surcharges, thus allowing the upgrade of these civic buildings without burden to the taxpayer.

The most serious problem at The Orpheum, and the most difficult to solve, was the *image shift* heard on the balcony. In the most expensive seats in the house, singers or soloists appeared to be perched somewhere above the ceiling. Corollaries of this effect meant that it was very difficult for conductors to achieve a reliable balance between the different sections of the orchestra. Computer modelling confirmed that reflections coming from concave parts of the ceiling were in fact directed to seating areas where the problem could be heard.

Analysis of in-situ measurements indicated that focused ceiling reflections were 10 dB higher than the direct sound at 1 kHz and some 20 dB higher at lower frequencies associated with wave effects known as *seat dip*. Neither focusing or seat dip are easily handled with existing computer modelling algorithms. In scale modelling the behaviour of sound scales up or down perfectly. Wave effects, focusing and the chaotic nature of reverberant sound are all present in the model. As such, small scale modelling was the best possible tool for the renovation design.

Using binaural impulse response functions measured in the hall, our colleagues at the National Research Council of Canada found that the ceiling reflections had to be 0 dB or less with respect to the direct sound in order to prevent an audible image shift.

A 1:48 model was used to confirm the existence of the problem, then to fine tune the solutions. Convex reflectors were hung underneath the offending areas of the model ceiling. The first proposal for the convex reflector did reduce the focused reflection but it was still 7 dB higher than the direct sound. With the assistance of Vancouver architects Thom Weeks and Jennifer Stanley, a series of tests then ensued using cardboard drawing tubes, drain pipes and a heat sensitive plastic that was malleable when hot and quickly hardened to shape when cool. It was found that an arc radius of 15' was required to reduce the reflection to the required 0 dB. The reflectors were fabricated of 1" plaster and were installed over the summer of 1995.

Impulse response measurements performed in the auditorium before and after the renovation are shown in Figures 1 and 2, below. The impulse response function contains within it all the necessary information to describe the acoustics of the space. Under ideal conditions the impulse response of a concert hall should look like a Christmas tree turned on its side. In Figure 1 the focused reflection that led to the image shift dominates at 50 ms. After the renovation, a measurement at the same location shows the complete eradication of the 50 ms focus and an ideal 'Christmas tree' shape.

Other work carried out at the time included the removal of plastic

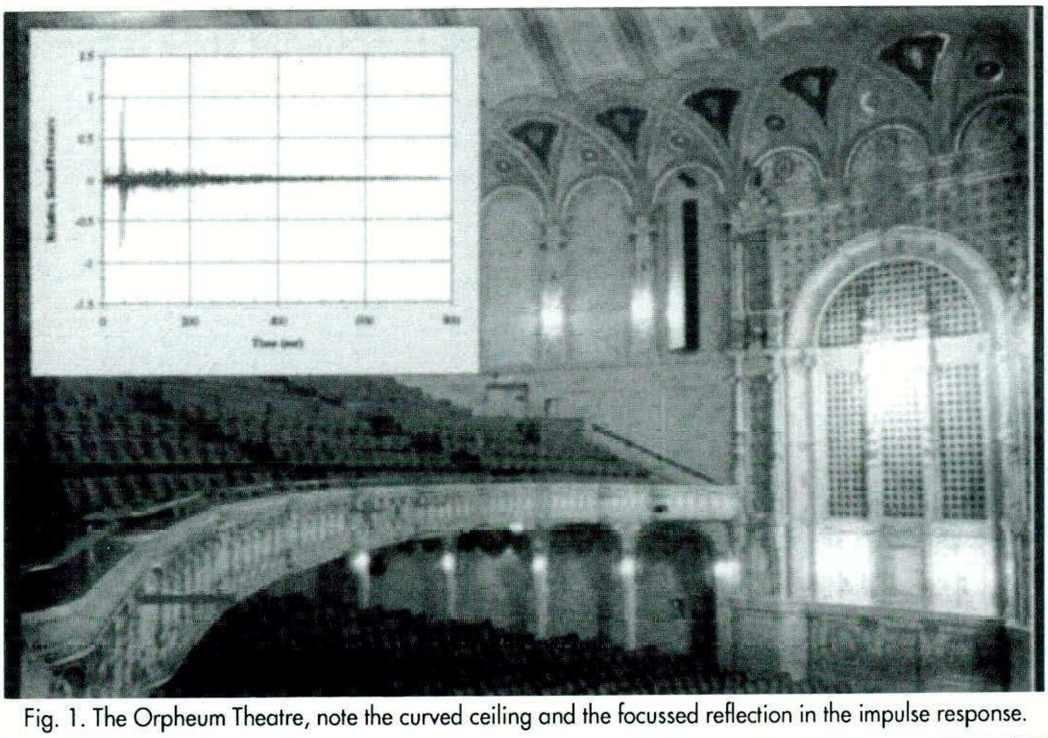

Fig. 1. The Orpheum Theatre, note the curved ceiling and the focussed reflection in the impulse response.

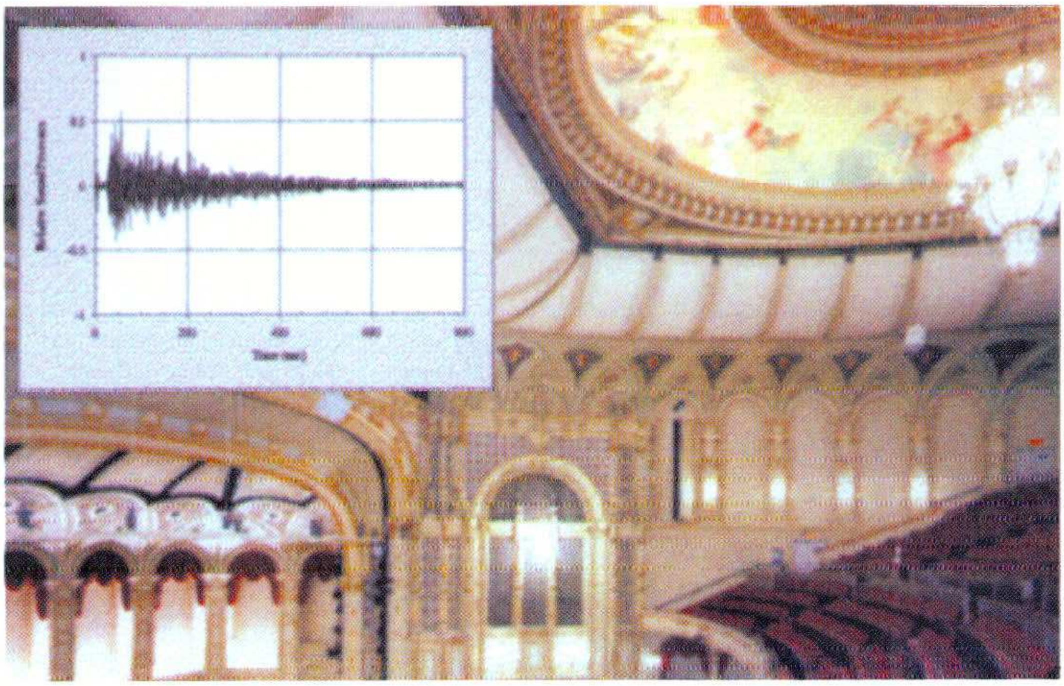

Fig. 2 After the renovations, the impulse response demonstrates the ideal 'Christmas Tree' configuration.

reflectors above the stage, a process assisted by measurements and binaural listening tests. Approximately half of the reflectors were removed during the renovation without issue or complaint.

Acoustics in the seats underneath the long balcony overhang were significantly improved by making a subtle adjustment to an existing but disused electro-acoustic system. By moving the microphones of the system from their spot in front the stage to a new location above the balcony, significant amplification before feedback has been achieved. The result is a louder sound underneath the balcony that is more reverberant and spacious where, prior to the modifications, the system used to howl with feedback.

The renovated acoustics of The Orpheum have been well received by music makers and concert goers alike. The image shift on the balcony has been eradicated and the listeners underneath the balcony now experience some of the best acoustics in the house.

John O'Keefe MIOA is at Aercoustics Engineering Ltd, Toronto, Canada

L'ACUSTICA COME BENE CULTURALE

Turin, October 1996

This international conference entitled, 'The Cultural Heritage of Acoustics, Acoustic Design of Opera Houses: Protection and Research', was organised by the city of Torino (Turin) to coincide with the completion of the acoustic realignment of the Teatro Regio, Torino.

Derek Sugden and Rob Harris of Arup Acoustics were invited to give papers and other speakers included most of the leading consultants from Europe and the US. Some key points from the presentations are reported below. It may be of assistance to readers if some of the terms used in this report are explained.

C_{80}: Clarity Index, an objective measure relating to musical clarity.

IACC: Inter-aural cross correlation.

LEF: Lateral Energy Fraction is a measure of the amount of early lateral sound which is desirable for spatial impression.

G: The strength index, an indicator of loudness.

NR 15: NR stands for Noise Rating value and a limit of NR 15 indicates that the octave band background noise data should not be greater in any band than a certain predetermined graph.

Occupied RT: The occupied Reverberation Time is the value relevant to 'audience present' conditions.

STI (Speech Transmission Index): This is a widely encountered index that expresses the modulation depth reaching a listener using synthetic source signals designed to simulate the acoustic content of speech. STI can vary between 0 and 1 and is degraded by noise and excessive reverberation; a value that exceeds 0.5 would probably indicate good conditions for comprehending speech.

The first paper, by speakers from the University of Ferrara, described the computer reconstruction and auralisation of a long-gone historic opera theatre. These techniques offer the possibility of rediscovering acoustic environments and knowledge from the past. The need for a wider range of anechoic music for auralisations was noted.

Professor Barbieri of the Università de Lecce discussed the acoustics of opera theatres in Italy between 1630 and 1830. This included the use of elliptical forms with the performer at one focus and the prince (would this be the sponsors today?) at the other focus. The historical documents show the use of acoustical ray tracing as far back as 1719.

The conflict between visual sightlines (and views of the audience) and useful reflections, with regard to the ratio between box openings and balcony fronts was noted. As early as 1676 Motta describes a splayed proscenium to improve sound projection. Little is new! In Bologna in 1710 it was decided not to install box dividers in order to improve sound distribution.

Michael Forsyth (the author of 'Buildings for Music', who also is a lecturer at the University of Bristol and a violinist) summarised the geometric development of the European opera house. The acoustic (ie reflecting) advantage of the extended forestage, particularly for gallery listeners – now largely lost – was discussed.

Roberta Bortolozzi (University of Venice) talked about Ricotti's 18th century treatise on (opera) theatre design, including an observation that, in a theatre in Lombardy, sound quality was lost when the doors at the rear of boxes were opened up to allow easy access for ladies with large headdresses.

Maria Iola Biggi (also from the Venice University) talked about the recently designed Teatro La Fenice in that city. The original 1790 brief listed many requirements but did not mention acoustics. Snell's law was applied in the analysis of the possible forms for the theatre. Smooth marble pilasters were proposed by one architect in lieu of proscenium boxes to improve the sound, but this was not endorsed by the selection committee. Another (unsuccessful) entrant wisely suggested the avoidance of all tapestries and fabrics. Several designs were rejected on the grounds of cost (again, little changes!). The winning architect noted that good sightlines imply also good 'soundlines'.

Professor Leschiutta of the Turin Polytechnic described the second half of the 18th century as the golden age of Italian opera theatres, with around 1500 theatres (most subsequently destroyed by fire, a few by structural collapse). Most were between 4,000 m^3 – 6,500 m^3 volume and 40 m^2 – 45 m^2 for the orchestra. In the original Teatro Regio, Turin, the number of string players increased from 16 in 1740 to 57 in 1790! The overall orchestra in 1790 numbered 75 and this had to be fitted into the small area available.

Domenico Stanzial discussed loudness and suggested that it may correlate with the average energy density of sound power at the listener.

The conductor, John Mauceri, gave an interesting talk on the relationship between the auditorium and the orchestra. Musical variants – tempo, dynamic, pitch and articulation – are all affected by the room. In a reverberant hall the conductor will adjust to play at an overall slower rate, though without loss of the range of tempi. Conductors need to make adjustments to achieve the psychoacoustic result congruent with the intentions of the composer. It appears that the Teatro Regio, prior to the recent acoustic reconstruction, posed serious difficulties for the conductor and performers in terms of orchestral/vocal balance.

Christopher Blair of ARTEC discussed opera house acoustics from a performer's perspective. He used the 'two audio stream' model (early sound for articulation, later sound for 'room response' or 'room support'). Three points emerged:

- Some portion of the reflected energy will be inaudible to performers because of masking
- Reflections between 160 ms and 330 ms result in room response
- Small changes (eg 1 dB) on room support level can be important subjectively.

Paris Opera (Garnier) and Teatro Colon both claimed to provide good support, despite a big difference in RT (1.1 s and 1.7 s). Common features were:

- Effective modulation of walls to sides of pit (ensemble/articulation too early for 'room' response)
- Well-modulated and high (1m) balcony fronts
- Shallow balconies: some return from rear walls
- Reflections from curvature of dome at rear (but well outside zone of focus)
- Reflecting surface above pit (but these are high, and hence not 'early': 100 ms and 140 ms but relate to 'running reverberance' period).

He has concluded (following geometric comparison with the old New York Met) that tier fronts alone may not provide enough 'room support'. There is currently insufficient data for early/late support ratios which are optimal for performers.

At Singapore there is an experimental inclined lower front pit wall, to improve reflections to/from stage and reduce early energy in the pit, possibly improving room response. Christopher Blair suggested that perhaps acousticians have recently concentrated too much on *early* energy return for performers, ie ensemble reflections, at the expense of room support.

Professor Sacerdote from Turin reminded the audience that Ando has shown that IACC is a function not only of the room but of the music.

Mike Barron, University of Bath, emphasised the importance of the proscenium zone geometry to provide early reflections of the singers' voices and (with adequate diffusion) support from the pit sound back to the musicians. (Perhaps also pit to stage and vice versa?)

Daniel Commins asserted: 'Do not do what the brief says, do what the brief means'. In the refurbished Paris Garnier, where new draperies have been installed, the sound is now very poor in the boxes, excepting the front row.

In his paper, Helmut Muller remarked that the major classical Italianate opera houses have overall dimensions around 30 m wide, 30 m long and 20 m high. He proposed that pit overhangs should not exceed 2 m.

Discussing multi-channel reverberation systems, Stefan de Koning stated that the design loop gain is around –20 dB in a $^1/_3$ octave band.

Allessandro Traldi described how a 'self-climbing' orchestral shell and a LARES electronic enhancement system have been used to enable an existing conference hall in Bologna to host serious music.

Karlheinz Müller described the acoustic of the unique Bayreuth Festspielhaus. The pit area is 150 m^2 –

adequate for 100 to 130 musicians. The high audience rake angle results in high vocal strength, ie G, values and excellent vocal clarity. A recent renovation has improved the reflective properties of the proscenium sides. Replay of dummy head recordings showed the singers to sometimes be totally inaudible at the rear of the pit! (but with a fine balance within the auditorium). Even with a large orchestra the orchestral G is 5 – 15 dB less than the vocal strength (and typical pit sound C_{80} of – 7.5 dB).

Jean-Paul Vian described the Opéra de la Bastille, with 50 dB(A) sound insulation to foyers, 60 dB(A) external and 80 dB(A) to other areas. Services noise less than NR 15, occupied RT target 1.6 s, G –31 dB(A) (± 3 dB(A)). Speech intelligibility STI > 0.5. Furthest seat is 48 m from the stage, but satisfactory acoustically. Width average 33 m, 7.7 m^3/seat (2700 seats). Seat rows average 840 mm, seat absorption 0.4 – 0.5 metric Sabines/seat (unoccupied). Final RT was 1.5 s (~1.8 s @ 125 Hz), C_{80} ~ 3 dB.

The acoustic problems (semi-circular) of the Amsterdam Opera House (1689 seats, volume 10,000 m^3, height 15 – 17 m) was appraised by Renz van Luxemburg. The wide stage opening (21 m x 10 m high) is too wide acoustically. The orchestra pit has a very large maximum area of 180 m^2, of which only 75 m^2 is open. Measured RT is 1.45 s rising to 1.9 s at 125 Hz, but the acoustic response of the hall is considered weak. Clarity is low (~1.2 dB) as is the LEF (0.06 to 0.2). The services noise level is high, NR 27, contributing to the perceived weakness of the orchestral sound.

The Teatro Carlo Fenice in Genoa (2000 seats) has a volume/seat of 8.3 m^3. The hall is wide, but with good direct sound and a relatively low ceiling. The proscenium header is acoustically absorptive, to control possible late reflections from the rear. Areas of the stone walls are slotted to act as Helmholtz resonators. The surface mass of the auditorium ceiling is 20 kg/m^2.

The Athens concert hall (also used for opera) is wide (42 m) and low (16 m), but with side walls below side tiers to reduce the width across the stalls to 23 m. The volume is 19,100 m^3 (8.5 m^3/seat). Services noise is limited to 22 dB(A). The RT is 1.9 s, occupied, with no bass increase. For opera, the occupied RT is reduced to 1.4 s, but much of the side seating must be unsaleable in this mode. Also there is no sidestage nor backstage.

Gerhard Müller described the measures carried out to improve the acoustics within the Teatro Regio, Torino. Absorption was removed and replaced with sound diffusing elements, increasing G by around 3 dB average, reducing C_{80} (but still within the satisfactory range) and increasing unoccupied mid-frequency RT by around 0.5 s. A new removable proscenium zone has been inserted to improve reflection patterns, (but perhaps visually puts the stage a long way from the audience, and loses side seats because of sightlines).

Rob Harris FIOA

CALL FOR PAPERS

1997 Auditorium Conference

AUDITORIUM DESIGN AT THE MILLENIUM

(Organised by the Building Acoustics Group)

Belfast, Northern Ireland

22–24 May 1997

There is a lot of activity in Britain on the auditorium front at present, mainly due to the new National Lottery.

Two major concert halls have, however, been built independent of the Lottery: the Bridgewater Hall, Manchester and the Waterfront Hall, Belfast. This meeting will be linked to the Waterfront Hall which opens in January 1997. Delegates will have an opportunity to attend a public concert in the hall on Thursday 22 May. Papers will be given on the new Bridgewater Hall which opened in September 1996.

As well as considering these two completed halls, the meeting will also act as a forum for presentations and discussion of the many new-build and refurbishment projects currently under way.

Offers of contributions are invited on acoustic aspects of auditorium acoustics, including concert hall, opera, drama theatre and multi-purpose hall acoustics. These should be sent in the form of a brief abstract to one of the Programme Organisers before 31 January 1997. Notification of acceptance will be sent by 15 February 1997.

Papers presented at the conference will be printed in Volume 19 of the Proceedings of the Institute of Acoustics (1997) which be available to delegates on arrival and for which camera-ready paper will be supplied. Completed manuscripts are required no later than 5 April 1997.

Conference Organisers:

Dr Mike Barron MIOA
University of Bath
School of Architecture &
Civil Engineering
Bath
BA2 7AY
Tel: +44 (0) 1225 826715
Fax: +44 (0) 1225 826691
e-mail: m.barron@bath.ac.uk

Dr Raf Orlowski FIOA
Arup Acoustics
St Giles Hall
Pound Hill
Cambridge
CB3 0AE
Tel: +44 (0) 1223 355033
Fax: +44 (0) 1223 361 258
e-mail: raf.orlowski@arup.com

SECOND ANNOUNCEMENT

One-Day Meeting

The Noise Act 1996

(Organised by the Environmental Noise Group and the Measurement and Instrumentation Group)

The Commonwealth Institute, Kensington, London

12 February 1997

The Noise Act 1996 introduces a new night noise offence and a new procedure for the confiscation of noise-making equipment. The Act aims to complement the way in which problems of neighbour noise are tackled in England, Wales and Northern Ireland. Clarified powers of confiscation of noise-making equipment for statutory nuisance offences have already been brought into force, and the new night noise offence will be available for local authorities to adopt, at their discretion, in April 1997.

The noise complained of must be measured using an approved device in a specified manner. In contrast to statutory nuisance, the night noise offence is based on the exceedance of an objective standard, the 'permitted level'. The permitted level is established by reference to the 'underlying level of noise'.

Presentations from organisations including the Department of the Environment, the Building Research Establishment (who were asked to develop the measurement protocol), and local authorities are intended to address topics such as:

The background to the Act

Formulation of the measurement protocol

Measurement of the 'permitted level' and 'underlying level'

Views for and against the adoption of the new night noise offence

The afternoon will feature workshop sessions that will examine the measuring techniques required by the Act. The sessions will be led by representatives of instrument manufacturers:

Brüel & Kjær (UK) Ltd, CEL Instruments Ltd, Gracey & Associates (Norsonic)

There will also be ample opportunity for discussion of all the issues raised during the meeting.

Meeting organisers:
Richard Tyler, CEL Instruments Ltd (IOA Measurement & Instrumentation Group)
Colin Grimwood, Building Research Establishment (IOA Environmental Noise Group)
Certificates of attendance for CPD purposes will be available to delegates.

Numbers will be limited. Early application is advised.

Please register me as a delegate to the one-day meeting on the Noise Act 96 on 12 February 1997

Name:

Address:

Tel: Fax:

☐ I enclose a cheque for the delegate fee ☐ Invoice me

☐ Members £80.00 + £14.00 VAT = £94.00 ☐ Others £110.00 + £19.25 VAT = £129.25

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EDUCATION

Certificate of Competence in Workplace Noise Assessment

The following were successful in the October 1996 examination

Amber
Huckerby, A J
McLelland, B A

Bristol
Brenton, J V
Christie, S R
Fawcett, E
Serle, M E
Spokes, S J

Colchester
Catton, N
Dixon, D W
Eames, C N
Finch, L
Harris, R
Kyte, J P
Monk, C J
Rollings, C H
Smyth, B W
Tyler, A J
Wellaway, H

EEF
Gregory, M C
James, C
Martlew, M
Nixon, M

Glasgow
Barbour, D
Hamilton, W S
Murray, A
Nicolson, A D
Woolcott, S L

Leeds
Cox, T J
Eccleston, S
Pritchard, G
Robinson, G
Russon, D S
Stephenson, R J

Liverpool
Carpenter, F A
Critchley, I C
Green, D M
Hughes, D F
King, V J
Phelan, J
Schoelzel, H M
Silva, E B
Waring, N A

Loughborough
Abbott, J
Balmer, S
Barugh, G
Beecroft, I D
Brown, M
Davis, P J
Hobson, E
Lancaster, D A
Main, A B
Tyrrell, M
Westley, A C
Weiss, S W

NESCOT
Allan, G M
Brooks, C J
Hardcastle, L T
Wakeham, K J

Staffs
Beakes, S J
Stringer, R P
Warburton, K J

Ulster
Searson, K V

Certificate of Competence in Environmental Noise Measurement

The following were successful in the November 1996 examination

Bristol
Austin, C H
Calderwood, R
May, J E
McMahon, A
Williams, H L

Colchester
Atkins, S E
Bint, D A
Dargan, J
Grayson, H E
Green, I M
Joseph, C
Sadler, D E

Derby
Carpenter, G R
Daley, A
Green, A
Green, B
Hamer, E
Morgan, B C
Ward, D

Liverpool
Blair, J
Bull, T
Carpenter, F A
Doig, I R
Elliott, C S
Greenup, P M
O'Mahony, T G
Scott, D L
Smail, L R
Smyth, B S

NESCOT
Baker, L J
Carne, M
Eastwood, P M
Feus, M D
Francis, A C
Habgood, R T
Kansara, A T
Mayne, S J
Nicholas, P J
Rowland, C L

Strathclyde
Baird, S M
Duffy, L
Fraser, R J
Kerr, S
McGahan, J

Ulster
Curran, A
De Paor, N
Duggan, C M
Gilboy, P J
Gleeson, C T
Hanna, J
Kellegher A
Kelly, R
McCann, M M
McClenaghan, W P
McSweeney, G J
McSwiggan, P
McWeeney, J
Mullarkey, D
O'Scanaill, T
Rainey, D
Richardson, P E C
Savage, M
Scullion, A P
Searson, K

MEMBERSHIP

The following were elected to the grades shown at the Council meeting on 5 December 1996

Fellow
Hemsworth, B
Wright, J R

Member
Bennett, A J
Din, M A
Ho, W L
Hubbard, P F
Lee, Y H B
Leung, H Y
Martin, P J
Newell, P R
Rostrup, F
Slaughter, P A
Smeatham, D

Associate Member
Aazem, J
Allen, L
Barber, J
Bentley, C F
Birkett, G P
Bland, J D
Blundell, L C
Boughton, P W
Callingham, A J
Carlin, S
Carpenter, T C
Carter, D J
Cassidy, P R
Collins, R
Dawson, G M
Dodd, A P
Dunne, S
Elliott, A C
Fosker, J A
Gascoigne, C M
Gibson, A R
Gray, I T
Gunn, G
Henderson, A M
Holmes, J
Hutt, R
Ingram, Z
Jefferson, K M
Jones, K L
Long, A
Longhurst, M J
Lord, R M
Maidment, R J
Marshall, P A
Mason, P R
McEvoy, R P
Moore, S J
Mumford, A E
Newman, J
Nugent, C
Oakley, S
Pennington, A
Peters, H M
Powell, A
Pulford, R J
Randles, T J
Sabberton, J R
Schofield, J
Scott, N
Sharp, P J
Simpson, P C
Simpson, T R
Tate, R M
Thiara, J
Thomas, S J
Thresh, Y
Walker, J F
Watts, G W
Wheeler, H C
White, A
Wildfire, C E

Associate
Austin, N C
Bond, G D
Buckland, L A
Calvert, R L
Collie, J
Findlay, R R
Flatt, S J
Froud, M E
Furssedonn, P
Harris, H J
Kelly, F J
Luck, A J
Mann, J K
McCormick, L E
Middleton, S A
Read, A L
Stone, L C
Taylor, P
While, P J
Wilkinson, A

INSTITUTE DIARY 1997

6 FEB
IOA Publications, Meetings Committee
St Albans

7 FEB
IOA CofC in W'place Noise Exam
Accredited Centres

12 FEB
One-day meeting - The Noise Act 1996
London

13 FEB
IOA Membership, Education Committee
St Albans

27 FEB
IOA Medals & Awards, Council
St Albans

1/2 MAR
Acoustics for Sound System Engineers: Course
St Albans

7 MAR
IOA CofC in W'place Noise Ass't Advisory Committee
St Albans

18 MAR
Noise Impact Assessment Working Party
St Albans

24 APR
IOA Publications, Meetings Committee
St Albans

1 MAY
IOA Membership, Education Committee
St Albans

15 MAY
IOA Medals & Awards, Council
St Albans

16 MAY
IOA CofC in W'place Noise Exam
Accredited Centres

22-24 MAY
Conference: Auditorium Design at the Millenium
Belfast

6 JUN
IOA CofC in Env Noise M'ment exam
Accredited Centres

13 JUN
IOA CofC in W'place Noise Ass't Advisory Committee
St Albans

19/20 JUN
IOA Diploma Exams
Accredited Centres

8 JUL
IOA CofC in Environmental Noise M'ment Advisory Committee
St Albans

19/22 AUG
ISMA '97 International Symposium on Musical Acoustics
Edinburgh

Institute of Acoustics, 5 Holywell Hill, St Albans, Herts AL1 1EU
Tel 01727 848195 Fax 01727 850553 email Acoustics@clus1.ulcc.ac.uk Registered Charity No 267026

REPRODUCED SOUND 12

Windermere, 25 – 27 October 1996

After twelve years of a successful series of conferences on a common theme, it becomes difficult to avoid repeating the well worn phrases when describing the scene and the atmosphere. But it was a success; the weather was kind; the delegates were enthusiastic, multi-talented and thoroughly enjoyed themselves; the lake steamer trip and fell walk did give the usual pleasure and complemented the technical fare. Confirmation of this came from Ken Dibble, Technical Programme Organiser, who wrote the following: 'I have to say that I personally considered this to have been one of the best RS conferences for some time. Thanks to sterling work by the organising committee – and particularly by Julian Wright (of Celestion International), Peter Mapp (consultant), Paul Darlington (Salford University), Mark Bailey (Harman UK) and Allen Mornington West (consultant) – this year's theme – transducers – seems to have hit the right industry pressure points.

The conference attracted a landmark programme with contributions from internationally acknowledged experts from the UK, Denmark, Germany, Holland, the universities of Salford, York and Bradford, and many leading international manufacturers and research establishments. One departure from normal IOA policy this year was to allow a 30-minute time slot for each paper in response to many comments that 20 minutes is insufficient to get the point across without rushing the presentations.

Moves are already afoot to start work on RS13 – although the superstitious amongst us seem to think the 1997 conference should be titled RS12A! The Reproduced Sound conferences must by now be the longest running of any IOA single theme programme and it begins to look as if the year 2000 may see RS16 – any ideas?

The papers delivered during the main technical sessions can best be described by the session chairmen whose reports are given below.

The first session on loudspeakers was chaired by Julian Wright of Celestion International; he writes:– 'The conference opened with the first Keynote Paper given by Graham Bank, Research Director at Celestion International Ltd who discussed the effect of material variations on loudspeaker performance. Graham reviewed methods of studying the mechanical behaviour of loudspeaker diaphragms and showed some finite element analyses of variation of surround and cone material properties.

Joachim Schwender of AP&T in Germany demonstrated the benefits of ferrofluids in loudspeaker magnet systems, showing improvements in thermal performance and control of damping and voice coil centering.

Joerg Panzer of Panzer and Partner discussed the technical aspects of modelling compression drivers with the AkAbak program running under Microsoft Windows, showing the ability of the software to represent acoustical elements and to investigate the sensitivity of a system to parameter changes.

Peter Barnett of AMS Acoustics demonstrated with a balance of maths and humour that sound system performance is independent of loudspeaker performance under certain conditions. A lively debate ensued!

Patrick Macey of PAFEC Ltd, showed how acoustic finite element analysis can be used to model a loudspeaker in a cabinet, predicting both mechanical modal behaviour and acoustic radiation in the near or far field.

The session closed with an interesting look into the future by Paul Darlington of Salford University, who revealed a method of actively controlling bass reflex systems – perhaps to optimise their response dynamically according to the characteristics of the programme material.'

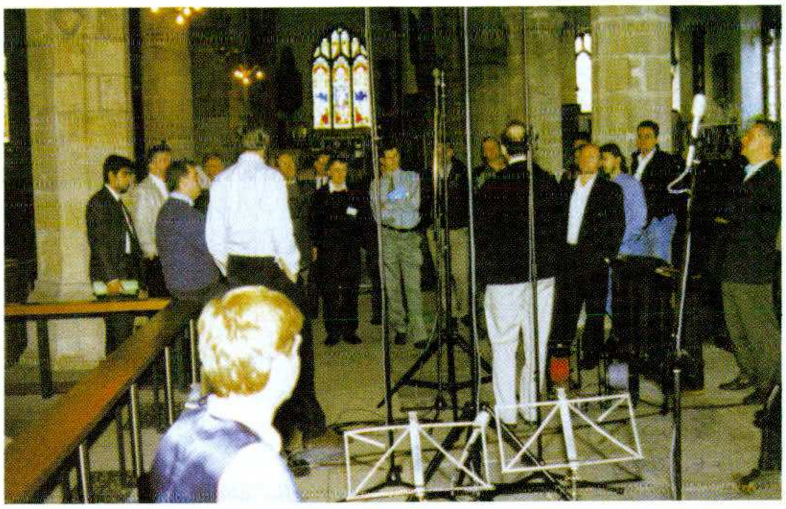
Peter Mapp organised and chaired the session on measurement: Paul Darlington elucidated the mysteries of the transfer function and the nuances of windowing functions to an attentive audience in an interesting and often humerous way.

Jeff Rocha from B&W presented a most interesting paper on the 'Beamwidth delimited Power Response' and opened up a debate that will continue for some time regarding the limitations of traditional loudspeaker measurements.

Bruce Howze of Community Professional Loudspeakers, USA, provided a fascinating insight into how his company has tackled the problem of accurately measuring the low frequency performance and the overall response of their products at an acoustically sensible distance. For anyone who saw the photographs of the test rig suspended 3 floors up outside the factory building on an ingenious series of pulleys and tracks, the phrase 'free field testing' will never be the same again, a view probably shared by Community's neighbours!

Sam Berkow, from JBL Professional, USA, although at Windermere for the first time, made a considerable impact on this year's event. Apart from the fact that he has managed to produce some very fine measurement software for a very economical price, the analysis capability it can provide to the specialist user is truly limited only by the user's imagination. The formal discussion benefitted not only from Sam's unique personality but also from the brief, live measurement demonstration performed at the chairman's request with only a few minutes preparation. This provided a most worthwhile appetiser for the more commercial demonstration that was to follow in the evening.

Unfortunately Felicity Seidal was not able to be present to give the Keynote Paper on the proposed AES loudspeaker measurement standard. The task was carried out by her co-author Heinrik Staffeldt from the University of Denmark. Heinrik gave a thorough review of the errors



The recording session at Kendal Parish Church

introduced by using too low a measurement resolution for loudspeaker frequency response and polar measurements. The implications for manufacturers both in terms of the complex test rigs, measurement time and data storage and handling requirements, were well illustrated.

Regretfully, Professor Wolfgang Ahnert was not able to be present to give his paper, with a contrasting view to Siedel and Staffeldt, due to his wife being involved in a serious car accident just two days before. The interest shown in the preceeding papers however, allowed the chairman some freedom to let the debate and demonstrations continue right up to the time the bar opened.

The session on microphones and the second on loudspeakers were chaired by Ken Dibble. He reported as follows:

'The morning session started with an excellent Keynote Tutorial Paper by Mark Gander, Director R&D at JBL, Northridge, California, and John Eargle of JEM Consulting, Los Angeles. The paper was presented by Mark Gander and covered the historical development and basic physics of cone and pressure driver behaviour with particular emphasis on their respective radiation mechanisms; an interesting and succinct presentation with minimal mathematical formulae on the screen!

Craig Janssen, another American visitor, from Dallas, Texas, and sponsored by EAW, gave a paper entitled 'Large room sound system design techniques for improved gain before feedback'. Craig started off by examining the precepts of maximising gain-before-feedback and then took the audience on a tour of the various concert hall, theatre and church layouts and considered the implications of central cluster and left/right stack.

Next came another Keynote Paper, this time by Bruce Howze, President, Community Sound Inc of Chester, Philadelphia, entitled 'Design and development of two new high performance compression drivers'. Bruce took us through the development of the new Community VHF-100 HF ring diaphragm HF unit and EM280 2" carbon fibre low compression midrange driver, step-by-step, showing how the minutest changes to diaphragm shape, voice coil mass, suspension shape/compliance and phasing plug geometry produced considerable changes in the measured performance. Bruce was absolutely candid on every aspect of the development process and consequently his presentation received the full attention of the packed lecture room. Anyone who has listened to Community systems will know that their empirical approach to component and system design produces some of the finest sounding professional loudspeaker products around and it would be fascinating to compare the Community approach with that of a product designed on a computer using the AKABAK Electroacoustic Network Simulator software which Joerg Panzer had presented the day before.

The final paper of the session, 'A spherical harmonic analysis of head related transfer function measurements', by Michael Evans, James Angus and Anthony Tew of the University of York, was presented by Mick Evans. The paper explained the concepts of head-related transfer function and its role in localisation judgement which arises because of the phase and spatial differences of the stimulus received at each ear for a given source. Having developed the mathematical principle of spherical harmonic analysis, the paper went on to explain a series of laboratory measurements and the spherical harmonic analysis thereof, and concluded that, subject to one or two qualifications, this provided a worthwhile means by which the directional component in hearing perception can be measured.'

Sam Berkow from JBL Professional, USA

The third Keynote Paper of the morning was presented by Peter Dobbins of BAeSEMA's Marine Division, and entitled 'Microphone and loudspeaker arrays: practical lessons from radar, sonar and astronomy'. This fascinating presentation proceeded to use array, waveguide and interference tube theory as developed for radar and sonar as an illustration of how microphones and loudspeakers behave in similar arrays, showing that under comparable wavelength vs source dimension/spacing ratios, the behaviour is the same irrespective of the particular waveband of interest. The classic line-source array, with its various side-lobe characteristics, as applied to so many public address systems in the 1950's and 1960's, along with typical rifle microphone polar patterns, clearly emerged from the radar and sonar plots presented. The array behaviour was supported by graphical results and mathematical calculations and showed that a minimum of nine array elements are necessary in critical applications.

Peter Mapp gave a lighthearted and very informative overview of the effects of voice directivity in the context of single and arrayed microphone polar response characteristics and Robin Cross (British Telecom Research Centre, Martlesham) described a 'speech absorbing microphone' currently under development for telephone handsets in which reactive termination principles are applied using the damping mechanism as the transducer. Initial tests suggest that when fully developed, a competitively priced telephone handset with enhanced speech quality and greatly improved noise cancelling properties is expected to emerge.

On Saturday afternoon whilst some were enjoying the lake trip or fell walk, the really keen types indulged in a hands-on workshop, on the practical use of microphones, in Kendal Parish Church. After an initial talk on microphone placing and other practical problems given by Dave Fisher (University of Surrey) the party departed for Kendal. The workshop was organised by Allen Mornington-West (consultant) and his report on the proceedings follows.

'The opportunity to compare the effect of using different microphone techniques on the same recorded piece of music does not happen often. The question is just how much does the microphone placement – not to mention the precise make and model of microphone – affect the final sound of the recording. Indeed is there even a truly right and a wrong method or is there simply a chain of preferences? Engineers who make recordings have the benefit of hard won experience to guide them but, as purchasers of recorded music perhaps, we might better appreciate the effect of a particular microphone strategy if we could carry out some experimental work ourselves.

Led by Ken Blair and Dave Fisher of Surrey University's Performing Arts Department, 22 delegates elected to spend the Saturday afternoon in Kendal church taking part in a workshop and demonstration of microphone use for recording. Ken had arranged for a string duo from the London Sinfonietta to play before an array of microphones. Delegates were able to move about the musicians and place their ears where microphones might be placed. The results could be checked in the control room – in fact the crypt kitchen! Having decided suitable microphone positions the effect of the conventional combinations could be checked out in the same way.

After a considerable amount of experimentation by all present some ten minutes of music – the Kodaly duet for violin and cello and the Beethoven viola and cello duet, popularly known as 'through the opera glass', were recorded. Whilst the delegates returned to the hotel the recording equipment was packed up and re-installed in the hotel in order to provide for a short didactic entertainment after the conference dinner. Dave introduced the efforts of the afternoon and demonstrated some of the combinations.'

After this Guy Hawley ran a workshop on Acoustics on the Internet which was vastly entertaining to suit the after dinner mood and extremely instructive, especially to those there who felt they would very soon have to come to grips with this aspect of developing technology.

The reception on Saturday evening was hosted by the Department of Acoustics and Audio Engineering, University of Salford. During the reception, Dr David Saunders explained that the Department (formerly the Department of Applied Acoustics) had made a number of significant strategic investments allowing it to broaden its activities in Audio Engineering. Dr Paul Darlington described the range of courses offered at Salford, including the new part-time Post Graduate Certificate in Reproduced Sound, and reminded the conference delegates of the breadth of Salford's research activities in Audio Engineering.'

The final session of the weekend was the third on loudspeakers and was chaired by Paul Darlington of Salford University. He sent in the following report.

'The Sunday morning session on loudspeakers opened with a paper on loudspeaker requirements for pipeless organs, by Dr Lucy Comerford and P J Comerford of University of Bradford. Lucy presented the paper in which she made a request for help and advice from conference delegates. She also raised some interesting questions concerning room interaction with organ pipes, linking into a theme addressed by other presenters later in the session. Julian Wright then described different approaches to modelling sound in enclosed spaces, illustrating the problems of image source techniques with an entertaining parallel from astronomy. Dr James Angus's paper had the provocative title 'The reflection full zone' and explained how diffusing structures could be used to re-distribute the energy of early reflections with resulting improvements in perceived sound quality.

Bob Walker of the BBC presented a paper drawing on his considerable experience in low frequency sound in small rooms. He explained the modal approach to modelling the enclosed soundfield, making a valuable contrast with the boundary element approach described by Julian Wright. Dr Tony Ward's paper completed the morning's survey of low frequency modelling techniques as it focussed on the image source technique. Tony's presentation described an elegant re-formulation of the image source problem, making the complexities of the higher order images understandable even to Paddington Bear! The final paper was a Keynote Paper by Jan Abildgard Pederson, of Bang & Olufssen A/S. Jan presented the results of simulations and experiments designed to illustrate the position dependence of soundfields in small rooms. He showed that the spacial variation is greatest around the nodal planes of standing waves and made some interesting observations on room equalisation.

John W Tyler FIOA

How Sound Are Your Measurements?

Strathclyde University, 9 October 1996

This one day meeting, organised by the Measurement and Instrumentation Group, attracted 24 delegates and followed the pattern of the 'Roughly how loud is that?' meeting (held in London in February 1996) by including workshop sessions as well as formal presentations.

The meeting opened with a presentation by Bob Peters (NESCOT) on the Measurement Module of the Institute's Diploma in Acoustics and Noise Control and the general validity of measurements made in the field. The Measurement Module covers the use of suitable instrumentation for reliable and accurate measurements, and the choices to be made in practical measurement situations, where the measurement accuracy may well be determined by the selected measurement method and equipment.

Ian Campbell (Gracey & Associates) introduced a new design of electroacoustical sound calibrator, suitable for use in laboratory and field conditions. The calibrator employs active compensation for changes in environmental conditions and for the different loading volumes of different microphones. Peter Hanes (National Physical Laboratory) then described the tests required for ensuring that a sound calibrator complies with the specification standard BS 7189:1989, and the NPL facilities for performing both these compliance tests and full evaluations of new instrument models.

Bill McTaggart (Brüel & Kjær) compared the recent advances in sound level meter technology with the influence of the measurement method, instrument position and environmental conditions to show that care must still be taken in order to achieve 'precision' results. The emergence and advantages of computer-based, distributed instruments were discussed by John Shelton (AcSoft). Such instruments are subject to the same performance tests as dedicated units, requiring a flexible specification of the computing platform for the instrument. The formal presentations were concluded by Richard Tyler (CEL Instruments), who described the current situation regarding electromagnetic compatibility and CE marking of acoustical instruments and the implications for both manufacturers and users.

After lunch, two workshop sessions were held that allowed the delegates to try out measurement techniques using their own instruments. Richard Tyler and Glynne Parry of CEL Instruments oversaw an exercise on sound calibrators, illustrating some common faults and the correct procedure for use of these devices. In the second workshop, John Shelton and Ian Campbell guided delegates through the measurements used to determine the performance of a sound level meter, pointing out the information revealed by each test about the instrument's condition. The meeting concluded with an open discussion of points raised in the presentation and other issues.

Peter Hanes MIOA ❖

AN AGENDA FOR ACTION

Mike Heath, Director General, the Engineering Council

These are exciting times for the engineering profession. The Year of Engineering Success (YES) is revving up towards the official launch at the beginning of next year. SET Week next year looks like being the biggest and best ever with a much enhanced engineering dimension. We can look forward to stronger links between the profession and Government, industry, academia and other bodies associated with engineers and engineering. And the General Election may bring rafts of new policy initiatives that affect us whoever wins. This year for the first time ever the Engineering Council was represented at all three political party conferences where party leaders and senior front bench spokesmen were lobbied on behalf of the interests of engineers.

Closer to home the profession's new regional structure is now gathering momentum. Despite the good work of so many individuals in the old Engineering Council Regional Organisation (ECRO) it was soon clear that the new partnership with the Institutions called for arrangements that were much more participative and jointly owned. The 15 new regional bodies that will replace the ECROs will be called Professional Engineering Institutions or PEIs as in 'North West PEI'. The Transition Project Group consisting of Institution representatives, is driving progress with the aim of setting up all the PEIs by the end of March 97. Membership will consist of Institution local branch chairmen and activity will take the form of joint ventures with fundamentally importantly, the backing of national headquarters. PEIs will need the support of engineers locally so please contemplate a personal contribution.

Thanks to the effectiveness of our partnership and the support the Council is now receiving from Institutions the series of high profile events we staged in September turned out to be a great success. Although these three events were staged under the Engineering Council's banner there were numerous examples of our colleagues throughout the profession making a valuable contribution.

First, was the Council's Annual Conference which was combined with an exciting presentation to pre-launch YES. YES has the not inconsiderable task of beginning to turn around the public's perception of the role of engineers, in short, to change the culture of the nation. I am confident that with the strength of commitment of its supporters it will be a significant force in influencing change. Engineers could not offer support to a more worthwhile cause

The joint event served to demonstrate to an influential audience the forward-looking outlook of our profession. The Conference agenda gave us the opportunity to address key issues and highlight both the challenges and the opportunities that lie ahead. Delegates from Government, industry, academia, the profession and the media were enthused by two excellent presentations by the Presidents of ICE and IMechE respectively on two of the '20/20 Vision' Joint Venture Study Groups covering transport and energy issues.

Next, the Council's Environment Award ceremony was an opportunity to recognise the skills of engineers and technicians in responding to environmental issues. Four finalists had been selected from entries that were 60% up on last year. Their project presentations showed an outstanding commitment to environmental concerns. My thanks go particularly to the sponsoring organisations whose support has enabled us to establish the Award firmly as the premier accolade of its type in the UK.

Then, with barely a weekend to catch our breath, the national final of the Young Engineers for Britain competition was upon us and held by courtesy of British Airways Engineering, in a specially fitted out hangar at Heathrow. The competition was, by common consent, the best ever; a superb feast of engineering creativity and invention from young people. Again, it is an event only possible because of the commitment of so many organisations with the vision to put real effort and resource into encouraging tomorrow's engineers.

These occasions of course are just the more visible higher profile signs of the profession making things happen and a means of presenting a public face. Our role now is to build on this profile and demonstrate to the public the contribution that engineers make to everyday life.

I wonder how many of you have access to the World Wide Web and in particular the Engineering Council home page (http:\www.engc.org.uk). Growing numbers of engineering Institutions now have their own Web pages and the Council pages offer hyperlink access to all of them. A recent innovation is the inclusion of role-model CVs to encourage young people who may have an interest in an engineering career but wonder what real engineers actually do. This project will grow into 'Career of the Week' next year and we hope it will help teachers to answer career questions. We also hope to show, with some real life examples, the enormous contribution some particular engineers have made to UK plc

This ambition brings us full circle. Not only to the broad mission of the YES campaign but to the prime purpose of the new Engineering Council, which is to enhance the standing and contribution of the engineering profession in the national interest and to the benefit of society.

It is a mission that I know has the support of the whole profession. I am pleased to report that the Government has given its recognition to our task in an official statement of support. This 'acknowledges and endorses the essential role of the Engineering Council in representing its constituent members' collective commitment to maintaining the highest standards of engineering expertise for the benefit of the community'.

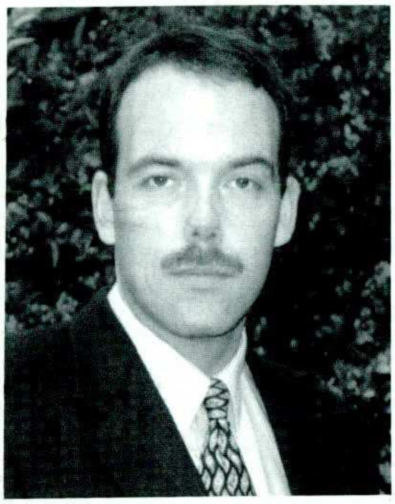
The Government has also given general agreement to a potential Memorandum of Understanding (MOU) with the Council and drafting work is in hand. We hope this MOU will add even greater authority to the voice of the engineering profession.

The tasks that have been set will be no sinecure. But I am convinced that with the goodwill and commitment we have throughout this profession we will succeed.

AWARDS

Chartered Engineers

Simon Butler graduated with a degree in mathematics from the University of Reading in 1984 and took a temporary post as a technician with Essex County Council in the same year. Six months later he joined the Environmental Assessment Team in the county highways department, where he received his basic training in acoustics and also studied for an HNC in Civil Engineering.



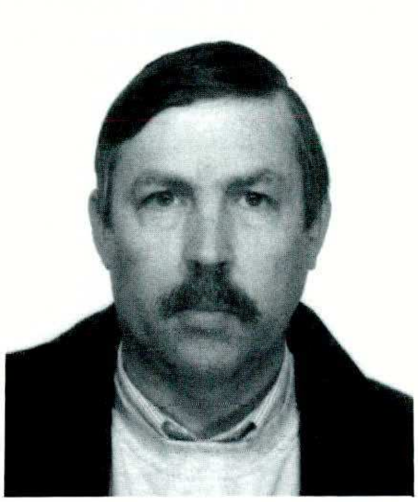
In 1990 he moved to Dorset as an Assistant Engineer in the Noise Team of the County Council's Transportation and Engineering Department, based in Bournemouth. He took over as Principal Engineer in 1992 heading a team responsible for all aspects of noise, vibration and more recently air quality, relating to the construction and use of Dorset's roads. He has represented the county as an expert noise witness at a number of public inquiries and lands tribunals. He finds one of the most satisfying aspects of the job is being involved in each scheme from its conception, through the design stages, to its construction and beyond.

Having completed the Institute's Diploma in Acoustics and Noise Control by distance learning, Simon is currently in his final year of an MSc course in Acoustics and Noise Control at NESCOT.

John Miller studied architecture at Sheffield University and obtained a BA (Hons) degree in 1975. He joined Bickerdike Allen Bramble in London that year to take up a permanent post in the acoustics group under Bill Allen and Jeff Charles. During his fifteen years with the firm, he became a member of the Institute of Acoustics in 1982 and, in 1987 gained an MSc in Environmental Acoustics following part-time study at the Polytechnic of the South Bank, London. In 1990, John left Bickerdike Allen Partners to set up his own independent practice, which was a member firm of the Association of Noise Consultants. He joined Arup Acoustics in October 1995 to take up an Acoustic Consultant post in the London office.

John served on the London Branch Committee of the Institute of Acoustics between 1988 and 1996 and was Honorary Secretary for most of that period. His work experience embraces architectural acoustics, the sound insulation of buildings and the control of noise and vibration from building services and environmental sources. He has carried out work both in the United Kingdom and abroad and has presented papers and published articles on a variety of acoustic topics.

Stephen Roberts has an HNC in Electronics, the IOA Diploma, an MSc in Environmental Acoustics and a BSc in Computing. Joining the MoD in 1975, his early career involved the assessment of communications systems in harsh acoustic environments.



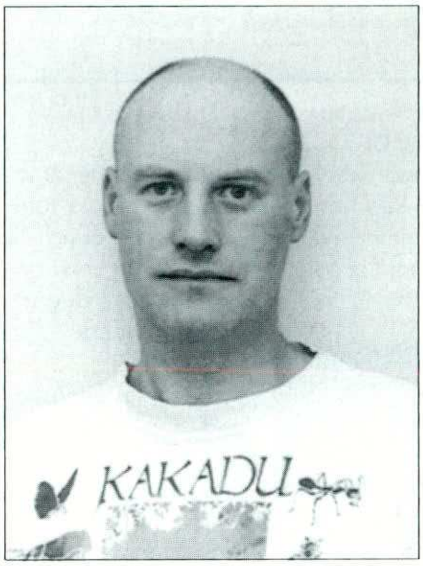
Moving on from IAM Farnborough to the RAF Institute of Community Medicine he became an expert in the assessment of the acoustic impact of military aircraft on the environment, carrying out noise assessment surveys at many RAF establishments. He implemented a noise modelling program developed for the RAF by the National Physical Laboratory, and carried out other acoustic and vibration surveys within the RAF. A move to the Royal Signals and Radar Establishment (now part of DERA) in 1986 increased his expertise in the assessment of communications systems and gave an introduction to mobile communications for the army. He became the UK delegate on a NATO working party on narrow band speech coding standards. In the last few years he has been involved in providing project support for a number of army communications projects and a project manager for various projects.

EurIng Award

Stuart Litobarski left Sloane school at 16 and started work as an apprentice telecommunication technician with the GPO in 1968. Soon realising that a career involving electronics was the way ahead he commenced City & Guilds evening classes. A series of day jobs such as underground railway guard, computer operator, hotel and record company clerks, maintenance technician in a film lab – you name it . . . supported a youthful dedication to playing the guitar in a rock band.

Eventually the new TEC certificate was obtained and a degree course in Electronic & Communication Engineering completed at what is now North London University. Stuart then went on to work for BBC TV, as a Recording Engineer, and was attached to SCPD department – designing and project managing new television studio installations. The excellent BBC training, together with an acoustic engineering module taken at BSc, allowed admittance to an MSc in Applied Acoustics at Chelsea College, University of London.

University research followed – with the Underwater Acoustics Group at University of Bath – on a seabed classification project for the Admiralty Research Establishment. Stuart then worked for a year at BAe, on digital signal processing for sonar, before emigrating to Australia in 1989. He achieved the level of Research Fellow at Curtin University, Western Australia, before leaving academia to found an acoustic consulting business – Soundwave Acoustics – specialising in studio sound.



Currently based in England, Stuart has contributed a popular series of articles on studio acoustics to The Mix and Studio Sound magazines, and is a regular reviewer of microphones. He is studying for a PhD in Engineering at Washington University by distance learning. Stuart still plays and records music – now on Fender Bass with the Bristol Jazz Workshops and in impromptu performing jazz bands.

David Watts of the Acoustical Investigation & Research Organisation Ltd was also given the title EurIng; his profile was published in the January/February 1996 issue of of Acoustics Bulletin, when he became a Chartered Engineer.

❖

Hansard

28 October 1996
Noise (Vehicle Sound Systems)
Mr Andrew Smith: To ask the Secretary of State for Transport (1) what are the operational needs of the police to enable them to combat excessive noise emitted from stereo systems in motor vehicles;
(2) what representations he has received from environmental and enforcement bodies (a) on the scale of the problem of excessive noise emitted from stereo systems in motor vehicles and (b) the most effective way for dealing with it;
(3) what existing powers and practices exist to enable environmental health officers to combat excessive noise emitted from stereo systems in motor vehicles.
Mr Bowis: Following the failure of a prosecution under regulation 97 of the Road Vehicles (Construction and Use) Regulations 1986, which relates to excessive noise from vehicles, the Metropolitan police have suggested that the regulation be amended so as specifically to include noise from car accessories, such as stereo systems or radios. This would enable the police to continue to issue fixed penalty notices to offenders.
In response, I have sought comments from bodies representing environmental, local authority, police and motoring interests to ascertain their views on the scale of the problem and the adequacy or otherwise of existing powers to deal with it. I am currently considering these comments.
Local authority environmental health officers have powers under part III of the Environmental Protection Act 1990 as amended by the Noise and Statutory Nuisance Act 1993 to deal with noise of all types from vehicles parked on premises and in the street. I understand that a number of local authorities have also recently brought successful prosecutions for noise from car stereos under the loudspeaker provisions of the Control of Pollution Act 1974.

29 October 1996
Transport
Helicopter and Aircraft Noise
Miss Hoey: To ask the Secretary of State for Transport if he will make a statement on the redress in law available to people who are disturbed by low-flying helicopters in the early hours of the morning when the helicopters were operating under permission issued by the Civil Aviation Authority for filming purposes.
Mr Bowis: Under Section 76 of the Civil Aviation Act 1982, no action may lie in respect of trespass or nuisance because of overflight, provided that the conditions referred to in section 76(1) have been duly complied with. Subsection (2) sets out the circumstances under which damages in respect of material loss or damage may be recoverable. Legislation similar to section 76 has been in force since the early days of aviation, and comparable laws exist in other countries.
Miss Hoey: To ask the Secretary of State for Transport what plans he has to make changes to section 76 of the Civil Aviation Act 1982.
Mr Bowis: None.

11 November 1996
Channel Tunnel Rail Link
Miss Hoey: To ask the Secretary of State for Transport what measures are proposed to mitigate noise levels along the rail link from Waterloo station to the channel tunnel.
Mr Watts: There is no statutory requirement for railway operators to provide noise mitigation on existing railway lines. However, a number of voluntary, jointly funded noise mitigation schemes have been agreed between Railtrack and several London boroughs and local authorities in the south-east. Under these schemes, acoustic barriers, and in some cases secondary glazing, have been installed at certain locations worst affected by noise from existing lines to the channel tunnel. The Government have encouraged and supported these schemes by allocating supplementary credit approvals to the local authorities concerned. As far as the new channel tunnel rail link is concerned noise mitigation proposals were set out in the environmental statement that accompanied the CTRL Bill on introduction. Mitigation at source, rather than relying simply on noise insulation of affected properties will be provided in connection with new works – the CTRL itself and the reinstated Gravesend west ine. These proposals will be further developed during the detailed design of the project and will be subject to approval by the local planning authorities along the route of the CTRL.

19 November 1996
Aircraft Noise (London)
Mr MacShane: To ask the Secretary of State for Transport how many aeroplanes have landed at Heathrow airport in 1996 before (a) 5.00 am, (b) 5.30 am, (c) 6.00 am, (d) 6.30 am and (e) 7.00 am.
Mr. Bowis: Records are not kept in the format requested but I am able to provide the number of arrivals between 1 January and 31 October prior to 5.00 am, between 5.01 and 6.00 am, and between 6.01 am and 7.00 am. These figures have been taken from the London (Heathrow) airport, runway utilisation logs produced by National Air Traffic Services.
Arrivals at Heathrow between midnight and 7.00 am (local time) 1 January 1996 to 31 October 1996
Midnight to 5.00 am: 1,419
5.01 to 6.00 am: 2,358
6.01 to 7.00 am: 9,025
Mrs Dunwoody: To ask the Secretary of State for Transport what assessment he has made of the effect of the proposed legal challenge by the International Air Transport Association on the implementation date for the new aircraft noise limits at Heathrow and Gatwick airports.
Mr Bowis: None.

29 November 1996
Noise Barriers
Sir John Stanley: To ask the Secretary of State for Trans-

port under what statutory provision highway authorities are empowered to fund the construction of noise barriers on existing motorways and trunk roads.
Mr Watts: Highway authorities are empowered under section 282 of the Highways Act 1980.
Sir John Stanley: To ask the Secretary of State for Transport what is the statutory provision under which his Department exercises a descretion to provide noise barriers to trunk roads built before October 1969; and if statutory provisions are subsequently amended to be disapplied to motorways and trunk roads built after October 1969.
Mr Watts: My Department occasionally and in exceptional circumstances exercises a discretion to provide noise barriers on roads built before 17 October 1969 under section 282 of the Highways Act 1980. This section, which replaced section 23 of the Land Compensation Act 1973, provides the power to carry out works within a highway to mitigate the adverse effects of its construction, existence or use.
Other sections of the Land Compensation Act 1973 provide powers to insulate residential properties against noise, and to pay financial compensation to property owners for loss of value attributable to the construction, or substantial improvement, of a road. These powers were applied retrospectively to roads built or improved after 16 October 1969.

House of Lords
Noise Act 1996 – Implementation
The Viscount of Falkland asked Her Majesty's Government:
What minimum action should be expected from local councils by way of implementation of the Noise Act 1996.
The Minister of State, Department of the Environment (Earl Ferrers): My Lords, it is up to local authorities to determine how best to implement the Noise Act in their area.
The Viscount of Falkland: My Lords, I thank the Minister for his Answer. However, is he aware that a number of local authorities have stated quite openly that they are not in a position to implement the legislation? Will he agree that that is little comfort to old people in particular who are subject to loud noise from unco-operative neighbours? Noise is in fact an environmental hazard at least as bad, if not worse, than the fumes from a bus or, indeed, other kinds of pollution. Is the noble Earl aware that the failure by local authorities to meet the requirements of the legislation could result, among other things, in serious damage to the health of elderly people?
Earl Ferrers: My Lords, I have a great deal of sympathy for the remarks made by the noble Viscount. Loud noise can be very offensive, not only to old people but also to younger people, especially if it is of the 'thump-thump' variety which can go on during the night. The noble Viscount said that local authorities were not in a position to fulfil the requirements of the Act. I believe that that is the case with practically all local authorities.
The legislation falls into two parts. The first deals with a new night offence while the other clarifies the law on confiscating noise-making equipment. The new night offence was open to consultation which began on 23rd September. That consultation relates to the noise level which the Secretary of State should set, the type of devices which should measure noise and the type of draft circular to be issued to local authorities. We have now received the response to that consultation and are considering it. We shall soon be able to issue a draft circular to local authorities on the basis of which they will be able to take action.
Baroness Nicol: My Lords, has the Minister noticed that, since the introduction of CCT in your Lordships' House, the noise level in some of the corridors has risen beyond that which most of us feel to be acceptable? Is that the province of Westminster City Council? Or is it a matter for your Lordships' House to determine?
Earl Ferrers: My Lords, I am sure that it is a matter for your Lordships' House. If the noise level has risen in the corridors of the House, I think it is quite likely, based on my experience, that it has also risen in the Chamber, especially when some noble Lords make provocative speeches.
Lord McNally: My Lords, although my noble friend rightly talked about noise affecting the elderly, is the Minister aware that a noisy neighbour can be a neighbour from hell for families of any age? Will the Minister applaud those local authorities which have used the new legislation to end tenancies for persistent noise offenders? A noise offender on a housing estate can bring down the quality of life for all the people living there.
Earl Ferrers: My Lords, the noble Lord is perfectly correct. Noisy neighbours can be deeply offensive. It is right that some local authorities should take the steps they can to remove noisy neighbours in order to enable other people to live reasonable lives. I cannot help but be reminded of the little jingle that says, 'A noisy noise annoys a noisy oyster'; indeed, I think that it also annoys a noisy next-door neighbour too.
Lord Merrivale: My Lords, can my noble friend the Minister say whether he is satisfied with the evaluation carried out by certain local authorities regarding the level of noise emitted by certain equipment in some areas? I give your Lordships one example. Kensington and Chelsea Council seems rather lax in its evaluation of noise emitted by equipment in that area.
Earl Ferrers: My Lords, I am not too familiar with the study to which my noble friend refers. The Noise Act only relates to noise emitted between the hours of 11 o'clock at night and 7 o'clock in the morning. I rather doubt whether the employees of Kensington and Chelsea Council operate at that time. Of course, if they do, no doubt the local authority will take such measures as are appropriate.
Lord Williams of Elvel: My Lords, assuming that the consultation goes forward and we get the proper response from the Government, can the noble Earl say what powers local authorities will have to ask the police to investigate noise? It seems to me that one of the problems is that, at present, the police have very few powers. That is one of the reasons why the Noise Act was passed. Will local authorities be able to call upon the police immediately? Will the environmental officer in the local authority be able to contact the local police station and ask the police to move in?

And will such incidents constitute a criminal offence?
Earl Ferrers: My Lords, it will be up to the environmental health officer concerned to take the necessary proceedings against the people who are emitting the noise. He can call upon the police for support. They will be able to give him the support he requires provided that it falls within their priorities. However, if there have been three murders next door, it is much more likely that the police will be employed in that respect rather than chasing the noise makers. Nevertheless, as I said, providing that there is sufficient reason for the police to be able to support the environmental officer, they will be able to do so. But it is not really a matter for the police.
Lord Williams of Elvel: My Lords, following on from that, if the police are investigating three murders on their doorstep and there is a noise incident, can the noble Earl say what action the local authority environmental health officer can take other than simply walking around to the place himself?
Earl Ferrers: My Lords, that is exactly what he would do. Indeed, the environmental health officer would walk round to the place, go to the people concerned and say, 'You are making a noise.' He will go there with his decibel counter and assess whether or not they are emitting 35 decibels. I see that the noble Lord, Lord Williams, finds that extremely funny, but if an environmental health officer visited his house when he was having some people to dinner and that officer did not bring a decibel counter, I dare say the noble Lord might feel very upset if told to remove half of those people because they were making too much noise. It is up to the environmental health officer to determine whether or not the noise being emitted by the people concerned is above the level. If it is, then the officer can impose a fine, a fixed penalty of £100, or he can take the people to court where a maximum penalty, at level 3, of £1,000 could be imposed.
Lord Williams of Elvel: My Lords,.... is not the difficulty the fact that the environmental health officer really does not have the support of the police? Indeed, the police may have other priorities. If he does not have such support there is very little he can do about night-time noise.
Earl Ferrers: My Lords, ... Not all noise is emitted by loud hi-fis. Sometimes people use sanders and do-it-yourself kits in the middle of the night. It is surprising what people do. In that situation it is perfectly all right for an environmental health officer to call on that person to ask him to stop using the sander. The person will invite the officer in, apologise and agree to stop using the sander. However, if it is a case of hi-fi music, a loud thumping noise and the presence of lots of people, that is different.
Lord Merrivale: My Lords, at what distance from the noisy equipment does the counter have to be put for it to be determined there is a disturbance to people in that area?
Earl Ferrers: My Lords, the person who complains of the noise will invite the environmental health officer into his room and it will be determined whether or not the noise in the room concerned is at a level of 35 decibels or more. It would have to be more than 10 decibels above the underlying noise over an average period of five minutes. The next question my noble friend will ask is: what is 35 decibels? The Building Research Establishment states that it is the level which is experienced in 90 per cent of single-glazed bedrooms which are in the front elevation on a busy suburban street. Your Lordships who have houses which fall into that category will know exactly what 35 decibels is.

Extracts provided by Rupert Taylor FIOA.

BSI News

New and Revised British Standards

BS 6840:-Sound system equipment
BS 6840: Part 18: 1996 Peak programme level meters. Guide for digital audio level meter. Recommends characteristics to be specified and methods of measurement for digital audio peak level indicators for professional and consumer use. No current standard is superseded.
BS 7698: Part 9: 1996 Measurement and evaluation of mechanical vibrations. Describes a procedure for measuring and evaluating the external mechanical vibration behaviour of generating sets. No current standard is superseded.
BS 7827: 1996 Code of practice for designing, specifying, maintaining and operating emergency sound systems at sports venues. Provides recommendations for use by local authorities and administrators of sports grounds and sports stadia for the correct installation, maintenance and operation of permantely installed sound systems used for emergency purposes. No current standard is superseded.

BS EN Publications

The following are British Standard implementations of the English language versions of European Standards (ENs)
BS EN 61063: 1996 Acoustics – Measurement of airborne noise emitted by steam turbines and driven machinery. No current standard is superseded.
BS EN 61094: Specification for measurement microphones.
BS EN 61094-3: 1996 Primary method for free-field calibration of laboratory standard microphones by the reciprocity technique. Supersedes BS 5679: 1979
BS EN 61094-4: 1996 Specifications for working standard microphones. No current standard is superseded.
BS EN 61329: 1996 Sound system equipment – Methods of measuring and specifying the performance of sounders (electroacoustics transducers for tone production). Defines the definitions, characteristics and their methods of measurement for sounders treated as entirely passive electroacoustics transducer elements, and piezoelectric diaphragms. Buzzers which are sound sources with built-in electric circuits are excluded. No current standard is superseded.
BS EN 10228-4 Non-destructive testing of steel forgings – Part 4: Ultrasonic testing of austenitic and austenitic-ferritic stainless steel forgings

International New Work Started

Many of these international projects are eventually adopted as European and British Standards

IEC 704 Test code for the determination of airborne acoustical noise emitted by household and similar electrical appliances – Part 2: Particular requirements – New Section 7: Fans

ISO 140 Acoustics:- Measurement of sound insulation in building and of building elements – Part 12: Laboratory measurement of room-to-room airborne and impact sound insulation of an access floor

Other Documents not Issued as DPCs

ISO/DIS 10452 Hearing protectors – Recommendations for selection, use, care and maintenance – Guidance Document

ISO/DIS 10449 Hearing protectors – Safety requirements and testing – Ear muffs

ISO/DIS 10453 Hearing protectors – Safety requirements and testing - Ear plugs

The above drafts issued under the ISO Fast Track procedure will not be circulated for public comment.

CENELEC Publications

EN 60094-3: April 1996 (IEC 94-3:1979 + A1: 1980 + A2: 1988) Methods of measuring the characteristics of recording and reproducing equipment for sound on magnetic tape (IEC 94-3: 1979 + A1: 1980 +A2:1988)

EN 60268-7: May 1996 (IEC) 268-7:1996)

Sound system equipment – Part 7: Headphones and earphones (IEC 268-7: 1996)

EN 61000: – (IEC 1000:–) Electromagnetic compatobility

EN 61000-2-9: May 1996 (IEC 1000-2-9: 1996) Environment-Section 9: Description of HEMP environment – Radiated disturbance – Basic EMC publication. (IEC 1000-2-9: 1996)

EN 61000-5-5: May 1996 (IEC 1000-5: 1996) Installation and mitigation guidelines – Section 5: Specification of protective devices for HEMP conducted disturbance – Basic EMC Publication (IEC 1000-5-5:1996)

Drafts for Public Comment

96/562265 DC BS ISO 10534 – 2 Acoustics – Determination of sound absorption coefficient and impedance in impedance tubes – Part 2: Transfer-function method (ISO/DIS 10534-2)

Draft ETSI Standards for Public Comment

prETS 300 717: 1996 Radio Equipment and Systems (RES); Electro-Magnetic Compatibility (EMC for analogue cellular radio communications equipment; Mobile and portable equipment

prETS 300 753: 1996 Equipment Engineering (EE); Acoustic noise emitted by telecommunications equipment

ETSI documents issued for Unified Approval Procedure (UAP)

ETS 300 086:- Radio Equipment and Systems (RES); Land mobile group; Technical characteristics and test conditions for radio equipment with an internal or external RF connector intended primarily for analogue speech, Amendment prA1: 1996 to ETS 300 086

prl-ETS 300 302-1 1996 Integrated Services Digital Network (ISDNO); Videotelephoney teleservice - Part 1: Electroacoustic characteristics for 3, 1 kHz bandwidth handset terminals

This information provided by John W Tyler FIOA, was announced in the July & August 1996 issues of BSI News.

Book Review

Acoustics in Buildings
Bernard Grèhant
Thomas Telford 1996 305 pp
ISBN 0-7277-2511-4 Hardbound £35

This is an unusual book; its principal subject matter is highly specialised yet it is not written for the specialist, on the contrary, it is written for the reader with no prior knowledge of acoustics (although some basic understanding of physics or engineering is required). It is a translation of Bernard Grèhant's text first published in French in 1994 with a preface by Professor F J Fahy. The subject is noise in buildings produced by motorised light building envelope elements such as sun screens, blinds and awnings. In France these are common in residential properties as well as commercial buildings.

The author leads the reader through the step-by-step process of analysing and solving the problems of noise from the actuators (the motor, gears and rolling tubes) and the casings and fixings and recommendations are given for design and installation. Test data from the manufacturers SOMFY and the Centre for Building Science and Technology (CSTB) are presented to illustrate the process.

The first half of the book is a thorough elementary introduction to acoustics covering basic physical acoustics, human hearing and standards (with special reference to French and Swiss Standards), vibration isolation and the behaviour of sound in rooms. The field of auditorium acoustics is not covered. For those new to the concept of decibels there is even a chapter on logarithms. More detailed mathematical descriptions of sound power and intensity, the Sabine formula, transmission through walls and sound radiation from structures are given in appendices.

The style of the author (or perhaps translator) is very readable and the text is well illustrated with good diagrams and although there are a number of typographical errors these do not seriously detract from the content. The book is very sturdily bound in a hard cover which may explain the slightly high price for a book of this length.

Although the book refers to specific SOMFY products, the principles of noise and vibration control presented can be applied to a wide range of products and situations. This book is not for the experienced acoustician but it will be of use to those involved in the design, specification or installation of motorised building elements. It will also be of interest to students and professionals who wish to gain an understanding of acoustics, especially the phenomenon of noise transmission in buildings.

G A A Rock MIOA ❖

New Products

EUROCOUSTIC
Stone Wool Products

Eurocoustic is one of Europe's leading manufacturers of stone wool products offering ceilings and wall panels in a wide range of designs and colours which complements the interiors of any room. They are stated to provide excellent sound absorption levels especially in the middle to top end of the frequency range.

A number of interesting installations have been completed where acoustical control has been achieved using the range of colours available in the Eurocoustic range. Projects completed so far include: bingo halls, cinemas, recording studios, lecture rooms and swimming pools.

Eurocoustic Acoustiroc absorbent wall lining is said to offer excellent impact resistance, easy-clean maintenance and is quick and simple to install. Acoustished industrial lining panels offer not only good acoustical control but thermal insulation as well and come in a wide range of colours.

Acoustisport has a highly durable, impact resistant surface with excellent low frequency noise absorption.

Eurobaffles offer an easy to install solution to sound control in Industrial and Commercial premises again in our wide range of standard colours.

For further information please call Chris Wallis on 0181 866 6126 for enquiries in the South or Phil Dodd on 01434 604 595 for enquires in the North. The London Sales Office is at 13 Deanecroft Road, Pinner, Middlesex HA5 1SS, the Northern Sales Office at 5 Shaftoe Leazes, Hexham, Northumberland NE46 3DF.

GRACEY & ASSOCIATES
Sound Power Measurements

Norsonics SLM116 with option 8 enables the engineer to make a complete sound power measurement, resulting in the L_{WA} value of any 'product' in accordance with ISO 3746 and related Standards. This means that testing the L_{WA} of new 'products' for CE-labelling may be performed in the production area.

Option 8 adds to the functionality of a conventional hand-held sound level meter by automating the procedure set out in the International Standard ISO 3746 and will therefore give a direct read out of the sound power level. The standard calculates the power level from the average sound pressure levels that are present on a hypothetical surface that surrounds the machine under test. It is possible to select this surface as either a hemisphere or parallelepiped, whether it is on a hard reflecting plane or standing in a corner and to select various distances at which measurements are made. Having keyed these selections into the instrument the measurements may be made. The background noise levels are measured as part of the process to ensure that the results are accurate and the other correction data set out in the Standard is simply keyed in. The result is available on the instrument's display and may be downloaded to a standard printer in a report ready format.

Further information is available from Gracey & Associates, High Street, Chelveston, Northants NN9 6AS. Tel: 01933 624 212 Fax: 01933 624 608.

Gracey & Associates is a Sponsor Member of the Institute

DIGISONIX
Active Sound & Vibration Control

Digisonix Inc announces the addition of the powerful new Digisonix dX-200TM Controller to its DIGIWARE® Active Sound and Vibration Control (ASVC) Development Systems product line. The Digisonix dX-200 Controller is a scaleable, multichannel, digital signal processing controller that utilizes the Texas Instruments TMS320C40 microprocessor. DIGIWARE Development Systems build upon a strong foundation of proprietary Digisonix®

ASVC Technology, technical support, and training to give engineers powerful, yet easy-to-use, tools for integrating active sound and vibration control into their products.

The DIGIWARE Software has been upgraded to take full advantage of the capabilities of this new controller and provide support for multiple hardware configurations without the need for additional software installations. The combination of a powerful new hardware platform and enhanced software development tool enables users to implement very sophisticated signal processing techniques, including parallel processing.

Digisonix Inc, Corporate Headquarters, 8401 Murphy Drive, Middleton, Wisconsin, USA. Tel: ++1 608 836 3999 Fax: ++1 608 836 5583

Digisonix is a Sponsor Member of the Institute

ACSOFT
PC-based FFT Analyser

The high-performance PC-based Spectralys multichannel realtime FFT analysis system is available from Ziegler Instruments' UK distributor, AcSoft.

In conjunction with Ziegler Instruments' iXYS range of PC expansion cards, Spectralys provides a fully specified, portable FFT analyser with a real-time rate exceeding 20 kHz for analysis of vibration and sound signals. Its benefits include an optional integral 8 Gbyte DAT recorder for mass storage of time domain data, superior display, cursor and marker functions, and options for acquiring and exporting data for modal analysis.

Spectralys supports data acquisition in two and four channels, expandable in four-channel increments up to 16 channels. High resolution analogue-digital conversion and fast data processing ensure gap-free data acquisition. Overlap processing ensures that even transient events are faithfully recorded. Spectralys' windowed environment allows acquisition parameters such as signalling conditioning, triggering, frequency bandwidth, resolution and averaging to be set up at the click of the mouse.

FFT analysis capability offers up to 3200-Line resolution, with the user's choice of up to nine windows, and numerous window evaluation functions covering a wide range of applications. The excellent cursor functions assist in data analysis and allow selection and display of particular events. Marking functions, difference and harmonic cursors, peak and maximum search functions, as well as special cursors such as variable harmonic cursors with display of the fundamental frequency, sideband cursors and integrators, and damping cursors, are all available.

There is a wide range of user-configurable display options combining multiple diagrams with set-up details and user comments. Results screens can be output to most word-processor systems for documentation. A function generator providing comprehensive standard functions as well as user-defined functions completes the standard equipment.

The optional intelligent modal analysis interface provides easy-to-use control of the measurement process for natural and operational vibrations. It can export data to Ziegler Instruments' modal analysis packages, and to proprietary programs such as LMS-CADA-PC and SMS-StarModal.

Also available is a 5 MHz bandwidth, 12-bit card for underwater acoustic and electronic applications. And two- to 16-channel On-Line versions use native signal processing on the host PC to perform the FFT analysis, avoiding the need for a DSP card but at the expense of real-time performance. The On-Line version offers a low-cost entry level, with the opportunity to upgrade at a later date.

For further information: John Shelton, AcSoft Ltd, 6 Church Lane, Cheddington, Leighton Buzzard LU7 0RU. Tel: 01296 662852 Fax: 01296 661400

AcSoft is a Sponsor Member of the Institute

INDUSTRIAL ACOUSTICS COMPANY (IAC)

SNAP Selector

Industrial Acoustics Company (IAC) has completely updated and relaunched its popular 'SNAP Selector', a slide rule which simplifies the process of selecting silencers for supply and return air handling systems.

Originally produced several years ago, the plastic calculator proved a hit with over 3000 UK specifiers, including architects, mechanical services engineers and contractors and acoustic consultants. The new version provides performance data on IAC's five most popular silencer designs – including two low frequency models – and is supplied in a protective wallet complete with detailed instruction card. It is available, free-of-charge, to anyone routinely engaged in selecting silencers.

Side one of the slide rule is devoted to selecting the optimum silencer for the job, based on the type of air handling system being used, the acoustic characteristics of the building it serves and the desired noise criteria. Full forward-flow dynamic insertion loss (DIL) ratings for each silencer type are shown.

The reverse side of the SNAP Selector provides a quick and simple means of calculating the silencer pressure drop, face velocity and thus silencer face area. Reverse-flow DIL values are given on this side.

IAC points out that the slide rule is intended to help specifiers make a rapid initial assessment of the silencers required for a given air handling system. Final checks are always carried out by highly experienced engineers in the company's Building Services Division to ensure that the most cost-effective choice has been made.

To obtain a copy of IAC's new SNAP Selector contact the company direct at its Winchester HQ (Tel: 01962 873000) or its Warrington, Cheshire office (Tel: 01925 653423). IAC's new address is Industrial Acoustics Company, IAC House, Moorside Road, Winchester, Hampshire SO23 7US.

Industrial Acoustics Company is a Sponsor Member of the Institute

CEL INSTRUMENTS

Reducing Noise Testing Time

CEL Instruments have published an application note which explains how new instrumentation, providing real-time measurement capability, can reduce product noise testing by a factor of 12.

The note is based on a real case study carried out at Brush Electrical Machines Ltd of Loughborough, England who manufacture machines for the electricity generating business ranging from 65 kWatt units to giants providing 120 MWatts and weighing over 120 tons.

WIth their earlier equipment, two Brush engineers would take measurements of both the ambient levels and while the machine was operating which could involve up to 350 readings. These were then manually entered into a computer.

Since March 1996 Brush Electrical Machines have used a CEL-593 Real-Time Sound Level Analyser which has eliminated nearly all of the manual and repetitive work by simultaneously measuring all of the octave bands and automatically storing the data to memory.

This typically means that the time spent carrying out an assessment of an average machine has been reduced from 6 man hours to half an hour.

The application note provides information on the methodology, the conformance standards and the measurement criteria used.

A free copy can be obtained by contacting CEL Instruments Ltd, 35 – 37 Bury Mead Road, Hitchin, Herts SGS 1RT. Tel: 01462 422411 Fax: 01462 422511

CEL Instruments is a Key Sponsor of the Institute

HHB COMMUNICATION

Data MiniDisc

MiniDisc Data has become established as the new medium for personal digital multitrack recording with the launch of 4 track systems from three major manufacturers – Sony, Tascam and Yamaha. HHB offers a high quality 140 MB data MiniDisc, the HHB MDD140.

Like other products in the HHB Advanced Media Products range, the MDD140 is said to set new standards for performance and data security, excelling in the critical areas of high carrier to noise ratio and low block error rates. Uniquely, the MDD140 has been specified, developed and tested specifically for use in professional audio applications, providing users with dependable and cost-effective recording media, and the assurance of compatibility with all available hardware.

The HHB MDD140 Data MiniDisc is available now from HHB Advanced Media Products dealers and distributors, alongside other products in the HHB digital recording media range which now includes DAT tape, CD-R discs, MO disks, recordable audio MiniDiscs and a dedicated 45 minute S-VHS tape for use with ADAT digital multitrack recorders.

For further information, contact: David Beesley, Advanced Media Products Sales & Marketing Manager, HHB Communications Ltd 73-75 Scrubs Lane London NW10 6QU Tel No. 0181 962 5000 Fax No. 0181 962 5050.

BRITISH GYPSUM

Gyproc Gyptone

When the first phase of the campus construction was completed in late 1995, the University of Sunderland found that the refectory area was the perfect space to host concerts and live shows from. It thereore followed that the acoustic environment requirements of this project were more demanding. This discovery coincided with the development of British Gypsum's Gyproc Gyptone sound absorption board and its specification helped meet these newly identified requirements.

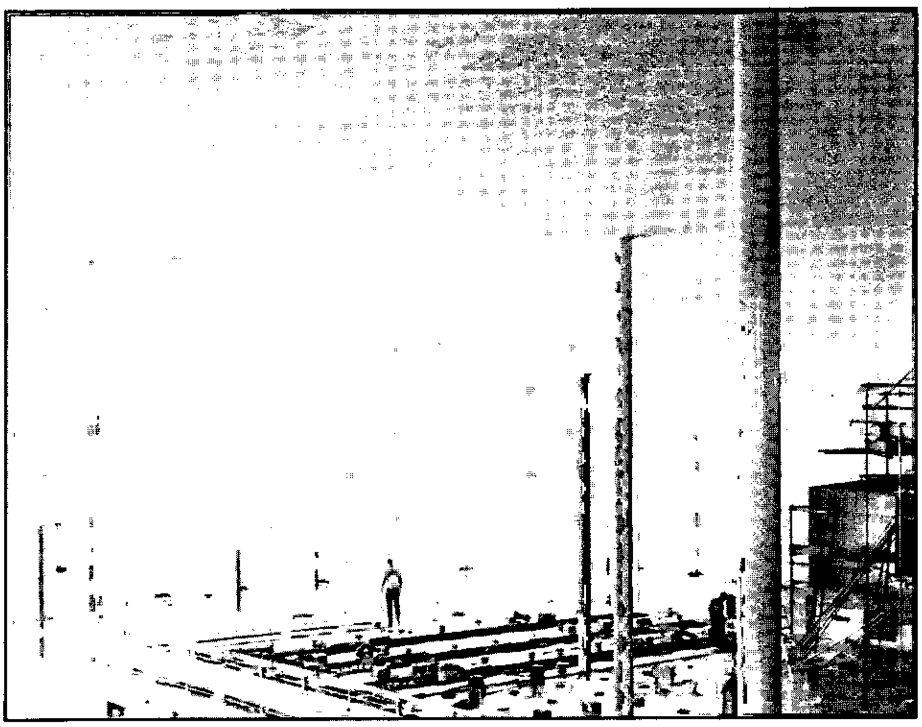
Gyproc Gyptone, one of British Gypsum's high performance plasterboards, was specifically designed for environments where both acoustic performance and aesthetic appeal are vitally important. Architects on the project, Building Design Partnership, specified over 2,000m² of the product, fixed in the Gyproc M/F suspended ceiling system as shown in the photograph . The results have illustrated the acoustic effectiveness of the product with positive testimonials from architect, sub-contractor and, most importantly from those who live and work there, the staff and the students. Additionally, the appealing perforated design of Gyproc Gyptone has added to the aesthetic personality of the building.

Gyproc Gyptone is backed with absorbent acoustic felt to provide the excellent acoustic correction performance whilst enabling the surface to be repeatedly decorated.

The new product comes with tapered edge as standard for smooth seamless jointing and can be used to create flat or curved surfaces. Though new to the UK market, the product, developed in conjunction with sister companies of BPB, is already widely specified across Europe.

Further information from: British Gypsum Ltd, East Leake, Loughborough, Leics LE12 6HK Tel 0115 945 1000. Fax: 0115 945 1901.

Items for this section should be sent to Mr J Sargent MIOA, Oak Tree House, 26 Stratford Way, Watford WD1 3DJ



1995 A B Wood Medal

Dr Nicholas C Makris received his SB degree in Physics from the Massachusetts Institute of Technology in 1983, following which he began his career in ocean acoustics through PhD research at MIT with Professor Ira Dyer. His work resulted in important papers in Arctic Acoustics, including perhaps the most widely referenced paper on Arctic ambient noise, which demonstrated the remarkably high correlation between low frequency ambient noise and stresses applied to the ice by wind, current and drift. He was awarded his doctorate by MIT in 1990.

Since 1991 Dr Makris has continued his career in ocean acoustics at the Naval Research Laboratory in Washington DC, during which time his investigative work has produced outstanding results in several areas.

He was awarded the status of Office of Naval Research (ONR) Young Investigator in ocean acoustics at the ONR 50th Anniversary Symposium, May 1996, for his 'pioneering contributions' to ONR's multi-disciplinary, multi-institutional Special Research Program (SRP) on acoustic reverberation. He designed the SRP's Main Acoustics Experiment and used the data acquired to document the deterministic relationship between low-frequency ocean-basin reverberation and detailed geomorphology of the Mid-Atlantic Ridge. He developed sophisticated signal processing and nonlinear optimization methods for resolving ambiguity in towed line-array measurements and provided a rapid and accurate means of modelling wide-area ocean-basin reverberation. He then showed that acoustic systems can be used to remotely image uncharted bathymetric features over hundreds of kilometres in near real-time at resolution significantly higher than that of currently available radar altimetry methods.

Dr Makris has also worked on the concept of using ambient noise as a source of opportunity to image objects submerged in an ocean waveguide. He developed the first wave model for this purpose by integrating full-field waveguide scattering, propagation and noise models, and evaluated the viability of the technique for use with conventional arrays by application of sophisticated statistical parameter resolution bounds. An interesting by-product of this work was a proposal that dolphins may be able to passively detect nearby prey using scattered ambient noise. Perhaps the most important aspect of this work has been its extension to the more general problem of active localization and classification in shallow water, for which Dr Makris is the Principal Investigator in an ongoing ONR project. Dr Makris has used estimation theory, optimal filtering and information theory to provide a theoretical foundation for the use of logarithmic measures of fluctuating intensity in acoustics, radar and optics. He has shown that log transformation of fluctuating intensity leads not only to the optimal method for pattern recognition, but also to a greater understanding of the information contained in intensity images. This has strong implications for the estimation of quantities from radiometric measurements of backscatter, random sources and transmission through a fluctuating medium such as the ocean, and may also be the basis for the apparent logarithmic response of human auditory and visual perception to intensity stimulus exhibited in the Weber-Fechner Laws.

More recently, Dr Makris has developed a statistical theory for ocean acoustics that includes the effects of temporal coherence and measurement duration. He has formulated general parameter resolution bounds for acoustic interferometry techniques such as matched-field processing and tomography, and has shown that the sonar equation must be corrected for an inherent statistical bias that depends on the time-bandwidth product of the measurement.

With this and other such work, Dr Makris' broadening interests and research are leading to a fuller understanding of signals/noises in the ocean and are also finding applications in other scientific fields such as pattern recognition, tomography and bioacoustics.

Dr Makris has a distinguished record of published work, has participated fully in Acoustical Society of America activities, and is the Naval Research Laboratory representative on the ASA Standards Committee for Underwater Acoustics.

The Institute of Acoustics is pleased to award the A B Wood Medal for 1995 to Dr Makris for his outstanding contributions to the science of underwater acoustics.

FUNDING FOR R & D PROJECTS

Introduction

£12.5 million is available from the European Commission (EC) to enable Small and Medium-sized Enterprises (SMEs) to participate in research into Standards, Measurement and Testing (SMT).

Grants of up to £36,000 to enable SMEs to prepare a research proposal and up to £400,000 for the larger Cooperative Research Projects.

This scheme entitled *'Technology Stimulation Measures for SMEs'* was set up by the European Commission to encourage SMEs to participate in European Research and Technological Development (RTD) programmes.

SMT Technical Areas/Research Topics.

Measurements for Quality European Products, including written standards for industry. The objective is to support European Industry in the timely production of products of the requisite quality and at an acceptable price by the development of improved measurement and testing techniques.

RTD activities are:

- the development of measurement methods, instrumentation and reference data required in the course of research;
- the development of generic measurement and testing methods, instrumentation and reference materials required in the course of product development;
- the development of generic measurement and testing methods/ instrumentation required for production and quality assurance. Special efforts are being made to enable SMEs to adopt new measurement technologies and to establish quality assurance procedures appropriate to their needs.

These activities include, where necessary, the development of written standards which do not arise directly from Community legislation but are requested by industry in consultation with European standards bodies.

Who can apply?

The scheme is for the benefit of industrial SMEs whose main activities concern manufacturing, processing, mining, building or industrial services and, as defined by the EC, must satisfy simultaneously the following criteria:-

- have no more than 500 employees;
- have an annual turnover of no more than £30m;
- are no more than 1/3 owned by an organisation larger than an SME

What is available?

1. Exploratory Awards
2. Cooperative Research Awards (CRAFT)

1. Exploratory Awards

This first grant is to help an SME prepare a full research proposal for a Cooperative Research project. It covers two complementary activities:-

- Proposal expansion: to define and plan the R&D programme, to search for partners, to verify the novelty of the idea and to establish the market potential.
- Research Feasibility Study: to explore the feasibility of a research topic or concept before entering the research phase.

Funding: Limited to 75% of the total costs: award up to £36,000. *Duration:* 3-12 months. *Deadline:* open until July 1997. *Participants:* Typically 2 SMEs from different Member States.

2. Cooperative Research Awards (CRAFT)

Cooperative research projects will enable SMEs, who have similar technical problems in the field of measurements and testing but do not have adequate research facilities of their own, to engage research performers to carry out RTD on their behalf.

Funding: 50% of the total cost: award up to £400,000. SME contribution can be in cash or 'in kind'. *Duration:* 1–2 years. *Deadline:* open until December 1997. *Participants:* At least 4 partners from at least 2 different Member States.

The Benefits

for SMEs

- cash grants to defray the costs of proposal preparation
- funding to enable a large programme of research to be carried out by centres of excellence
- rights to the results of research for exploitation
- improved competitiveness
- experience in research
- experience in Europe
- prospects of new European markets

for Research Performers

- 100% funding for the execution of research on behalf of SMEs

for Large Enterprises, non eligible SMEs and Trade Associations

- Opportunity to join projects, add value to the research and to share in the exploitation

Interested?

For further information and FREE assistance, details can be obtained from Beta Technology Limited (the UK Focal Point for SMT).

Derrick Taylor
Beta Technology Ltd
Riverside House
Weedon Street
Sheffield S9 2FT
Tel: 0114 242 2004 Fax: 0114 256 0950
e-mail: 100745.743@compuserve.com

Letter to the Editor

From Professor Emeritus Peter Fellgett, FRS FIOA.

Sir,

Loudspeaker Design

The three Technical Contributions in Volume 21 No 5 all relate directly or indirectly to the design of loudspeakers, and each complements the others.

A notable feature of both articles which refer to loudspeakers explicitly is that they are addressed entirely to frequency response; no consideration is given to such matters as efficiency, distortion, cone-amplitude, Doppler intermodulation, necessary rigidity of enclosure, etc. A cause of this emphasis is that the market is perceived in terms of passive loudspeakers, with the consequent problems of adequately controlling frequency response with passive crossover networks operating at comparatively high powers and into the adventitious impedances presented by the drivers.

Historically the problem did not arise with single-driver loudspeakers, and multiple drivers were introduced in the days when amplifiers used valves and consequently were comparatively hot and expensive. Moreover the custom has grown up of loudspeakers and amplifiers being marketed by different manufacturers, each with its own mystique.

The time has come, I submit, to break away (as at least one British manufacturer has done) from historical limitations which are no longer applicable, and from assumptions that are merely matters of habit, and to design loudspeakers on the basis that each driver can be fed from its own amplifier driven by whatever frequency-shaping filter that is appropriate. Such filters of course operate at low signal levels and can be implemented compactly and cheaply with modern microelectronics.

Some manufacturers may be inhibited by the legal and administrative problems of active devices, especially in view of the different safety requirements in different countries, but these problems surely can and should be overcome for the sake of opening up a new market in advanced audio technology.

Yours faithfully

P B Fellgett

1996/7 Institute Register of Members

The Production Editor apologises for the following omissions

Building Research Establishment is a Sponsor Member of the Institute (Entry 4.062)

David Trevor-Jones' telephone number is 0171 922 8861and Fax 0171 922 8863 (Entry 4.015)

Non-Institute Meetings

January 8-9,1997: Society of Acoustics (Singapore) Annual Meeting, Singapore. Contact: W Gan, Acoustical Services Pte Ltd, Innovation Centre, 209-112, Nanyang Ave. NTU, Singapore 2263; Fax: +657913665; e-mail: chenzhen@pacific.net.sg

January 20-22, 1997: EAA-Symposium 'Psychoacoustics in Industry and Universities', Eindhoven, The Netherlands. Contact: Armin Kohlrausch, Institute for Perception Research (IPO), PO Box 513, NL-5600, Eindhoven, The Netherlands. Tel: +31 40 27 73 873; Fax: +31 40 27 73 876; e-mail: kohlrausch@natlab. research.philips.com ttp://www.tue.nl/ipo/hearing/symposium

March 3-6, 1997: DAGA 97, German Acoustical Society Meeting, Kiel, Germany. Contact: Tagungsbüro DAGA97; Foschungsanstalt der Bundeswehr für Wasserschall und Geophysik; Klausdorfer Weg 2-24; D-24148, Kiel, Germany. Tel: +49 431 7204 -281; Fax: +49 431 7204 – 150; e-mail: daga97 @fwg.ki.eunet.de;http:// daniels.techfak. uni-kiel .de/daga97

March 17-19, 1997: Spring Meeting, Acoustical Society of Japan, Tokyo Japan. Contact: Acoustical Society of Japan, Ikeda Building, 2-7-7 Yoyogi, Shibuya-ku, Tokyo, 151 Japan. Fax: +81 3 3379 1456

March 24-28, 1997: 2nd Ultrasonics Symposium (part of International Science and Technology Conference), Havana, Cuba. Contact: Carmen Alvarez, Calle 15 No 551 e/C y D, CP 10400, Ciudad de La Habana, Cuba; Fax: +53 733 3373; e-mail: cimaf@redacc.cu

April 2-4, 1997: International Symposium on Simulation, Visualization arul Auralization for Acoustic Research and Education, Kobe, Japan. Contact: Symposium Secretariat, Environmental Acoustics Lab, Faculty of Engineering, Kobe University, Rokko, Nada, Kobe, 657 Japan. Fax: +81 78 881 25 08, e-mail: asva97@icluna.kobe-u.ac.jp

April 13-16, 1997: 23rd International Symposium on Acoustical Imaging, Boston, MA. USA. Contact: S Lees, Bioengineering Dept, Forthys Dental Center, 140 Fenway, Boston, MA, USA. Fax: +1 617 262 4021; e-mail: slees@forthys.org

April 14-18, 1997: 4th French Congress on Acoustics Marseilles, France. Contact: Secretariat CFA, 4; 31 chemin Joseph Aiguier, F-13402 Marseille Cédex 20, France. Tel: +33 91 16 40 68; Fax: +33 91 22 82 48; e-mail: cfa4@lma.cnrs-mrs.fr; http://alphalma.cnrs- mrs.fr/cfa4.html

April 21-24,1997: International Conference on Acoustics, Speech, and Signal Processing - ICASSP 97, Munich, Germany. Contact: H Fastl, Lehrstuhl für Mensch-Maschine-Kommunikation, Technical University of Munich, 80290 München, Germany. Tel: +49 89 2105 -8540; Fax: +49 89 2105 -8535; e-mail: fas@mmk.e-technik. tu. muenchen.de

April 21-25, 1997: Intemational Conference on Shallow Water Acoustics, Beijing, China. Contact: SWAC '97 Secretariat; c/o Institute of Acoustics, PO Box 71, Beijing, 100080; China. Fax: +(86-10) 6256 -9079 (Beiing): + (1-404) 894 -7790 (Atlanta); e-mail.: xwf@ canna.ioa.ac.cn (Beijing); swac97@ gatech.edu(Atlanta)