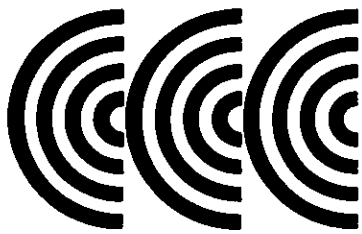

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January 1989 **Volume 14** **Number 1**

Contents

The Institute of Acoustics was formed in 1974 by the amalgamation of the Acoustics Group of the Institute of Physics and the British Acoustical Society and is now the largest organisation in the United Kingdom concerned with acoustics. The present membership is in excess of one thousand and since the beginning of 1977 it is a fully professional Institute.

The Institute has representation in practically all the major research, educational, planning and industrial establishments covering all aspects of acoustics including aerodynamic noise, environmental acoustics, architectural acoustics, audiology, building acoustics, hearing, electroacoustics, infrasonics, ultrasonics, noise, physical acoustics, speech, transportation noise, underwater acoustics and vibration.

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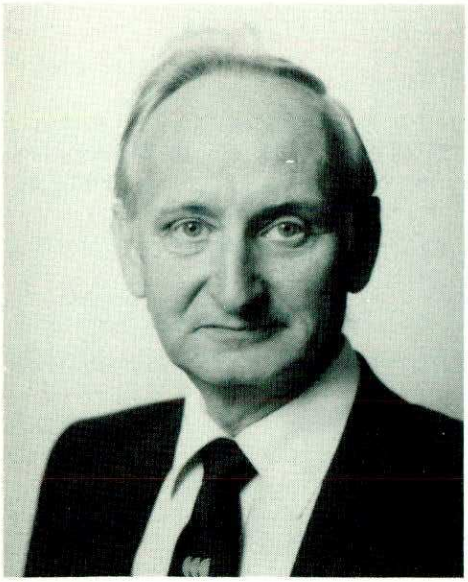

President's Letter

Dear Fellow Member,

The New Year sees the tenth anniversary of our Diploma in Acoustics and Noise Control, and I would like to take this opportunity of thanking all those members who have so actively contributed to its success over the years. The Diploma currently provides an alternative route for members to meet the academic requirements for Corporate Membership of the Institute, not only as a first qualification in its own right, but also as a conversion course for graduates from other disciplines. One- or two-year part-time courses are available from at least thirteen educational establishments situated throughout the country. A special anniversary meeting is being arranged to celebrate the event: details will be announced shortly.

The Institute has recently been involved in commenting on two documents circulated for public comment; the HSC Consultative Document 'Prevention of damage to hearing from noise at work' and the Draft Revised BS 4142 'Method of rating industrial noise affecting mixed residential and industrial areas'. My thanks are given to members who contributed to these activities, especially those who spent time organizing the appropriate discussion meetings and collating the comments. The HSC document has resulted in Council approving the formation of a 'Certificate of Competence in Work-place Noise Assessment'. Education Committee will be handling the arrangements.

I am hoping that 1989 will see a significant increase in membership. Special efforts will be made to recruit new members, and the AMIOA grade should play an important role in this. Another feature would be if all members could make it their New Year's resolution to recruit at least one new member; there must be many opportunities to persuade colleagues of the advantages of supporting the profession of acoustics. Efforts will also be made to persuade 'lapsed members' to rejoin.

The Autumn Conferences at Windermere were a huge success, and it is hoped that the Spring Conference at Oxford during the period 3 – 6 April will prove just as popular. I hope you will all make the special effort to come and participate and give support to Rayleigh Medallist Dr Henning von Gierke, to Dr Tony Embleton who will deliver the Stephens Lecture, to the Revd Dr Michael Delany our new Honorary Fellow and to the Simon Alport Prize winner, Dr Adrian Raper. The Annual General Meetting will also be held.

May I wish you all a happy and successful New Year, and remind you that nominations for the 1990 Medals and Awards are now being sought, together with nominations for Council and its committees. Your participation in these activities is vital for our future well being.

Chris Rice

Calculation of Road Traffic Noise (CRTN)

Background to the Technical Memorandum

In July of 1988 the revision of the Technical Memorandum 'Calculation of Road Traffic Noise' was published by the Department of Transport. This document forms part of the Noise Insulation Regulations of the Land Compensation Act of 1973. Effect has been given to the method via amendments to the Regulations dated 14 November 1988.

In order to trace the history of the development of this method, it is necessary to refer initially to the White Paper 'Development and Compensation – Putting People First' which was published in October 1972 and which heralded the introduction of the Bill for the Land Compensation Act 1973. The White Paper followed two major studies dealing with ways of preventing damage to the environment from essential public development and, for situations where full prevention was not practical, how to compensate for it. The White Paper contained many major provisions but in essence it advocated the provision of new powers to highway authorities to acquire land to mitigate the effects of road traffic and the construction of highways, and provided new duties to pay for the sound insulation of property. Additionally, the White Paper recommended entitlement to compensation where property suffers a loss of value because of the effects of a new road.

The original Noise Insulation Regulations came into operation in England and Wales on 1 September 1973 (modified 1975) with the basic aim of stating the conditions for entitlement to sound insulation treatment of residential property, and the method to be used to determine eligibility. The method specified in the 1975 Regulations was that given by the Technical Memorandum 'Calculation of Road Traffic Noise' which was published in the same year.

Simply stated, the regulations specify that when a new road is built or when an existing road is substantially modified by the addition of an extra lane or carriageway, then it is mandatory for the highway authority to offer sound insulation treatment to the owners of property whose traffic noise level exceeds 68 dB(A) on the L_{10} (18-hour) traffic index and whose traffic noise has risen by at least 1 dB(A) from all highways and by at least 1 dB(A) from the new highway. (NB the L_{10} is the noise level exceeded for ten per cent of the time. In this case the L_{10} (18-hour) dB(A) is the average of the 18 one hour values taken between 0600–2400 h on a normal working day). A discretionary power to offer insulation is provided for in the 1975 Regulations, in relation to alterations to the highway. A common example would be a widening not involving the creation of a new carriageway.

When using 'Calculation of Road Traffic Noise' for the purpose of the Regulations, it is necessary to calculate the noise level for the worst case condition covering a 15-year period from the date of opening the road.

Since its introduction in 1973 many thousands of properties have been insulated against traffic noise, at a cost in excess of £60 M to date. Insulation costs can represent a significant component to the total cost of a road and it is important, therefore, that the method should be as accurate as possible so that resources are effectively targeted to eligible dwellings.

The publication of the new method represents an important step forward in this respect as it will enable accurate predictions to be made for a much wider range of circumstances than was possible with the previous method. It has also been substantially rewritten and restructured with the intention of removing all possible ambiguity and misinterpretation.

The changes that have been made to the method were highlighted in a paper produced for presentation at the Autumn Conference of the Institute, and since it received a great deal of interest at that meeting it was felt that it would also be useful to readers of the Bulletin who were not at the conference. The paper is, therefore, reproduced in the following pages.

It was realized that the introduction of the new method would give rise to some problems during the transitional phase, partly as a result of the need to re-programme the method, in some cases, and also partly as a result of difficulties in developing a full understanding of new procedures. To help with the introduction of the new method it is intended that one or more workshops will be run on the development and use of the method, depending upon demand. The first workshop will be held at TRRL on 15 March. More information on this event can be obtained from: Transport and Road Research Laboratory, Crowthorne, Berkshire RG11 6RJ. Contact for Workshops: Mrs Jean Dart. Tel: (0344) 770905.

The Revision of Calculation of Road Traffic Noise (1988)

P G Abbott and **P M Nelson** Transport and Road Research Laboratory

Introduction

The technical memorandum 'Calculation of Road Traffic Noise' (CRTN) was first published in 1975[1]. It describes procedures for both predicting and measuring the noise from road traffic, and is intended to be used primarily as the method for calculating entitlement to sound insulation treatment of residential properties under the Noise Insulation Regulations 1975[2] of the Land Compensation Act 1973. In addition, it is also referred to in the Department's *Manual of Environmental Appraisal* of road schemes[3], and has general application in highway design and land use planning.

The method has performed well for many years, but it was realized that its range of application was limited. Ambiguities in interpretation also led to difficulties in determining entitlement under certain conditions. TRRL was given the responsibility of researching and revising the method following the findings of the Working Party on the Review of the Noise Insulation Regulations 1975, and in 1988 a revised CRTN was published[4].

At the time of writing, the current method for calculating entitlement to noise insulation is the 1975 version of CRTN, although it is expected that the revised method will come into effect later in 1988.

This paper summarizes the major changes that have been made to the method.

Presentation

The presentation of the method has been improved to assist interpretation, reduce ambiguities, and provide a clearer sequence by which calculations are carried out in practice. The revised method is divided into three sections.

Section I deals with the general procedures for predicting road traffic noise at a point in the vicinity of a road or road network. The procedures are shown diagrammatically in Figure 1. This section consists of five main parts which enable the user to:

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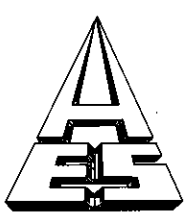

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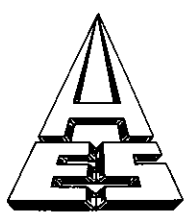

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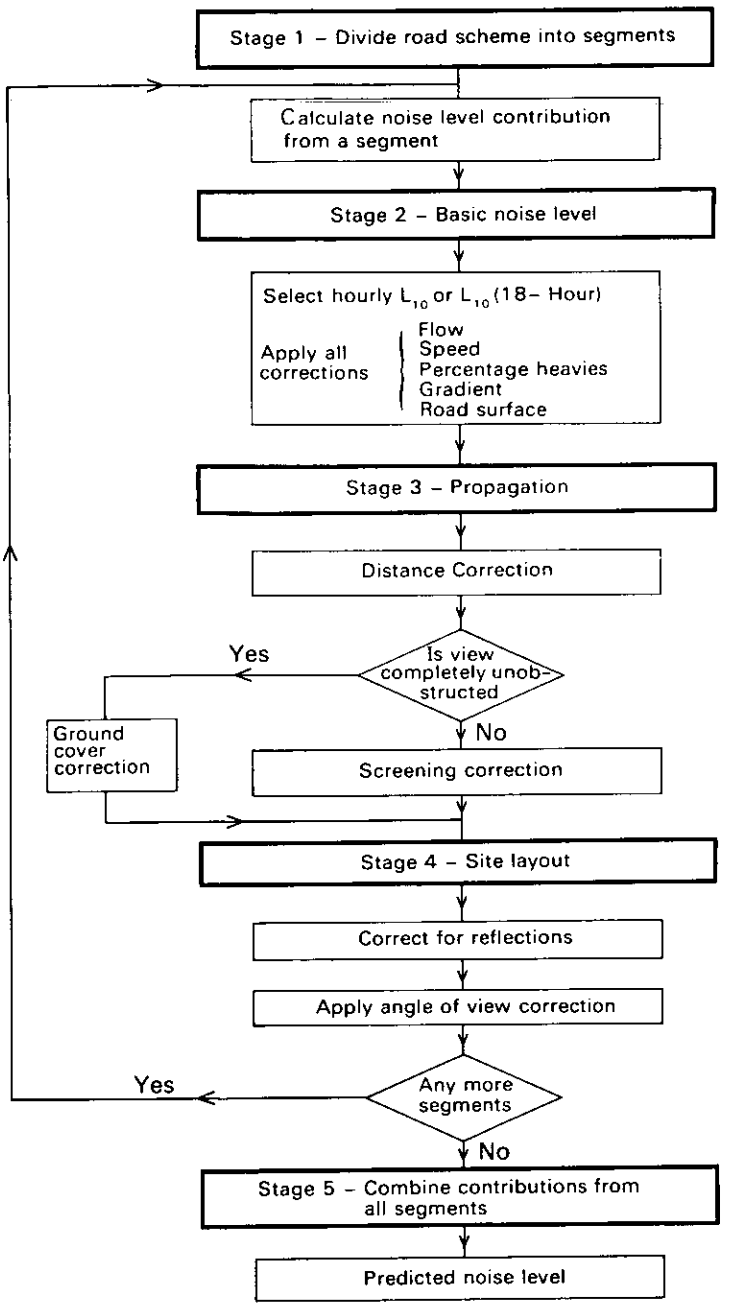


Fig. 1. Flow chart for predicting noise levels from road schemes

1. divide the road scheme into one or more segments such that the variation of noise within each segment is small, i.e. less than 2 dB(A);
2. calculate, for each segment, the basic noise level at a reference distance of 10 metres away from the nearside carriageway edge, as a function of the vehicle flow, traffic composition, average traffic speed, road gradient and road surface texture;
3. assess for each segment the noise level at the reception point taking into account distance attenuation and screening of the source line;
4. correct the noise level at the reception point to take account of site layout features, including reflections from buildings and façades, and the size of the source segment;
5. combine the contributions from all segments to give the predicted noise level at the reception point for the whole road scheme.

Section II of the revised method describes the additional procedures which may need to be considered when predicting traffic noise for particular types of traffic conditions, screening, or site layout not covered in Section I. Section III gives the procedures to adopt when it is necessary to measure traffic noise, and gives general advice on the use and quality of the instrumentation.

The layout of the annexes has been improved and additional examples included.

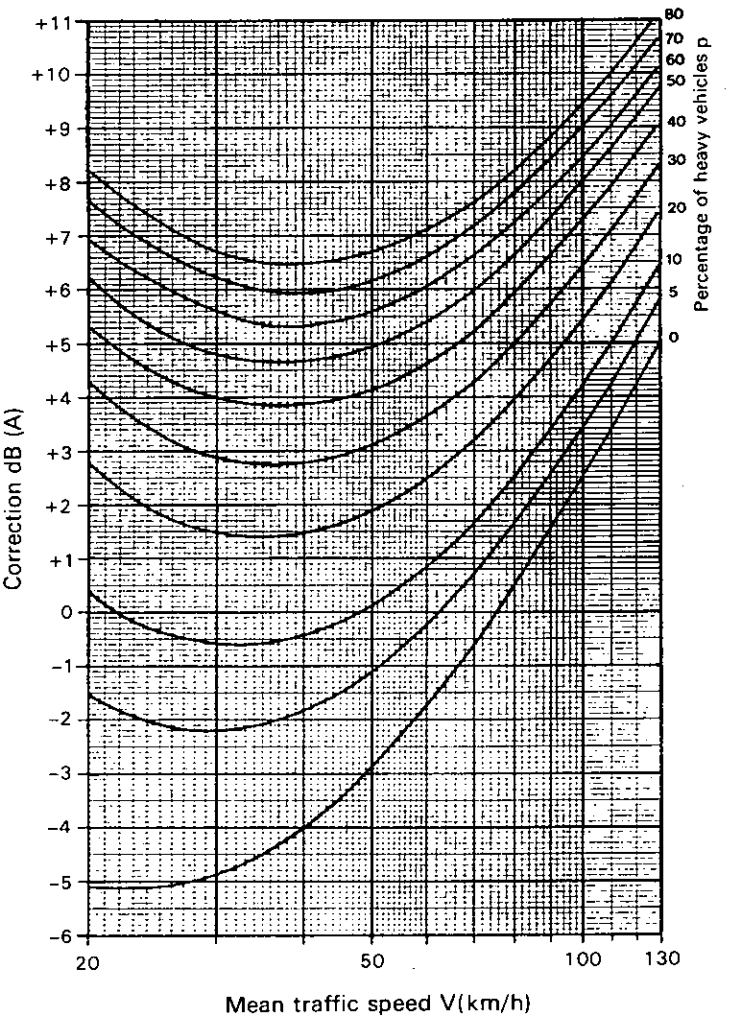
The method

Where possible, the method has been extended to cover a wider range of application without the need for additional input data. The following sections summarize some of the main areas of the revision.

Traffic speed and composition, and roads on gradients

When determining the basic noise level it is assumed that the road is level and that the traffic speed, averaged for all vehicles travelling in both directions, is 75 km/h. For different traffic speeds the basic noise level is adjusted according to the chart reproduced here as Figure 2, which also shows how allowance can be made for the percentage of heavy vehicles.

When the road is not level, an additional correction is



Correction =

$$33 \log_{10}(V + 40 + \frac{500}{V}) + 10 \log_{10}(1 + \frac{5p}{V}) - 68.8 \text{ dB(A)}$$

Fig. 2. Correction for mean traffic speed, V and percentage of heavy vehicles, p

required for the influence of the gradient on the noise emitted by the traffic stream. In the previous method, two corrections for road gradient are given. These corrections are reproduced in Figure 3, correction A being used when input speeds are actually measured values, correction B being used when traffic speeds are estimated from the road classification.

This approach assumes that the measured speeds already contain the influence of gradient on average traffic speed. When traffic speeds are estimated from the road classification, the method assumes that increasing gradient causes the speed to fall and that this leads to a reduction in the basic noise level. This effect is taken into account by the lower correction for gradient given by line B.

In practice, this has proved to be an oversimplification. Indeed, it can be seen from Figure 2 that even though the speed/noise level function decreases with speed over much of the range, this feature is not present at low traffic speeds with a high percentage of heavy vehicles, where the inverse can occur with noise levels increasing with decreasing traffic speeds.

For these reasons, the previous CRTN tended to under-predict the basic noise level for severe gradients with low estimated average traffic speeds.

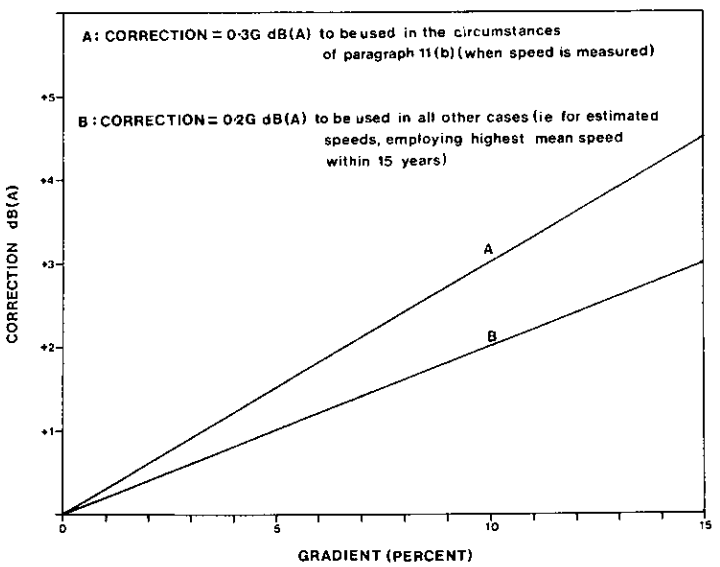
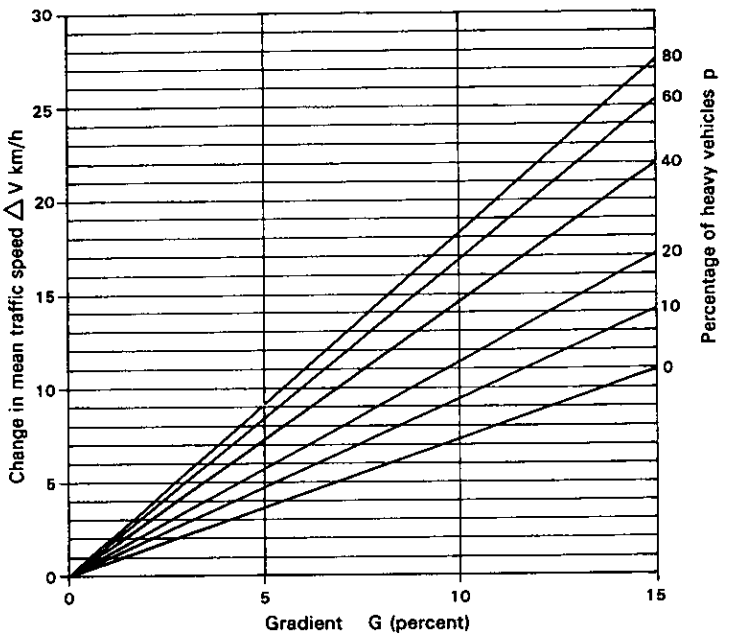


Fig. 3. Correction for gradient, G (per cent), current method

In the revised version of CRTN this problem has been overcome by obtaining a more general correction for the reduction in traffic speed due to road gradient. The functional form of the speed correction is shown in Figure 4 and was derived from traffic speed observations on roads with different gradients[5]. This can then be used to adjust the estimated traffic speed before entering the speed value in the correction chart, Figure 2. The noise level correction for gradient is then obtained using correction A in Figure 3.

Road surface correction

During the development of the previous version of CRTN it became clear from preliminary research that the basic noise level generated by a stream of traffic depended upon some characteristics of the road surface type and/or texture pattern. Although, at that time, little was known about the influence of the surface pattern, it was known that certain types of deeply textured grooved concrete road surface finishes were producing high noise levels. Consequently, in the absence of more detailed information, the method included a broadly based correction to cater for the increased noise generated by



$$\Delta V = \left[0.73 + \left(2.3 - \frac{1.15p}{100}\right)\frac{p}{100}\right] \times G \text{ km/h.}$$

Fig. 4. Reduction in mean traffic speed, Δ V in terms of the percentage of heavy vehicles, p and gradient, G used when speeds are estimated by class of road

these very deep textures. Since the publication in 1975 of the previous CRTN, a great deal of research on tyre/road surface noise has been done by TRRL, and the results of this research have now been included in the revised version of CRTN[6].

Principally, it has been found that the noise generated as a result of the road surface can be related to the materials used and texture pattern of the road surface, i.e., whether it is a concrete surface with a transverse texture pattern or a bituminous material with a randomized texture pattern, and upon the average texture depth of the surface as determined by the sand-patch test[7]. From the results of this research the following formulae have been derived to correct the basic noise level:

Concrete Surfaces:
Correction = 10 log(90TD + 30) − 20 dB(A)
Bituminous Surfaces:
Correction = 10 log(20TD + 60) − 20 dB(A)
where TD is the texture depth in mm.

It should be noted that these corrections are identical when the skidding performance as measured by the Δ BFC value is the same for both surface types[6].

In addition to the surface texture, the average speed of the traffic is important. For most conventional road surfaces the corrections are only relevant for high speed roads where tyre/road surface noise levels dominate other vehicle noise sources. To account for this speed dependence, the above corrections are only applied when the average speed is 75 km/h or more; for average speeds less than 75 km/h the basic noise level is reduced by 1 dB(A).

It should be noted that, for high speed roads, the basic noise level has been increased in the revised method by 1 dB(A) to refer the method more closely to the textures achieved on motorways and other high speed road constructions. This follows from the consideration that in developing the previous method a wide range of road surface types were implicitly incorporated when evaluating the empirical deter-

minants of the basic noise level. Therefore, the adjustment upwards of 1 dB(A) reflects the average difference in reference level between modern high speed road textures and the notional average textures of the roads included in the development of the previous method. The correction formulae given to account for the actual road texture are, of course, entirely consistent with this fundamental change in the basic noise level.

Although the above considerations apply for the vast majority of road surface finishes, research at TRRL and elsewhere has consistently shown that road surface materials which are designed to be permeable to surface water exhibit a different behaviour and have to be treated separately in the calculation of the basic noise level.

These surface types exhibit high acoustic absorption characteristics which can significantly reduce traffic noise levels. A specification for this type of surface has recently been included in the British Standard, BS 4987[8]. Research has shown that, for these materials, the noise generated by road traffic is largely independent of the surface texture of the material and the reductions in noise typically achieved range between 3 and 4 dB(A) depending upon the proportion of heavy vehicles in the traffic stream[9]. Accordingly, in the revised method, for pervious macadam surfaces a reduction of 3.5 dB(A) is applied to the basic noise level.

Propagation over mixed surfaces

In determining the noise level at a given receptor position the method takes into account the attenuation with distance of the basic noise level assuming propagation occurs over either a 'hard' sound reflecting surface or a 'soft' acoustically absorbing surface.

Where the ground cover is a mixture of both types of ground classification, the original method advises using the attenuation rate corresponding to the type which is most prevalent, i.e., more than 50 per cent of the total ground cover area. This procedure can lead to large discrepancies in the predicted levels where the reception point is distant from the road and where the proportions of ground cover types are similar. For these conditions, a small difference in the ground classification can lead to the ground being classified as either totally hard or totally soft. For such situations the difference between hard and soft ground attenuation can be as high as 8 dB(A).

In revising this aspect of the method an investigation into the propagation over mixed ground was carried out. It was concluded that, to a reasonable approximation, there was a linear relation between hard and soft ground attenuation dependent on the proportions in area of sound absorbing ground to the total ground cover area between the reception point and the road. Consequently, in the revised CRTN a method is given which allows the user to interpolate between hard and soft ground propagation according to the areal proportions of these ground conditions under the propagation path.

Reflection effects from opposite façades

Where there are houses, other substantial buildings or a noise fence or wall beyond the traffic stream along the opposite side of the road, the noise from the traffic can be reflected back towards the reception point. The extent of this depends upon the size of the reflecting façades and their position in relation to the reference position. In the previous method an allowance of 1 dB(A) is made, provided the reflecting façades occupy more than half the length of the road segment under consideration. In practice, this rather simple correction can lead to inconsistencies, primarily because it does not take into account the position of the reflecting façades relative to the reception point or allow for differing effects due to the number of contributing façades.

To overcome these problems, the results of a model developed by Hothersall and Simpson[10] were used. Using geometrical reflection theory they derived expressions for reflections from opposite façades in terms of the façade and receptor distances from the source and the angles subtended by the source and image source lines at the receiver. In addition to this work, further analyses were also carried out at TRRL and an improved correction formula for the reflection from opposite façades derived. This has been included in the revised method and is given by:

Correction = 1.5 (θ'/θ) dB(A)

where θ' is the sum of the angles subtended by all the reflecting façades on the opposite side of the road facing the reception point which are at least 1.5 m above the road surface, and θ is the total angle subtended by the source line at the reception point, see Figure 5.

Although the above procedure does not completely take into account the effect of distance, the results, in most cases, are not significantly different from those obtained using a more exact solution involving a more complex procedure[10].

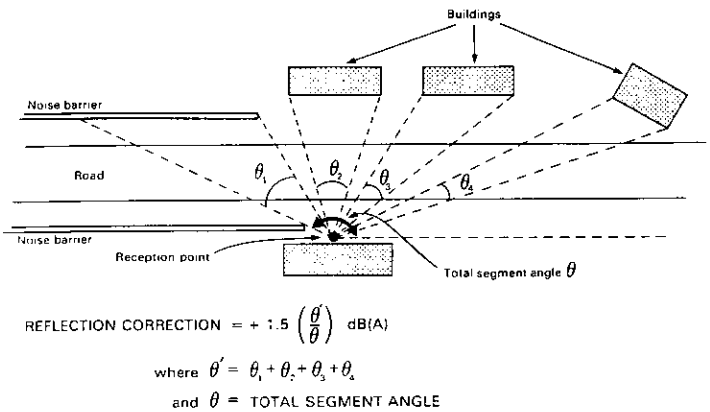


Fig. 5. Reflection correction for façades facing the reception point on the far side of the traffic stream

Screening by more than one obstruction

Where a road is screened by more than one obstruction, the previous method advises calculating the attenuation provided by each screen in turn and selecting the value which, when combined with the basic noise level, gives the lowest predicted noise level. The method therefore ignores the potential benefit to be derived by secondary screening.

In the revised method, consideration has been given to the effect of secondary screening using the results of scale model investigations[11] and barrier geometry theory. Additionally, some site measurements were available mainly at locations which were screened by two rows of fairly continuous housing. Using all the available data the following formula was derived to calculate the overall attenuation provided by two barriers:

$$A_c = -10 \log [\text{antilog}(-A_A/10) + \text{antilog}(-A_B J/10) - 1] \text{ dB(A)}$$

where A_C is the combined attenuation for two barriers.
A_A is the performance of the most effective barrier.
A_B is the performance of the least effective barrier.

$$\text{and } J = \left[\frac{\text{distance between barriers}}{\text{distance between source and receptor}}\right]^{1/4}$$

N.B. A_A and A_B are negative values.

Generally, this formula will provide a combined performance value similar to the performance of the most effective screen or barrier, which is, therefore, similar to the previous method. However, under certain conditions, particularly when one barrier is positioned close to the source and a similar barrier is close to the receiver, the above formula may allow a further 2.5 to 3 dB(A) extra attenuation than that resulting from applying the method in the previous CRTN.

Low traffic flows

The philosophy underlying the CRTN method relies upon the assumption that individual vehicles in the traffic stream act as omnidirectional and incoherent point sources which, when present in sufficient numbers to form a traffic stream, produce a line source of sound energy which obeys the fundamental laws of line source propagation. With these provisos, the effect of varying the numbers of vehicles in the traffic stream does not affect the characteristics of the source, and its magnitude can then be represented by an unique logarithmic function of the flow number. The following form has been found to apply in most cases and has been incorporated in both the previous and revised versions of CRTN:

$$L \propto 10 \log Q$$

where L is the basic noise level dB(A) and Q is the vehicle flow.

However, as the flow reduces, the individual vehicles become progressively more separated in the traffic and begin to behave more as independent point sources. This change in the flow pattern has an effect on both the distance attenuation, which becomes more closely similar to point source propagation, and the flow term which, when expressed in terms of changes in L_{10}, also takes on a different form[12].

The previous method does not recognize these characteristics of the source, as the method was designed specifically to deal with moderate and high vehicle flows where both distance attenuation and flow coefficients remain effectively constant over the range of application. However, for low vehicle flows the previous method will tend to over-predict L_{10} with a maximum theoretical error rising to 4 dB(A) approximately. Although low vehicle flows are rarely encountered in entitlement calculations, situations can occur when using the method to examine traffic management changes where traffic flows may be very low. For example, where a bypass is constructed such that nearly all traffic is diverted onto the new road[13].

To cater for these situations the revised CRTN provides correction formulae for low vehicle flows in the range:

$$50 \leq q < 200 \text{ vehicles per hour}$$

and,

$$1000 \leq Q < 4000 \text{ vehicles per 18-hour day}$$

The correction to the basic noise level for vehicle flows in these ranges is given by:

$$\text{Correction} = -16.6 (\log D) (\log C)^2 \text{ dB(A)}$$

where $D = 30/d'$,

d' is the shortest slant distance between the reception point and source line. (N.B. the correction applies only when $d' < 30$ m),

and $C = q/200$ or $Q/4000$

depending upon whether the correction is applied to an hourly L_{10} or L_{10} (18-hour) dB(A) value respectively, and q and Q are the hourly and 18-hour traffic flows respectively.

The above formula was developed using a computer simulation model developed at TRRL[14] and was later checked using site data.

In defining the flow ranges where this method is to be applied it is recognized that when traffic flows are below 50 veh/h or 1000 veh/18-hour day, calculations become unreliable and measurements should be carried out.

Roads in retained cut and noise barriers flanking both sides of the road

Where a road is flanked on both sides by substantial noise reflecting surfaces, such as retained walls or purpose-built noise barriers, the screening performance of such barriers can be reduced due to reflection effects. The previous method makes allowance for these effects. For example, for the case of a road in a retained cut, the reflection correction is determined from the depth of cutting and the angle subtended to the vertical by the retaining walls. For dual barriers, however, the reflection correction is 1 dB(A), which is added to the basic noise level irrespective of the heights of the barriers and other site-layout features. These procedures in the previous method led to the following criticisms:

1. Although the method treats retaining walls and purpose-built noise barriers as hard reflecting surfaces, the difference in the procedure for calculating the reflection correction can be as much as 5 dB(A) under similar propagation conditions.
2. Both procedures for calculating the reflection correction are independent of site layout, e.g., where the retaining walls or barriers vary in height and distance of separation.
3. Where barriers are erected on top of retaining walls, no advice is given on which correction should be applied to take account of reflection effects.

To improve the method to take account of these deficiencies, a computer model has been developed based upon ray path techniques to simulate the results obtained from scale model work that formed the basis of the reflection correction for retained cut in the previous method[15]. The computer model was then extended to investigate the variation in the reflection correction for different receiver positions and changes in the distance separation between the screening and reflecting walls. An interpolation technique was then developed to take account of the effect of differences in the height of the screening and reflecting walls.

In the revised method a compatible procedure for calculating the reflection correction for both dual barriers and retained cut situations has been included. In calculating the reflection correction the revised method takes into account the site-layout parameters shown in Figure 6. Briefly, these are: the relative heights of the reflecting (Y) and screening (W) walls and their distance of separation (E) together with the relative position of the reception point (α, β). The revision also includes additional procedures to enable the reflection effects to be calculated where purpose-built noise barriers are erected on top of retained cut as shown

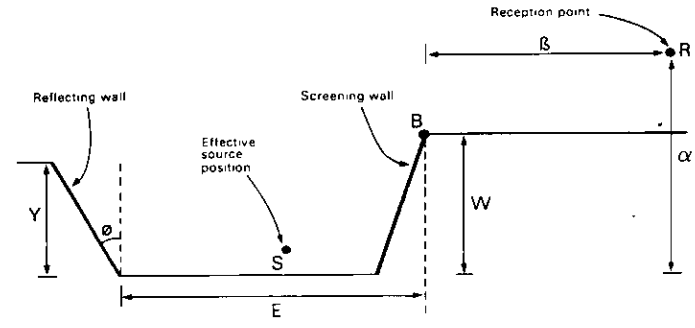


Fig. 6. Site parameters for calculating reflection correction for roads in retained cut or flanked by barriers

diagrammatically in Figure 7. The relevant parameters, i.e. W, Y and ϕ, are calculated by treating the barrier and retaining wall as a single structure.

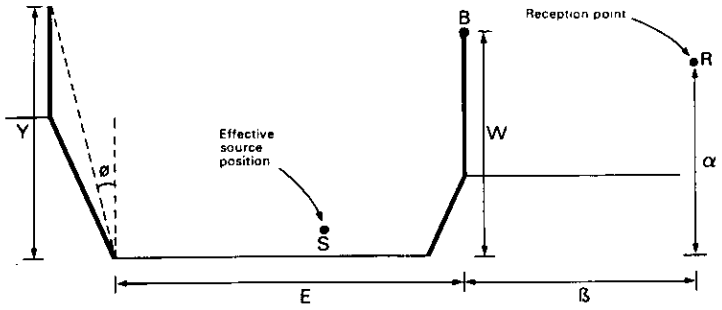


Fig. 7. Dual barriers on top of retained cut

Although the revised procedure is more complex, it does enable the prediction method to be applied to a greater range of site configurations.

Overall prediction accuracy

Comparing the predicted noise levels using the previous method with a data bank of 2064 measurements, the mean prediction error (predicted minus measured) is −0.6 dB(A) with an rms error of 2.5 dB(A)[12]. It has not been possible to compare the predicted noise levels using the revised method with the original data bank. However, a small survey consisting of 46 measurements at 10 different locations has been carried out. Comparing the predicted and measured noise levels using the previous method gives a mean prediction error of −0.4 dB(A) with an rms error of 2.1 dB(A) and for the revised method the mean prediction error is +0.1 dB(A) with an rms error of 1.9 dB(A). Based on this small sample there is no significant difference in the prediction accuracy of the revised method. However, the main aim of the revision was to extend the range of application of the method and, therefore, in these situations the overall accuracy of the method will be improved by the revision.

Conclusions

The main aim of the revision of CRTN has been to extend its range of application and under these situations to improve the prediction accuracy. In particular, the revised method allows calculations to be carried out taking into account the following factors which the current method does not fully consider.

1. An improved procedure to take account of road gradient.
2. The effect of road surfaces on traffic noise levels.
3. The propagation of traffic noise over mixed types of ground cover.
4. The reflection of traffic noise from façades located on the opposite side of the traffic stream.
5. The additional attenuation of traffic noise offered by secondary screening.
6. The change in the traffic flow function with traffic noise level for low traffic flows.
7. The effects on the reflection of traffic noise due to changes in the design of roads situated in retained cut or flanked on both sides by purpose-built noise barriers.

Acknowledgements

The work described in this paper forms part of the programme of the Transport and Road Research Laboratory and the paper is published by permission of the Director.

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IOA HONOURS AND AWARDS

The Institute of Acoustics annually honours people whose contributions to the world of acoustics have been particularly noteworthy. Since its creation in 1974 the Institute has been able to award the Rayleigh, Tyndall and Wood Medals and offer Honorary Fellowship to chosen recipients. More recently the Stephens Lecture and the Simon Alport Prize have been introduced.
Members are reminded that nominations for the 1990 Medals and the 1989 Simon Alport Prize are now being sought.

Rayleigh Medal

John William Strutt, Third Baron Rayleigh (1842–1919) is remembered as a most versatile physicist, both as an experimentalist and as a physician. A graduate, fellow and finally Chancellor of Cambridge University, he was early elected to Fellowship of the Royal Society of which he was President from 1905 to 1908. He received the Nobel Prize for physics in 1904.

Rayleigh's work covered practically every branch of physics and he was the co-discoverer with William Ramsay of the rare gas argon. In acoustics, he published over 100 articles and his book *The Theory of Sound* remains a landmark in the development of the subject.

The Rayleigh Medal, of gold-plated silver and bearing the portrait of Lord Rayleigh, is awarded without regard to age to persons of undoubted renown for outstanding contributions to acoustics. The award is normally made to a United Kingdom acoustician in even-numbered years and to a foreign acoustician in odd-numbered years. The Medal was instituted by the British Acoustical Society and has been awarded by the IOA since 1975. The Institute is pleased to have honoured these acousticians with the Rayleigh Medal:

P H Parkin UK 1975
L M Brekhovskikh USSR 1977
E G S Paige UK 1978
E A G Shaw Canada 1979
P E Doak UK 1980
K U Ingard USA/Sweden 1981
G B Warburton UK 1982
E J Skudrzyk USA/Austria 1983
J E Ffowcs Williams UK 1984
P J Westervelt USA 1985
E J Richards UK 1986
M R Schroeder Germany 1987
D G Crighton UK 1988
H E von Gierke USA 1989

Tyndall Medal

It may surprise some readers to discover that John Tyndall (1820–1893) was active in acoustics before Rayleigh, and indeed Rayleigh actually succeeded Tyndall as Professor of Natural Philosophy at the Royal Institute – a post Tyndall had held for most of his career. Born in Co. Carlow, Ireland, he studied chemistry, physics and maths at Marburg University (under Bunsen) and was elected a Fellow of the Royal Society in 1852. Later he took up the subject of the acoustic properties of the atmosphere and his volume of lectures On Sound has been reprinted many times.

Tyndall was a distinguished experimental physicist but is remembered primarily as one of the world's most brilliant scientific lecturers. The Medal named after him, a silver-gilt medal, is awarded to a citizen of the UK, preferably under the age of 40, for achievement and services in the field of acoustics. The British Acoustical Society first awarded its silver medal in 1970 and since 1975/6 the Tyndall Medal has been awarded biennially. The following is the list of recipients:

M E Delany 1975
H G Leventhall 1978
R K Mackenzie 1980
F J Fahy 1982
R G White 1984
J G Charles 1986
M F E Barron 1988

A B Wood Medal

Albert Beaumont Wood was born in Yorkshire in 1890 and graduated from Manchester University in 1912. In 1915 he became one of the first two research scientists to work for the Admiralty on anti-submarine problems and he later designed the first directional hydrophone for use in submarine detection. He was well known both for his many contributions to the science of underwater acoustics and for the help he gave to his younger colleagues. The A P Wood Medal and Prize, instituted after his death as a result of the generosity of his friends on both sides of the Atlantic, is aimed at younger researchers whose work is associated with the sea. The silver-gilt medal, parchment scroll and cash prize were first awarded by the Institute of Physics in 1970 and are awarded alternately to a UK and to a USA acoustician, recommendations for the USA recipients being made by the Acoustical Society of America. Recipients of the A B Wood Medal are as follows:

P A Crowther UK 1976
P R Stepanishen USA 1977
A D Hawkins UK 1978
P H Rogers USA 1979
I Roebuck UK 1980
R C Spindel USA 1981
M J Buckingham UK 1982
P N Mikhalevsky USA 1983
M J Earwicker UK 1984
T K Stanton USA 1985
P D Thorne UK 1986
D Chapman USA 1987
V F Humphrey UK 1988
M G Brown USA 1989

Stephens Lecture

The first major honour to be created since the Institute's inception in 1974 was fittingly instigated ten years later when at the Spring Conference in Swansea, and in the presence of Dr R W B Stephens himself, Dr Edgar Shaw gave the first Stephens Lecture. Dr Stephens, a graduate of Imperial College London where he subsequently created his Acoustics Research Group, is known to us not only for his own acoustics work but also through that of the many students whom he helped and guided in their careers; he was also the first President of the Institute of Acoustics, which he was instrumental in creating. The Stephens Lecture, set up in honour of his eightieth birthday, is held annually, and given at the Spring Conference, and is intended to be an important occasion at an IOA Meeting, marked by the presentation of a scroll to the Lecturer.

The following distinguished acousticians have given the Lecture:

E A G Shaw Canada 1984
L Bjørno Denmark 1985
H Kuttruff W Germany 1986
A Sliwinski Poland 1987
D E Weston UK 1988
A F W Embleton Canada 1989

Simon Alport Prize

The prize is donated by Cirrus Research and awarded by the Institute in memory of Simon Alport, a young engineer whose career in acoustics was tragically cut short. It is presented to the person or persons who, in the opinion of the judges, have published during the year of the award the best paper describing work involving the use of computers in acoustics. Papers published in English in

recognized journals or in the proceedings of conferences or meetings will be eligible for consideration. Recipients must be under the age of 28 years on the date of publication. The previous winners are:

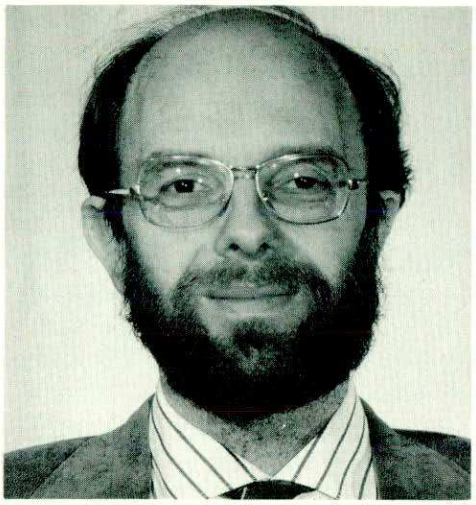
J R Wright UK 1987
A M Raper UK 1988

Honorary Fellows

Honorary Fellowships are awarded to distinguished persons intimately connected with acoustics, or a science allied thereto, whom the Institute wishes to honour for exceptionally important services in connection therewith, and any distinguished person whom the Institute may desire to honour for service to the Institute or whose association therewith is of benefit to the Institute, shall be eligible to become Honorary Fellow of the Institute. The total number of Honorary Fellows shall not exceeed 2 per cent of the number of persons elected as Corporate Members of the Institute. Honorary Fellows are:

W P Mason USA 1974
D G Tucker UK 1975
R W B Stephens UK 1977
L W Cremer W Germany 1977
J Lighthill UK 1978
W A Allen UK 1978
E J Richards UK 1978
J Lamb UK 1980
W Taylor UK 1980
F Ingerslev Denmark 1981
C A Taylor UK 1985
B Pippard UK 1985
P V Bruel UK 1986
C M McKinney USA 1986
M E Delany UK 1989

Michael F E Barron – Tyndall Medal 1988



Michael Francis Evan Barron was born on 6 September 1945 and received his secondary education at Clifton College, Bristol. He went up to Pembroke College, Cambridge and graduated in 1967 with a first class honours degree having read both Engineering and Economics in three years.

Michael Barron's interest in auditorium acoustics can be traced back to his postgraduate research at the University of Southampton and the University of Western Australia. His doctoral thesis is a seminal work which provides fundamental evidence to support the hypothesis that early reflections in concert halls give rise to a desirable subjective impression of spaciousness when listening to music. This publication, together with two important papers derived from it, are standard references on the topic.

In 1975 he was invited by Professor Peter Parkin to set up an acoustic modelling laboratory in the Department or Architecture at the University of Cambridge. During this period he developed innovative techniques for the testing of small scale models. More recently he embarked upon an acoustical survey of the major auditoria in Britain. The field work for this project is complete and the results of the survey will be published shortly in a book which will undoubtedly be a definitive reference work. His main activity at present is in consultancy with Fleming & Barron and in January he will be taking up a Lectureship in the School of Architecture at Bath University.

With his experience and insight Michael Barron is recognized worldwide as a leading authority in auditorium acoustics. His advice is constantly sought by architects and acoustic consultants. The results of his research provide fundamental guidance for the acoustic design of auditoria.

The Institute of Acoustics takes great pleasure in awarding Michael Barron the Tyndall Medal for 1988.

1989 Spring Conference

ACOUSTICS '89

University College Oxford, 3 – 6 April 1989

Conference Organizer: Dr H G Leventhall, FIOA, Department of Environmental Engineering, Polytechnic of the South Bank

The Institute Annual Spring Conference is an opportunity for acousticians to present progress reports of their work in any field of the subject. It also offers members at all grades of the Institute the chance to participate in the major events in the Institute's year, including the 1989 AGM, the Annual Dinner and Presidential Address, the 1989 Rayleigh Medal Lecture and the R W B Stephens Lecture.

The following topics will receive particular emphasis this year.

- Physical acoustics including ultrasonics
- Warning signals and behavioural response
- Human response to vibration
- Outdoor sound propagation
- Environmental noise
- Aerospace noise and high intensity sound
- European issues.

There will also be a student session and an open session.

Papers considered to be of sufficient merit will be published in Volume 11 of the Proceedings of the Institute of Acoustics (1989) which will be available to delegates on arrival and for this purpose authors will be supplied with eight pages of camera-ready paper.

Companies wishing to take space at the manufacturers' exhibition should contact the Institute office.

IOA Diploma Examination 1988

Report of the Chief Examiner

The table of results shows few changes this year; these arise from changes in the Examiners of specialist modules. The total number of passes was 454. The Law and Administration module, as last year, had a slightly higher failure rate than others, though the average marks and standard deviations of the marks do not stand out particularly. As last year, again, the Transportation Noise module had a notably higher overall mean mark but the pass rate remained near normal. This year, the Noise Control Engineering module had a much larger than usual number of failures; it seems that the candidates were upset by a paper concentrating largely on description rather than calculation. It is well known that some candidates can remember formulae 'blindly', and they seem to have been unearthed this time.

Technical Articles

The editorial board would welcome offers of technical articles on Acoustics and related subjects likely to be of general interest. Please contact the Editor, John Tyler, at Pooh Corner, Chalkhouse Green, Reading RG4 9AG.

IOA Diploma Examination 1988

The following candidates are to be congratulated on qualifying for the award of the Diploma in Acoustics and Noise Control

Bristol Polytechnic

A R Billinghurst
Mrs M E Hopkins
Mrs M J Weston

Colchester Institute

D M Britt
J N Carpenter
T Curd
A A Gibson
J Grayling
C J Jackson
S C Lipscombe
A D Roddham
M D Wheatley

Cornwall College

P R Cumberlidge
J K Davies
P Stanton
D A Tilley
J A Timmins

Derbyshire College

M J Brown
R Carroll
P G Davies
Miss J M Dimberline
B B Fulford
P J Insley
E W Kelley
A V Kemp
D R Kettlewell
D Patterson
Miss J M Plumb
M C Rayns
E G Staley
J M Staniforth
P Sunderland
C E Wright
J Zarins

Leeds Polytechnic

D V Randon
I. Twynholm-Mason

Liverpool Polytechnic

G Adamson
C D Beer
A G Bibi
G Brown
Mrs S L Clowes
R B Cresswell
J A Crosbie
P J Gordziejewicz
Miss J C Hope
S Lockwood
A D Muir
K Pemberton
B Phillips
T Richards
C R Sharp
D P Tilleray
I J Westbrook
C J Willans

IOA Diploma Summary 1988

College	General Module M P F	Architectural Acoustics M P F	Noise Control Engineering M P F	Transportation Noise M P F	Vibration Control M P F	Law and Administration M P F	Measurement and Instrumentation M P F	Project M P F	Totals M + P + F → T	Pass %
A	5 21 3	6 11 0	2 11 3	3 13 0	— — —	0 13 1	1 4 1	6 8 0	23 81 8 → 112	92.9
B	3 14 2	2 15 2	0 1 0	1 18 1	— — —	— — —	— — —	3 15 0	9 63 5 → 77	93.5
C	2 15 2	5 12 2	2 9 9	— — —	— — —	— — —	— — —	2 12 1	11 48 14 → 73	80.8
D	0 3 0	0 4 0	0 2 1	1 2 0	— — —	0 8 1	— — —	3 1 3	4 20 5 → 29	82.8
E	0 8 3	— — —	0 6 5	— — —	— — —	0 7 5	— — —	0 2 0	0 23 13 → 36	63.9
F	0 1 0	1 0 0	1 1 0	— — —	— — —	0 2 0	— — —	0 1 1	2 5 1 → 8	87.5
G	4 8 1	0 5 4	0 1 4	0 7 3	0 1 0	2 7 2	0 2 0	3 7 0	9 37 14 → 60	76.7
H	3 16 0	0 3 0	2 9 1	1 17 0	— — —	0 10 1	— — —	2 12 0	8 67 2 → 77	97.4
J	3 8 0	— — —	0 9 2	— — —	0 4 1	2 7 1	— — —	5 5 0	10 29 3 → 42	92.9
K	0 2 0	— — —	— — —	— — —	— — —	0 1 0	— — —	— — —	0 3 0 → 3	100.0
L	— — —	— — —	— — —	— — —	— — —	— — —	— — —	— — —	— — —	—
P	— — —	— — —	— — —	— — —	— — —	— — —	— — —	0 2 0	0 2 0 → 2	100.0
Totals	20 96 11	14 50 8	7 49 25	6 57 4	0 5 1	2 55 11	1 6 1	24 63 5	76 378 65 → 519	87.5
Pass %	91.3	88.9	69.1	94.0	83.3	83.8	87.5	94.6		

Key to Diploma Centres:

A North East Surrey College of Technology
B Liverpool Polytechnic
C Newcastle Polytechnic
D Cornwall College of Further and Higher Education
E Leeds Polytechnic
F Bristol Polytechnic
G Tottenham College of Technology
H Derbyshire College
J Colchester Institute of Higher Education
K Heriot-Watt University
L North Staffordshire Polytechnic
P Sheffield Polytechnic

Newcastle Polytechnic

J L Boyle
T J Deveaux
P Doughty
Mrs V E Harrison
R Martin
P M Robertson
K A Wallace

North East Surrey College of Technology

Miss C Barlow
D A Bryce-Smith
Miss J E Clark
B G S Heywood
M D Hills
Miss J E Humphries
B R Q Hunter
Ms I M Kruszewska
J W Mann
G E Scott
G J Steady
Ms A E Thomas
Ms T J Viney
C A Wootton

Sheffield City Polytechnic

N Jones
G Rees

Tottenham College

M Berman
Miss D A Bond
P J Carey
Mrs S C Coxell
J D Jackson
S J Habgood
A J Rees
D Serota

Congratulations also go to the candidates listed below for obtaining passes in additional Specialist Modules in 1988

Colchester Institute

S J Ferenczi
D W Harper

Derbyshire College

P G Davies
A V Kemp
D R Kettlewell
C E Wright

Newcastle Polytechnic

L J Dodds

North East Surrey College of Technology

D S Cunningham
J M Fletcher
L T Glass
K Harpur
Mrs D G Langdown
R A Parker-Harding
J R Pyke
P R Reddell

Tottenham College

A Conrad
N L Forster
A J Rees
D Serota

Institute of Acoustics Prize for the best overall academic performance in the Diploma Examinations

Prizewinner:
Mrs Vivien Elizabeth Harrison (Newcastle)

Specially commended:
Miss Deborah Ann Bond (Tottenham)
Mrs Ann Carolyne Ashby (Colchester)
Miss Jennifer Jane Farr (Nescot)

HEARINGS AIDS: THE CASE FOR CHANGE

The Royal National Institute for the Deaf has launched 'The Fair Hearing Campaign' and published a supporting document entitled *Hearing Aids: The Case for Change.*

The document makes the case for a re-organization of existing services for the provision of hearing aids and auditory rehabilitation, and makes proposals on how these may be achieved. The aim of the campaign is to better provide for the future needs of the consumer.

Members of the Institute have been invited to comment on the document, either individually or collectively. Could I therefore suggest that those wishing to take part in the debate write to the Royal National Institute for the Deaf, 105 Gower Street, London WC1E 6AH, and obtain their personal copy of the document. I would be happy to collate contributions which should be sent to me by 18 February 1989.

C G Rice, President

NEW ELECTIONS

The following elections to membership of the IOA were recently approved by Council.

Associate

*N J N Alexander
P M Anakwue
P J Ashford
B D Billington
C A Brown
S P Brown
D A Coggins
P A Dennis
J M Dimberline (D)
N R Duffin (D)
B Duncan
P S Evans
N J Felgate
J M Fletcher (D)
F D W Fraser
C J Greaves
S J Halsall
J D Hand
D J Howes
J E Humphreys (D)
D R Hunter
*K Lambell
G T Lawton
*J Lloyd
*F Khair
B Ma
J W Mann (D)
P R J Mansfield
H M McDonald
*T E Noble
R Pemberton
*N Porter
A M Raper
P Rodwell
E S Scott
J Sim
P P Soiza
S Stenson
D M Stevens
C P Stollery
S Viadyanathan
D A Wright

Student

M Brooke
K G Hamson
P Hanes
N Hogwood
P R Malpas
A Mavroidis
A R Raymond
M H D Santer
A Shadbolt
M A Sugden
A C Thompson
B A Wilkins
E N Wrigley

D: Diploma Student
*: From Student to Associate

Call for Papers

Non-Contacting Ultrasonic Techniques and Applications

University of Warwick – 21 March 1989

It is proposed to hold a one-day meeting at Warwick to review the present status and future possibilities of non-contact generation and detection of ultrasound. Presentations will describe the techniques of ultrasound generation by pulsed lasers, chopped cw lasers and by EMATs in conjunction with ultrasound detection by laser interferometry and EMATs. Possible applications will be emphasized.

Since this field is now more than ten years old it is proposed to address the question of industrial relevance of the various methods and pinpoint the areas where non-contacting techniques can make a significant contribution. The programme is nearly complete but there are some spaces for additional papers and authors should send a brief title and abstract to Professor S B Palmer, Department of Physics, University of Warwick, Coventry CV4 7AL, from whom further information and registration forms can be obtained.

It should be noted that the meeting is co-sponsored by the Physical Acoustics Group and Materials & Testing Group of the IOP, the Research Group of the British Institute of NDT and the Institute of Acoustics.

CHARTERED STATUS

Members of the Institute of Acoustics have welcomed the possibility of enhancing their status and hence their profession by acquiring the title of either Chartered or Incorporated Engineer. Many members already have that status through their corporate membership of other professional institutions such as the Institution of Electrical Engineers and Institution of Mechanical Engineers, etc. This, however, is not possible for all members of the IOA and so the Institute Council worked hard to provide an alternative route to chartered and incorporated status.

Engineering registration

One of the responsibilities of the Engineering Council is to maintain a Register of Engineers and only those registered as such can call themselves Chartered or Incorporated Engineers. The Engineering Council recognizes that the Institute of Acoustics has members employed in engineering but at the same time covers a much broader spectrum of interest. In order to cater for the engineers the Institute has become an 'Institute Affiliate'. This means that the IOA has the same responsibility for processing applications but instead of sending approved applications direct to the Engineering Council they are assessed by a nominated body.

The Institute of Acoustics is an Institution Affiliate of the IMechE. The IMechE will act on behalf of the Engineering Council in checking that the criteria set by the latter are met.

As the process of applying for engineering registration must be kept separate from the process of applying for membership of the IOA, an Engineering Division Committee has been set up to deal with all matters relating to engineering registration. To assist it in this task two sub-committees have also been created, one for Joint IOA/IMechE Registration and the other to cover Education and Training as described in the October 1988 *Bulletin*.

An important aspect of becoming an Institute Affiliate means that not only members of IOA can be given guidance and assistance to become Chartered or Incorporated Engineers but also that it will become part of the Accreditation Process for degree and training courses. It will also have representation on the Engineering Council which thereby gives the IOA a voice on a very influential and policy making body.

Registration

In the first instance the Engineering

continued on opposite page

Diploma in Acoustics and Noise Control 1988

Titles of Diploma Projects

Bristol Polytechnic
Sound insulation of internal partition walls in new hospital buildings

Colchester Institute
Noise from a diesel generator set
Construction noise from house renovation
Motorway noise – background levels and meterorological conditions
Occupational noise exposure of poultry meat inspectors
Road surface noise – an appraisal
Controlling noise in a computer suite
The influence of the listening room on the reproduction of music
Vibration characteristics of diesel engine supports
Noise control of a 33/11 kV sub-station
Village hall acoustics

Cornwall College
The noise impact of opencast operations
Prediction of noise level from cattle grids
The environmental impact of motorcross in a rural residential area
An assessment of the effect of de-trunking the A40 on traffic noise in Cheltenham

Derbyshire College
Environmental control of modern-day car washers
An investigation into the potential for disturbance by noise created by a heavy industrial factory
Noise from vehicle mounted refrigeration units
An investigation of the acoustic requirements of modern multi-purpose auditoria
Study of noise produced during machining of aluminium–bronze castings
Clay pigeon shooting
Sheffield 'city' airport: an assessment of noise impact
An investigation of speech privacy in offices
An investigation into impact sound reduction of floors
An assessment of the interference due to traffic noise in a noise abatement zone
Measurement of SRI for various panels and louvres using a purpose-built test chamber
Aircraft noise at Barnastoi airport
Noise emission from a woodworker's factory
Noise produced during the recovery of coal from a disused spoil heap

Liverpool Polytechnic
Subjective and objective aspects of recording studio design
An investigation of turbulence noise in a heating/ventilation system
The design and testing of an antivibration system, for protection against vibration from underground trains
An investigation into sound propagation through an area of woodland
Noise emission from the use of portable powered tools
Investigation of acoustical performance of Lower Hall of Ashton Memorial, Lancaster
The effect of measuring sound power levels of a noise source in contrasting acoustic environments
Testing a practical method of improving diffusion in a reverberation room
The effectiveness of secondary glazing on a busy dual carriageway
The decay of sound pressure level from a shotgun over distance on a slightly sloping site
Hearing loss in livestock dealers and potential sources of harmful noise
An investigation into the effects on frequency of extending the head joint of a flute
Aspects of the relationship between LAeq and LA10 for road traffic noise
Speech intelligibility in swimming baths
Comparison of background noise levels in Blackpool, in and out of the holiday season
An investigation into the effect of the sea, and consequent tidal variation, on background noise levels in Blackpool
The acoustic assessment of a remote broadcasting studio
An evaluation of reflection effects with distance

Newcastle Polytechnic
An acoustic assessment of Newcastle Civic Centre banqueting hall with regard to speech and music use
Prediction of railway noise from a proposed reinstatement of a mineral railway line
Road traffic noise – comparison between measured and predicted L_{10} noise levels
Investigation of the sound radiation field from a vibrating panel
Study of the frequency spectrum of the normal adult voice
Investigation into the effectiveness of ear plugs on the hearing threshold using an automatic recording audiometer
An attempt to establish whether a noise nuisance actionable by Statute is being caused to a complainant by the operation of the Tyneside Metropolitan Railway
Comparison of sound power level measurement methods
The prediction of noise from construction sites and an evaluation of monitoring techniques
A noise control investigation of an articulated dump truck
Comparison of actual and predicted noise levels on a central station air conditioning unit
The occupational exposure of guards on Darlington railway station to noise
Prediction and measurement of the effectiveness of pipe isolation mounts
An investigation into the prevailing noise levels within a teaching workshop

North East Surrey College of Technology

An acoustic assessment of the Lodge Studio
Assessment of the hearing protectors available for the protection of the DIY enthusiast
An acoustical investigation into the problems associated with the use of a Whales Jet-Vac vehicle
An investigation to test the simple theories of sound pressure level prediction
An assessment of the acoustic quality of the Commonwealth Institute Theatre, Kensington High Street, London W8
An evaluation of the hazard to hearing consequent upon the firing of small arms in indoor ranges
An acoustical survey of a manufacturing light industrial unit and the levels of occupational noise experienced by the employees
An acoustic study to test the accuracy of prediction of reverberation time using Sabine's Formula and published absorption coefficients
An investigation into the noise disturbance brought about by the installation of a new lift motor in a block of flats
An investigation into the attenuating effects of distance and barriers on the sound from 0.22 inch rifle and pistol shooting
The noise problems between flats in converted dwellings
An assessment of the effectiveness of utilizing low frequency structural bearings to reduce railway vibration at 70 Kingscroft Lane
A comparison of the practical and theoretical evaluations of the performance of an enclosure
An investigation into the impact sound insulation offered by a variety of surface treatments to a suspended timber floor

Tottenham College

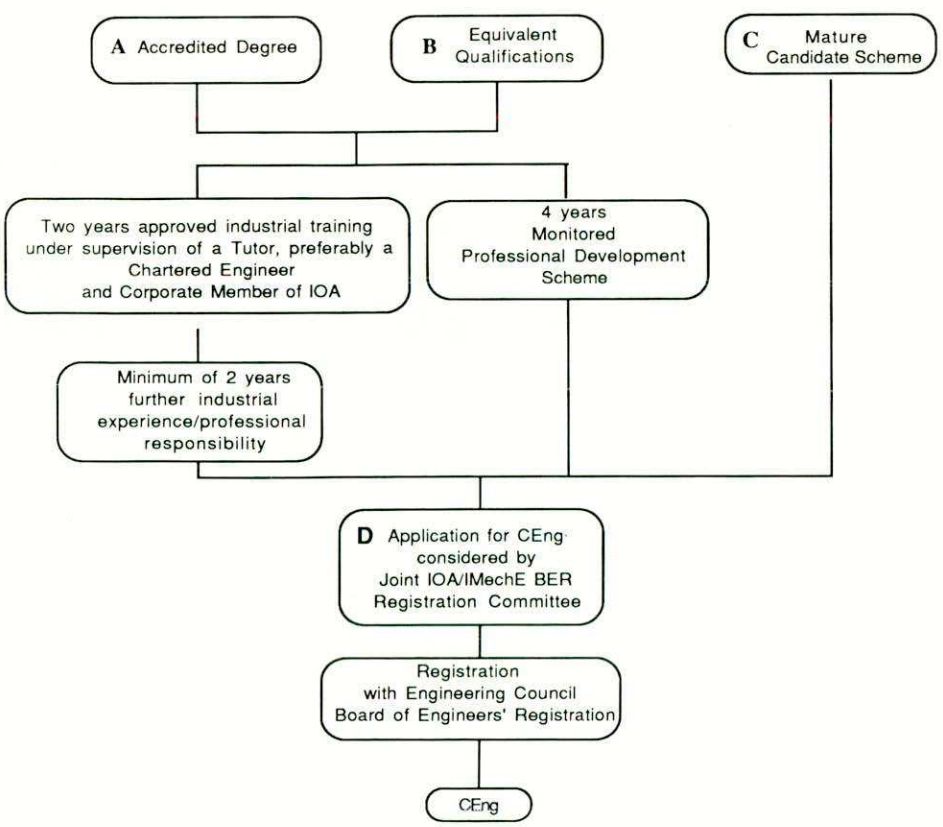
An assessment of noise nuisance caused by portable air compressors
A study of the noise generated by Victoria Coach Station
Reflection effects of aircraft noise in the Camel Road area
A model to objectively assess the sound level produced by 'secondary activities' resulting from proposed large-scale recreational facilities affecting mixed residential areas
Noise problems associated with a bottle bank
Helmholz resonators and resonator tubes – an investigation into the effects to the resonant frequency caused by angling these resonators
The problem associated with general aviation airfields and their control
Determination of the LAeq of a site intended for residential development adjacent to a railway
To assess the occupational exposure noise levels in a fire engine cab
Refurbishment of a reverberation chamber

CHARTERED STATUS contd

Division will concern itself with those who are seeking Chartered Engineer status. To become a Chartered Engineer members must have completed

(a) education at degree level, and
(b) two years training in the profession of acoustics, and
(c) five years of responsible professional service.

ROUTES TO CEng



An Engineering Council accredited honours degree in Electroacoustics (BEng University of Salford) or in Engineering Acoustics and Vibration (BEng or MEng University of Southampton) or equivalent qualification (for example an Engineering Council accredited degree together with an MSc in Acoustics from Heriot-Watt, Salford or Southampton Universities or the Institute's Diploma in Acoustics and Noise Control, providing this includes two merit awards in approved subjects) forms the basis of the educational requirement. The training and professional experience requirements are as outlined in the Institute's document 'Training and Experience Regulations for Chartered Engineers'. A Mature Candidate Scheme forms an alternative way of achieving the formal academic requirements. The diagram outlines the alternative routes to becoming a Chartered Engineer.

All candidates who intend to proceed with a route to Chartered Engineer must complete the appropriate form* and return it to the Education and Training Sub-Committee of the Engineering Division.

Cost of Registration

The processing of applications for registration will require both time and resources. As it would be unreasonable to expect the cost to be shared amongst all Institute members a charge will be made to those members applying. This will be in addition to any charges made by the Engineering Council. It is hoped that the Institute's application fee will shortly be decided.

*All application forms and guidance documents are currently with the printer. Members will be informed of their availability as soon as possible.

Peter Lord

Notes to diagram

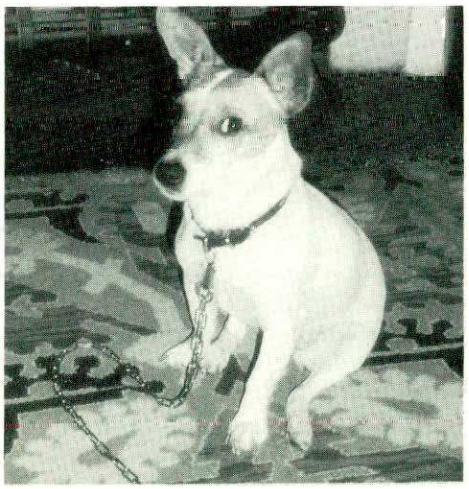
A Engineering Council accredited BEng in Electro-acoustics of the University of Salford or BEng/MEng in Engineering Acoustics and Vibration of the University of Southampton.
B Other Engineering Council accredited degrees supported either by the Diploma in Acoustics and Noise Control of the Institute of Acoustics, with at least two merit awards in approved subjects, or by a postgraduate course in acoustics and/or vibration approved for the purpose by the Institute of Acoustics, such as the MSc degrees in Acoustics of Heriot-Watt, Salford and Southampton Universities.
C Provides alternative to the SARTOR Codes of Practice Stage 1 academic requirements.
D Corporate Membership of IOA required. Minimum time requirement is seven years from A or B to application for CEng at D. Minimum age requirement is 25 years for routes A and B, and 35 years for route C.

Windermere Conferences 1988

A personal view of this year's events by Mike Ankers

The beauty of Lakeland in autumn provides a firm incentive for delegates and their families to brave long distances and uncertain weather conditions in order to attend one (or both) of the Institute's November conferences. Such events have been a part of our calendar for some nine years and have proved a consistent success.

This year we have again held two November conferences. First came *Reproduced Sound 4* (3-6), followed by the *Autumn Conference* (24-27) which took as its theme *Noise in and around Buildings*. With 86 and 125 delegates repectively the numbers were a little below what the organizers had hoped for but were satisfactory nevertheless. Much more gratifying was the increase in what are now referred to as 'accompanying persons'. This admittedly clumsy phrase covers a wide and happy band of non-conferees – wives, husbands, friends, children and dogs[1] – who soften the



sharp and formal edges of the conferences and spread them into a wider and more communal experience.

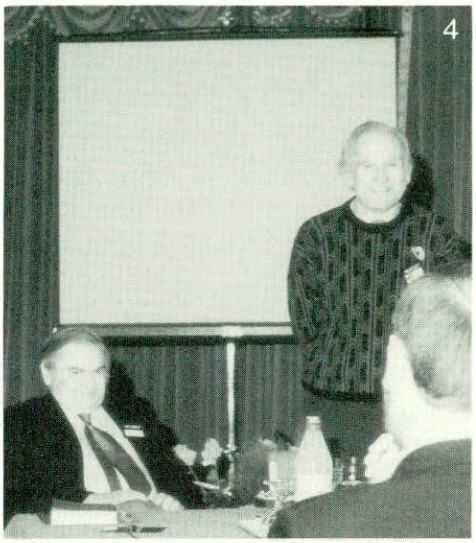
Their programme of visits, conducted by our team of skilled and intrepid minibus drivers Mike, Martin and Jill, leads them to wild places, to crofts with sheep and spinning wheels, to magical castles and stately homes, to shops for coffee and discreet present-buying, as well as to cold yet memorable views of the area from the deck of a lakes cruiser. The weather was unseasonal (for the Lakes) this year, being fine and dry with clear and sunny skies at the beginning of the month. Whilst the rest of England was suffering dense fog, we had some light mist with clear periods during the last week of November. Without the rain, however, there would be no Lakeland, so we never complain (much).

While there have been changes of style, format and content there have also been elements of constancy. The Windermere Hydro itself has moved from private ownership into the Mount Charlotte group, happily retaining most of its familiar and efficient management people. Many of the reception, bar, kitchen and porter staff remain to provide consistent and friendly levels of service in all areas and at all hours[2].

There were complaints this year – too much food! Similar remarks were heard about the quantity of punch which was liberally dispensed at the bonfire with fireworks held during the first conference.

Reproduced Sound 4

Tutorial sessions, ostensibly for those requiring an introduction to various aspects of acoustical theory and practice, were a feature. Much to the surprise of the tutors (R Lawrence[3], P Lord and J R Wright) these proved highly popular and not a little provocative, even at 8.30 a.m.! The invited lectures by Professor P B Fellgett[4], J



Watkinson and Profesor A E Evans were presented to packed audiences and clearly deserve to be more widely published.

However, a special place of honour must go to the tireless Ken Dibble[5]

who, in addition to presenting three papers, provided the sound reinforcement and replay facilities, ably 'driven' by Dibble minor, Robin[6]. As if this were not enough, Ken was a source of musical entertainment, too.


6

Whilst it is a little unfair to pick out particular papers, special mention must be made of those presented by Gordon Dalgarno and Andy Hunt, both of the University of York. The former is deeply involved in the design of systems by which deaf and partially hearing people may be helped to sense and appreciate music. Andy demonstrated 'MIDIGRID', a computer program which enables almost anyone to compose and perform music, live. Even the extensively disabled can participate in the production of music by tailoring the system to their special needs and desires. Like much research in fields involving minorities, funding is short, and perhaps the Institute could act as catalyst for fund-raising for such deserving causes.

Noise in and Around Buildings

The single session format was again tried for the 42 papers presented and, although this required early starts and late finishes, all asked expressed their satisfaction with the result. It is most frustrating at a one-topic conference to have to choose between several parallel sessions! Particular features were a workshop on the newly published *Calculation of Road Traffic Noise* and the presentation of a BRE video on *Sound Insulation*. Dr M F Barron delivered the 1988 Tyndall Medal Lecture and received the Medal and citation from the President[7].


7


10

Of special significance to me was another presentation, that of the Institute Prize (a cheque) to the best Diploma Student for 1988, because it went to Mrs V E Harrison[8], an Environmental Health Officer. A sizeable proportion of our membership is now drawn from EHOs, and even though they find it difficult to attend Spring and Autumn conferences, they are often active at Branch level. The President also expressed his pleasure at this evidence of increasing involvement in acoustics by women.


8

The presence at the conference of one of the world's greatest acousticians, Leo Beranek, here seen talking to Mrs Rice[9], was a singular honour. His after-dinner speech, in which he reflected on the non-acoustic parameters which influence (plague) the production and publication of reports, brought knowing nods from conference organizers throughout the room![10]


9

No conference would be complete without the exhibition, and the exhibitors always participate fully in all aspects of the weekend. Here D Coffey[11]


11

(Hakuto International) awaits the opportunity to participate! We are grateful for the support of our exhibitors, new and not-so-new, and I hope that the links between the Institute and the hard world of commercial acoustics can be extended and strengthened.

As has been said many times before, the major benefits to be derived from any conference are those of participation and contact. The unique, intimate and family atmosphere which pervades the Windermere Conferences is an experience to be enjoyed at least once, and preferably often. Why don't you make a special effort to reserve a space in your diary for 1989?

More about noise control in factory buildings

IOA Meeting at Salford University, 27 June 1988

As the title suggests this meeting was the second on this subject and had the general aim of bringing delegates up to date on various aspects of noise control in factories. The first meeting was held in Cambridge in 1982.

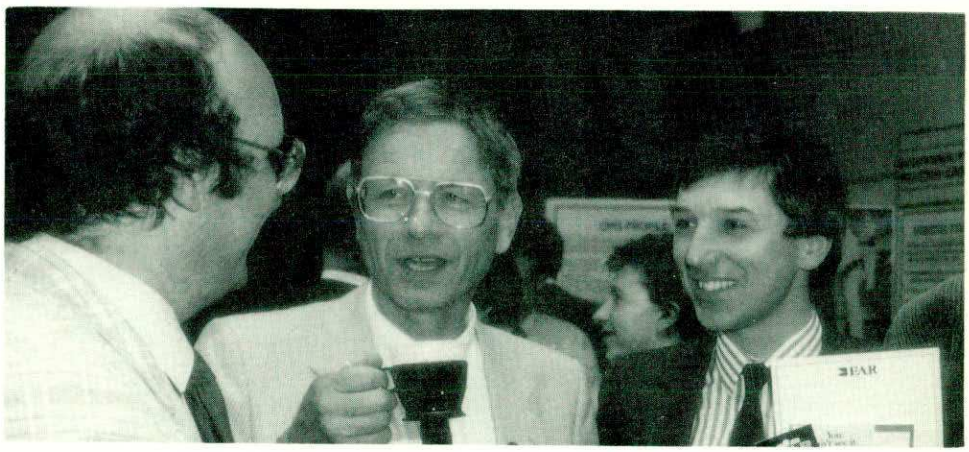
The papers presented fell broadly into three groups: namely, strategies and procedures for noise control; the prediction of noise levels in factories; and an examination of the acoustic properties of the materials encountered in factory buildings.

The morning session was chaired by Professor Peter Lord who welcomed delegates to Salford and introduced the first speaker, Mr Graham Custard, who has recently left the Health and Safety Executive (HSE) to become a consultant with Salford University Business Services Ltd. Mr Custard gave an overview of the impact which the new Noise Regulations are likely to have on the control of noise in industry and how the HSE will respond. He stressed that noise consultants will have to maintain a very high professional standard in order to achieve a balance between the requirements of the legislation, the needs of the workpeople and the resources of the employer.

Mr Ernie Hill, a past employee of ICI Mond Division and now a member of the Department of Applied Acoustics at Salford, gave an account of the noise problems which can be commonly found in large plants. He showed how a case book can be compiled which enables many of the problems to be solved in an almost routine, but highly effective manner. Particular emphasis was placed on making provision for noise control at the design stage.

Dr Raf Orlowski presented an overview of the behaviour of sound in factories and the factors which influence it. He then discussed the various methods that have been proposed for predicting noise levels in factories and concluded that although no single method has yet emerged for accurate prediction, there are several strong contenders.

Miss Ceril Jones and Dr Bridget Shield discussed their work on computer modelling of noise levels in factories. Dr Shield showed how she had developed a model by considering the direct sound from the source and the first reflections. This produced a noise level at a point which appeared to indicate a sound pressure fall-off something less than the inverse square law. Miss Jones summarized the further work she was doing to increase the accuracy of the model and to investigate the attenuation law more closely.



Three of the speakers in conversation; from left to right, Keith Attenborough, Erik Vigran and Raf Orlowski (the meeting organizer).

Unfortunately Graham Custard was unable to show the scheduled HSE video film on ear protection which was not quite ready for public viewing but he did present some stills from it. Mr Paul Randall of Portsmouth Polytechnic was able to stand in and showed a video on noise control which is part of a new distance learning package he has prepared on occupational health and safety.

Before lunch, delegates were invited to attend a sherry reception hosted by Salford University Business Services Ltd. Although a modest gesture it was very much appreciated and one was gratified to see how much bonhomie it generated.

The afternoon session was chaired by Dr Ian Hempstock who invited Professor Erik Vigran to present the first paper. Professor Vigran described a simple prediction model based on four pole theory for calculating the absorption of sound absorbing layers and also their effect on sound transmission. He demonstrated that this model provides results which are in good agreement with measurements. In the case of sound absorption Professor Vigran described a new measurement technique based on positioning a pair of microphones close to the sample which is placed in a free field environment.

Continuing on the theme of sound absorption and transmission, Mrs Nicola Alexander described measurements on corrugated steel plates. This material in various forms is now extensively used for the construction of factories. Mrs Alexander illustrated her talk with a fascinating video film which showed the modal vibrations of a corrugated steel plate. The film had been produced in collaboration with Vibro-noise, using finite element analysis.

The final two papers were concerned with industrial noise breaking out of factory buildings and propagating into the environment. Mr Mark Rowell and Dr David Oldham described investigations into the directional radiation from factory cladding panels. Emphasis was placed on the fact that profiled panels are orthotropic and exhibit two critical frequencies; the possible effects of this were discussed.

Dr Keith Attenborough, whose paper was co-authored with colleagues Dr Heap, Dr Li and Mr Nagra, presented an initial approach to the problem of predicting noise levels at distances up to several hundred metres from large factory buildings. From preliminary results, he concluded that the ground effect will play an important role in modelling of noise around factories.

A lively discussion period followed the formal presentations. The overall conclusion that emerged from the meeting was that the role of the noise consultant will be far more exacting when the Regulations are introduced and that accurate noise prediction methods will have an important part to play.

One other feature of the meeting to be mentioned is that it was held in parallel with a similar meeting on the Control of Substances Hazardous to Health (COSHH). This meant that around 150 like-minded delegates were expected in one building, making it feasible to hold a joint manufacturers' exhibition; this included stands from CEL, EAR, Salford University Business Services Ltd and others. Moreover, it enabled many useful conversations between IOA delegates and COSHH delegates.

Rafal Orlowski

The abstracts of this meeting were published in the October issue of Acoustics Bulletin.

SPEECH '88

The seventh FASE symposium – Speech '88 – was held in Edinburgh from 22 to 26 August under the auspices of the Institute and organized by Bill Ainsworth (FIOA, Keele University). Some 200 papers streamed in four parallel sessions attracted up to 400 delegates from many European countries, North America, the Middle East, India and Japan. The University venue and facilities were excellent for a meeting of this kind, to say nothing of the fact that it took place during the Festival period – a stroke of good luck or possibly very efficient planning and organization. Cathy Mackenzie and her team were constantly on hand to meet even the most difficult requests from delegates, thus ensuring that the Conference ran smoothly, effectively and with a great deal of good humour.

Following introductory remarks by organizer Ainsworth and a brief welcoming address and good wishes from V D Kalic, President of FASE, the meeting began with a plenary lecture given by Gunnar Fant, Professor at the Royal Institute of Technology, Stockholm, entitled 'The Human Voice Source: Acoustics and Models'. The other plenary lecture, given by Wiktor Jassem, Professor at the Polish Academy of Sciences, Poznan, was entitled 'The Phoneme and the Acoustical Speech Signal'. Both speakers have unarguably been leading figures in the areas of speech acoustics and phonetics during recent decades.

Automatic speech recognition by machine remains the dominant research area in speech, and this was reflected in the conference programme by the many papers covering all aspects of ASR. The other side of the technological coin – speech synthesis – is beginning to re-emerge as an area attracting significant attention: it is becoming increasingly clear that the present state of the art is inadequate for our needs at the man-machine interface.

Although acoustics and the technology of speech have in recent years been the more prominent areas of research in our field, it was good to see such a strong representation at Speech '88 of other important areas: speech and hearing disability, linguistics and phonetics, psychology, artificial intelligence. Many speakers emphasized the truly interdisciplinary nature of speech research and technology, and a few were keen to point out that the immediate attractions of the rapid technological developments we are experiencing must not be at the expense of continuing evolution of the underlying theoretical bases.

Speech '88 was a resounding success: the overall quality of papers was very high, wide-ranging in scope and deep in intellectual content. What ultimately makes the success of a conference, though, is its organization, and those who organized this one are to be wholeheartedly congratulated.

Marcel Tatham

isvr Short Courses 1989

1989

20-22 March	Vibration Measurement using Laser Technology
20-22 March	Active Noise Control
4-6 April	Image Processing
4-6 April	Adaptive Signal Processing
11-13 April	Digital Audio Signal Processing
17-21 April	Clinical Audiology
5-9 June	Applied Digital Signal Processing
10-14 July	Noise Control for Process Engineers
10-14 July	Practical Course in Community & Workplace Noise
5-7 September	Condition Monitoring
11-15 September	Technical Audiology
12-14 September	Introduction to Mechanical Vibration Measurement Techniques
13-15 September	Engine Noise and Vibration Control
18-22 September	Advanced Course in Noise and Vibration

ACOUSTICS AT
British Aerospace (Dynamics) Ltd

D Sims, Chief Acoustics Engineer

During a technical meeting at British Aerospace, Dynamics Division, in May 1988 considerable interest was expressed in the acoustic activities of the Hatfield site. In response to that interest this short note gives an overall view of the activities within the Acoustic Test Centre at Hatfield.

Historical background

The Hatfield site of the company is the research and development centre for air launched weapons. At an early stage the need to prove the operation of the various weapon systems under their arduous service operating conditions was apparent, and test laboratories were set up to provide the necessary simulated environments. The primary mechanical and climatic environments are: vibration, high and low temperatures, low pressure, mould growth and salt corrosion. Over the years the relative importance of these with respect to the reliability of the systems has been better established. For example, corrosion and mould growth testing on complete systems is no longer carried out, since problems in these areas are prevented by suitable selection of materials and finishes, the properties of which are now well established.

Temperature and vibration are, however, still the major environments from the aspect of equipment reliability. In the vibration field the early work was carried out using sinusoidal excitation. Then with the development of random vibration generators and computer controlled systems the realism of reproduction of the service environment was improved. Consequently it was possible to excite a structure with a random vibration source and control its level and spectrum shape at given points to provide a good approximation to its operational environment.

But developments in aircraft and weapons were also progressing. Both were flying faster and therefore getting hotter, and their internal components were getting smaller and so more sensitive to higher vibration frequencies. As the structures in question were usually long and thin, high frequencies did not transmit well from a single input source. Techniques were changed to introduce multiple inputs with multipoint control to improve the vibration distribution. Additionally, temperature conditions were added to provide a combined temperature and vibration environment, occasionally with the addition of low pressure for altitude simulation. This multiple input situation improved the simulation but it was still possible to introduce structural failures at the vibrator attachment points due to the mismatch in drive impedance. A major problem arose from the fact that the vibrators were adding unnatural masses and restraint to the structure and thus changing the natural modes of vibration.

It was known that the primary source of vibration in service was the turbulent boundary layer and this had an overall bandwidth significantly greater than could be applied by a mechanical system. This boundary layer turbulence applied the vibration stimulus as a distributed input over the whole of the exposed surface of the weapon and the mechanically coupled vibration transmitted from the parent aircraft was only a small proportion of the total, covering a limited low frequency spectrum. So in the 1960s work started on the development of a system that would vibrate weapons structures using high intensity noise to apply the distributed vibration input.

This development work was spurred on by a particular high frequency vibration problem within a ramjet powered missile. Initially, work was performed in a small reverberation chamber but the improved power efficiency of the progressive wave tube (PWT) was soon realized and a PWT system was built to suit this particular missile. Later a special noise generator, capable of producing random noise in the frequency range up to 5 kHz, was designed for use with the PWT and once the problem was isolated and cured this system was further modified to include temperature conditioning. It was kept in use to check reliability of production missiles due to its ability to provide a good representation of free flight conditions.

Having demonstrated the practicality of the PWT system a contract was awarded by MOD in 1969 to develop the test method for application to any missile system. This work involved the development of coupling horns and acoustic terminations, design of the PWT structure to contain maximum energy and design of the noise generator, all aimed towards optimization of the acoustic performance. The noise generator used was the multi-rotor pseudo-random siren and considerable design and operational experience was gained with this concept.

With the increasing complexity of weapon systems it became necessary to carry out reliability tests on a number of missiles concurrently, where equivalent flying hours were required to be built up at a faster rate than that possible with a single PWT. This need produced a requirement for a large reverberation chamber.

Current test facilities

To satisfy this new requirement a 100 m^3 reverberation chamber was built that would enable up to four missiles to be tested, together with the simultaneous application of temperature cycling. This facility was commissioned and formally opened in April 1985.

Known as the Acoustic Test Centre, this facility has a noise generation capability of 150,000 acoustic watts. With this power a broad band random noise spectrum at a maximum noise level of 165 dB re 20 μPa can be achieved. The chamber size limits the low frequency acoustic energy levels and to compensate for this limitation the chamber also accommodates two low frequency vibrators each providing 90 kN of thrust in the frequency range up to 250 Hz. These vibrators provide about 10% of the total vibration input to the weapon under test. Additionally temperature-controlled air can be ducted into the chamber through the roof to give temperature conditions at the missile skin representative of the extremes of flight. Sufficient thermal power is available to provide temperature changes at the skin of up to ±20°C per minute within the temperature range of +80 to −50°C. While undergoing these environmental conditions the missile's systems can be functioned to check their performance against simulated targets. This chamber is seen in Figure 1, where a number of missiles are shown being prepared for testing. As a combined environment acoustic test facility the Centre is unique in Europe.

Other reverberation chambers are also available, capable of producing similar noise levels on smaller units and components. Additionally, a progressive wave tube is available, primarily for testing missiles but capable of adaptation to a number of applications. When this was developed for missile work in the mid-1970s a survey of all operational air carried weapons at that time showed that these nominally fell into two basic

diameters. This PWT was therefore constructed so that, by altering the assembly of the structure, it could accommodate any air-carried weapon of the day. It is shown in Figure 2 in the largest configuration. It should also be noted that a loading frame is mounted over the working section and this performs two basic functions. Firstly, weapons may be suspended from the frame, within the PWT, on launchers or ejection release units; and secondly, lateral loads can be applied via hydraulic jacks to simulate manoeuvre loadings.

Having acoustic test facilities that are developed for missile testing does not preclude their use for other work. Another area where the acoustic environment is significant is that of the satellite launch vehicle. The launch payload is subjected to a high noise and vibration environment during both the launch and high aerodynamic pressure phases. Sensitive payload subsystems must be subjected to a simulated noise environment before launch to demonstrate survivability and such tests can be, and are, carried out in the 100 m^3 chamber. A typical test assembly is shown in Figure 3. This is an antenna for Intelsat VI and several of these have been tested as have a range of similar units for the Olympus satellite. Other space systems tested have included an experiment for the Rosat satellite and an advanced solar array.

The Acoustic Test Centre is part of a test house approved under the National Measurement Accreditation Service (NAMAS) Executive. A wide range of other environmental test conditions can also be applied in these facilities under this approval.

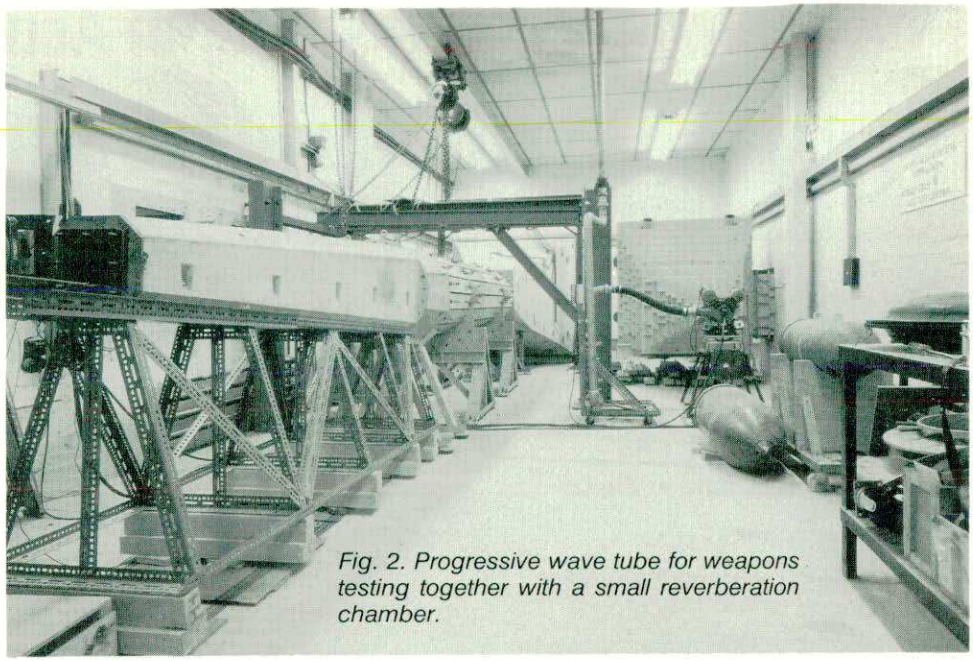


Fig. 2. Progressive wave tube for weapons testing together with a small reverberation chamber.

Other acoustic activities

There are more than 25 years of experience at Hatfield in the high intensity noise field with application in facility design, noise generation and testing. This has been built on missile work but has now extended into other areas, albeit mainly in the aerospace industry. In addition to providing a test service, therefore, the Centre also offers measurement and consultancy services to industry.

With a wide ranging expertise, consultancy is provided particularly in the areas of high intensity noise generation, analysis, isolation and control. Advice can also be given on the design of structures to operate in this environment. An area of expertise that is currently arousing interest is that of the design of acoustic test facilities. The advantages of acoustic excitation having been demonstrated to a number of organizations, they are proceeding to construct their own facilities, especially in the military area where confidentiality is required, and making use of the Hatfield expertise in this field.

Measurements undertaken include sound power measurements under free field conditions and sound pressure and vibration responses under a wide range of operating conditions on land, on sea and in the air. A wide range of analysis techniques is available to establish transmission paths and sources. Considerable effort is also applied to the examination of the effects of high inten-

continued on page 28

Fig. 3. Satellite antenna prepared for testing in the large reverberation chamber.

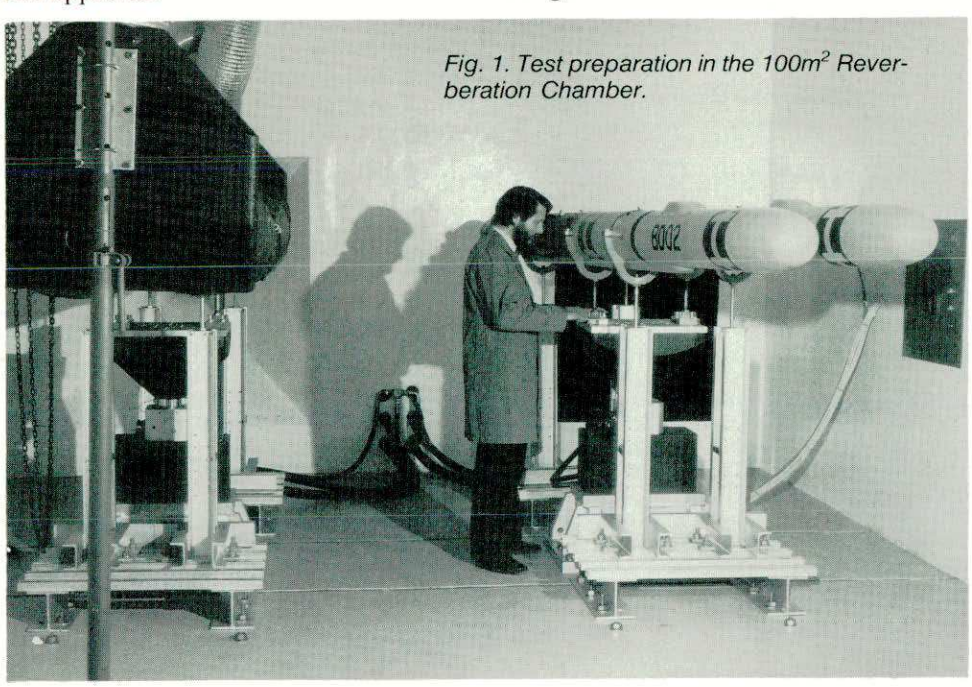
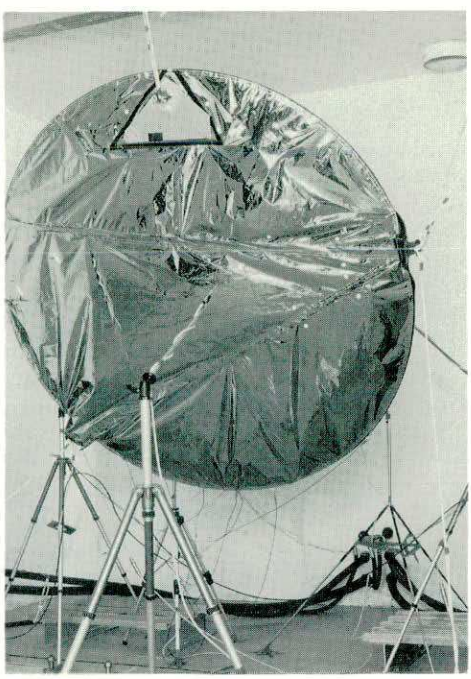


Fig. 1. Test preparation in the 100m^2 Reverberation Chamber.



Proceedings of the Institute of Acoustics – Abstracts

Reproduced Sound 4

Fourth Annual Weekend Conference held at the Hydro Hotel, Windermere, 3-6 November 1988

Programme Coordinator I H Flindell

1. INVITED LECTURES

What the ear does not hear the heart should grieve over
Professor P B Fellgett, FRS

Quality considerations in digital audio
John Watkinson

Ears for music – an ear for music and deafness
Professor E F Evans

2. TUTORIAL SESSIONS

The language and ideas of acoustics
R Lawrence

Sound in Buildings
Professor Peter Lord

Loudspeaker locations in rooms
J R Wright

3. TRANSDUCER SYSTEMS

High frequency charactertistics of loudspeakers

J R Wright
Celestion International Ltd

The mechanism and characteristics of the low-frequency performance of loudspeakers have for many years been quantifiable, allowing engineers to model or predict low-frequency behaviour with reasonable accuracy. However, there is still no acceptable general model for the high-frequency behaviour, dominated by the inductive effects of the voicecoil. This paper will introduce such a model, based on curvefitting techniques, which realizes a high accuracy method of broadband characterization of loudspeakers.

Wide imaging stereo

H R Negishi
Canon (UK) Ltd

Human perception of locating a sound source in stereophonic reproduction relies on two factors; sound pressure and arrival time. Normally, the hot spot is the only recommendable listening point since in all other areas the sound image may be distorted by non-optimum geometry. The Haas effect tells us that the remedy for compensating the arrival time difference for the non hot spot area can be accomplished by control of loudspeaker system directivity. The wide imaging stereo speakers are designed to serve stereo sound not only at the hot spot, but also in a much wider area. Optical theory has been applied to the audio system to accommodate controlled polar directivity in a wide frequency range. The arrival time difference at the non hot spot area is compensated by sound intensity to provide a high quality stereo image in the non hot spot area too.

New studio condenser microphones designed for the digital age

M Hibbing, read by P Arasin
Sennheiser Electronics

Digital recording may reveal inherent noise and distortions of condenser microphones previously concealed by the deficiencies of the analog recording technique. The causes for the imperfections of condenser microphones and measures to improve their characteristics will be discussed. The features of a new line of high-grade condenser microphones based on these improvements will be presented.

Large multi-channel wireless microphone systems

H Kuehn, read by P Arasin
Sennheiser Electronics

In theatres, film industry and TV shows wireless microphones become more and more important. In the past, the use of 6 channels simultaneously seemed to be a limitation. Now, in major musical productions the number of channels has been increased to 30. What are the main problems with large multi-channel wireless systems and how could they be overcome?

Subjective noise assessment using binaural headphone presentation

A R McKenzie and I H Flindell
University of Southampton

A technique has been developed involving headphone presentation of the stimulus material to ensure accurate reproduction of the spatial, temporal, and frequency characteristics of the original stimulus using dummy head recordings. There are a number of problems with equalization and the head-locked stereo image but subjective comparisons have demonstrated a potential for valid and meaningful results.

The measurement of a telephone's minimum side-tone impedance

R C Cross
British Telecom

ZsO is the abbreviation for the complex impedance, which when connected across the two wire port of an analogue telephone, results in complete suppression of local electrical sidetone. The TIGGER automatic telephone test system has been adapted to synthesize the required impedance by using an agile source of alternating emf. By this means it is possible to suppress the sidetone by up to 80 dB over all four quadrants of the complex impedance plane. A useful increase in the speed of measurement has been achieved, especially when the package is used for development rather than specification control.

Control of turntable speed to compensate for disc eccentricity

J P Atherton
Bolton Institute of Higher Education

A method of turntable speed control, still under development, is described which is intended to minimize the slow frequency variation (wow) caused by disc eccentricity. No special transducers are required since the pick-up output has a component due to the wow. This can therefore be used as the error signal in a control loop designed to vary the angular velocity of the platter in order to keep the tangential velocity at the stylus relatively constant.

4. TV SOUND SYMPOSIUM

Another year on with stereo sound at BBC TV

M F Johnson
BBC TV

The BBC has made steady progress towards the 5-year development plan for a start date some time in 1990, using NICAM 728 stereo sound. The experimental service from the Crystal Palace Transmitter has been maintained with UK and EBU agreement on the NICAM 728 format with a lower audio line-up level than last year. Considerable efforts have been made with training programmes for engineers and producers to enhance the use of stereo ideas and techniques.

Stereophonic sound – will it work for television

J White
Granada Television

Broadcasters in the UK are preparing to meet the challenge of realizing Blumlein's 1933 ideas for improvements in and relating to sound transmissions, sound recording and sound reproducing systems to 'improve the illusion'. This paper discusses a number of issues related to the perception of stereo sound in the control room and in the home, particularly in relation to the special requirements of TV.

Dual channel sound in the independent television network

G J Bensberg and J R Emmett
Thames Television

Production of stereo programmes within the independent television companies may not be significantly different to production within other organizations. However, the distribution of the audio signals inside the studio as well as along the network to the transmitter forms a unique system. This paper outlines the reasons for this: historical, organizational, and technical. The economics of studio centre conversion from mono to stereo operation are discussed, as are the special requirements for commercials. Finally, the outline is given for the introduction of the ITV dual sound service starting next year, and some of the AES/EBU interface equipment developed at Thames Television for this service will be shown.

Acoustics of the monitoring environment

A Munro
Windmill Munro Design Ltd

At every stage of the programme making process it is necessary to monitor the quality of audio signals relative to their intended finished format and to adjust them accordingly. Meaningful mea-

surements of the monitoring system require an understanding of the relationship between time, energy, and frequency as a complex transform. The paper will show how analysis of the energy time curve obtained by Time Delay Spectrometry can be used to reveal control room and monitoring system deficiencies so that any problems can be overcome, with reference to a number of practical examples and case histories.

5. ELECTRONICS AND MUSIC

Open loop distortion of operational amplifiers

J A S Angus
University of York

Operational amplifiers are used in large numbers in both professional and domestic audio systems. However, despite recent advancements in their performance they still have a limited gain at high audio frequencies. Because of this the open loop distortion of operational amplifiers is still a significant factor in the performance of these devices. This paper will describe the major sources of distortion in operational amplifiers. It will discuss how these may be measured and will then present some measurements on real op-amps. The paper will then conclude with some suggestions on circuit design given the results obtained.

Midigrid – A new musical performance and composition system

A D Hunt and P R Kirk
University of York

In the last few years – with the invention of MIDI (musical instrument digital interface) and the development of powerful and relatively cheap home microcomputers (such as the Atari ST) music technology has become readily available in the home, in education, and in music studios. Music software for microcomputers has previously been directed towards sequencers (programs which play back music in a structured manner) and score-writers (those which print out music on manuscript paper). Midigrid is an innovative program allowing the user to perform live music as well as being, in effect, a compact recording studio. Midigrid is adaptable to each person's individual needs, which is why it is particularly accessible to disabled people and is breaking new ground in the field of music therapy and rehabilitation. However, to the non-handicapped musician, it offers a totally new approach to the composition and performance of synthesized music.

Digital generation of musical instrument sounds via stochastic techniques

J A S Angus and S P Norris
University of York

This paper will describe a method of generating pitched and unpitched musical sounds very simply by using a stochastic method. Recirculant Markov chains are used to generate frequency shaped noise. This is fed to a comb filter with frequency dependent feed-back to provide pitched sounds with natural attack and decay. The technique can be used to provide synthesis of both percussive and sustained sounds. The paper will describe a method of calculating the necessary probabilities for the Markov chain to give the desired frequency response. The paper will conclude by highlighting the methods, weaknesses and strengths as an instrument synthesis technique.

Music for deaf and partially hearing people

G Dalgarno
University of York

Technology can be applied to allow partially hearing and deaf people to perceive music more clearly. Sound can be tailored to suit residual hearing using analogue signal processors or computer enhancement of synthesized music. A visual display can be designed to give a close representation of the music. In addition the music can be presented as a vibrotactile sensation using arrays of vibrator devices. Taken together or separately, these techniques have been shown to offer worthwhile benefits, depending on the nature of the hearing loss, and on personal preference.

High order LPC analysis/synthesis of atonal percussion

M B Sandler
King's College, London

The linear predictive coding (LPC) algorithm is discussed showing how it can be used to formulate a data efficient representation of acoustic phenomena – in particular for drum sounds. Its use in the analysis and synthesis of drum sounds is developed, and illustrated by time domain graphs, which demonstrate the effectiveness of the algorithm.

6. DIGITAL DEVELOPMENTS

Direct access recording: a survey of the state of the art

F Rumsey
University of Surrey

The earliest commercial digital sound editing equipments used computer disk drives on which to store the audio data. These media are popular at the present time. The Winchester disk is the preferred medium where random or direct access is required to any part of the recorded material as these disk drives provide fairly high storage capacity at a reasonable price. Transfer rates and access times allow for simultaneous audio outputs from a single drive system. Recent developments in magneto-optical drive technology are beginning to overcome the disadvantages of Winchester technology, namely, non-removable media, and up and down loading from tape for editing. Magneto-optical drives appear to be ideal for audio use where the same disk can be used for recording, editing, and long-term storage at a competitive price.

Multi-level to 1 bit transformation for application in digital to analogue converters using oversampling and noise shaping

M O J Hawksford
University of Essex

Earlier work has shown the feasibility of using noise shaping and oversampling, together with low resolution, high precision digital to analogue convertors, where decorrelation of systematic distortions can be demonstrated. The paper extends this work by consideration of multi-level to 1 bit mappings as a means of reducing the complexity of the DAC structure. The methodology compares favourably with delta–sigma modulation though, since the noise shaper order is not limited, a performance advantage at high oversampling ratios is obtainable. The paper describes the extension to 1 bit mapping and presents the results of several transformations.

Least squares approxiations to exact multiple point sound reproduction

P A Nelson and S J Elliott
University of Southampton

Advances in sound recording and reproduction technology now leave three main obstacles to the further improvement of the quality with which a number of recorded signals can be reproduced at a number of points in the listening room. The first of these factors is the cross-talk component where, in terms of two-channel reproduction, the signal reproduced by the right channel is reproduced at both the right and left ears of the listener (and similarly for the left signal). The second factor is the acoustic response of the listening room reverberant field, which is additional to the reverberant field of the space in which the recordings were made. The third factor is the imperfections of the loudspeaker frequency response. This paper presents a theoretical basis for the design of the inverse filter matrix enabling the best approximation (in the least squares sense) to perfect reproduction of acoustic signals at multiple points in a listening space. The theory is first presented with reference to two channel stereophony and then extended to the case of arbitrary numbers of recorded signals, reproduction channels and reproduced signals.

Multiple point least squares equalization in a room

S J Elliott and P A Nelson
University of Southampton

Equalization filters designed to minimize the mean square error between a delayed version of the original electrical signal and the equalized response at a point in a room have previously been investigated by several authors. In general such a strategy degrades the response at positions in the room away from the reference point. A method is presented for designing an equalization filter by adjusting the filter coefficients to minimize the sum of the squares of the errors between the equalized responses at multiple points in the room, and delayed versions of the original electrical signal. Such an equalization filter can give a more uniform frequency response over a greater volume of the enclosure than the single point equalizer above. Computer simulation results will be presented of equalizing the frequency responses from a loudspeaker to various typical ear positions, in a 'room' with dimensions and acoustic damping typical of a car interior, using the two approaches outlined above. Adaptive filter algorithms, which can automatically adjust the coefficients of a digital equalization filter to achieve this minimization, will also be discussed.

A new digital audio signal processing research system using the Motorola DSP56001

H Hamada and S Sakamoto
Tokyo Denki University and MTT Japan

A new digital audio signal processing system using the Motorola DSP56001, CPU 68020 and FIR filter chip 56200 has been developed for research and development in Japan. The system has dual channel DAT interface, dual channel 16 bit A to D and D to A, and a host interface for downloading applications from UNIX or MS-DOS environments. The system monitor has a window based graphic presentation and software has been written for adaptive system identification, adaptive noise cancellation using the LMS algorithm, real time FIR filtering, and the wigner distribution of measured impulse responses.

7. SYSTEM DESIGN AND CONSTRUCTION

Reverberation enhancement and reflected energy system – Trinity Church, Southport, Connecticut, USA

P W Barnett and P H Scarbrough
AMS Acoustics and Jaffe Acoustics

The paper will present the findings of a joint venture two year development programme between Jaffe Acoustics and AMS Acoustics. The system incorporates the Jaffe Acoustics reflected energy system and the AMS Acoustics reverbera-

tion control device. The system provided up to 140% change in reverberation at lower frequencies and 80% at mid and high frequencies. The system was entirely stable and without any noticeable coloration.

Fast track construction for television centres

C Nicholas
Industrial Acoustics

The paper describes two case studies of television centre construction where the time scale was so short that the design programme is run only one step ahead of the actual construction. The actual design had to take account of constantly changing customer requirements in the light of developments during construction with a need for constant vigilance to ensure that standards of workmanship were maintained in order to meet acoustic specifications.

System design for German Federal Historic Government Building

C Baldwin and P W Barnett
ACT Consultant Services and AMS Acoustics

This paper reviews the design problems associated with the acoustics and electro-acoustics, and the visual problems of housing loudspeakers in this important building. The design of the sound system involves time alignment of vertical arrays of constant directivity horns together with the aesthetic considerations necessary to preserve the architecture of the space. The paper will include full design parameters and calculations for coverage and intelligibility etc.

Compact discs for the Robin Hood Centre

S P Jones
B J Auditorium Design

The paper describes an automated sound system for the new Robin Hood visitor centre in Nottingham, where extensive use of compact disc sources allow the benefits of digital audio technology to be exploited to the full. Domestic grade CD players were used with electro-mechanical control keyed from microswitch and other input devices, to include mobile sound sources, automated cross fades, and cine synchronization.

Microprocessor controlled variable acoustics in Hobart

A Burd and L Haslam
Sandy Brown Associates

This paper provides a brief description of the variable acoustic treatment installed in the Production studio at the new Hobart Radio Studios of the Australian Broadcasting Corporation. Twenty-four absorbers are independently adjustable under microprocessor control to any one of up to 100 pre-set arrangements, with a VDU display to provide a complete representation of each preset. Reverberation times were variable from 0.6 to 1.4 seconds over the range 250 to 4000 Hz whilst maintaining a uniform and high quality acoustic result. Subjective appraisal with two groups of musicians confirmed the flexibility and acoustic appeal of the studio for a diverse range of recording requirements.

8. NOISE COUNCIL SESSION ON ENTERTAINMENT NOISE

Low frequency sound from open air pop concerts

J E T Griffiths, S Patel and S S Kamath

Travers Morgan Consulting Group and London Borough of Brent

Open air pop concert noise control is commonly based on guidelines which use the A weighted sound pressure level to minimize environmental impact whilst not affecting the enjoyment value of the show. However, control of the A weighted sound has led to new problems with the long range propagation of low frequency components which can give rise to complaints whilst being barely audible in some cases. This paper presents a case study of this year's Wembley Stadium pop concerts and shows good agreement between a simple propagation model and actual results. The main problems were caused by low frequency sources limited only by the capacity of the loudspeaker systems to reproduce them.

Disco deafness – the myth?

K Dibble
The Sound Practice

This paper presents a comprehensive review of the literature concerning the hearing loss hazard of exposure to loud music in discotheques, and questions the basis for the inclusion of music within the term 'Noise' – especially in relation to the forthcoming legislation arising from the EEC directive 86/188/EEC. The paper concludes that DRC values obtained from industrial noise studies cannot be justified on present evidence and that there is therefore a clear need for comprehensive research to determine realistic exposure criteria, to be kept under review in the light of experience.

Sound level limiting – an overview of the means for effective control

K Dibble
The Sound Practice

This paper considers the merits of the principal methods and devices that are commercially available and discusses one or two less obvious and artistically more acceptable solutions.

The Code of Practice on sound levels in discotheques

J Bickerdike
Leeds Polytechnic

The Draft Code of Practice on Sound Levels in Discotheques was published in 1987, and has been criticized in certain quarters on a number of counts. The author of the code comments on some of the issues raised and puts them in perspective in the light of conditions existing at the time the code was originally written and on the basis of the most recent evidence.

9. POSTSCRIPT

The 1988 BEDA discotheque survey project

K Dibble
The Sound Practice

This project was commissioned by the British Entertainment and Dancing Association to provide a representative industry response to the recent HSE consultative document and to provide a basis for future agreement on working practices on up to date knowledge of typical exposure levels and operating practice within the discotheque and night club industry. The paper describes the survey procedures and gives a summary of the results.

Towards 1992 – an educational discussion document

P Turner
Sandwell College of Further and Higher Education

This paper looks at education and training within the sound industry; the ways in which a national framework of vocational qualifications can be achieved within the industry; how this could be achieved in relation to the National Council for Vocational Qualifications and why this framework should be achieved by 1992. The author recommends the establishment of a Lead Industry Body to coordinate requirements, with representation from the various institutions and organizations involved in the industry.

ACOUSTIC CELEBRATIONS IN POLAND

The occasion of the 35th Polish Open Seminar in Acoustics, which was held on 19-23 September last in Bialowieza near the famous 'puszcza' forest gave an opportunity for the celebration of several important anniversaries. The celebration was shared with the 35th anniversary of the founding of the Institute of Fundamental Technological Problems of the Polish Academy of Sciences in Warsaw – one of the major centres of ultrasonics in Eastern Europe, and also the 35th anniversary of the Kathedra of Acoustics and the Theory of Vibrations (now the Institute of Acoustics) at the Adam Mickiewicz University in Poznan.

At the 9th Seminar, held in 1962 at Szczecin, a group of 38 people met to discuss the possibility of starting the Polish Acoustical Society (Polskie Towarszystwo Akustyczne). This was founded formally in 1963 and celebrated its silver jubilee this year. It presently has 7 branches (at Gdansk, Glawice, Krakow, Poznan, Rzeszow, Warsaw & Wrocław) with a total membership of 482. Of the 16 honorary members half are from abroad and included among them is Dr R W B Stephens, the founding President of our Institute.

One of the group of 38 was Professor Marek Kwiek who first held the chair of Acoustics at the University of Poznan. He died tragically in an air crash in Warsaw in 1962 and 15 years ago a competition in his name was started by the PTA for the best papers presented at the Open Seminar on Acoustics by young research workers.

The jubilee celebration took the form of a convivial evening at which several of the founding members shared their reminiscences. Greetings were brought by Dr Schommartz of Rostock from the Acoustical section of the GDR Physical Society and, on behalf of Council, Dr Bob Chivers took greetings from our own Institute. The evening concluded with a video film of the ICA sponsored conference on Education and Developments in Acoustics organized by Professor Sliwinski in Gdansk in 1987.

R C Chivers

BRANCH AND GROUP NEWS

Scottish Branch

After a quiet period over what passes for summer in this country, the Scottish Branch had a most enjoyable evening meeting in the new Royal Scottish Academy of Music and Drama in Glasgow. Eighteen members and friends were given an introductory talk by Alastair McGregor assisted by Ian Gillies, both of whom are with the executive architects for the project, W Nimmo & Partners.

The audience were fascinated as Alastair outlined the scale of the teamwork required for the project and the problems posed by the need to have high values of sound insulation between rooms. The nature of the construction means that the wall area represents 20 per cent of the total floor area in the building! Alastair and Ian also described the new techniques which had to be evolved in supplying electrical services to avoid bridging isolated walls. Another interesting fact to emerge was that there are 600 door-sets in the building, each with an insulation of better than 30 dB and many achieving 35 dB.

After the introductory talk, there was a most interesting tour of the RSAMD which took in the experimental theatre, the concert hall, the TV studio and the theatre/opera house as well as the practice rooms. Members were very impressed at the scale of the building and were most interested to see the many features included in the construction designed to maximize sound insulation. The general view at the end of the evening was that the students attending courses in the RSAMD were privileged to have such a delightful environment in which to work.

Musical instruments talk

On Tuesday 6 December members of the Scottish Branch enjoyed a fascinating presentation on 'Musical instruments and their spectra' in the Physics Department of Edinburgh University. The lecture-demonstration was given by Dr Murray Campbell on violin, alphorn, oboe, electric guitar, trombone *et alia*, supported by Dr Clive Greated on flute, piccolo, saxophone and clarinet, Dr Raymond Parks on tubular bells and overhead projector and our Chairman Bill McTaggart on real-time frequency analyser. Members were treated to a highly informative and entertaining review of the production of musical sounds from a large variety of instruments. With the aid of the frequency analyser, Dr Campbell examined the harmonic content of notes from various sources, giving an expert analysis of the physics of the production of notes and a commentary on the perception of the sound by the brain.

In the course of the presentation Dr Campbell explained the resonances in the violin, multiphonics on the oboe, the 'waa-waa' on the trombone and electric guitar and the pitch of tubular bells. To this was added a Brahms theme on the alphorn and 'Trumpets shall sound' on hose-pipe and filter funnel.

Dr Campbell finished a thoroughly entertaining evening by a demonstration of the perceived pitch of long and short bars and a mention of Bessel functions as he closed with the tympani.

An extensive question and answer session followed which, given the enthusiasm of the Drs Campbell, Greated and Parks, would have continued into the small hours. A final thought for a Christmas present was the book written by Murray Campbell and Clive Greated *A Musician's Guide to Acoustics*, and at least two institutions should acquire copies in the near future.

The Annual General Meeting of the Scottish Branch will be held in Glasgow College on Wednesday 15 February 1989 and will be preceded by a technical meeting on aircraft noise.

W J Laurie

Eastern Region Branch

The inaugural meeting

The inaugural meeting on Tuesday 11 October, was opened at 7.45 pm by David Bull, who welcomed the 38 members present and announced eight apologies for absence. He felt that the level of support was most encouraging.

Chris Rice, President of the IOA gave the meeting an outline of the workings and philosophy of the Institute. He stressed that the Institute should strive to maintain and improve its status, an important element of this being the expansion of membership, hopefully to 2000 within the next two years. In closing Chris emphasized to all members that active support is essential for a branch to be successful.

Geoff Kerry then gave a brief talk on the operation of branches, and stressed the importance of an active committee. He suggested that the branch should aim to stage a major Institute meeting within two years.

David Bull was then proposed and accepted as Chairman, and the original steering group plus two further members were adopted to complete the committee for the first term.

With official business completed,

continued on next page

Letter from the Vice-President Groups and Branches

At the beginning of October I attended the inaugural meeting of the Eastern Branch. Forty-two members turned up to hear the President, standing in for Bernard Berry from NPL who was ill, give an interesting talk on Environmental Acoustics. Chris Rice also took the opportunity to bring members up to date on the Engineering Division, the new Membership grade and the Certificate of Competence, three important initiatives which will be of benefit to members in the near future.

A new committee was elected and I have heard since that a full programme of meetings has been organized for 1989. I hope that members living in the eastern part of the country will support these activities.

The President has now attended seven Group or Branch committees or meetings and has asked that I remind other Groups and Branches that he is willing to attend such meetings and talk about and listen to ideas to improve the benefits that membership of the Institute brings.

Group and Branch finances were thrashed out at a recent Representatives meeting. Revised procedures for deciding subventions and handling accounts were discussed and passed for approval to Council. The Treasurer will be putting them into operation shortly. If Group and Branch treasurers have any difficulties please let me know.

I shall shortly be writing to all Group chairmen to ask them to get their committees to consider what they think their group's aims and activities should cover. This is a preliminary step towards defining more clearly the role Groups can play within the Institute. I hope that the ideas floated at the Representatives meeting and the discussions I have had with a number of chairman will help broaden the outlook and ultimately get more members to become involved in group activities.

Geoff Kerry

Chris Rice returned to the floor to give an entertaining and wide ranging presentation on the general topic of 'Noise Pollution'. This included a potted history of noise problems from the turn of the century to the present day.

The first committee meeting was on 2 November 1988 when the basis of the future events programme was formulated. Any members who have suggestions for future branch activities should contact either David Bull on 0206 761660 ext. 27672 or Peter Hunnaball on 0206 44122 ext. 446.

Meetings Programme, Spring and Summer 1989

1 March, 7.30 pm: Colchester Institute. Noise Standards and Legislation
Alan Dove, of the Health and Safety Executive, will discuss the proposed UK legislation on occupational noise and Bill Uttley of BRE will discuss the proposed changes to BS 4142 (as Chairman of the working group). Meeting contact: David Bull; Tel: 0206 761660 ext. 27672.

26 April, 7.30 pm: The Athenaeum, Bury St Edmunds. Getting Computers to Talk
By Marcel Tatham, Professor of Cognitive Studies at Essex University.

When human beings communicate with machines they do so on the machines' terms; we use keyboards, VDUs, MICE and all the other devices needed to get information into, and out of, the computer. The situation is now changing: we are gradually moving toward the time when direct communication using speech will become viable. We shall hear about the progress being made and why the situation is not quite as simple as the science fiction films imply. Working demonstrations will be an important feature of this presentation. Meeting contact: Brian Coley; Tel: 0284 757042.

14 June: Radio Essex, Chelmsford. 21 June: Radio Norfolk Norwich.
Keith Rose, BBC Acoustics Architect, will give a tour of both studios, and will discuss their design, construction and use. Numbers will be limited on both of these visits, so please let the organizers know if you wish to attend. Meeting contact: Peter Hunnaball; Tel: 0206 44122, ext. 446.

Peter Hunnaball

North West Branch

November evening meeting
The Branch emerged from the relatively barren summer and autumn months with a very well attended evening meeting at Salford University. Graham Custard of Salford University Business Services Ltd gave an excellent presentation on 'Hearing Protection in the Real World'. He introduced hearing protection as the first line defence against deafness, describing the mechanism of the ear and illustrating how its delicate internal structure is damaged when exposed to excessive noise. He described the current exposure limits and the various types of hearing protector available, illustrating their advantages and disadvantages. He stressed the importance of choosing the most suitable defender for the job; this requires good competent measurements of the noise together with well designed techniques for accurately measuring the response of the protectors. Only then can the best protector be selected.

Graham went on to describe BS 5108 and other methods used for measuring the response of protectors and illustrated some of the problems associated with the test figures. In particular hearing protector data can often mislead anyone not familiar with the current standards. In addition, people often do not like wearing hearing protection and often it is not worn properly on site. BS 5108 is a subjective test and provides a measure of how well protectors perform; however, it gives a wide variation in results. Many manufacturers would prefer more objective testing to reduce the spread of results. The problem with this approach is that it is not clear how the results relate to the subjective methods. Graham opened up the discussion to the branch and a lively and provocative debate ensued, during which the single figure descriptor of protector performance was pitted against third octave band analysis.

Light refreshments followed before Ian Hempstock of the Acoustics Department introduced and demonstrated the capabilities of the Mobile Hearing Protector Testing Laboratory, which will provide valuable data on the amount of protection workers on site actually get from their hearing defenders. The lab. is owned by the Health and Safety Executive and the data will be collected and analysed by Salford University.

Future programme
The Branch committee have been spurred into activity and have organized several meetings and a visit for early in the New Year. The programme is as yet provisional and further details will be sent out before each of the events.

In January we will have a talk and demonstration on 'Structural Analysis' by Tom Murphy and Robert Collier. If you came to Tom's last superb presentation you will not want to miss this one.

For the Annual General Meeting in February to be held at the Bruel and Kjær Northern Office, our President Chris Rice has kindly agreed to give a presentation on 'Assessment of Tonal and Impulsive Components in Noise'.

In March a visit has been arranged to the Liverpool Cathedral Organ Maker, David Wells, followed by a recital at the Anglican Cathedral by the Cathedral Organist Ian Tracy. It is planned to go on for a meal in the evening. Suggestions for a suitable restaurant in the area would be very helpful. I look forward to our next meeting in the New Year.

Chris Waites

North East Branch

This has been a quiet time for the North East Branch with a general fall off in support and interest in the Branch activities. This has been to a large extent to do with a scaling down of acoustic work in local industries with people's work being switched to other non-acoustic activities. Pressure of work of committee members has also meant that it has not been possible for the Branch to get together to organize future meetings and social events.

The Branch's future position is now under review with the possibility of carrying out a recruitment drive to get more new members involved in Branch activities. A new programme of events is now being considered and it is hoped that there will be a good turnout of members at the AGM in January in order that ideas and areas of interest can be identified and events organized to fulfil people's needs.

Mike Sullivan

Building Acoustics Group

The AGM of the BAG was held on 27 November 1988 in conjunction with the Autumn Conference. The main items on the agenda were: 1, election of the committee; 2. future BAG activities.

The officers elected are:

J G Charles (*Chairman*)
N F Spring (*Treasurer*)
L C Fothergill (*Secretary*)
M F Barron
R J M Craik
P Lord
R J Orlowski

Time did not allow lengthy discussion of future activities and suggestions are welcome. Please send them to L C Fothergill, BRE Garston, Watford WD 7JR.

L C Fothergill

Book Reviews

Noise in the Military Environment

R F Powell and M R Forrest

Published by Brassey's Defence Publishers, 1988; 126 pages paperback, £9.95.

This purports to be a specialist book for those concerned with the noise from warfare. The early part of the book consists of a brief and qualitative account of the physics of noise. The latter part of the book concentrates on noise in workshops with a strong emphasis on hearing conservation and protection and on communication.

The first part, being mainly descriptive, is rather short on explanations. For example, the various loudness weightings could easily be explained in relation to equal loudness contours. However, this is clearly a matter of compromise between clarity of explanation, space available in the book, and reader requirements. The presentation here covers the same ground as traditional introductory textbooks (of which there are relatively few available at the present time) but with much less detail. If these comments seem adversely critical it is worth adding that the material is presented in a refreshingly different manner and not only because of the different military viewpoint: for example, we have the interesting question – why is it difficult to heat a kettle of water by shouting at it? In addition, there are interesting practical examples such as the noise spectrum from a Lynx helicopter.

Chapter 8 is concerned with noise in workshops and maintenance areas. It is used as a means of introducing concepts concerned with sound in enclosed areas and noise control. Again, the coverage of this material is rather superficial and basic; but again the presentation and examples used are not the usual ones which the acoustician will come across. It therefore has intrinsic interest for the general reader. This chapter lacks an account of noise problem diagnosis and a logical approach to control strategies.

Chapters 9, 10 and 11 cover Hearing Protection; Noise, Performance, Annoyance and Health; Noise and Communication. These are the areas of special application to the military problem, though they are obviously relevant elsewhere too. Chapter 9 on hearing protection is particularly interesting and well-written. Chapters 10 and 11 are both thought-provoking. This section of the book, while aimed at the military specialist, makes a very interesting read for acousticians in general.

The bibliography is rather an unbalanced selection, particularly for the general reader, and to some extent this is reflected in some of the written content. For example, in the rating of noise there is a considerable discussion of BS 4142, including its well-known shortcomings. Strangely, there is no mention of the International Standard ISO R1996 which is widely held to be a far superior method of rating.

Taken all in all this is a refreshingly different book, at primer level. It makes no claim to be aimed at the general reader. However, at the price, it must be a good buy for the bookshelves of those of us more generally interested in acoustics and its applications.

A J Pretlove

Guided Weapons

R G Lee *et al*

Published by Brassey's Defence Publishers, 1988; in hardback, £18.95; softback, £9.95

Although this volume does not specifically cover the acoustics of guided weapons it will still be of general interest to members of the Institute of Acoustics, especially those who are involved in modern military technology. The volume provides a great deal of interesting general information on the basic principles of guided weapons and would, as such, be a good introductory text on the subject. The technical subjects covered are: propulsion, power supplies, control and guidance methods, warheads and modern structural techniques in guided weapon design. It also describes the main divisions of guided weapons. The text is not mathematically or technically complex but to grasp some of the concepts does require more knowledge than may be expected of school-leavers (contrary to the statement in the preface).

If there are criticisms to be made of the book the main one is that it has been written by too many authors without a controlling editor, and consequently lacks continuity and a uniform style. It suffers from having been very badly proof-read and has many typographical errors including an error in a chapter heading (Chapter 7) and an error in a formula (page 69) which took the reviewer some time to unravel. The use of obscure acronyms is widespread and the glossary does not help much. The gravitational constant is both loosely and incorrectly defined and this does not inspire confidence.

In the chapter on structural design of airframes there is a section headed 'Loads created by life'. This mystified the reviewer for a while. Were kamikaze weapons being considered? However, it seems that life here means movement through the air. The misuse of the word is just an extension of the current vogue for the misuse of the word 'viable'.

In spite of these relatively minor criticisms the book is an interesting account and certainly worth having on the bookshelf. It is a factual introductory text to the subject of Guided Weapon design and good value at the price.

JRGP

Noise Control in Building Services

Edited by Alan Fry

Published by Pergamon Press, 1988; £30; 441 pp. ISBN 0-08-034067-9

This excellent book has been written by staff from Sound Research Laboratories of Colchester and fills a long-felt need. Previous books on the subject of noise in building services have all too often failed to satisfy: either they are too academic and are of little use to the practising consultant or they are merely a collection of useful rules of thumb which do not encourage or permit the practitioner to cope with new problems. This refreshingly different publication not only describes solutions to problems which often arise but it also explains carefully why those solutions can be expected to work. The book is liberally sprinkled with case studies and at the same time does not lose sight of the general principles involved. The book is obviously based on the accumulated experiences of the ten consultants who collaborated in writing it, and thus it would be difficult to imagine one which could more comprehensively cover the ground.

The technical structure of the book is based on four fundamental chapters on the nature of sound, human response, sound in rooms, and criteria. The latter is a welcome inclusion, rare in other books, although it suffers from a failure to discuss adequately the important factor of cost-effectiveness. This is followed by specialist chapters on sound insulation, vibration isolation, three thorough-going chapters on ductborne noise, noise from room units, noise to the exterior, construction site problems and, finally, laboratory testing.

The volume is liberally and well illustrated, it has been presented with

great clarity by both the authors and publishers and, in hardback form, is good value for money. It is, perhaps, rather a shame that it is not available in soft covers to suit the student pocket because this is the type of book that students ought to take with them from the classroom to the working office. If you are Mr Average-Member-of-the-IOA, this is a book which will grace the general-reading end of your Acoustics bookshelf with distinction and provide useful information in its field. Go to your bookshop and give yourself a treat.

A J Pretlove

New Materials and their Applications 1987

Institute of Physics Conference Series number 89

Edited by S G Burney. Published by Institute of Physics, 1988; 316 pages hardback, £40. ISBN 0-85498-180-2.

These proceedings attempt to embrace modern material developments in composites, polymers, ceramics and electrical and magnetic materials. The book opens with an excellent survey paper by Kelly on new materials and their application. The first section is on high temperature materials and in particular developments in ceramics for turbines. Papers of particular interest are the reviews in each section. Thus the papers by: (i) Meetham on limitations on high temperature materials, (ii) Cogswell on thermoplasic structural components, (iii) Partridge on glass-ceramics, (iv) Overshoot on rapidly cooled materials and (v) Goodman on new electronic materials. In a book of such wide-ranging subject matter it is a pity that there are a small number of papers on relatively obscure topics; these articles could profitably have been omitted from these proceedings. Also, to save expense the IOP clearly required camera-ready copy which is common nowadays. However, some papers actually suffer from this and are difficult to read.

Bradley Dodd

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sity noise on the instrumentation systems used to measure the required environmental parameters.

Future developments

Over a period of more than 25 years a number of acoustic test facilities have been developed at Hatfield, primarily for guided weapon applications. This has led to an accumulation of considerable experience in the design and operation of these facilities which, over the past five years or so, has been made commercially available to industry.

The aerospace industry is one of continuing development and the associated test facilities must keep pace. Aircraft and their weapons are required to fly even faster and consequently the turbulent pressures seen by their outer surfaces will generate energy at higher frequencies. Also vertical landing and take-off aircraft, with high powered engines, will produce high intensity jet noise and jet impingement on the undersurface of the aircraft fuselage. This latter effect is known as 'fountain flow' and the impingement area is a site on the aircraft where weapons are often installed.

Both of these problems are currently being examined and new facilities are under consideration that will be capable of applying high intensity noise, at levels in excess of 170 dB re 20 μPa, to the new range of weapons.

New Products

Submissions for inclusion in this section should be sent direct to J W Sargent, Building Research Establishment, Garston, Watford WD2 7JR.

Software to capture data and tune FE model

Dynamic Engineering have announced two new software products for use in testing and analysis of structures.

SYSTRAS is a time record and data analysis system for VAX computers, with up to 256 simultaneous channels, real time acquisition of vibration, acoustic and other data, and modules for modal analysis, sensitivity, structural modification and other applications. Menus and multi-windowing give user-friendly access.

SYSTUNE bridges the gap between finite element analysis and experimental modal analysis. It applies sensitivity analysis and parameter algorithms to the measured vibration data, and selectively modifies the FE model to represent true structural behaviour. By dealing with physical parameters such as Young's modulus or beam properties, SYSTUNE gives accurate, reliable results – unlike older methods based on changing numerical values in matrices of the FE model.

Further details from Dynamic Engineering, Bennett House, Pleasley Road, Rotherham S60 4HQ. Tel: 0709 366376.

dBanK – for field storage of data

Field data storage is now available for Bruel & Kjær's 2231 Modular Sound Level Meter.

dBanK is a mass storage and data annotation system which provides an integrated measurement management system for field use. The system is based on the pocket-sized Psion Organiser XP and includes all the software required to communicate with the 2231 and download readings to B&K's 2318 Graphic Documentation Printer or to an IBM PC or compatible. The 2318 turns numerical results into fully annotated tables and graphs. Using a PC, the data are transferable to standard spreadsheets for transformation into report-quality output.

The system is compatible with all current modules for 2231, providing on-site storage for statistics, spectra, reverberation time, even events. Measurements are downloaded from the 2231 together with instrument set-up, time and date, and users' comments can be added via the integral keyboard.

A standard 64K of non-volatile RAM is supplied, with expansion to 256K if required. With the standard memory this versatile system allows, for example, storage of more than 50 basic sound level and L_{eq} measurements; up to two days of basic statistical and L_{eq} measurements carried out at hourly intervals; 24 complete ⅓ octave spectra, many more if ½ octave measurements are used or the frequency range reduced; reverberation time measurements in tabular or graphical format; several hundred events.

The dBanK package includes all software, connections and serial interface.

For further information contact Alan Gibson, Bruel & Kjær (UK) Ltd, 92 Uxbridge Road, Harrow HA3 6BZ. Telephone: 01-954 2366. Telex: 934150 BK UK G. Fax: 01-954 9504.

NON-INSTITUTE MEETINGS

1989

19 January	One-day Seminar: Using experimental measurements of dynamic behaviour to update finite element models, at Aston University, Birmingham. Details from: Dynamic Engineering, Bennett House, Pleasley Road, Rotherham S60 4HQ. Tel (0709) 366376.
17–20 January	1989 Annual International Course: Digital communications: Theory and practice, Switzerland.
23–26 January	1989 Annual International Course: Modern digital modulation techniques, Switzerland.
8 February	Institution of Environmental Sciences open evening meeting: Industry's responsibility towards the environment. Open from 6–7 informally, 7–8.30 for Meeting. Details from Roy Waller (01-647 5015).
27 February–3 March	*1989 SAE International Congress and Exposition,* in Cobo Hall, Detroit, Michigan, USA. Topics include: Engine Noise Control at Source and at Response; Engine Redesign for Low Noise; Vehicle/Engine Noise and Vibration. Organizer: Prof. Sam D Haddad, FIMechE, Dept. of Mech. and Aerospace Engineering, 2005 Engineering Complex, University of Missouri-Columbia, Columbia, Missouri 65211, USA.
7 March	IES open evening meeting: Common ground between landscape architects and environmental practitioners. Details as above.
7–10 March	*86th AES Convention* to be held in Hamburg, FRG. Information from: H A O Wilms, Exh. Director, Zevenbunderslaan 142/9, B-1190 Brussels, Belgium.
14–16 March	*STRESS AND VIBRATION: Recent Developments in Measurement and Analysis,* incorporating the Third International Conference on Stress Analysis by Thermoelastic Techniques, to be held in London. Information from: Conference Office, SIRA Ltd., South Hill, Chislehurst, Kent BR7 5EH.
15–17 March	*DOI 89* (Defence Oceanology International), at the Brighton Metropole, Brighton, UK. The twentieth anniversary of the Oceanology International series: The Gap between Civil and Military in Oceanology.
21 March	One-day meeting: Non-contracting ultrasonic techniques and applications. University of Warwick.
3–5 April	Modern Practice in Stress and Vibration Analysis, University of Liverpool. Organized by the Stress Analysis Group of the Institute of Physics.
10–12 April	*AIAA 12th Aeroacoustics Conference* at the Hilton Palacio del Rio, San Antonio, Texas, USA. Topics include: Unsteady loads on hypersonic vehicles; computational aeroacoustics; control of acoustic/fluid dynamic phenomena; duct acoustics; helicopter and V/STOL noise; jet aeroacoustics; sonic fatigue; turbomachinery and core noise. Information from: Dr James F Unruh, Southwest Research Institute, 6220 Culebra Road, San Antonio, TX 78284, (512) 522-2344.
24 April (week of)	*8th Fase Symposium on Environmental Acoustics,* in Zaragoza, Spain. Details from Secretariat Viajes el Corte Ingles, Dpto. Congresos, Avda-César Augusto, 14, 2.ª planta, 50004 Zaragoza (Spain).
25–29 April	International Conference on *Acoustics, Speech and Signal Processing,* in Glasgow. Details from: Institute of Electrical and Electronics Engineers, Inc., Conference Co-ordination, 345 E. 47th St., New York, NY 10017.
26–28 April	*Sixth Symposium on Maritime Electronics,* Rostock, DGR. Details from: Wilhelm-Pieck-Universität Rostock, Sektion Technische Elektronik, Albert-Einstein-Str.2, Rostock 1 2500.
22–26 May	Meeting of the Acoustical Society of America, New York. Details from: Murray Strasberg, 500 Sunnyside Blvd, Woodbury, NY 11797.
7–10 June	*6th Seminar and Exhibition on Noise Control,* to be held in Pécs, Hungary. Details from: The organizers, Optical, Acoustical and Film Technical Society, Föu.68. H-1027, Budapest II, Hungary.
16–18 August	*Noise and Vibration '89,* to be held in Singapore. Abstracts by 15th November, 1988. Details from: The Secretariat, International Conference Noise and Vibration 1989, c/o School of Mech. and Production Engineering, Nanyang Technological Institute, Nanyang Avenue, Singapore 2263.
24–31 August	*13th ICA Congress,* International Commission on Acoustics, Belgrade, Yugoslavia.
4–6 September	*Symposia:* Dubrovnik on *Sea Acoustics*; Zagreb on *Electroacoustics.* Details: Secretariat, Sava Centar, 11076, Belgrade, Yugoslavia.
4–6 September	Comadem 89 International at Birmingham Polytechnic. Conference Organizer: Dr Raj B. K. N. Rao, Dept. of Mechanical and Production Engineering, Birmingham Polytechnic, Perry Bar, Birmingham B42 2SU. Tel 021-331 5441.
26–28 September	*Eurospeech '89,* European Conference on Speech Communication and Technology, Paris. Details from: Secretariat, CEP Consultants Ltd, 26-28 Albany Street, Edinburgh EH1 3QH. Tel 031-557 2478.
October	28th Acoustical Conference on Physiological Acoustics: *Acoustics of Speech and Music.* Details: Secretariat, House of Technology, Eng. L. Goralikova, Škultétyho ul.1, 832 27 Bratislava, Czechoslovakia.
4–6 October	IEEE/UFFCS Ultrasonics Symposium, Montreal, Canada. Details: Allied-Signal Inc., Attn. H van de Vaart, PO Box 10221R, Morristown, NJ 07980, USA.
24–26 October	*Sensors & Systems '89.* Test and Transducer Conference at Wembley Conference Centre. Offers of papers by 31 January 1989, to Norma Thewliss, Conference Secretary, Trident International Exhibitions Ltd., 21 Plymouth Road, Tavistock, Devon PL19 8AU. Tel 0822 614671.
6–10 November	Meeting of Acoustical Society of America, St. Louis, USA. Details: Murray Strasberg, (see above).
6–10 November	Meeting of Acoustical Society of America, New York. Details from Murray Strasberg (see above).
4–6 December	Inter-Noise 89, Newport Beach, CA, USA. Details from: Internoise '89, Institute of Noise Control Engineering, PO Box 3206, Poughkeepsie, NY 12603.
December	European Symposium on Transportation Noise, Braunschweig, FGR. Details from: Deutsche Gesellschaft für Luft- und Raumfahrt e. V., Godesberger Allee 70, D-5300 Bonn 2.

1990

February	*Fourth Conference on Hydro- and Geophysical Acoustics,* Rostock, E Germany.
21–25 May	Meeting of the Acoustical Society of America.
8–10 August	International Tire/Road Noise Conference, Gothenburg, Sweden. Details from: U. Sandberg, Swedish Road and Traffic Research Institute, S-581 01 Lonkoeping, Sweden. Tel +46-13-115200.
October	*29th Acoustical Conference on Room and Building Acoustics* – Czechoslovakia.
26–30 November	Meeting of the Acoustical Society of America – San Diego, California.

Information relating to meetings of possible interest to readers should be with the Editor at the address on page 1 no later than four months before the date of the meeting.

Institute of Acoustics Meetings

1989			
Early January	SB	Railway Vibration and Planning (Mike Griffin, ISVR) 7.30 p.m.	Guildhall, Winchester
18 January	NWB	An evening on Structural Analysis 6.30 p.m. (Entek Scientific Co. and Scientific Atlanta)	Salford University
Early '89	M	PC Programs in Acoustics	London
1 February	SB	AGM and 'New Ideas in Community Noise Research' 7 p.m.	Winchester
7 February	NWB	AGM and 'Assessment of Tonal and Impulsive Components in Noise' (Chris Rice, IOA President) 7 p.m.	Bruel & Kjær Northern Office
1 March	EB	Noise Standards and Legislation Alan Dove (HSE) and Bill Uttley (BRE)	Colchester Institute
7 March	M	Acoustic Consultant	London
8 March	M	Inaudibility – A Concept in the Assessment of Noise Nuisance	Reading
8 March	SB	Sound Conditioning – talk and presentation by Sound Attenuators Ltd. 2 p.m.	Council Offices, Newbury
21-22 March	UAG	Progress in Fisheries Acoustics (International Conference)	MAFF Fisheries Lab., Lowestoft
22 March	NWB	Visit to Liverpool Cathedral organ maker David Wells, recital by Ian Tracey at the Metropolitan Cathedral, and dinner. Transport leaves Salford 1.45 p.m., arriving Liverpool 3 p.m.	Liverpool
April	SB	Engine Test facility	(to be announced)
3-6 April	M	Spring Conference – **Acoustics '89**	University College, Oxford
21 April	M/ING	Mining and Drilling Operations on Land	Bournemouth
26 April	EB	Getting Computers to Talk M. Tatham (Essex University)	The Athenaeum, Bury St. Edmunds
May	SB	Visit to TRRL and talk: Road Induced Ground Vibration (Greg Watts)	Transport and Road Research Laboratory
May	M	Entertainment Noise Control	(to be announced)
May/June	M	Post-Diploma Seminar – 10th Anniversary	London
June	M	Military Aircraft Noise	East Anglia
14 June	SB	Active Attenuation (5.00 p.m.)	Tizard Bldg, Southampton University
14 June	EB	Tour of the Radio Essex Studios	Chelmsford
21 June	EB	Tour of the Radio Norfolk Studios Park by Keith Rose, BBC Acoustics Architect	Norwich
2-5 November	M	Reproduced Sound 5	Windermere
23 November	M	Hand-Arm Vibration	Salford
23-26 November	M	Autumn Conference – Industrial Noise	Windermere
11-13 December	UAG	Digital Sonar Processing	Loughborough

Key

M = Meetings Committee Programme
BAG = Building Acoustics Group
ING = Industrial Noise Group
MAG = Musical Acoustics Group
PAG = Physical Acoustics Group
SG = Speech Group
UAG = Underwater Acoustics Group
LB = London Branch
EB = Eastern Branch
EMB = East Midlands Branch
NEB = North East Branch
NWB = North West Branch
SB = Southern Branch
ScB = Scottish Branch
SWB = South West Branch
YHB = Yorkshire and Humberside Branch

Further details from:

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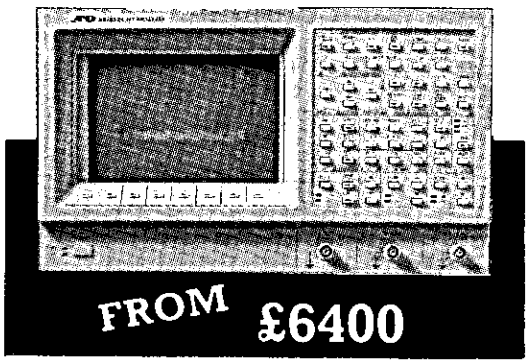

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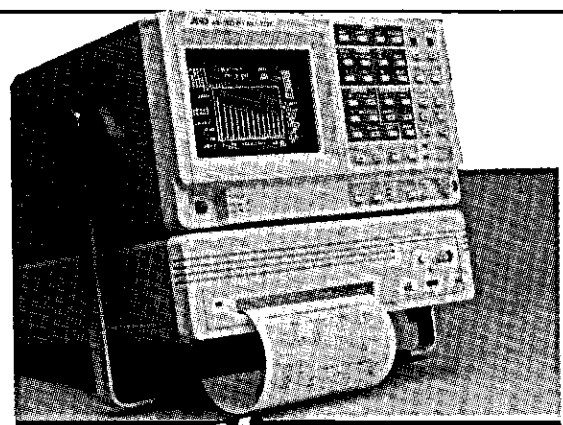

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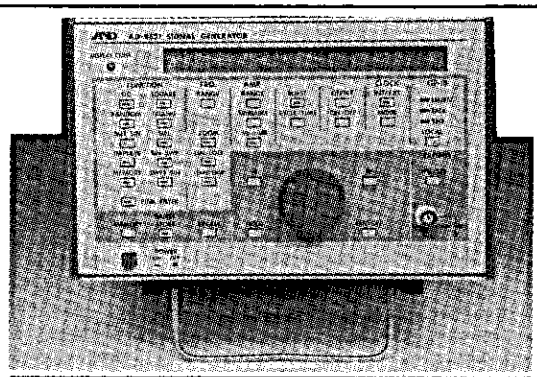

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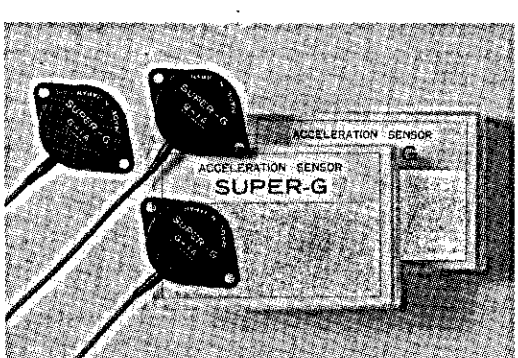

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