

Acoustics

BULLETIN

VOL 29 No2 Mar/April 2004



IPPC and environmental noise

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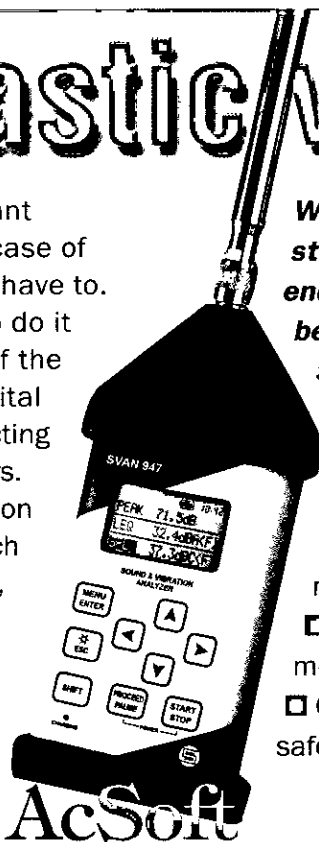
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Acoustics

BULLETIN

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Institute of
Acoustics

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

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**Dear Members**

We recently held the Group and Branch Representatives meeting which provides a forum for a biannual general exchange of ideas and information. This year we decided to extend the discussion to allow the Strategic Development Group, set up by Council to consider the future organisation and activities of the Institute, to listen to the views from Groups and Branches. The debate proved to be quite lively and broad ranging. Although we started the discussion with the premise that 'the Institute cannot stay as it is', I gained the impression that most active members are generally satisfied with the services offered by the Institute, given the realisation that it is not a large or wealthy organisation. Nevertheless, a number of suggestions were put forward that require further thought and deliberation. In particular it was suggested that more could be done to enhance the image of the Institute, especially in the eyes of other professional groups. I hope there will be an opportunity to report more fully on our strategy planning in the near future. In the meantime, please let me have your views on how you wish to see the Institute develop.

I received a piece of good news the other day when I learnt that our nominee, Professor Tim Leighton, had been awarded one of the first International Acoustics Congress (ICA) Early Career Awards. The nomination was prepared with some assistance from Underwater Acoustics Group members and I thank them for that. Congratulations Tim, it's good for you but also for UK acoustics. Tim will receive his award in Kyoto in April.

Sadly for me, this will be the last time that I write to you as President. I shall hand over the reins to Tony Jones, whom I have known for many years, at the AGM in May. I know that I leave the Institute in safe hands. I have enjoyed my term as President, working with Roy and the office staff, with Council and with our many committees. So many of you give up your time to ensure that the acoustics profession flourishes in the UK and it has been a privilege to meet with you, talk to you and work with you. Thank you all.

Geoff Kerry
President

Notices from Head Office

2004 A B Wood Medal Nominations invited

The A B Wood Medal and prize is awarded to an individual, usually under the age of thirty five, for distinguished contributions to the application of underwater acoustics. The award is made annually by the Institute of Acoustics, alternately to a person from Europe or from the USA and Canada.

Nominations should consist of the candidate's CV, clearly identifying peer reviewed publications, and a letter of endorsement from the nominator identifying the contribution the candidate has made to underwater acoustics. In addition, there should be a further reference from a person involved in underwater acoustics and not closely associated with the candidate. Nominees should be citizens of an EU country.

Nominations, which should be marked '*Private and confidential*', should be received by 31 May 2004 and be addressed to:

The President, The Institute of Acoustics,
77A St Peter's Street, St Albans, Hertfordshire AL1 3BN
Tel: 01727 848195 Fax: 01727 850553

IOA ANNUAL GENERAL MEETING



The Royal Society, venue for the IOA AGM

The Annual General Meeting of the Institute will be held at the Royal Society, 6 Carlton House Terrace, London SW1Y 5AG on
Thursday 13 May 2004

Forthcoming examination dates

Members are asked to encourage their colleagues to study for the Institute's qualifications. Details can be obtained by e-mailing: education@ioa.org.uk

Examinations will be held as follows:

- ☐ Diploma in Acoustics and Noise Control
11 and 12 June 2004
- ☐ Certificate of Competence in Environmental Noise Measurement
30 April and 15 October 2004
- ☐ Certificate of Competence in Workplace Noise Assessment
14 May and 12 November 2004
- ☐ Certificate Course in the Management of Occupational Exposure to Hand Arm Vibration
21 May and 19 November 2004

Membership fees reminder

Membership Fee Notices sent to all members at the beginning of January were due for payment by 31 January 2004. It would be appreciated if those members who have not yet forwarded their payment could do so within the next few days.

Members are reminded that membership fees are tax allowable.

How you can help our membership grow

Members are asked to encourage their colleagues to consider the benefits of membership of the Institute. Details and Application Forms for all grades of membership are available from The Institute of Acoustics, 77A St Peter's Street, St Albans, Hertfordshire AL1 3BN

Have you moved recently?

We try to keep our mailing list as accurate as possible. Any members who suspect that we do not have their most up-to-date data, should please send details to ioa@ioa.org.uk

REGISTER OF MEMBERS 2004/2005

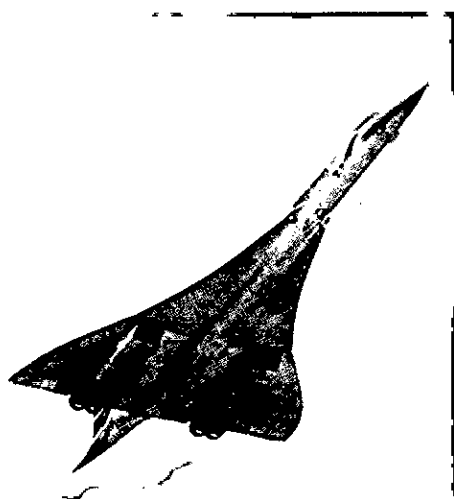
A considerable number of Entry Forms are still outstanding. An early response would be appreciated and certainly no later than 5 April 2004.

Please ensure that only one form is returned for your organisation.

NW Branch report

Sonic booms fail to dent historic buildings

On 23 October 2003, following a branch AGM that could have been over in record time, had Geoff Kerry not remembered he was The President and spoken about something or other, we were treated to an enlightening talk by said President on the research work carried out to determine the effect of sonic booms on historic buildings, specifically those produced by Concorde. Early supersonic trials were made on a flight path that ran southwards over the western coast of Scotland, briefly within earshot of Down on the east coast of Northern Ireland, continuing out across the Irish Sea, passing over the Pembroke peninsula and finally crossing St Michael's Mount, off the Cornish coast. This last location was where our illustrious leader and colleagues were based for the experiments back in 1970, 33 years ago, under the name of Operation Trafalgar. A history of St Michael's Mount and its monastery was given, covering Henry V, the Dissolution of the Monasteries, the English Civil War, World Wars I and II, and the Lady of the Castle incumbent at the time of the tests. Lots of lovely holiday snaps ensued, some of which had accelerometers in them - and in one, a microphone. Occasional references were made to acoustic issues, but this did not detract from the flow of anecdotes that kept the audience not only highly amused, but awake too.



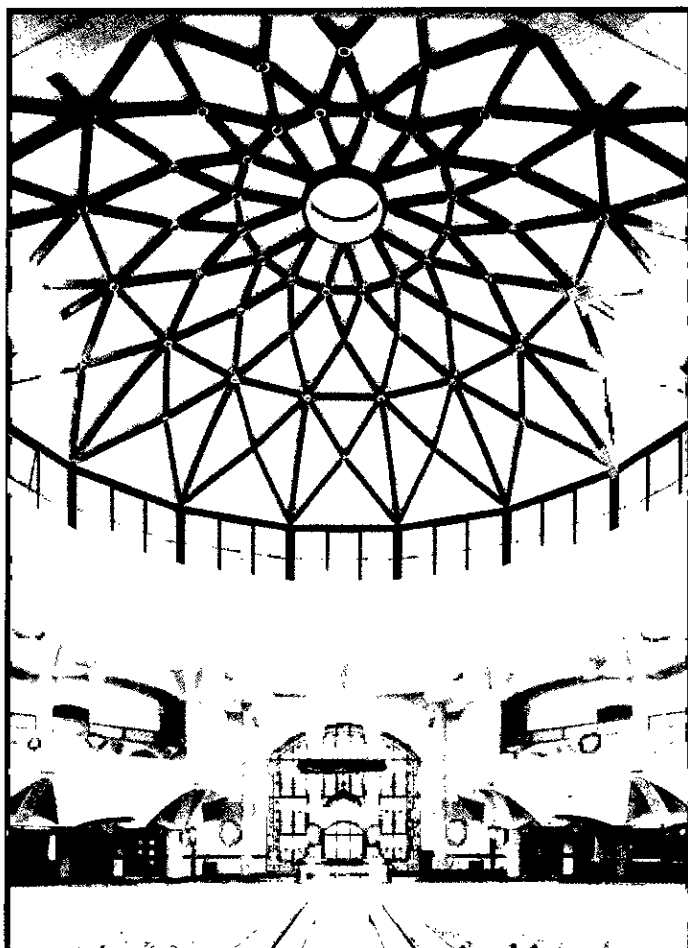
'It is astounding to think that all those years ago, the Normans had the foresight to invent window systems that would withstand a sonic boom'

One point did come across, which was that the sonic boom had no damaging effect on windows or structures. In fact, measured vibration levels were at times comparable to those produced by wind and weather, or from blasting at a quarry in Newlyn, on the mainland, just across the Causeway. On old stained-glass windows, much of the shock wave's effect was taken care of by the damping provided by the lead itself. It is astounding to think that all those years ago, the Normans had the foresight to invent window systems that would withstand a sonic boom.

Altogether a rattling good talk, delivered just one day after Concorde's final visit to Manchester's Ringway Airport and one day before the final flight to Heathrow. Oh, and coincidentally just two days after Trafalgar Day.

Our thanks go to Ove Arup and Partners for providing the venue and the buffet. It may be worthy of note that Nick Antonio managed to polish off a giant slice of carrot cake single-handedly, although it took some twenty minutes to complete the exercise, such was its size! The rest of us elected to cut the cakes in half in an attempt to add some sense of decorum to the proceedings.

Peter N Greenhalgh MIOA



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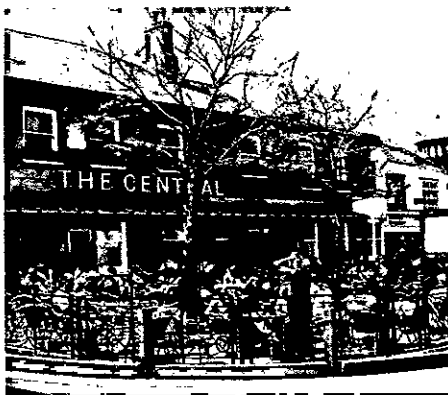
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NW Branch report

The new Licensing Act explained

At a well-attended meeting Hamish Lawson, Partner and Head of Licensing at Cobbetts, Solicitors gave an excellent presentation describing the *Licensing Act 2003*. The Act, which will not come into place fully until 2005, has excited considerable interest because of its wide ranging changes. Hamish described the multiplicity of different licences currently available for different activities. The new scheme rationalises these to a single licence - the 'premises licence'. Hamish went on to describe the licensable activities and the four detailed licensing objectives: prevention of crime and disorder; public safety; the prevention of public nuisance; and the protection of children from harm. Of these, from a noise standpoint, protection of public nuisance could be seen as the main objective, and might well be applied to cover just a few residents. The Secretary of State's guidance has been published in draft form, and is intended to provide a consistent approach for local authorities. One significant change is that licensing law is not intended as a mechanism for general control of Antisocial Behaviour, once customers are outside the Licensee's direct control.

A local authority Licensing Authority will set its own policy, and delegate its licensing functions to a committee. Responsible Authorities should be notified (these include police, fire authority and pollution/environmental control) as should local residents or residents' associations. While the form of the application has yet to be finalised, Hamish described the anticipated content and detailed requirements, which include an operating schedule setting out steps to promote the four objectives identified above.



A local authority Licensing Authority will set its own policy

He continued by describing the determination of an application, including the interesting point that the Licensing Authority must grant a licence in the

absence of any objections. Where there are relevant representations then conditions may be imposed, or an application may be rejected. Premises licences do not require renewal but a responsible or interested party can seek a review at any time. Hamish concluded the evening by answering a number of pertinent questions and explaining the likely issues associated with the Act. However, those associated with anti-social behaviour and at what point music is no longer incidental, but should be classed as live or recorded music and hence a licensable activity, were left in the air.

Peter Hepworth of Hepworth Acoustics, who had arranged the meeting, concluded the evening with a request for case histories to help provide evidence for the *Control of Noise from Pubs and Clubs* publication.

Nick Antonio

OBITUARY

Colin Ross

We are sorry to announce the passing away of Mr Colin Ross. Colin worked with the Royal Air Force for the past six years, completing his Diploma on a part-time basis. Many of you will have met him at IOA meetings and seminars or through his work with the RAF. Colin was diagnosed with cancer and died following major surgery to remove a tumour. We know you will join us in passing our condolences to his family and friends. He will be greatly missed.



Editor's Notes



Ian F Bennett BSc CEng MIOA
Editor

The Spring Conference is just around the corner, so that must mean it is nearly spring. Judging by the snow outside my window, it is spring ... nearly.

It is some time since the IPPC regime was introduced, and I am sure many members have long since had to come to grips with its implications for the average acoustic practitioner and client. At last we have space in the *Bulletin* to consider the important issues it raises for the control and reduction of environmental noise from industrial premises - industrial in the widest sense. I am grateful to Lesley Ormerod and Gordon Brown for revisiting the papers they presented at Oxford, and providing useful guidance from their contrasting perspectives.

This issue sees the resumption of the popular 'Pioneers of Acoustics' series with a brief biographical article on Robert Hooke. (In anticipation of comments about his not being an acoustician, consider where we might be without Hooke's Law!). I was interested in the enmity that developed between Hooke

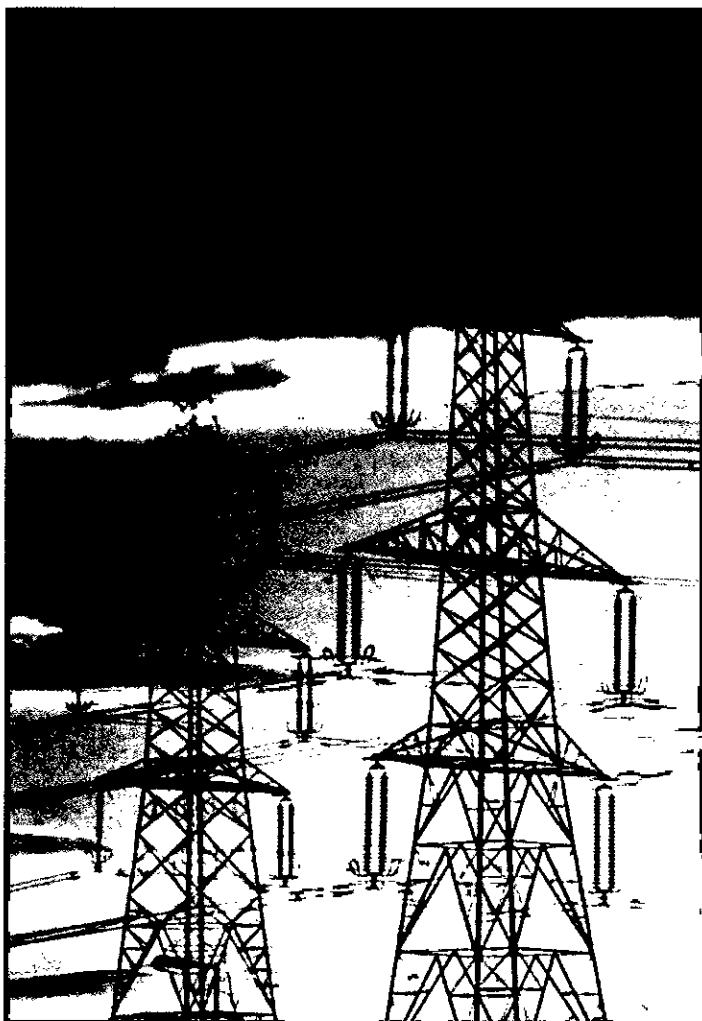
and his more famous contemporary, Newton: professional jealousy among academics is certainly not a new phenomenon.

I have just realised that for the first time ever, this issue has been produced without any paper copy or glossy photographic prints whatsoever: we can at last reasonably claim an entirely electronic publication process. I would encourage authors of articles, and contributors to the product news sections, to continue to use e-mail rather than the postal service, despite being aware that the entire system could fall over under the influence of the latest worm.

Copy date for the next issue is 10 April 2004 please. Offers of contributions to this or future *Bulletins* are always welcome.

Ian F Bennett

Ian F Bennett
Editor



IPPC and noise

An environmental health officer's perspective

G Brown MIOA and C Pink AMIOA

This article presents the views of two Environmental Health Officers who have had experience of the current regime of Integrated Pollution Control (IPC), on the inclusion of noise as an emission controlled by the new Integrated Pollution Prevention and Control (IPPC) system. It should be noted that the opinions expressed in the paper are personal to the authors and do not necessarily represent the views or policy of either Suffolk Coastal District Council or the Chartered Institute of Environmental Health

'PART A' PREMISES AND THE EHO

Current position

At present the local authority for the geographic area in question deals with noise emission issues from Part A premises, which are the responsibility of the Environment Agency for IPPC purposes. In this respect, there are two primary control systems, the first being the nuisance provisions of the *Environmental Protection Act 1990* (1) and the second being the use of planning conditions where new development takes place. It would be fair to say that whilst these systems do provide mechanisms for both responsive and pro-active control, they are by no means perfect.

Where enforcement using the Environmental Protection Act is involved, the local authority will not usually intervene until complaints are received. By this time it may be too late to take truly effective action, and it will certainly be much less efficient than designing with noise in mind in the first instance. Statutory nuisance action, in the absence of complaints, does not adequately address the situation where noise emissions gradually increase over time. As has been clearly stated in *Horizontal Guidance Note H3* (2), whilst complaints may be an indicator of potential or actual problems, their absence does not necessarily indicate that the acoustic climate in that environment is satisfactory. Action is also limited by the need to consider 'best practicable means', which does not usually represent as high a standard as 'loss of amenity' in the context of the *Town and Country Planning Act* (3) or 'best available techniques' where IPPC applies.

In addition, there has so far been no explicit requirement for operators of these premises to consider noise when installing or modifying equipment, buildings or systems to achieve other IPPC aims (except where planning consent is required). Unless operators of the premises have had significant previous experience of noise issues, this presents the considerable risk that modifications of this nature may result in intervention by the EHO, potentially requiring the replacement of newly installed equipment, a situation that anyone would regard as deeply unsatisfactory.

The foregoing effectively constitutes crisis management, and whilst legislation such as the nuisance provisions is an essential part of any regulatory system, it is an unsuitable tool for achieving long-term strategic objectives. It is such objectives, covering a range of emissions to the environment, which IPPC aims to address and the inclusion of noise within that regime should help to prevent the necessity for crisis management.

A more pro-active approach to noise management from Part A premises is currently possible where planning consent is required for the works, because the *Town and Country Planning Act* allows the local authority to include conditions on such a consent. There are, however, serious limitations imposed by the planning system that prevent the system being truly effective. The first of these is that any conditions included on a planning consent can only relate to the development itself, but the development may constitute only a relatively minor part of large existing premises. Whilst it may be possible to ensure that particular development does not contribute to a rise in noise emissions from the site, there are few opportunities to achieve an overall improvement in noise levels unless the development involves replacement of an existing, noisy installation.

Secondly, it should also be borne in mind that the planning system is a 'one shot' system, and once the consent has been granted it is extremely difficult to revisit it if the conditions that are imposed do not have the desired effect. In particular, it may be difficult to correct errors and oversights in planning consents and conditions, and such errors are by no means unknown.

Finally, it must be recognised that, inevitably, there will be within any area businesses that have the benefit of a pre-existing planning consent or established use, where there are no conditions related to noise. It is generally not possible to apply such conditions retrospectively within the present planning system.

Post-IPPC

The introduction of noise controls to the IPPC system will have a significant impact on the involvement of Environmental Health Departments with premises subject to permits, as once such a permit has been granted the premises are immune from statutory nuisance action - a fact that came as some surprise to many of the delegates at a recent IOA Conference!

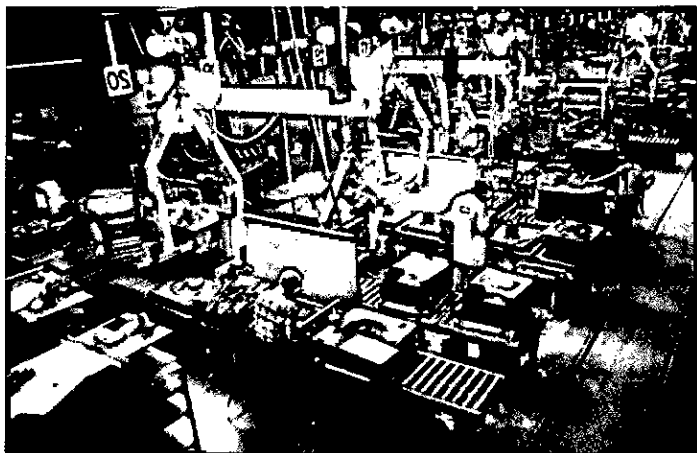
In itself, this does not appear to present any significant difficulties, as the principle is that compliance with the conditions of the permit should mean that nuisances will not occur. However, in reality there will inevitably be circumstances where the local authority will receive noise complaints relating to Part A premises. It is then essential that both the Agency and the Council are able to respond in a coordinated fashion that not only effectively resolves the noise issue in a timely fashion but also addresses the concerns of complainants.

Where a complaint that is usually the responsibility of the local authority is in fact the province of another organisation, communication and responsiveness become critically important if the situation is not to arise where both bodies are putting the same level of resources into dealing with the same issue. Noise is traditionally associated with the local environmental health department and it is inevitable that virtually all complaints of noise from Part A premises will be first made to the local authority.

It is therefore vital that detailed local arrangements are made to ensure that proper liaison and transfer of information takes place. The Agency and the Local Government Association have jointly produced a document entitled *Working Better Together* (4) which aims

continued on page 10

'Inevitably, there will be within any area businesses that have the benefit of a pre-existing planning consent or established use, where there are no conditions related to noise'



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IPPC and noise

An environmental health officer's perspective

continued from page 9

to address these issues, but the experience of the authors is that it would appear details have yet to be effectively disseminated to all concerned, particularly at grass roots level.

As statutory consultees the local authorities will also have a very significant role to play in the permit application process and this is clearly recognised in the horizontal guidance. It is possible that this will have resource implications for authorities that have significant numbers of Part A processes within their area. However, it is hoped that this would be offset by a reduction in the number of complaints associated with the relevant premises. The authors have evidence to indicate that this is certainly the case where similar resources are put into the planning process, resulting in a gradual reduction in the number of complaints regarding industrial and commercial premises.

It is hoped that the conditions attached to IPPC permits do, in fact, meet the requirements of BAT (best available technology) and thereby provide a commensurate level of protection for the public. Where there are failures in this process - as inevitably there will be - it is equally important that the Agency takes due regard of information and advice fed back from the local authority to ensure that conditions are amended appropriately.

Potential obstacles

Whilst the general view of the authors is that the inclusion of noise in the IPPC regime has the potential to be an invaluable tool in the long term management of noise emissions from industrial premises, there are a number of concerns regarding the practicalities of the system.

Concern has been expressed that at present the Agency may lack sufficient internal expertise in noise to carry out its function to the standard that they would wish. The types of premises that fall within the definition of Part A industries are generally large, diverse and complex, which may present very serious difficulties in assessing site noise emissions. This will inevitably result in operators

submitting applications accompanied by noise reports that are equally large, diverse and complex. The authors have had considerable experience in assessing reports of this nature, usually those that accompany planning applications, and can testify to the expertise, experience and resources needed to carry out this task satisfactorily.

However, the assessment process goes further in the case of IPPC as it is then necessary for the Agency to determine if BAT is being used to control noise emissions, and this is considered to be a task that will be particularly problematic unless considerable expertise is available. It is understood that the Agency is in the process of training relevant staff in basic acoustics and whilst this is without doubt welcome, it may still be appropriate to utilise external specialist resources in the interim period until Agency staff reach the requisite skills level.

As has already been stated, the formal protocol for cooperation between the Agency and local authorities does not appear to have filtered down to grass roots level and it is essential that efforts should be made by both parties to ensure that this does happen. Without a wholehearted commitment to cooperative working and good communication from all involved in the process, the system will not operate efficiently.

There is also concern at the Agency's ability to respond to complaints where instances of noise nuisance occur. Where breaches of permits occur that result in excessive noise emissions it is possible that this will generate large numbers of individual complaints and, as most local authorities will testify, this situation requires considerable resources and skills to handle efficiently. Noise complaints in particular are, in the authors' experience, capable of precipitating very large numbers of individual complainants, possibly more than any other nuisance-related issue. Environmental Health Departments are highly experienced at dealing with problems of this nature as much of their work involves responding to complaints.

The responsibilities of the Agency are primarily proactive and programmed and it is essential that systems be put into place and staff to deal efficiently with these eventualities. Again, much can be achieved through effective communication with the local authority and it is suggested that responding to major incidents of noise nuisance should be the subject of an explicit, detailed arrangement between local Agency staff and the relevant

'The types of premises that fall within the definition of Part A industries are generally large, diverse and complex, which may present very serious difficulties in assessing site noise emissions'



Council. Of particular concern is the recent change in the way in which the Agency handles complaints, as the first point of contact is no longer the local office, but the regional one.

A major part of the system of liaison with local authorities is the provision of consultation information where an application for a permit is received. Whilst the majority of the information requested on the pro-forma shown in the guidance should present few difficulties to provide, the request for details of complainants may prove to be more problematical. Local authorities are bound to keep complainants' details confidential and there have been a number of incidents in recent years that the authors have had experience of, where third parties have become aware of the identity of complainants. Although this was not by virtue of action or omissions on the part of Council officers, this has resulted in the complainants becoming highly aggrieved. As a result of this type of incident, many local authorities have become extremely cautious about revealing any details of complaints that may result in identification of the complainants. This includes revealing postcodes or similar level of detail, although there is a very wide variation between local authorities in what they will or will not reveal.

Whilst it is appreciated that the Agency forms a statutory body, and this may mean that there are legal provisions for the interchange of information of this type, it cannot be over-emphasised that such data is extremely sensitive. It is critical that there is in place a system to ensure that such details are not made public in any way that may result in identification of complainants.

Advantages of IPPC noise control

Local authorities face an ever-increasing number of noise complaints each year and at least a proportion of these arise from premises that will be brought within the IPPC system. The inclusion of noise as a controlled emission will therefore go some way towards reducing this burden as well as assisting in a progressive improvement in environmental noise levels. However, it is accepted that this is entirely dependent upon the number of businesses within an area that are subject to IPPC.

In this context IPPC has one very significant advantage over planning conditions in that it is possible to revise permit conditions in the light of experience or technological development. Where a planning consent is concerned, the imposition of conditions is effectively a once-only business where errors or omissions remain to haunt local authorities for the lifetime of the premises.

It is also inevitable that the IPPC process will raise the awareness of operators in respect of noise as an environmental emission issue and this can only be regarded as advantageous to all concerned. It can be extremely frustrating for both businesses and enforcement authorities when it becomes necessary to either carry out additional works to newly installed equipment, or even completely replace it simply because the acoustic implications of the works were not considered at the outset. In principle, this simply should not happen where premises are subject to an IPPC permit.

Because operators will be required to submit applications accompanied by a detailed study of noise emissions from the site, this should bring about a

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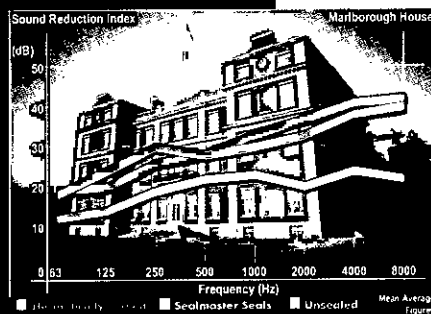
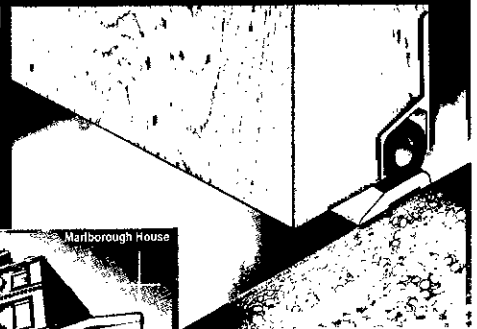
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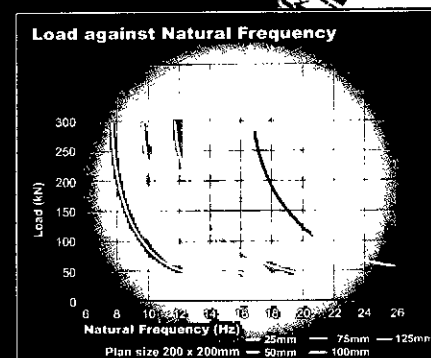
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IPPC and noise

An environmental health officer's perspective

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structured, risk based approach to noise management, rather than the *ad hoc* reactive approach that has been usual in the past.

In conclusion

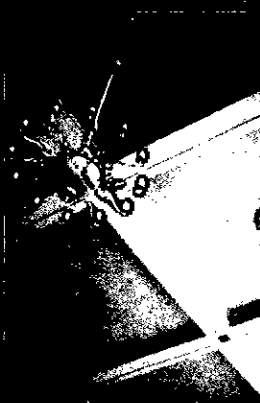
There is no doubt in the minds of the authors that the implementation of a system such as IPPC will result in significant gains for the environment surrounding premises subject to permits, as well as global improvements owing to reductions in more widely dispersed emissions. However, it must be recognised that in the case of noise emissions, only a relatively small proportion of industrial and commercial premises in any area will be subject to IPPC control, and this raises the question of how effective such a system can be in strategic noise control.

Many of these businesses will be located in areas where there are other premises in the vicinity producing far higher levels of noise emissions that are not subject to such stringent control. It is inevitable that operators will question the rationale of noise being included in IPPC in these circumstances. This also gives rise to curious, almost bizarre cases, where essentially similar installations may be subject to different noise control

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RECOMMENDATIONS

- ☐ Efforts must be made to ensure that the basic principles of interagency cooperation are made clear to all parties concerned, especially those with day-to-day responsibility for managing the impacts of IPPC sites.
- ☐ Early involvement of the environmental health officer in the application process is essential, and this should be at the pre-application stage to take best advantage of both local knowledge and specific acoustics skills. Although the guidance recommends this take place, there is some evidence that it is not occurring in all instances.
- ☐ Consideration should be given to engaging specialist external resources to assist with the assessment of applications until such time as the Agency has sufficient in-house capability to undertake this effectively.
- ☐ Prior to the issue of a permit, we would strongly recommend that the advice of the local authority be sought on the suitability and enforceability of the proposed conditions.
- ☐ Explicit and detailed contingency plans should be drawn up to deal with incidents of condition breaches or nuisance where both the Agency and the local authority are fielding complaints, to avoid conflicting information being distributed or duplication of effort.
- ☐ The results of investigations of complaints by either the Agency or the local authority should be effectively fed back into the IPPC permit review process.

regimes purely because some aspect of the operation of one of them requires an IPPC permit. The two Sizewell nuclear power stations on the Suffolk coast are a good example: the 'B' station is subject to IPPC, but the 'A' station is not.

It is clear that the success or otherwise of the IPPC noise regimen, so far as local authority officers are concerned, will depend heavily on the adequacy and efficiency of local liaison arrangements and the level of expertise available to the Agency in the assessment of applications. It is hoped that the issues raised here will be of some assistance in this respect.

References

- 1 Environmental Protection Act 1990, Stationery Office ISBN 0 10 544390 5
- 2 IPPC Guidance Note H3, Part 1. *Horizontal Guidance for Noise - 'Regulation and Permitting'*, Environment Agency
- 3 Town and Country Planning Act 1990, Stationery Office ISBN 0 10 540890 5
- 4 *Working Better Together*, Environment Agency and Local Government Association July 2000 ISBN 1 84049 191 4

Gordon Brown is from 10dB Acoustics (and formerly with Suffolk Coastal District Council) and **C Pink** is with Suffolk Coastal District Council



'From the outset, the Agency considered that the importance of noise at an installation was proportional to the environmental risk, and noise must also be balanced alongside other emissions and environmental impacts'

Noise and IPPC

Lesley Ormerod MIOA

Noise regulation at major industrial installations was a new challenge facing the Environment Agency following implementation of the PPC regime in 2001. To date over 450 permits have been issued, and as expected, relatively few have required specific noise conditions. From a noise perspective some applications have been very straightforward but others have been more complicated. Interestingly, some of the existing installations have been as challenging as new ones.

The Agency approach

From the outset, the Agency considered that the importance of noise at an installation was proportional to the environmental risk, and noise must also be balanced alongside other emissions and environmental impacts. This approach has been well received by industry, and other regulators. Clearly, many applications do need a detailed noise report, but not as a matter of routine. This risk-based approach determines not only the amount of information required in the application but also the importance of noise in the permit. The Agency understands the need for good liaison with local authorities who have a valuable role to play and a wealth of experience to draw from. However, a balance has to be struck between liaising with local authorities and giving them every opportunity for an input and giving the impression that the Agency is using them as unpaid consultants, which is very definitely not the Agency's intention.

Best Available Techniques (BAT) must be used to ensure the underpinning of good practice and in some situations the need to prevent creeping ambient (or background) sound levels is a consideration. In all situations there is the need to ensure that no reasonable cause for annoyance due to noise is caused to persons in the vicinity. The concept of 'reasonable cause for annoyance', although in various statutes, has no numerical definition either in

terms of volume of noise or duration, and the assessment of 'reasonable cause for annoyance' has to take into account a combination of many factors.

The aim is to determine if the noise would annoy a reasonable person expecting reasonable standards in their home or garden. The allegation that someone is annoyed by noise does not necessarily automatically meet the criterion. One advantage of this criterion is that it enables the Agency to filter out complaints made by particularly sensitive or intolerant people and yet still offer adequate protection to the reasonable general population. It is not a new concept and has been on the statute books since the *Local Government Act 1972* (1) which allowed local authorities to make bylaws for 'good rule and government'. Reasonable cause for annoyance is found in many local authority bylaws eg ball games, noise, and skateboards. The same or a very similar phrase has also been used in the following legislation:

- ☐ *Control of Pollution Act 1974* (2) (noise in streets and construction sites)
- ☐ *Noise and Statutory Nuisance Act 1993* (3) (burglar alarms, although not enacted)
- ☐ *Local Government (Misc. Prov.) Act 1982* (4) (Public entertainment licences)

There are several factors to take into account when considering 'reasonable cause for annoyance', including duration, volume, time of day (evening, night or weekends), acoustic features, number of people affected, and type of receptor.

A single factor or more than one, in combination can significantly influence the assessment. Part 1 of *IPPC H3 Horizontal Guidance for Noise* (5) sets out the Agency's approach to noise and permitting. Generally speaking it has been well received, both through the consultation process and in its practical application. As most acousticians know noise is very site specific and an absolute level approach to regulation is not appropriate. Nevertheless, it was felt important to give some guidance on what might constitute acceptable noise levels.

In order to balance these two issues and retain flexibility, a 'starting' point approach was adopted. It must be emphasised that the levels in H3 are not rigid levels, and intentionally are the opposite - they are a 'starting' point from which satisfactory levels can be determined.

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Noise and IPPC

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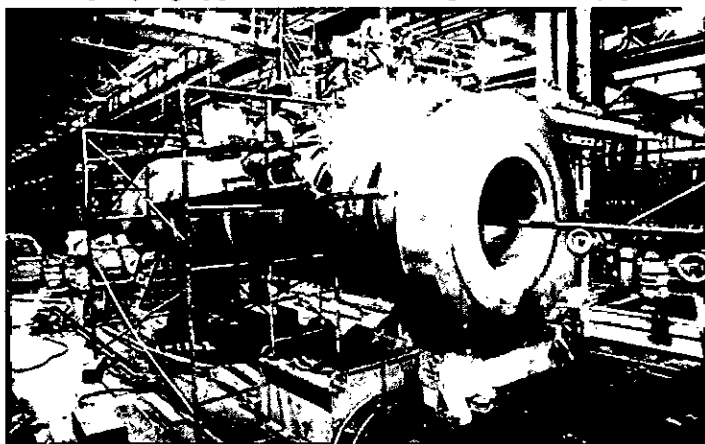
These may be higher or lower than the 'starting point', according to the risk and local circumstances, and do not necessarily need to be incorporated into a permit as conditions. In fact, it is considered that numerical limits should only be applied when there is a particular need and a demonstrable benefit. Wherever possible, the emphasis should be on good design, control at source and the use of good practice to prevent or minimise emissions.

Some experience to date

Both the quality of, and noise reports received, in connection with applications has been varied.

Whilst there have been some very good applications, extensive use has had to be made of the Schedule 4 procedure requiring further information. This has resulted in considerable work for the operators and the Agency, causing delays in determining applications. Additional information is not requested just for the sake of it, and where the noise risk is low due to an inherently quiet operation and no sensitive receptors in the vicinity, less detailed information is required. Generally, the responses from local authorities have been very good, although this too has varied, and references have been made to the amount of work required to respond to the consultation.

Where required, the noise monitoring reports accompanying applications have ranged from very good



The frequency of any monitoring will be proportional to the risk

to those lacking in terms of quality, clarity and containing basic errors or omissions. Modified 'noise at work' reports are sometimes submitted, and sometimes reports do not always address the most critical impacts such as night-time or weekends. Somewhat surprisingly, although many reports are carried out in accordance with BS4142:1997 (6), very little of the information required under Section 10 is reported. Regular omissions include: a subjective view; a description of the noise being measured; the weather; and precise monitoring locations. Reports also vary in their detail, and all too often unattended measurements are relied upon, meaning the monitoring does not comply with BS4142, or even BS7445 (7).

Another common omission from applications has been the lack of identification of noise mitigation measures. This information is useful for two reasons:

- ☐ it may demonstrate that the operator has made great efforts to minimise noise emissions, and
- ☐ the information may be required during the permitting process.

Monitoring and modelling

At the present time the Agency has a noise modelling capability residing in the Air Quality Modelling and Assessment Unit in Cardiff. The aim is to offer advice to field officers and noise specialists when faced with acoustic reports relying on modelling. The preferred approach, at present, is for noise to be measured wherever possible. However there is no reason why modelling could not be used to back up real monitoring data. In the case of new installations, and planned changes to existing installations, modelling clearly has a greater role, but new applications relying on modelling alone will usually be the subject of detailed conditions and validations during commissioning etc.

Noise monitoring is not automatically required either pre or post permitting. Clearly the operator will have the responsibility for monitoring the compliance - or otherwise - with any permit noise conditions. However, the frequency of any monitoring will be proportional to the risk and, in general terms, short-term attended monitoring is preferred to unattended long-term exercises. One approach which has been adopted is the use of periodic monitoring to ensure that the noise climate around an installation does not increase and over the years gradually decreases with the introduction of newer and quieter plant. If the climate does deteriorate due to noise from the installation this could be an indication that the operator is moving away from BAT.

Strategic permitting groups

Three 'Strategic Permitting Groups' (SPGs) were established within the Agency in 2003, to determine PPC applications. These SPGs are based in Bristol, Nottingham and Warrington. They are made up of small groups of permitting experts, together with technical specialists, and the intention is for these groups to determine applications as industry sectors come into PPC. The use of SPGs will help streamline the permitting process and the use of application and permit templates will add to this.

The 'working better together' protocol

In June 2003, the Local Government Association and the Environment Agency launched a joint England and Wales initiative - the 'Working Better Together' agreement. Under the umbrella of this agreement a number of protocols has been drawn up. These cover particular aspects of environmental protection where the Agency and local authorities will need to work together or alongside each other to deliver specific environmental outcomes and to enhance quality of life of local communities. One of these protocols describes the arrangements for implementation of IPPC.

The purpose of the protocol is to set out high level principles to ensure that operations work in the most effective way possible and a high level of protection of the environment is secured. The document provides:

- ☐ a framework to facilitate the setting up of local arrangements to bring together the available resources and expertise of the regulators at a local level;
- ☐ in so far as their powers allow, for regulators to deal with non-compliant releases and non-permitted releases and to respond to emergency situations in a timely and co-ordinated manner as appropriate to the situation;
- ☐ means for furthering the understanding of IPPC regulation by providing relevant training and by the timely exchange of relevant information; and

□ for dealing with regulatory action against operators in the most effective way.

A National Liaison Group is to be established, the principal roles of which will be to provide a mechanism for resolving issues, monitor the implementation of IPPC and exchange relevant information and review the protocol as necessary. There will also be national level liaison regarding policy and regulatory approaches, as well as joint training as appropriate.

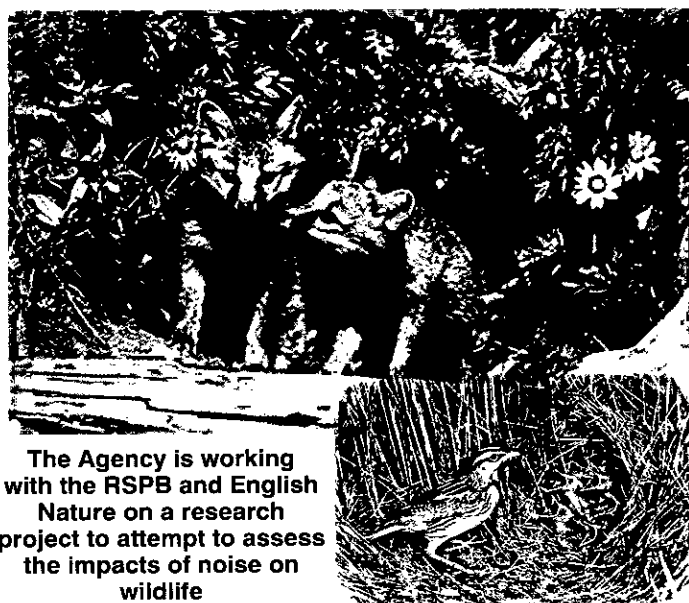
For effective implementation and on-going regulation of IPPC there is a requirement for close co-operation and working between the two parties at all levels. It is particularly important for noise in terms of planning issues and enforcement histories relating to specific installations; and to make this liaison effective, both the Agency and local authorities will need to use information from each other to discharge their responsibilities.

Habitats

The Environment Agency must comply with the EU Birds and Habitats Directives (Council Directives 79/409/EEC (8) on the conservation of wild birds and 92/43/EEC (9) on the conservation of natural habitats and of wild flora and fauna) in planning and carrying out all of its regulatory and operational activities. The Agency, as required by its obligations as a competent and relevant authority, will apply the *Conservation (Natural Habitats & c.) Regulations 1994* (10) (commonly referred to as the Habitats Regulations) when considering all applications for authorisations, major variations to authorisations, permissions, permits, consents and environmental licences (referred to as 'permissions') and all relevant Agency policy and operational activities. Clearly noise may be relevant as part of a PPC application/permission as it may have an adverse impact on species designated under these directives.

At present there is little, if any, relevant or robust information available to inform this decision when a noisy process may be impacting on bird species or wildlife. A precautionary approach would therefore suggest that the Agency cannot issue such permits. Previous studies of nightjars (*caprimulgus europaeus*) in Dorset have shown that the more urban heathland sites support fewer nightjars per hectare of heathland than the more rural heaths (Liley & Clarke, *in prep*). Fieldwork conducted by the Royal Society for the Protection of Birds (RSPB) Dorset Heathland Project in 2002 provided evidence that disturbance, which noise may be considered, did have a negative impact on breeding success, although the mechanism for the increased failure rates is not yet fully understood. The extent of noise impact from permitted activities as compared to other impacts is not known, and further work is required before the effect of disturbance is fully understood, in particular identifying the types of disturbance that are influencing the breeding success.

In recognition of these difficulties the Agency is working with the RSPB and English Nature on a research project to attempt to assess the impacts of noise on wildlife.



The Agency is working with the RSPB and English Nature on a research project to attempt to assess the impacts of noise on wildlife

Conclusion

The quality of applications, monitoring reports and consultation responses has inevitably been variable, and the determination of most permits to date has involved the use of Schedule 4 notices to obtain missing information.

Liaison with local authorities is particularly important when the Agency is considering the noise aspects of an application, and there have been some good examples of close working and the development of good working relationships at a local level. With the signing of the 'Working Better Together' IPPC protocol in April 2004 it is hoped that this will improve still further.

Noise has not been a major issue at every installation, and by taking a risk based approach to the regulation of noise at installations for which it has responsibility, the Agency aims to balance the burden on industry with the need to regulate noise and protect the environment.

References

- 1 Local Government Act 1972
- 2 Control of Pollution Act 1974
- 3 Noise and Statutory Nuisance Act 1993
- 4 Local Government (Miscellaneous Provisions) Act 1982
- 5 H3 IPPC Horizontal Guidance for Noise (IPPC H3) Parts 1 & 2, Environment Agency 2002 ISBN 0 11 310123 6 (Part 1) and ISBN 0 11 310187 2 (Part 2)
- 6 BS 4142:1997 *Method for rating industrial noise affecting mixed residential and industrial areas*, BSI ISBN 0 580 28300 3
- 7 BS 7445:1991 *Description and measurement of environmental noise: Part 1. Guide to quantities and procedures*, BSI, ISBN 0 580 19728 X; *Part 2. Guide to the acquisition of data pertinent to land use*, BSI, ISBN 0 580 19736 0; *Part 3. Guide to the application of noise limits*, BSI, ISBN 0 580 19734 4
- 8 79/409/EEC
- 9 92/43/EEC
- 10 Conservation (Natural Habitats & c.) Regulations 1994
- 11 Planning Policy Guidance Note PPG24: *Planning and Noise*, September 1994, DoE.

Lesley Ormerod is with the Environment Agency

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Accurately representing the sound field in industrial halls

using the ray-tracing technique

Stephen Dance

The advent of modern personal computers has allowed mathematical models to be implemented for the prediction of sound fields in industrial halls that are more and more complicated. Initially the model of a factory was simple, with just the room height and the source-receiver distance being considered (1), then one reflection from each room surface was included (2). Now, the room can be described in explicit detail with every surface described in absorption and scattering terms (3), every sound source detailed (4), random statistical models implemented to represent less organised objects in the room (5), and edge effects from room surfaces and barriers accounted for (6).

However, these models only become useful tools when used by highly skilled and experienced acousticians who have access to accurate descriptive information, the time to collate the necessary information, and the time to let the program execute. The mathematical model found to be the most flexible is the ray-tracing technique (7), in that it has been continually extended to include the very latest developments in the field. For in depth reviews of ray-tracing modelling two papers by Hodgson and Dance are recommended (8,9).

Ray-tracing

The origins of ray-tracing are in optics where the wavelengths are extremely small and so full details of the object viewed are visible. A secondary effect is that light tends to reflect from typical surfaces specularly, that is the angle of incidence equals the angle of reflection. Unfortunately at audible wavelengths these truths do not hold, but this did not stop acousticians from applying ray-tracing to room acoustic problems (7).

Since 1968 ray-tracing has been extensively researched and commercialised as a tool for the acoustician. To overcome some of the problems several categories of ray-tracing have been developed, including tracing rays (or visual lines), tracing cones, tracing beams and tracing beams which adapt with increasing distance.

Ray-tracing rays

Ray-tracing of rays is the original and simplest approach to the problem of simulating a sound field in a room. The rays are emitted from a source and bounce around the room. It is assumed that the wavelength being simulated is relatively short compared with the dimensions of the room, as any wavelength longer than the Schroeder cut off frequency for modal overlap cannot be accurately predicted by a geometric room acoustic model

$$f_c = 2000\sqrt{T/V}$$

where f_c is the critical frequency of interest, T is the reverberation time in seconds and V is the volume of the room in cubic metres.

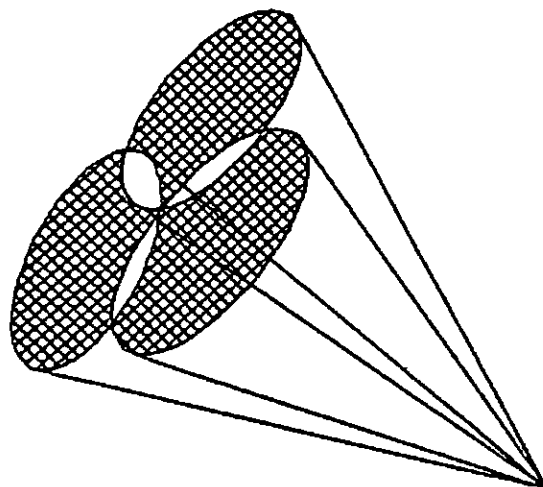
These geometric acoustic assumptions are used to simplify the problem, and sound is treated in terms of

energy rather than pressure, assuming reflections are purely specular or with an element of diffusion, referred to as surface scattering (3).

The rooms are defined geometrically, with any element less than two wavelengths in size ignored; the sound sources are treated as only producing sound in terms of energy with the option of including directivity information. This approach results in a model which should only be applied per frequency band, typically the octave band. For instance in a typical industrial hall the height of the room (say 8m) is the limiting factor, and frequencies below 125Hz (wavelength λ being 2.74m) should not be predicted. The octaves 125, 250, 500, 1k, 2k, 4k Hz should be predicted separately and combined to give an overall sound level. For each band the detail to be included in the geometrical description of the room should become more detailed as objects in the room 'come into focus' with increasing frequency. However, this would greatly increase the user input time, so only one model description is commonly used with frequency variation in the form of absorption and scattering coefficients from the room surfaces.

The sound is transmitted between sound source and receiver by way of many thousands of sound rays which diverge into a cone of sound over time and distance. The exact number required is open to dispute, but it is related to the size of the receiver cell (16). The receivers are volumes, usually cubic or spherical, which track sound rays as they cross the volume and attribute their sound energy to that of the volume based on the crossing distance. The receiver cell is usually scaled to the human dimension, 0.25m to 1.0m radius, and if the enclosed space is, for instance, 50m by 10m by 10m then 50,000 rays could be used to model accurately the sound field in the room, and a 0.5m radius is assumed. The ray is also attenuated by the air, and reflections from room surfaces, both effects being frequency dependent.

Figure 1. Cone-tracing requires overlaps



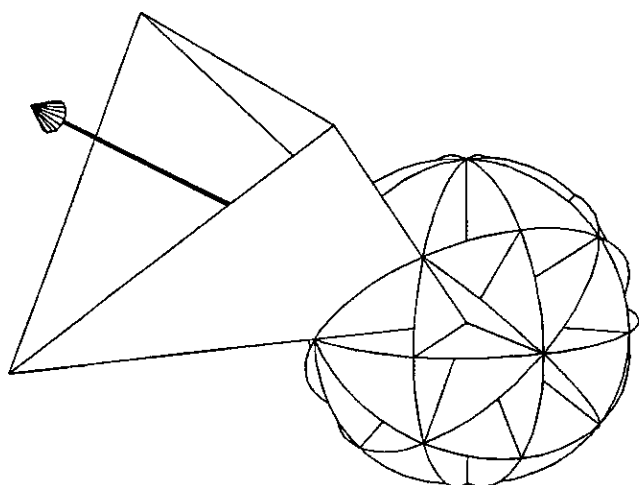


Figure 2. Pyramid-tracing tessellates exactly

The room surfaces are defined using planes, although modern models can represent curves either precisely or approximately (22). The surfaces have attributes such as absorption coefficients and, more recently, scattering coefficients, to model details which are 'out of focus'. These are the basics of a ray-tracing room acoustic model: there is a specific branch of modelling which deals with industrial halls.

Ray-tracing cones/pyramid/ adaptive

What has been described so far applies to the simplest ray-tracing technique. However, recent developments over the last decade have improved upon the basis design of the ray-tracing model. Hybrid models have been created using a ray-tracing model to alleviate the weaknesses, the execution time consideration, of the image source model in predicting highly geometrically complex rooms (17). A cone tracing algorithm was developed which tracks the cone of sound as it spread from the sound source (10) (Figure 1), and this was later changed to a pyramid tracing design (Figure 2) to improve accuracy and efficiency (18). The reason is that a radiation sphere from a point source can be evenly and exactly divided into pyramids whereas cones unavoidably involve overlaps, producing additional and unwelcome complications. The most recent developments are in adaptive pyramid tracing (19) which is only currently used in auditorium room acoustics. However, the latest thinking is to return to the simple ray-tracing model, but use more rays to describe the sound field [Delanbeck (23)].

The primary advantage of beam-tracing is that only a relatively small number of beams need to be traced to fill the room and hence produce an exact sound field prediction. This becomes especially significant when modelling internal-to-external noise emissions, as discussed below.

Industrial modelling

The above ray-tracing models were generally used to simulate auditoria, but more than twenty years ago a new branch of industrial room acoustics was developed where the particular problems of very large halls were addressed. For example Figure 3 shows the level of detail necessary to represent the premises pictured in Figure 4. The four most important areas for specific consideration are fittings, noise control, sound sources and external noise prediction.

Fittings

Fittings can be defined as any object in a room which could be considered difficult to define precisely, such as machinery, equipment or stock, *ie* not screens, internal offices, or acoustic barriers. The fittings might be located in a specific area such as near the floor, or near the ceiling, perhaps a crane or light fittings. More usually, the fittings are located between gangways to create plant lines.

As the ray-tracing approach is flexible many different techniques have been tried to describe these potential situations. Modelling each surface of each fitting is an approach still taken (10): an alternative is to assume the sound is attenuated as though it is travelling through a super-dense medium (2). However, the most successful approach has proved to be to model the fittings as randomly-positioned scatters or attenuators in the room, so that probability holds the complexity of the situation (11). This is refined so that different densities of fittings can be included using a zoning method, in order to represent the gangways and plant lines in a more realistic fashion (12). Dance (13) showed how the different representations of fittings, from extra absorbent on the floor, to evenly distributed fittings, to floor zoning of fittings, improved prediction accuracy. His work was extended to unevenly distributed fittings, which are more typical in industrial situations (14).

The fittings are described by a 'scattering frequency', q , calculated by the Kuttruff formula

$$q = \frac{S}{4V}$$

where S is the surface area of the fitting and V is the volume of the room. If the room is subdivided into zonal volumes then V becomes smaller and q increases.

The side effect is that the user must know the absorption coefficient and surface area for the fitting. This is often difficult for room acousticians to determine. Recently, it has been found that for typical industrial fittings the product of the absorption coefficient and surface area is critical, and does not vary significantly with frequency.

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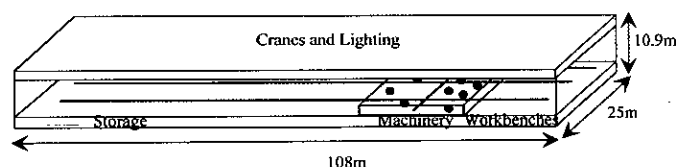


Figure 3: A simulation model of a metal working industrial hall with 12 machines running



Figure 4: Typical metalworking industrial hall, note the crane in the ceiling area

Accurately representing the sound field in industrial halls using the ray-tracing technique

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Noise control

Applying noise control in industrial environments is an essential part of acoustical design, and the mathematical model can help at the conceptual phase or in remedial work. Room surfaces can be treated either fully or partially, baffles installed, and noise enclosures or acoustic barriers erected. Ray-tracing models have the ability to represent any of these solutions with a high degree of realism.

The latest development is to simulate the effect of edges where at low-to-mid frequencies sound can be diffracted around corners using transparent extensions to the barrier. The size of the 'extensions' depends on the frequency of interest, which randomly influences the rays which strike them. This effect applies mainly to barriers (6) or in cases where the building's surrounding area needs to be modelled (15). In the latter case the sound can be transmitted through the walls, or may 'leak' out of apertures or delivery bays.

Sound sources

Various types of sound source are available, particularly in factory halls, where many types of machinery are used. The sound sources can be considered to be point sources, usually located near the floor, with a known sound power. However, they could be highly directional so more information is required to describe the acoustic near field around the machine. The directionality directly affects the number of rays produced in that direction (as usually there would be an equal chance of a ray in any direction) with thousands of rays produced from every sound source (16). The more powerful the source, the more rays should be used to model that source (16). If a machine is particularly large then it should be treated as either a line source, eg a conveyor belt, or a surface source, eg a radiating panel, to simulate the near field correctly (4).

External noise prediction

The emission of the internal sound field to the local external environment has recently been studied and predicted using two commercial models: a cone-tracer RAYNOISE (24), and a pyramid-tracer RAMSETTE (18), and one experimental model, FAME, from London South Bank University. It was previously necessary to use two models, one internally and one externally, using the Maekawa model (25), and producing two separate results, hence producing an approximation of the sound field.

Free field conditions

For the prediction of external sound propagation using mathematical models, it was first necessary to validate the free field propagation and compare the results with those using classical acoustics. The hypothetical space is a simplification of an outdoor environment. The floor was flat with a fixed absorption coefficient of 0.1. Air absorption was considered to vary with frequency, over the range between 125Hz and 4kHz. An omni-directional

point sound source was positioned 1m from the side of the floor, at a height of 1 metre. The sound source power was assumed not to vary with frequency and was set to 100dB. The external propagation of the sound was predicted on a doubling of distance basis up to 128m, as shown in Figure 5.

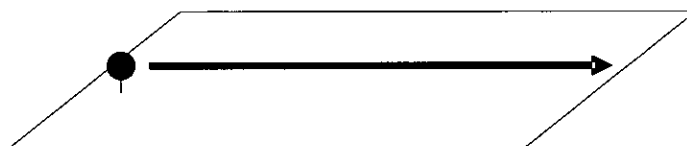


Figure 5: The 'room' was effectively just a floor 130m long with a line of receivers.

The 'room' is described identically by each of the models investigated, the floor being assumed to have an absorption coefficient of 0.1 whilst the rest of the room has an absorption coefficient of 1, equivalent to the free field condition. The number of rays traced is based on ten times the volume of the space, assuming 1m³ receiver cells. The room is assumed to be disproportionate with dimensions 130m by 100m by 10m and hence the number of rays traced is 131072. Only the low, mid and high frequency predictions are presented, for the centre frequencies 125Hz, 1kHz and 4kHz. Air absorption is represented by factors of 0.0001dB/m, 0.001dB/m and 0.05dB/m at the three respective frequencies.

Table 1 presents the predicted sound level, dB, at the furthest receiver position for three octave bands.

TABLE 1: Sound levels dB at 128m from the point source for three octave bands

Frequency	RAMSETTE v1.7	RAYNOISE v3.0	FAME
125 Hz	49.6	49.8	0.0
1000 Hz	49.6	49.5	0.0
4000 Hz	49.0	47.2	0.0

As can be seen from Table 1 the beam-tracing models predicted the sound level at the furthest receiver point of interest for this investigation, but FAME, being a ray-tracing model, could not. In a free field there should be a 6dB per doubling of distance from the sound source so the result should be approximately 49dB at a distance of 128 m, assuming no atmospheric absorption or ground effects.

Analysis of the FAME free field predictions

A ray-tracing model cannot predict the external sound field as the angular spread of a ray is limited compared with that used in a beam-tracing model. It is therefore necessary to use many more rays, and the number needs to be determined for future predictions. The number of rays was doubled and redoubled until a reliable result was reached, as shown in Table 2.

Table 2 Sound levels, dB, at 128m with varying number of rays predicted by FAME at 1kHz

Frequency	120,000	240,000	480,000	960,000
125 Hz	0	45.7	48.9	49.5
1000 Hz	0	45.2	48.4	49.0
4000 Hz	0	42.9	46.2	46.8

It can be seen that FAME required 480,000 rays before the predictions stabilised to a sound level similar to that

continued on page 20

Sounds amazing?

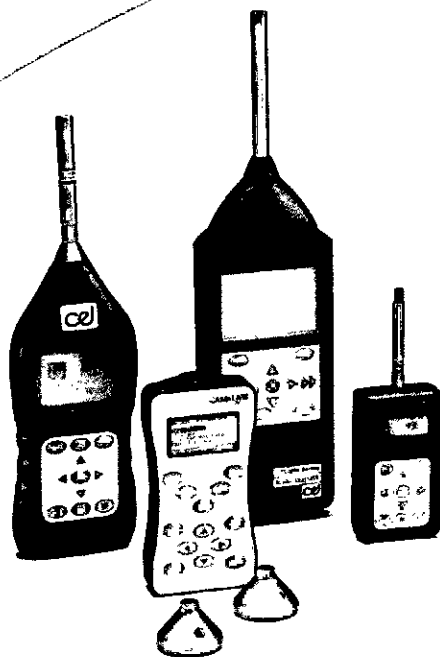
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Accurately representing the sound field in industrial halls using the ray-tracing technique

continued from page 18

modelled by the beam-tracing models. It can therefore be deduced that a ray-tracing model requires at least four times more rays than the beams in a beam-tracing model.

Model optimisation

Previously it had been established that for FAME in industrial halls, using a larger receiver cell size gave similar prediction accuracy to that of a standard 1m cubic cell size (7). The 1kHz octave band predictions were therefore reworked using a 2m cell size (volume 8m³), and hence a smaller number of rays were traced - a reduction by a factor of eight. The results showed that reliable results could be produced using 60,000 rays, although the predicted sound level at the furthest receiver position was only 45.6dB. When 120,000 rays were traced, where previously no reliable result was obtained, a sound level of 47.6dB was determined, a full 2 dB less than those predicted by RAMSETE and RAYNOISE. It follows that using a larger cell size allows for reliable although not necessarily accurate predictions (Figure 6).

A similar approach to optimisation of the number of

rays traced used in the FAME investigation was used for the beam-tracing models. The results demonstrated that beam-tracing has an inherent advantage over ray-tracing in that only 72 beams and 256 beams were traced by RAYNOISE and RAMSETE respectively, whilst retaining the prediction accuracy obtained using 132,000 beams. Beam-tracing is thus one thousand times faster than ray-tracing for sound level predictions in the free field. It should be noted that only one reflection is modelled, and the total run-time is significantly shorter than in an enclosed space.

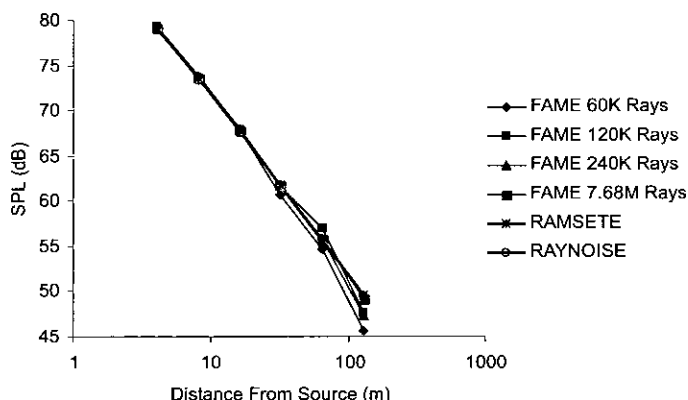


Figure 6. Predicting the sound level with increasing sound receiver distance, 1kHz octave band

Future developments

The simultaneous prediction of internal and external sound fields, although slow using a ray-tracing model, can be further optimised. When diffraction has to be considered then the two model approaches of the cone-tracers and pyramid-tracers will significantly slow the execution of those models. Although ray-tracing is an extremely slow process in free-field condition, in a more realistic or typical situation the benefits of the method should outweigh the large number of rays which need to be traced.

Other research undergoing current investigation includes using pressure rather than simply energy to model the sound field in a room. Recently, Dance and Shield (20) suggested that it is possible to predict the sound propagation in an empty factory more accurately using sound pressure to calculate the sound pressure levels in a room rather than modelling only the energy in the room. Hodgson *et al* (21) recently wrote a model which could calculate the precise phase change on reflection from a room surface to help improve the accuracy of prediction. These refinements to various mathematical models may provide predictions with a high degree of consistency and reliability. In addition Xiangyang *et al* (26) have written a hybrid model which can model phase. So far, only limited validation has been undertaken on their SOFIS model.

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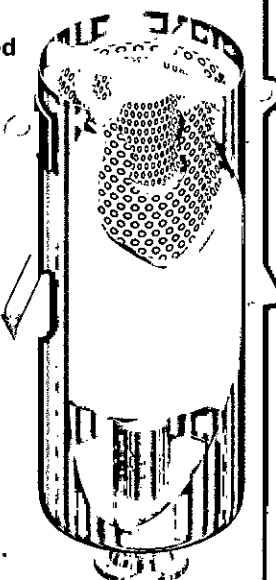
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The old Wembley stadium was fitted out with a sound system of professional grade with digital signal processing and fibre optic signal distribution

Sound system design and the digital domain

Steve Jones

Some 14 years after the first stadium sound system design using digital signal processing and fibre optic cable for signal distribution at Wembley stadium, the ability to design in anything but the digital domain is all but gone. However, the problem remains one of knowledge and experience. There are still a lot of Luddites who would never operate a digital mixing desk. There are some who still say that digital equipment cannot be used in a life safety application, others say that it does not comply with Standards. Is there any truth in these allegations? This article sets out to demystify digital system design and provide answers to those allegations.

The background

The compact disc (CD) was probably the most important breakthrough in the world of audio. It was not a variation on a theme like the compact cassette, but a true pioneering development. The fact that it was taken up with such great enthusiasm by the public made the prices drop to levels which were affordable. The term 'CD quality' was coined and for the first time it was common for the general public to be provided with high quality and come to expect it as a norm, rather than a rich man's preserve.

Alongside the audio CD there was the CD ROM,

which was a digital recording of computer data. The two mediums were exactly the same in terms of their recording method, it was just the data protocols which were different. Like so much in the world of electronics, the computer industry was driving a different industry and the latter was trying to stay independent. As we now realise, convergence between IT, audio and video is not only sensible - it was inevitable from the start. Nevertheless, even today, there are those who refuse to accept it for what it is, a mature and stable medium. There are those who cannot understand the advantages because to really work with digital, one has to look at it from a slightly different viewpoint.

Rock 'n' Roll

Back in 1990 the old Wembley stadium was fitted out with a sound system of professional grade with digital signal processing and fibre optic signal distribution to 12 rack locations around the building. It was the first 'house' sound system to be used by pop concert sound engineers as augmentation of the stage sound system.

The analogue mindset

Many of those same sound engineers are the very ones who refuse to use digital mixing consoles even today. Indeed, the console manufacturers went to great lengths to emulate analogue desks with their (literally) thousands of knobs and switches, just to make the engineer feel at home. The engineers would refuse to use a desk if they could not find the mid-high EQ level knob on channel 95 whether blindfolded or not.

The digital mindset

The digital way of doing it is that the mid-high EQ level is the same knob for all channels. One merely has to select channel 95 first. But wait! Why do you need to know that it is channel 95? Whereas in analogue you plugged it up and annotated it with a marker pen, in digital one plugs it up and types in 'Kylie vocals' or 'Hi Hat'; you then assign it to a sub-group, and possibly a song cue address. That way, during rehearsal, you have selected only the channels you need for that song, grouped up the drum kit and back line accordingly, and that leaves you with about 4 faders to control, each of which has got a name above the fader.

On the next song, the arrangement is different, but again you only have to operate the faders which are important. *If* something happens and you need to get something to the front, you hit 'open' and the screen will show you the names of the channels, you select (touchscreen?) the one you want and hit 'solo'. Now you have one channel's worth of all the control you need and it is right next to where you are standing, whereas in analogue it could be right up the other end of a 4 metre long desk.

Also, the monitor mixer has all the same channels as the FOH mixer, all the same facilities, there are no splitters to worry about, the method of using it is different because it is the monitor mix, but should the need ever arise, the FOH mixer could be switched to control the monitor mix (albeit temporarily) and vice versa.

Radio and TV

These days, the radio station doesn't just have

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SoundPLAN -one software for all environmental acoustic problems

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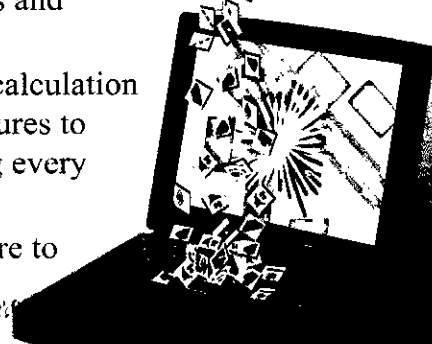
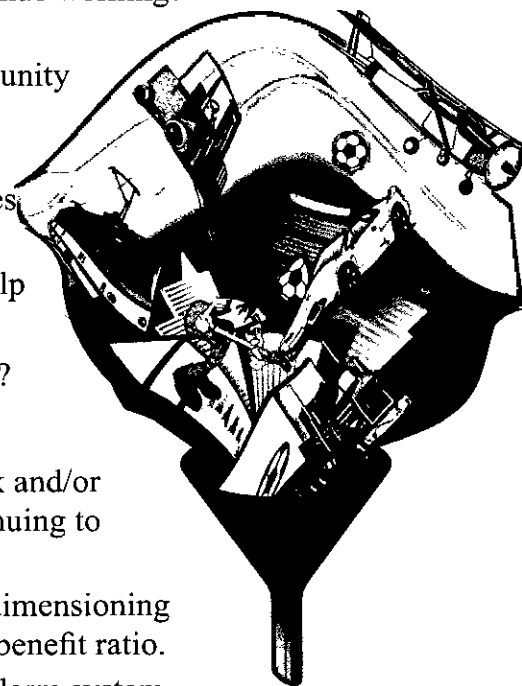
- ☐ How can I efficiently map the transportation and industrial noise from an agglomeration?
Can the software calculate in the background while I continue working?
Can I use a PC network to distribute the calculations?
- ☐ What is the most cost effective method to minimize community noise?
- ☐ How loud is it inside a building? Which sounds dominate?
Can the noise breakout be minimized with new doors, gates or window applications?
- ☐ Can I document my data sufficiently? Will the software help me comply with ISO 9000 quality control?
- ☐ Will I get the hotline support I might need in my language?

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Sound system design and the digital domain

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a mixer, it has a touchscreen. The touchscreen is 'scheduled' to change source, complete with ducking fading and cutting, so that it becomes an intuitive control surface which the DJ can use without having to have a producer. In fact, the only time faders may be used is when the live sources are the microphone for the DJ, the co-presenter and any guests or discussion panel, but even these can be configured as an automatic mix.

It is not just the mixing and control which is in the digital domain. The 'records', the adverts, the trailers, and just about every other form of non-live source is stored on hard disk. The aforementioned scheduler is merely selecting a filename in a computer. The same applies in television for some shows, and especially the transmission controller.

However, the TV studio is more akin to the stage application where the scenes are set up previously and brought in as cues. Again, in TV, whereas the video tape machines used to 'roll', now the pictures are stored on hard disc and can be called up by any studio or edit suite. Broadcast stations today are more of a high speed computer network than anything else. To achieve that speed, the connection medium is usually fibre optic.

Digital signal processors

Thinking digital

In analogue terms a circuit might consist of a microphone, going into a bass roll-off filter, then into some sort of mixing or routing, then into a room equaliser and then off into a crossover before going out to the amplifiers and loudspeaker units. To a DSP, all this equalisation boils down to two EQ parameters, one for each output.

On the other hand, a multi-delay system may seem to need a lot of RAM to produce, but in DSP it can be optimised by blocks of delay in series.

Different network configurations

In permanent installations there are many variations on the theme of DSPs. Some systems are centralised and the amount of DSP required is physically plugged into the mother board, rather like loading up RAM in a computer (but more expensive). Other systems have DSP engines not only in their own box, but also in the hubs on the network. This DSP can be utilised either

directly by the local connection or across the network, so effectively you are sending a bunch of signals over the network, processing them and sending them back to where they started to be used at the output stages.

The integrity of sound systems

We were recently asked to help a client in Canary Wharf to find the real source of the failure of the Voice Alarm (VA) system to broadcast an intelligible live announcement.

When is a voice alarm system compliant?

The client repeated the mantra from the fire detection and alarm company, ie. the fact that messages generated using the digital sound store were intelligible meant that the system was compliant with the Standards and hence there was no reason why the building could not be occupied.

The fact that the reason why the Client had realised that his five year old system was faulty was that 18 months ago (after 11 September) they decided that they should practice for emergencies other than fire, and that no pre-recorded messages were really suitable, so they had to be live announcements. It was then they realised that the system was faulty, and to date no-one had come up with a solution.

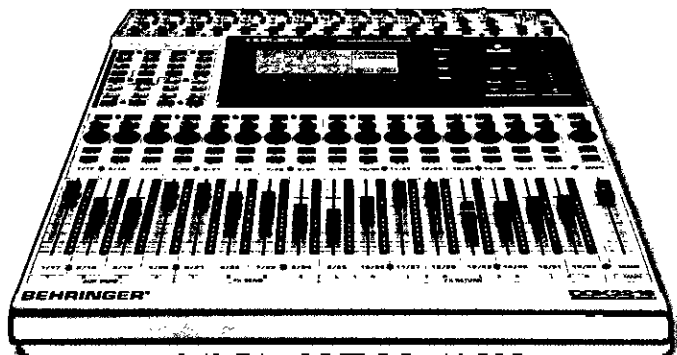
The 'compliance' in the true sense of the word must be questioned under these circumstances. Indeed it just serves to highlight that a system which is **only** used in emergencies, rather than every day, is actually very likely to be deficient when required. In fact, as proven many times, systems are certified as compliant by the installers when they have actually never worked, let alone complied. There are many excuses for this scenario, including not being allowed to test, or being thrown off site because the building is late and the client wants beneficial use etc., but in reality it begs the question 'what is the point of the Standard when there are no policemen?'.

Recent attempts to improve the relevant Standards for Voice Alarm such that it is performance based rather than product based have met with great resistance. The concept which should be adopted is that the equipment which is readily available and used across the spectrum of the whole audio industry in huge quantities is likely to have a known MTBF, or at least an industry accepted reputation, and that a performance based standard will allow this, and new technology, to be used. **Provided** that the system designer uses reasonable skill and care.

The resistance to this approach stems from people who are involved in manufacture. They manufacture to product Standards. The result is an old technology base which is over-priced, produced in low volumes, often over-engineered in the areas which are not critical, and even so, installed in a manner which does not work properly, if at all. This is a cottage industry using the Standards for trade protection. The result is the scenario described here i.e. life safety compromised by a cottage industry with Standards bigots.

Day and night

It transpired that the tests carried out at night showed that the live broadcasts were **generally** (but not totally) intelligible. However, the monthly



This 32 channel, 16 busses digital mixer features an analogue feel

daytime tests (during operational hours) were almost completely unintelligible. It was allegedly a combination of distortion and a Norman Collier comedy act of intermittent signals. So why the difference between day and night?

Configuration

The system was divided into five equipment locations, one (grandly titled) Fire Control and Command centre containing the routing selection, the microphone and the fault monitoring display, and four sets of equipment racks spread amongst the 20 or so floors of this high rise building. Each of the equipment rack sets comprised amplifiers, a set of digital sound stores, a token ring network decoder, and a network hub. This means that the selection of which message is broadcast, and to which amplifier channel(s) is controlled by a 'processor'. Now BE 5839-8 states that in the event of the failure of a 'processor', it should be by-passed.

The original meaning of this clause was that the 'processor' was a PLC which controlled only routing and therefore having by-passed it, the system should be able to broadcast an 'all call'. In this system, the live announcement was also carried on the token ring network. Now if that audio signal was distorted and intermittent, one has to question the integrity of the control system which was required to carry out routing and signal initiation. The fact that a digital network could not be by-passed meant that it was non-compliant.

So lets now consider this token ring network. How is it configured? It is carried on fireproof copper cables which are not screened, and the cable itself is not actually designed to carry digital signals. The fact that low speed data may be fairly tolerant of its transmission medium is not the same thing as a high density audio signal over such a network medium. It is then discovered that due to the steel construction of the building, it is difficult to get PMRs (Private Mobile Radio - walkie-talkies) or mobile phones to work. As a result, a leaky feeder aerial system has been installed up adjacent risers to the VA network cables. Also, mobile phone repeater access points are also installed.

So, when considering what is the difference between night and day? The answer (or at least part of it) is RF spectrum traffic!!

The cure

It is not the forte of a cottage industry to design systems for performance standards. Whilst all the indicators are the colour required by the Standards, the control panel is huge and custom built, the wiring was neat and tidy at one time in its life, the circuit boards have no indication as to what they do, what connections are for, and there is nothing in the O&M manuals which gives the slightest hint of what it does or how it is done. This is a 'professional' system for life safety which doubtless cost a fortune, it is fault monitored to the nth degree, runs from batteries when the mains fails (one hopes) and yet it produces a fault indication when the huge front panel is opened because one of the switches strains against the next door equipment. Compliant? Why bother when it is unintelligible.

The solution is as follows: firstly, eliminate the front end faults and check for distortion in the analogue domain. This means taking the telephone handset (which serves as the microphone for the live announcements) and making sure that it bridges correctly into the pre-amp feeding the



The consultants were asked to help a client in Canary Wharf to find the real source of the failure of the Voice Alarm (VA) system to broadcast an intelligible live announcement

A to D converter, and that it (via a compressor/limiter if necessary) does not overload the A to D converter.

Having established an intelligible signal in the analogue domain, any further distortion and the interference can be attributed to the digital domain. The copper cables can be bypassed by means of fibre optic cables and off the shelf boxes to convert fibre to Ethernet (on copper) and Ethernet to token ring, thus leaving the original system immune from interference. It is too early to say if the medicine worked, but it just goes to show that it is not necessarily digital or fibre optics which are 'non-compliant' as some in the fire industry would say, but the cottage industry which diverts good engineering practice into potentially fatally flawed system design.

The systems which we designed for buildings as far back as 1990 used fibre optics and digital, and these were used in life safety applications, but crucially, they were used operationally every day and therefore everyone could hear for themselves that the result was intelligible. The other big difference was that these designs used equipment which was on the open market, for which there were published and available circuit and equipment manuals. These, together with some decent system schematics, made the systems serviceable by any competent engineer.

Conclusion

Sound system design is like most professions, in the hands of bigots and Luddites, the result is of dubious quality and demonstrably poor value for money. The appeasement of these people by using analogue layouts with digital innards is wrong because it again costs too much and does not address the advantages of thinking with a mindset of digital signals. The answer is to embrace the digital domain, both in terms of audio signals and computer networks. So much so, that the convergence of these two technologies has already happened. It is unavoidable, therefore, that those who do not embrace it will be left behind. The next concept to embrace is the totally digital communication networks for vision as well as sound, because that too arrived some time ago.

Steve Jones is with Symonds Group Ltd



Robert Hooke

1635-1703

Robert Hooke's name is rather obscure these days, not least because of his opposition to, and passionate arguments with, the great Sir Isaac Newton. For Newton has been described as vindictive, and it certainly seems true that he used his immense influence and fame to subjugate those of his peers who dared to hold different views from his own. Nevertheless, Hooke was probably the single greatest experimental scientist of the seventeenth century. In an era when acoustics did not exist as a separate scientific discipline, his work with springs, and discovery of the law bearing his name, qualifies him not as an acoustician, but as a pioneer of acoustics.

Hooke's interests ranged from chemistry and biology through geology, astronomy and physics to architecture and what we would today call marine architecture. He corresponded with Wren, Huygens, van Leeuwenhoek, Newton and Boyle. He invented the iris diaphragm, the universal joint, the anchor escapement, the balance spring and an early respirator. As Chief Surveyor he helped rebuild London after the Great Fire of 1666. He formulated correctly the theory of combustion, assisted Robert Boyle in the study of gases, and improved several instruments used in meteorology.

Robert Hooke was born on 18 July 1635, the younger son of John Hooke, curate at All Saints Church, Freshwater, Isle of Wight. His father was, in practice, the priest of All Saints since the true incumbent was also Dean of Gloucester and Wells Cathedrals. The church had as its patron St John's College, Cambridge and was thus relatively well-off. Besides his church duties, John Hooke also ran the village school and tutored private pupils.

The eldest son, also named John, was five years older than Robert. His childhood is largely unknown, and the scant detail available is only that which Robert mentioned to acquaintances in later life. We do know that typically for the time, he was of poor health and the boy was not expected to reach adulthood. His father was from a family steeped in the church's traditions and, indeed, all three of John Hooke Senior's brothers were clergymen. If Robert had been hale and hearty as a child he would doubtless have gone into the church himself, and indeed, the beginnings of his education were planned with this in mind. Unfortunately, he suffered

'Hooke was probably the single greatest experimental scientist of the 17C'

from frequent headaches which adversely affected his ability to study. Doubting that he would actually reach adulthood, his formal education was largely abandoned by his parents, leaving the young Robert very much to his own devices.

These included his extraordinary powers of observation and the mechanical skills he was able to develop. Robert observed the animals and plants, the cliffs and rocks, the beaches and the sea close to his island home. He was fascinated by clocks and clockwork, creating wooden artefacts, mechanical toys and clocks. He even built a model of a fully rigged ship with working guns. The Preface to Hooke's *Posthumous Works*, published by Waller in 1705, suggests that from the age of around ten - when his imagination was allowed to burst forth - Robert Hooke believed in mechanics almost as an article of faith, and in nature as a complex machine.

At about that time his father became ill, so Robert was left even more to learn for himself in a highly practical and personal way. His talent for science emerged quite early, and he also showed some little aptitude for

representational art, especially drawing. A portrait painter called John Hoskyns was working at Freshwater at this time and the young Hooke was in the habit of watching him. It naturally followed that he began to imitate Hoskyns' pen and chalk techniques, and soon began to copy the portraits produced by his involuntary tutor. His talent became obvious, and after his father died in 1648 Robert's family decided that a living might reasonably be gained from sketching and drawing. He was left some money and all his father's books, and was sent to London as an apprentice to Peter Lely, the portrait painter.

Lely had studied at Haarlem, Netherlands and set himself up in London about five years before Hooke began his apprenticeship. He quickly gained recognition with his portraits of King Charles I and of James, Duke of York. Van Dyck was an important influence and in time he became the most technically proficient painter in England. Although the young Hooke could have learnt a great deal from such an authority, he quickly came to realise that studying under Lely would be a waste of money while he lacked a formal education. Hooke

'Hooke was involved with the greatest scientists of his day'

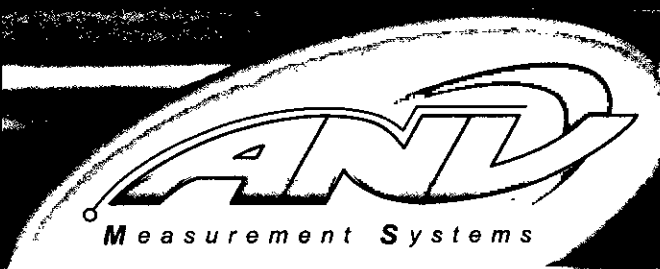
therefore enrolled in Westminster School and boarded in the house of the headmaster Richard Busby. As it turned out he was fortunate to come under the influence of Busby, a gifted teacher who quickly recognised the young student's innate abilities. After just a week Hooke had reputedly assimilated the first six books of Euclid's *Elements* and the headmaster encouraged him to continue his studies by himself in the library.

At Westminster Hooke learnt Latin and Greek but although he spoke the former, he never wrote in the language, unlike most of his contemporaries. His understanding of geometry was soon applied to the invention of possible flying machines. He found time to learn to play the organ. In 1653, having absorbed as much knowledge as Westminster School could offer, he won a chorister's place at Christ College and went up to Oxford. He began to study there at a particularly significant time: Robert Boyle, Thomas Willis, John Wallis, John Wilkins, Seth Ward, William Petty and Christopher Wren were already meeting as the Oxford branch of the philosophical or 'invisible' college following moves by many of their number from London to Oxford.

Hooke learnt astronomy from Seth Ward and impressed Wilkins with his knowledge of mechanics. The latter gave him a copy of *Mathematical Magick, or the wonders that may be performed by mechanical geometry* which he had published five years before, and this encouraged Hooke in his efforts to invent a flying machine. In the grounds of Wadham College he conducted experiments with pulleys, and assisted Willis with his dissections. This involvement with the greatest scientists of his day allowed him to acquire skills in a very wide range of disciplines. A biographer wrote that Hooke had never taken a bachelor's degree, but Oxford gave him more than a thousand degrees could match.

Boyle was seeking an assistant and Hooke joined him in 1655 as a result of Willis' recommendation. One of the earliest projects was to construct an air pump.

continued on page 28



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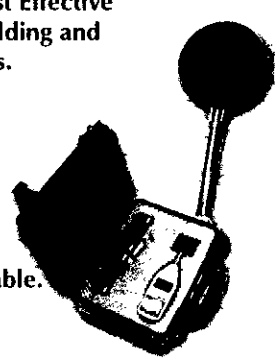
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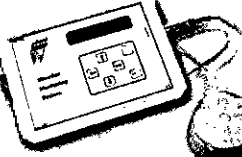
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Robert Hooke

1635-1703

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Boyle was principally interested in chemistry but had read of von Guericke's experiments using an air pump and, knowing Hooke's skill with mechanical devices, asked if he could build one. Although a better air pump than von Guericke's (strictly, a vacuum pump) had been constructed by Greville, Hooke designed and built a greatly improved version, and this is still the basis of the modern device.

Hooke never seemed to do just one thing at a time, and thrived on a multiplicity of ideas. Whilst working on the vacuum pump he was also pondering on clocks and the ways they could be used to determine longitude at sea. The pendulum clock was unable to keep proper time on a ship which was pitching and tossing over the waves, and he thought it may be possible to use springs instead of gravity for making a body vibrate in any posture.

Rather than controlling the balance wheel by a pendulum which was in turn moving under the influence of gravity, Hooke reasoned that controlling the balance

positions to their Puritan inclinations, and they were gradually supplanted by royalists. General George Monck, a former Puritan, called for new elections to Parliament, knowing that the mood of the people would elect royalists. The troops which had been stationed in Gresham College left, thus allowing scientists to begin meeting again in the College. On Wednesday 28 November 1660 a meeting there constituted the Society for the Promoting of Physico-Mathematical Experimental Learning, with the intention of promoting what was then called experimental philosophy.

Hooke's first publication was a pamphlet on capillary action: his paper was read to the Society on 10 April 1661. He showed that the narrower the tube, the higher water rose in it. The Society had by this time petitioned King Charles II for official recognition, to make a royal grant of incorporation. A Royal Charter was passed by the Great Seal on 15 July 1662, creating the Royal Society of London, and including a provision to appoint a Curator of Experiments. The Society already had Hooke in mind for this position and he took it up on 5 November 1662. He was required to demonstrate three or four experiments at every meeting of the Society, but this was never a realistic objective. Nobody but Hooke could have contemplated it with any seriousness. It

had been hoped that the Society would be able to provide payment, but Hooke was obliged to work without any remuneration until the Society could afford to pay him.

Hooke's reaction was to produce a wealth of original ideas over the next 15 years, and it was through these that the Society prospered, whilst the demands brought out Hooke's genius. He never had time to develop his ideas over time as most scientists would, but it

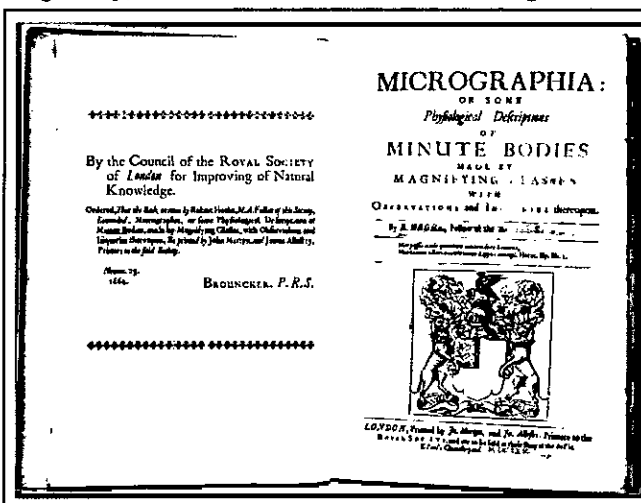
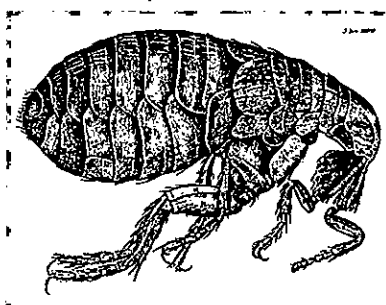
sued him to leap from one half-solution to the next. He was elected to the Royal Society on 3 June 1663 and although he was still unpaid the Society at least saw fit to waive the annual fees in his case.

In 1664 the Society agreed to pay Hooke £80 a year, then arranged for him the position of Cutlerian Lecturer in the Mechanical Arts at a salary of £50 per annum. They then reduced his salary as Curator of Experiments to £30 but appointed him for life. This did not provide the financial security for which Hooke might have hoped. The Society often had insufficient funds to pay him as Curator of Experiments, and he was obliged to go to law to obtain payment for his duties as Cutlerian Lecturer in the Mechanical Arts.

However, he took up another appointment in 1665, as Professor of Geometry at Gresham College, London. This gave him rooms at the College in return for a weekly lecture during term time. The lecture had to be given in Latin and then repeated in English. It was a requirement that he remained unmarried, although he was permitted a housekeeper.

In 1665 Hooke first achieved worldwide scientific fame. His book *Micrographia*, published that year, contained beautiful pictures of objects Hooke

Micrographia - best-seller of its day - was an accurate and detailed record of Hooke's observations, illustrated with magnificent drawings, such as the flea pictured below



wheel with a spring would have huge advantages for a portable timekeeper. Even if it were carried or transported by sea, it would still keep the correct time. He began in about 1658 and by 1660 had made two significant steps: the use of a balance controlled by a spiral spring, and an improved escapement called an anchor escapement. In 1660 he discovered the application of Hooke's Law while working on designs for the balance springs of clocks. He only announced the general law of elasticity much later, in his lecture *Of Spring* given in 1678.

In fact 1660 was the year of a peculiar event regarding the spring controlled clocks. He had the backing of Wren and others and drew up a patent which could have made him a fortune. Realising, however, that the patent would permit any future improver of his design to receive royalties, Hooke refused to continue with the patent. Indeed, it was some time before John Harrison was able to solve the technical problems with his H1 clock of 1730-35, and the other timepieces that followed.

Political circumstances now determined the course of events for Hooke. Oliver Cromwell died in 1658, and his son's rule did not last long: the monarchy was restored in 1660. Many of the scientists in Oxford owed their

had studied through a microscope he had himself constructed. The book contains a number of fundamental biological discoveries. Samuel Pepys made a diary entry that he had sat up until two o'clock in his chamber, reading Mr Hooke's Microscopical Observations, the most ingenious book that he had ever read in his life.

Micrographia is one of the masterpieces of seventeenth century science. It presented not a systematic investigation of any one question, but a bouquet of observations with courses from the mineral, animal and vegetable kingdoms. Above all, the book suggested what the microscope could do for biological science.

Hooke invented the conical pendulum and was the first to build a Gregorian reflecting telescope. He made

Bitter disputes over discovery sources led to enmity between Hooke and Newton

important astronomical observations including the fact that Jupiter revolves on its axis which he discovered from observing spots on its surface. He invented a helioscope to attempt to measure the rotation of the sun using sunspots, and made drawings of Mars which were later used to determine its period of rotation. He observed several comets and asked a number of important questions about them, including why the tail points away from the sun, and how if the comet is burning it could burn for so long and burn in a place where there is no air. In 1666 he proposed that gravity could be measured using a pendulum.

In addition to his post as Professor of Geometry at Gresham College, Hooke held the post of City Surveyor. He was a very competent architect and was chief assistant to Christopher Wren in the rebuilding of London after the Great Fire. The two men formed a friendship that lasted for the rest of their lives. Hooke found the position of surveyor more than compensated financially for the uncertainty of his other income.

When Newton produced his theory of light and colour in 1672, Hooke claimed that the correct parts of the theory had been stolen from his own ideas about light in 1665, and that the original parts were wrong. This was the beginning of the enmity between the two. In 1672 Hooke attempted to prove that the Earth moves in an ellipse round the Sun and six years later proposed the inverse square law of gravitation to explain planetary motions. Hooke wrote to Newton in 1679 asking for his opinion

'... of compounding the celestial motions of the planetts of a direct motion by the tangent (inertial motion) and an attractive motion towards the centrall body ... my supposition is that the Attraction always is in a duplicate proportion to the Distance from the Center Reciprocall ...'

Hooke seems to have been unable to prove his conjectures mathematically, or was perhaps unwilling to devote his time to it. He nevertheless claimed priority over the inverse square law and this led to a bitter dispute with Newton who consequently removed all references to Hooke from the *Principia*. Newton's famous admission that 'If I have seen further, it is by standing on the shoulders of giants', was actually written in a letter to Hooke in February 1676.

In 1678 Hooke published his treatise on elasticity, *De*

continued on page 30

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Robert Hooke

1635-1703

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Potentia Bestitutiva or Of Spring, upon which is based what we now know as Hooke's Law, which states that the extension of a spring is proportional to the applied force.

Throughout Hooke's life, there were often bitter disputes with fellow scientists, but he remained on very good terms with some colleagues, especially Boyle and Wren. Hooke has been described as a difficult and unreasonable man but this may be a harsh judgement coloured by the opinions of the great Newton. There is no doubt that Hooke genuinely felt others to have stolen his original ideas. This all too frequently happened because he never followed them through, and failed to develop major theories from his inspirations simply because he did not really have the technical ability to develop comprehensive theories, unlike Huygens and Newton.

Hooke's diaries tell something about his character, and paint a fascinating picture of the time. He was apparently a brisk walker, and enjoyed walking in the fields north of the City of London. He generally rose early in order to work in daylight and prevent strain to his eyes (and probably to save candles). Nevertheless, he would sometimes work all through the night, and then have a nap after dinner. As well as drinking a variety of waters, he drank brandy, port, claret, sack, and birch juice wine which he found delicious. He also had barrels of Flanstead's and Tillotson's ales. In a few instances he recorded in his diary that he had been drunk. He was gregarious and liked to meet people who had travelled abroad.

As Hooke aged he became more cynical and tended to shut himself away from company. The papers he wrote in the last few years of his life are full of bitterness. In February 1690 he gave two lectures to the Royal Society. At this time he was often troubled with headaches, giddiness, and fainting which hindered his philosophical studies, yet despite his general decline he still read some lectures whenever he was able.

The texts of some of these lectures reveal Hooke's bitterness, as the extract printed below highlights.



This commemorative window to Robert Hooke, installed in St Helen's Church, Bishopsgate, was subsequently destroyed by fire

After Hooke's death on 3 March 1703 Waller edited a major publication of previously unpublished works. A large portion of the work is devoted to Hooke's lectures on earthquakes. Over a period of thirty years he made major contributions to geology, particularly in investigating fossil remains, convincing him that major changes had occurred in the Earth's surface in order to lift the fossilised shells of marine animals into what were now mountain ranges.

Hooke has been described as a lean, bent and ugly man and it was believed that he did not sit for a portrait. However, a portrait painted for the Royal Society has recently been found after being missing for many years. There was once a commemorative window to him in St Helen's Church, Bishopsgate, but this was destroyed by fire.

Whose original ideas were they?

This extract from one of Robert Hooke's lectures, reflects his acrimonious disputes with Isaac Newton

'[Huygens'] preface is concerning those properties of gravity which I myself first discovered and showed to this Society and years since, which of late Mr Newton has done me the favour to print and publish as his own inventions. And particularly that of the oval figure of the Earth which was read by me to this Society about 27 years since upon the occasion of the carrying the pendulum clocks to sea and at two other times since, though I have had the ill fortune not to be heard, and I conceive there are some present that may very well remember and do know that Mr Newton did not send up that addition

to his book till some weeks after I had read and showed the experiments and demonstration thereof in this place and had answered the reproachful letter of Dr Wallis from Oxford. However I am well pleased to find that the truth will at length prevail when men have laid aside their prepossessions and prejudices. And as that hath found approvers in the world and those thinking men too, so I doubt not but that divers other discoveries which I have here first made (when they come to be well considered and examined) be found not so unreasonable or extravagant as some would willingly make them'.

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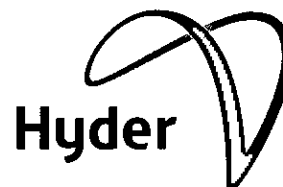
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Consulting

John Tyler FIOA reports from the Hi-Fi Show and AV Expo 2003

This annual show, sponsored by the publication *Hi-Fi News*, was held in late September at the Renaissance and Le Meridian Hotels, London Heathrow. As a contributor to *Acoustics Bulletin*, I was able to attend on the trade day, so avoiding the crowded conditions of the two public days. We thought a short report might interest those members involved in recorded sound and video.

This year the show attracted more than 200 exhibitors, including equipment manufacturers from Britain and other European countries, the USA, Australia, New Zealand and Taiwan.

There were also several special events backed by the British Audio Dealers' Association (BADA) and British Federation of Audio (BFA). These included demonstrations, lectures and open forums. Some of these were held on the trade day but many also took place on the public days. For example, visitors were able to hear a 'super system' comprising fully active 7.1 PMC loudspeakers, Linn and TAG-McLaren audio electronics, Chord Company cables and a new 30 chip Barco DLP projector. I was not able to sample this ultimate combination, which is probably just as well as I have already spent too much on audio equipment!

Among several specialist presentations held on the public days were Video Projection Technology (Phase Three Hi-Fi); Loudspeaker Design for Modern High Bandwidth Formats (PMC); Multi-Channel (Dolby and DTS); DVD-A or SACD? (Linn); and Evolving Your Two-Channel System to Multi-Channel (Ken Kessler).

Restricted to the trade day were three, hour long 'open forum' sessions planned specifically for trade and professional visitors, where a panel of specialists shared their expertise. These sessions included: 'Display and Video Technology'; 'Formats - Now and the Future'; and 'Structured Wiring'.

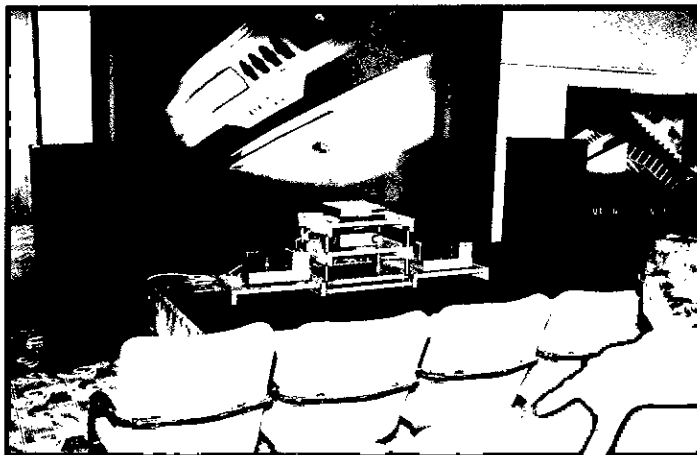
During the two public days there was live entertainment to be enjoyed, including performances by the singer and songwriter Eleanor McEvoy with pianist Brian Connor. Although I missed these on the trade day, I was able to buy one of her CDs.

Russ Andrews (left) and Ray Kimber demonstrating the DSD tape through the former's amplification and loudspeaker system



The demonstration rooms

Manufacturers showing off their latest wares occupied most of the bedrooms in both hotels. Those who have attended similar events will have experienced the difficulty of making sensible judgements on sound quality among the vast range of loudspeakers, CD/DVD players, video displays and amplifiers on show in these rooms. For my taste most of the sound levels were too high for comfort, particularly where popular music was concerned, and even on the trade-only day the rooms were quite crowded.



Quad demonstration room

Nevertheless the occasion does provide a unique opportunity to compare and contrast - and make notes on - particular items which would be worth hearing in the demonstration rooms of your local specialist dealer. However, there were havens of relative peace, among them the much larger room chosen by Quad to demonstrate its wonderful electrostatic loudspeakers-driven by Quad amplification. I'm probably biased here, since I have owned Quad equipment for many years (but sadly no electrostatic speakers!).

Another comparatively peaceful location was that provided by Russ Andrews and Ray Kimber. Members with long memories of *Reproduced Sound* Conferences in Windermere will perhaps recall that Russ Andrews exhibited at the first RS in 1985. Since then, his company has expanded considerably, offering a much extended range of mains and audio cables, connectors and mains filtering devices to improve your equipment's performance. He is now, and has been for some time, associated with Ray Kimber whose specialised cables are well known, under the name 'KIMBER KABLE', which are used in most of Russ Andrew's products.

Russ was demonstrating his recently designed, high end, loudspeaker and amplifier combination, using recordings made by Ray Kimber on a Tascam DS-D98 HR recorder, a Direct Stream Digital Tape Recorder, at a sampling rate of 2.8224Mhz, via an EMM DAC. These were recordings made by Ray Kimber using his new IsoMike (trade mark) microphone system. This uses two widely spaced omnidirectional microphones placed either side of an acoustic baffle. Unlike similar models used in this way, the IsoMike baffle is much larger and much more absorptive and has a special shape. The tapes were not processed in any way



Valves are alive and well

and thus the available dynamic range is the same as the original performance. This system was first demonstrated at the *San Francisco Home Entertainment Show* in May 2003.

Impressive recordings

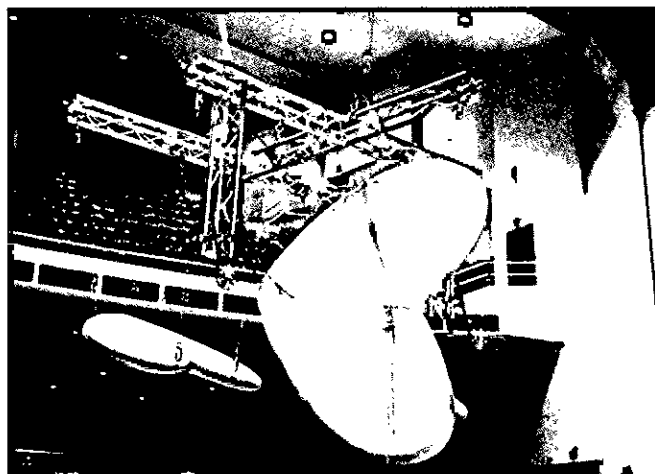
The recordings using the Tascam were of performances by the music students at the Weber State University. The recordings were certainly impressive at this demonstration. Then Ray Kimber gave me two copies of a CD that were Redbook 44.1kHz/16 bit down-converted from the DSD master tapes with no dynamic compression. I was warned to limit the volume level! Certainly when played back on my audio system the recordings sounded extremely good.

Any member who is interested in trying out these recordings and who does not possess a Tascam DSD recorder is welcome to borrow the CDs. Just let me know through the Institute's head office in St Albans. The tracks include a wide range of music types.

Ray Kimber's website gives more information on the IsoMike system - <http://kimber.com/isomike.htm>

By this time - mid afternoon - I was running out of energy, decided to call it a day and departed. However, I can thoroughly recommend readers who are interested in the subject to attend this year's show. It has a lot to offer in one place and you could end up spending serious money! Me? I bought just a few specialised CDs and some cable.

Ray Kimber's IsoMike system



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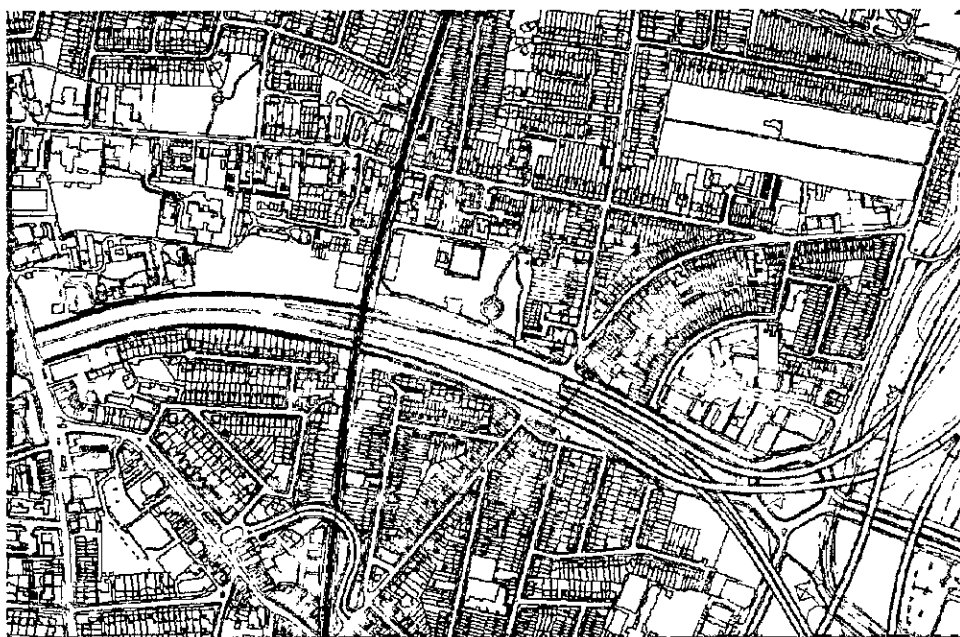
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Commons debates

6 January

Motorway Noise

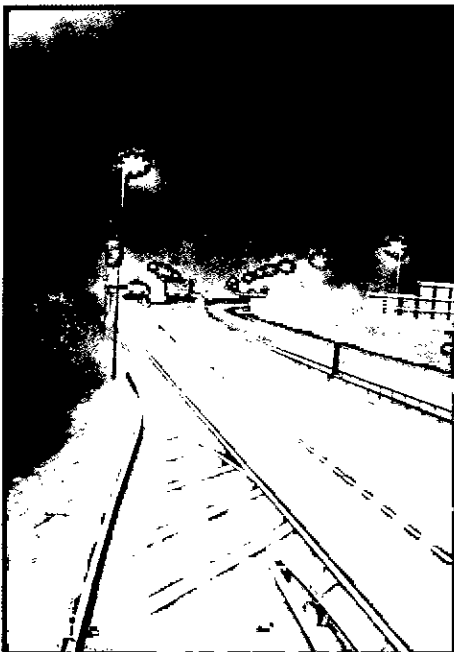
Mr Andrew Robathan (Blaby) (Con): What is policy on the introduction of quieter road surfaces on motorways?

The Parliamentary Under-Secretary of State for Transport (Mr David Jamieson): The Highways Agency always uses quieter road surfaces when carrying out resurfacing work on England's motorways and trunk roads. On 1 April last year, I announced a timetable for resurfacing all sections of concrete road on our strategic road network with noise-reducing material in order to provide relief from traffic noise for households living alongside noisy trunk roads. That work will be progressed in line with the priorities that were identified, which provide for the earliest relief to the worst affected properties, subject to the availability of funding.

Mr Robathan: Unfortunately, that will not reassure my constituents who live near the M1 in Narborough, Whetstone, Cosby and elsewhere. They were expecting to have the M1 resurfaced with quieter material this summer, but it has been put off for up to three years - because of value management work, according to the Highways Agency. Yet the Minister told me in a written answer that the resurfacing project is not the result of value management work. Will he tell me who is right - he or the Highways Agency? Will he get his act and his policy together with the Highways Agency; and will he reassure my constituents along the M1 south of junction 20 that they will have a quieter road surface?

Mr Jamieson: I would say very gently to the hon. Gentleman that, had it not been for this government bringing in the new quieter road surfaces, there would have been no quieter road surfaces at all, whenever the

'For people living alongside a motorway, noise can be extremely intrusive'



FROM HANSARD

surface was relaid. Work has to be carried out all round the country on the trunk roads and the major motorway system, including the M1 between junctions 20 and 21 - I appreciate that many of the villages all the way down to Lutterworth are affected as well - but it has to be done in order of priority.

Priority is given to road surfaces that are breaking up, and to locations where road safety is an issue, where there are potholes or where the skid value of the road has deteriorated. We carefully analyse each road that needs doing according to that list of priorities, and I can assure the hon. Gentleman that, although it is not possible this year, he will be in the three-year programme from 2005-06, when his constituents will be able to expect the government to provide a quieter road for them.

Mr Derek Wyatt (Sittingbourne and Sheppey) (Lab): Will my hon. Friend meet the parish council in Bredgar when he visits my constituency shortly? The M2 runs alongside that area, and there have been campaigns against the noise for ten years. It is an echo chamber. It seems to miss all the criteria that we apply to these problems, but the noise is unbearable to anyone walking there.

Mr Jamieson: A lot of meetings seem to be resulting from our questions today. Of course, I am always happy to meet my hon. Friend and I know what a strong advocate he has been on road and transport issues in his constituency. I would be happy to meet him, because I realise that this is a problem - just as it is in Leicester - for the people living alongside a motorway. Noise can be extremely intrusive.

Mr John Redwood (Wokingham) (Con): Can the Minister tell me, either now or in writing, when the M4 between junctions 8/9 and 12 might be resurfaced with a quieter material, which we would welcome? If he is planning an expansion of that motorway, could that be linked to the introduction of sound barriers to give some relief to residents?

Mr Jamieson: The Highways Agency looks very carefully at the environmental impact of any improvements that take place on our roads, particularly the impact of noise on local residents. I will write to the right hon. Gentleman on the matter of the M4. As he knows, certain stretches have been resurfaced with a quieter material, but this work has to be done in order of priority. Priority has to be given to surfaces that have deteriorated, and we cannot just resurface roads that are still in good

condition. I am sure that he appreciates that, in terms of value for money for the taxpayer, but I shall certainly write to him about the sections of the road that he mentioned.

Written Answers

13 January

M5

Mr Drew: To ask the Secretary of State for Transport if he will publish the resurfacing schedule for the M5; and what account it takes of requests to deal with excessive noise nuisance.

Mr Jamieson: Resurfacing schedules are established on an annual basis, based upon an assessment of surface condition and availability of funds. Next year's resurfacing will be determined as part of the Highways Agency's business plan development.

The *10 Year Plan for Transport* includes a commitment to use quieter surfacing materials where possible during routine resurfacing. Other noise reduction measures, such as noise fencing, are considered on an individual basis.

28 January

Road Noise

Sue Doughty: To ask the Secretary of State for Transport if he will make a statement on government strategy for decreasing the noise disturbances arising from main roads in residential areas, with particular reference to relevant measures in the *Traffic Management Bill*.

Mr Jamieson: The government recognises that traffic noise from main roads can be a significant nuisance, particularly where they run close to or through local communities. The government is committed to reducing such noise and our strategy is to set vehicle construction standards that reduce noise at source wherever feasible and desirable on safety grounds. We also encourage the mitigation of noise with insulation, barriers, traffic management measures and low noise surfaces.

The implementation of mitigation measures on the trunk road and motorway network, for which the Highways Agency is responsible, concentrates first on the most pressing locations. It is doing this by a variety of means, most importantly through a programme of re-surfacing all concrete roads with quieter materials by 31 March 2011 and re-surfacing blacktop roads with quieter materials as and when they require maintenance. In addition, the government provides funds to local authorities to maintain local roads, though how much they spend and what they spend it on is their choice.

The primary aim of the *Traffic Management Bill* is to improve the smooth flow of traffic but there are a number of reasons for believing that it will also help with noise problems. For example, better management of traffic incidents and street works will reduce the disruption caused to traffic and the noise created by slow-moving heavy traffic. It will also minimise the incentive for motorists to divert along adjacent residential roads.

The government is also encouraging a

substantial growth in investment in public transport. This will help reduce traffic noise by providing the public with a greater choice over how they travel.

28 January

Edinburgh Airport (Noise Pollution)

John Barrett: To ask the Secretary of State for Transport what estimate he has made of the number of households which will be subjected to: (a) a noise level of (i) 63dBA L_{eq} or more and (ii) 69dBA L_{eq} or more; and (b) an increase in noise level of 3dBA L_{eq} or more, directly as a result of the increased use of the existing runway at Edinburgh airport as outlined in the recent White Paper on Aviation.

Mr McNulty: This information is set out in the Scottish Consultation Document and supporting technical reports. These estimate the number of people who would be affected by different levels of noise under a range of runway options at Edinburgh airport including maximum use of the existing main runway, greater use of the existing crosswind runway and development of a new close parallel runway. Our analysis suggests that by 2030, under the maximum use option, and assuming a 8dBA technology improvement, there would be an increase of 300 people affected within the 63 dBA 16 hour L_{eq} contour with no increase at the 69dBA 16 hour L_{eq} contour. The equivalent figures with increased use of the crosswind runway are 800 and 200 respectively. The numbers of houses within these contours in the maximum use case is estimated to be 400 at 63 dBA and 100 at 69 dBA. Under the crosswind option the equivalent figures are 600 and 100 respectively.

2 February

Edinburgh Airport

John Barrett: To ask the Secretary of State for Transport what estimate he has made of the number of households which will be subjected to: (a) a noise level of (i) 63dBA L_{eq} or more and (ii) 69dBA L_{eq} or more; and (b) an increase in noise level of 3dBA L_{eq} or more directly as a result of (A) the construction and (B) use of a second runway at Edinburgh airport as outlined in the aviation white paper.

Mr McNulty: This information is set out in the Scottish Consultation Document and supporting technical reports. These estimate the number of people who would be affected by different levels of noise under a range of runway options at Edinburgh Airport including maximum use of the existing main runway, greater use of the existing crosswind runway and development of a new close parallel runway. Our analysis suggests that by 2030, the development of a new close parallel runway, assuming a 14 dBA technology improvement, would reduce the number of people affected within the 63 dBA 16 hour L_{eq} contour by 300 with an increase of 200 people affected at the 69 dBA 16 hour L_{eq} contour. The numbers of houses within these

contours for a new close parallel runway is estimated to be 200 at 63 dBA and 100 at 69 dBA.

12 February

Wind Turbines

Mr Cousins: To ask the Secretary of State for Trade and Industry what standards regulate aerodynamically generated wind noise in residential areas; and if she will make a statement.

Mr Timms: Currently planning authorities take into account the recommendations and methodologies for the measurement of noise in the case of windfarms as set out in the report *ETSU-R-97: The Assessment and Rating of Noise from Wind Farms*.

The report is available on the DTI website at www.dti.gov.uk/energy/renewables/publications/noise/assessment.shtml.

23 February

Wind Turbines

Dr Murrison: To ask the Secretary of State for Environment, Food and Rural Affairs for what reason noise from wind turbines has been excluded from the study at Salford University into low frequency noise

that approximately 3,500 to 5,000 wind turbines will be required. This includes both onshore and offshore turbines, and assumes that around 7% to 8% of electricity is generated from wind with the remaining 2% to 3% from other renewable sources.

Llew Smith: To ask the Secretary of State for Trade and Industry what assessment has been made of the potential hazard posed by wind turbines to migrating bats.

Mr Timms: Studies of the impact of wind farms on wildlife suggest that there is a small risk of bat strikes from the operation of wind turbines but that this occurs on a very irregular basis due to the good echolocation systems that bats use to navigate.

In addition, under the normal planning regime and for consent under section 36 of the *Electricity Act 1989* regime or the *Transport and Works Act 1992* wind farm developers are required to consider all environmental aspects of wind energy projects and produce an Environmental Impact Assessment. These assessments are available to the public.

The great majority of British bat species do



'Windfarm developers are required to consider all aspects of wind energy projects and produce an Environmental Impact Assessment'

sponsored by her Department.

Alun Michael: The study being carried out by Salford University aims to provide a method for assessing low frequency noise. Salford University has been asked to identify a number of examples of different types of low frequency noise for detailed investigation to determine how assessment of such noises could be carried by Local Enforcement Practitioners. Salford University is due to report shortly on the examples recommended for detailed investigation.

23 February

Wind Farms

Mr Peter Duncan: To ask the Secretary of State for Trade and Industry if she will make a statement on the number of wind turbines which will be required to meet government targets on renewable energy in the United Kingdom.

Mr Timms: To meet the government's target of 10% of electricity generated from renewable sources by 2010 we expect

not undertake large scale migrations and so would not be expected to interact with offshore wind farms. The exception to this is *Nathusius's pipistrelle* which is known to undertake long distance migrations in Europe (including sea crossings), but this is an uncommon species in the UK. The potential for bat interactions with wind turbines is recognised and is being considered in the Strategic Environmental Assessments that will precede any future offshore wind farm licensing rounds. Similarly, bats are listed as a consideration in guidance *Background document on problems and benefits associated with the development of offshore wind farms*, issued by the Convention for the Protection of the Marine Environment of the North East Atlantic (OSPAR document EIHA 03/4/6-E(L)) and thus potential effects on bats would be expected to be assessed in project specific Environmental Impact Assessments for offshore wind farms.

continued on page 36

FROM HANSARD

continued from page 35

See Crockford, N, February 1992. A review of the Possible Impacts of Wind Farms on Birds and Other Wildlife (Joint National Conservation Committee report no. 27), JNCC, Peterborough and National Wind Co-ordinating Committee, December 1999. *Studying wind energy/bird interactions: A Guidance document*: NWCC, Washington DC (USA).

Llew Smith: To ask the Secretary of State for Trade and Industry what research has been undertaken by: (a) her Department; (b) the Energy Technology Support Unit on behalf of her Department; and (c) consultants for her Department on (i) shadow flicker and (ii) noise from wind farms.

Mr Timms: Research on wind turbine noise has been carried out under the Department's New and Renewable Energy Programme. Copies of the reports from those studies are available on the DTI website at www.dti.gov.uk/publications. No research has been carried out into shadow flicker from wind turbines under the DTI's New and Renewable Energy Programme. However, others have conducted research in this area and references to those studies are provided as follows.

The Assessment & Rating of Noise from Wind Farms ETSU-97.

Noise Emission from Wind Turbines ETSU W/13/00503/REP.

Low Frequency Noise and Vibrations Measurement at a Modern Wind Farm ETSU W/13/00392/REP.

Assessment of the Effects of Noise and Vibration from Offshore Windfarms on Marine Wildlife ETSU W/13/00566/REP.

Aerodynamic Noise Reduction for Variable Speed Turbines ETSU W/45/00504/REP.

Machine Tests for Audible Noise Emission on an Atlantic Corporation 15/50kw Wind Turbine Installed on the Carmichael Estate ETSU W/24/00472/REP3.

Clarke, A D (1991), *A Case of Shadow Flicker/Flashing: Assessment and Solution*, Open University, Milton Keynes.

Clarke, A D October (1995), *Assessment of Proposed Wind Energy Project at Meenacahan, Donegal, Ireland, for Shadow Flicker*, Report for B9 Energy Services Ltd.

23 February

Road Noise

Mrs May: To ask the Secretary of State for Transport what budget was set for noise mitigation measures on roads in each financial year since 2000-02; and what percentage of this budget was used for noise mitigation measures in each year, including 2003-04 to date.

Mr Darling: A budget of £5 million was set for noise mitigation measures on roads for 2001-02, 2002-03 and 2003-04. 100% of the budget was used for noise mitigation purposes in 2001-02 and 2002-03 and we estimate that 100% of the budget will be used for noise mitigation purposes in 2003-04.

Adjournment debate

Railway Pedestrian Crossings

The following is a precis rather than a transcript of the debate which took place on 26 January 2004

Mr Philip Hammond (Runnymede and Weybridge) was drawing House's attention to a problem that blights the lives of many people in southern England and to address an important safety issue.

The specific issue he considered was footpath level crossings on the railway. It had two distinct aspects: noise nuisance that is caused by the sounding of train horns; and safety risk from trains, including electrocution in parts of the country that use a live rail.

Hon. Members who represented seats in southern England would be familiar with the surge of complaints about disturbance from train horns, especially at night, following the introduction of the modern, sliding-electric-door trains on Connex South Central and Connex South West, where the offending units are the class 458 trains.

The new trains are most welcome in every respect except for their noisy horns. When the new classes of train were introduced, it became apparent that the horn, in the range of 115 to 125 dB, was many times more powerful than that of the old slam-door trains, which was typically in the range of 90 to 95 dB. By way of illustration, 90 dB is the equivalent of a lawnmower and 125 dB is that of a jet plane flying at 150 ft. Although they are required to have a 400m forward range, reports confirm that the new horns can be heard two miles away in specific conditions. Railway safety rules operate on a type approval system. The old slam-door trains, which were designed in the 1950s and early 1960s, have been allowed to continue operating although their horn volume is considerably less than that under the current safety standards. The new trains comply with the standards that have been in force, but perhaps not in evidence, for many years. At the same time as the introduction of the new train types, the publicity surrounding the high profile rail accidents in the past few years and the consequent new focus on railway safety have clearly heightened driver awareness of and compliance with the

rules on requirements to sound the horn.

In the event of an incident, on-board data loggers can confirm definitively whether the driver complied with the requisite safety requirements.

Train drivers are no longer required to sound their horn when leaving a station over a level crossing. Nor are they now required to sound it when passing through a station where another train is stationary at the platform. Those two changes will reduce by a significant proportion the nuisance that has been experienced, focusing the use of the horn back on to incidents in which drivers identify a particular danger.

The Rail Safety and Standards Board expects to be able to scrap the rule that requires the horn to be sounded as a train enters a tunnel, and also when it leaves a tunnel during the night, although it will still be necessary to do so, for technical reasons, when leaving a tunnel during the day. That deals with two of the four main categories of mandatory horns use. The other two involve footpath level crossings and user-worked crossings - that is, private rights of way across the railway, with or without vehicles - and the former is the category that causes the majority of problems.

Of the 8,000 or so level crossings in the United Kingdom, 2,546 are footpath crossings. Perhaps rather alarmingly, while Network Rail and its predecessors have succeeded in closing a total of nearly 1,000 level crossings since 1991-92, during the same period the number of footpath crossings has risen by 240. The Health and Safety Executive sets the requirements for the placement of so-called whistle boards, which instruct a driver to sound the horn.

The siting of these boards is based on the line speed and the forward visibility from a footpath crossing towards the direction of the train. Where a whistle board is deemed necessary according to those criteria, all trains are required to sound the horn on approach from either direction, day

'The new class 458 trains are most welcome in every respect except for their noisy horns'



or night. It is a fact that, in urban areas, footpath crossings are often used late at night, sometimes by people who are not in a heightened state of alertness. In those circumstances, relaxation of the HSE standards does not seem to be a safe option. However, there are two issues to be addressed: the elimination of the noise nuisance that blights the lives of tens of thousands of people across southern England, which is a relatively new phenomenon, and the reduction of the risk to pedestrians using, or misusing, railway footpath level crossings.

The obvious and simplistic answer would be simply to close the crossings. Network Rail and its predecessors have long sought to eliminate footpath level crossings wherever possible, both to improve safety and to reduce the significant burden of maintaining the crossings in a safe condition. Unfortunately, from Network Rail's point of view, railway footpath crossings enjoy the same rights as the rest of the footpath network and can be closed only after a lengthy public inquiry process.

Railway footpath crossings appear to fall into three categories: those in rural areas - probably the majority - where noise nuisance is probably minimal and the status quo is probably acceptable; those in urban or suburban areas which are little used, where closure should be explored as the preferred option; and those in urban and suburban areas where the level of usage clearly indicates that they are an important local facility that cannot be closed.

Mr Hammond wanted the government to review all railway footpath level crossings where there are whistle boards, starting in the areas where the new trains have been introduced, to establish the numbers falling into each of those categories and, thus, the extent of the problem. Secondly, he asked the Minister to discuss with his colleagues in the Office of the Deputy Prime Minister the possibility of the development of an accelerated process for the closure of footpaths that are demonstrated to have low-level usage in urban areas. The risk to life and the constant nuisance and sleep deprivation from train horn noise surely could be justified by minor inconvenience to a small number of users. A proper balance must be struck.

Thirdly, on the relatively small number of high-usage crossings in urban areas, the traditional response to replacement of footpath level crossings has been grade-separated crossings, that is, bridges or tunnels. These are phenomenally expensive and often unsightly. There are one or two practical issues, however, which the Minister might be able to address.

At present, if Network Rail proposes to replace with a bridge a footpath crossing accessed by a stile, the bridge is required to be fully compliant with the Disability Discrimination Act 1995, complete with ramps and all the other facilities to ensure wheelchair and other disabled access. It seemed to him slightly absurd that if the track

operator wants to replace a dangerous and non-wheelchair-accessible level crossing with a safer bridge, the bridge must be provided with full disabled access. The consequence, of course, is that the bridge, in almost all cases, does not get built.

Perhaps the logical next course is to look for more innovative potential solutions. The Rail Safety and Standards Board is about to conduct a test on the south coast using a Japanese device, a broadband frequency horn, which apparently allows the horn to sound at different frequencies in an attempt to narrow the spread of sound. Some research is already under way examining the optimum location of the horn on the train to maximise the forward profile of the noise footprint and minimise the spillage, which causes most of the nuisance to residential properties.

He understood that other tests were about to take place using train-activated trackside horns - a horn that is located on the crossing

established that human rights legislation can bear on issues that relate to sleep deprivation, and when train horn volumes are equivalent to a low-flying jet plane, there is clearly a direct read across. Mr Hammond wants the railway and the community that it serves to operate in harmony, but that will require an urgent resolution to the intolerable burden that train horn noise at footpath level crossings currently imposes on his constituents and others.

Major steps have already been taken in relation to trains moving away from stations and trains passing through tunnels, but the noise problem generated by footpath level crossings will be more difficult to address.

The Parliamentary Under-Secretary of State for Transport (Mr Tony McNulty) replied that on train horn standards the Rail Safety and Standards Board was currently undertaking a review of the problem caused by noise from train horns to those who live near railways. The review was considering

whether changes can be made to the requirements that apply to pedestrian crossings without increasing the safety risks.

The review was considering the existing requirement to sound horns at level crossings, at the entrances and exits of tunnels, and at some railway stations. Research was under way into the possibility of alternative technology for providing warnings.

The design of the typical foot crossing relies on the user going through a special gate known as a 'kissing gate', which prevents them from walking across the infrastructure and ignoring the presence of a rail system. The pedestrian must then observe and listen for the approach of trains from both directions and cross when it is safe to do so. Judging the speed of trains is a skill quite different from

judging road traffic speed.

There are also signs that remind users not to trespass, that identify the presence of an electrified conductor rail, and that warn users to stop, look and listen for the approach of trains. Broadly speaking, the risks of electrocution are usually extremely low. However, where there is such a risk, it is important to provide effective safeguards to prevent access to dangerous live equipment such as the railway's conductor rail power supply or third rail.

In general the HSE supports Network Rail's attempts to close footpath crossings, especially where alternative access routes can be provided.

Network Rail is attempting to close pedestrian crossings on a progressive basis, but it is a costly and time-consuming exercise. There are 8,188 level crossings on the network, of which 2,546 are footpath crossings. Level crossings account for approximately 23% of train accident risk. In 2002-03 13 people were killed using level crossings, including 11 pedestrians who were struck and killed while using the crossings.

The minister concluded by congratulating the hon. Gentleman on raising such important matters, which went far beyond his constituency, and on the manner in which he raised the subject.



A review is considering existing requirements to sound horns at level crossings, tunnel entrances and exits and some railway stations

but activated by the approaching train. Clearly, because the horn is on the crossing itself, it does not have to be of the same loud volume as one that is train-mounted. Such a system can be supplemented by sensors on the crossing to detect the presence of pedestrians.

Even those measures, however, will have significant cost implications at a time when the railways are under financial pressure and he appreciated how difficult that made any of these suggestions for Network Rail, the train operating companies and the Minister. Mr Hammond urged him, however, to take this problem seriously, pointing out that the railways are a part of our communities. We all want rail to make a greater contribution to the total transport solution, but the inconvenience being caused to large numbers of his constituents and others across the south of England was creating hostility to the idea of any expansion of services on the rail network. Additional services produce more horn noise disturbance. For example, part of the line through Virginia Water and Egham could become part of the route of the proposed Airtrack south-western rail approach to Heathrow.

Health and safety at work legislation also imposes a duty of care to the public, and the recent Heathrow night flights ruling has

Tomlinson review of secondary education *etb welcomes new focus on skills and science*

The Engineering and Technology Board (etb) has given a cautious welcome to the interim recommendations of Mike Tomlinson's review of education for 14 to 19-year-olds.

Acting director of education, Ashley Rowlands, has welcomed the review's focus on basic skills development and its emphasis on improving vocational education alongside academic qualifications.

"For too long," he said, "capable young people have failed to fulfil their potential because of the false and harmful distinction between vocational and academic qualification. The dismantling of this artificial barrier is to be welcomed." However, he warned, there were still great challenges at the centre of the proposed reforms. He pointed out that the requirement for a flexible curriculum which meets the needs of individual pupils had to be reconciled with employers' demands for simple and easy to administer assessment which they could recognise and understand. He also called for "the competing demands of generic skills and specialist skills development to be met within the proposed qualifications framework."

As etb chief executive, Alan Clark, stressed: "The science, engineering and technology

(SET) sector is crying out for high quality recruits from technician level upwards. The opportunity to specialise in science subjects within the proposed new structure will make



The science, engineering and technology sector is crying out for high quality recruits says etb chief executive Alan Clark

an important contribution to reversing the decline in numbers of young people entering these disciplines in higher education."

The etb exists to inspire better understanding and enjoyment of science, engineering and technology within the UK. "Working in partnership with industry, government, professional institutions and education bodies, we aim to attract the best minds of a new generation to our diverse and exciting sector and to retain and support those already employed within it," said Alan Clark.

Between 1993 and 2003 the number of students achieving A levels in chemistry, physics and mathematics declined as follows:

	1993	2003
Chemistry	40,975	36,110
Physics	37,941	30,583
Mathematics	64,923	55,917

(source: Joint Council/AQA)

The ratio of A level physics, chemistry and mathematics awards to the 18 year old population as a whole has declined as follows:

	1993 %	2003 %
Chemistry	5.8	4.8
Physics	5.4	4.2
Mathematics	9.2	7.1

(source: Joint Council/AQA/Government population estimates)

LOUDSPEAKER DEVELOPMENT ENGINEER

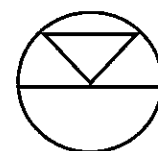
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LINN



'Noise was considered from all possible viewpoints uniting track bed, rolling stock and station design'

Designing a 'quiet' urban rail scheme for Hong Kong

where high rise living densities amplify sensitivity

Hong Kong's West Rail train project was inaugurated late in 2003, after six years intensive work. While it is important to any urban rail project, here the issue of noise sensitivity was greatly amplified. The city's densely packed population means people are pressed right up against the railway lines in tower blocks or multi-storey buildings. From the outset, therefore, quiet operations were central to Kowloon Canton Railway Corporation (KCRC). Hundreds of homes face the railway line directly. In some places the track could be elevated so as to lift noise from the trains above low-rise housing, but in Hong Kong, Kowloon and the new towns, to lift the track on piers would simply bring the noise sources closer to high-rise dwellings. The whine of electric motors and the clatter of wheels on tracks are the main problems, while the 'urban canyon' nature of the environment causes multiple reflections of sound.

In a high-rise population centre such as Hong Kong, running the track on a viaduct proved a far greater challenge than going underground. For the low rise villages along the route of West Rail, raising the source anything from 15 to 25 metres above houses shielded them from train noise. In complete contrast, the urban cores of new towns such as Yuen Long, Long Ping, Tin Shui Wai and Tuen Mun would have suffered intolerable noise problems if that approach had been adopted. It was also anticipated that present low-rise villages might in time grow into dense new towns themselves. For that reason, noise was considered from all possible viewpoints uniting track bed, rolling stock and station design.

Noise levels were measured 25m from the track side using a train travelling at 130kmh⁻¹. Huge effort was put into the design, aiming to reduce noise from the

average for a modern commuter railway - some 88 to 92dB(A) - to less than 81dB(A). Noise levels from the purpose-built West Rail trains were reduced to 76dB(A), and muffling on the viaduct achieved 64dB(A). The viaduct is a 13.4km structure composed of endlessly repeated 35m spans. There were fears that its hollow box section deck would act like a drum, resonating and reinforcing the sound of multiple wheel impacts. Therefore, the deck was built with a deep, narrow section to stiffen it and limit noise radiation from the underside. Fixed track bed, which offers higher construction tolerances and quieter

running than ballasted track, has been used everywhere except the maintenance yard.

Rails have been continuously welded to prevent the characteristic 'clicketyclack' of wheels over joints, and pads to damp the natural resonance that can be set up between wheels, rail and track bed are mounted on rubber. The softness of the rubber base pads had to be carefully designed in order to achieve precisely the right effect.

'Quiet traction' contains noise

Trains have been equipped with specially designed 'quiet traction' and air conditioning units. Mechanical noise is minimised, but the trains are fitted with skirts which help contain the noise beneath the carriage baffle noise, by working in conjunction with low-level trackside screens. There are aerodynamic front and rear ends to pierce the air smoothly, and the externally mounted air conditioning units are small and flush-fitting to keep wind resistance and thus airflow noise to a minimum.

The track is protected on both sides by solid concrete parapet walls which rise to the level of train windows and provide further noise barrier effects. The West Rail viaduct could have been entirely enclosed, but this would have created a serious problem of heat build-up by acting like a greenhouse. Even though passenger discomfort could have been dealt with using air conditioning, the heat would have adversely affected the signalling systems. Complete track enclosures are provided only where 'up' and 'down' lines cross each other.

Passengers are protected from track noise inside the train by rubber under-floor insulation, and from wind-induced noise by seals around the doors and windows that are described as 'perfect'.

ONE DAY CONFERENCES

The Art of being a Consultant

The Institute of Acoustics and Association of Noise Consultants are jointly holding one-day conferences in Southampton on *Wednesday 31 March 2004*, and Salford on *Wednesday 16 June 2004*. They are aimed at young consultants, those new to the profession and students considering a career in acoustics. The topics under discussion will cover a wide range of day-to-day issues that any consultant will need to address. All speakers are practising consultants and their combined wealth of industry knowledge is extensive.

Programme

9.00	Registration and coffee
10.00	What is acoustic consultancy? - <i>David Watts</i>
10.30	Negotiating Contacts - <i>Philip Dunbavin</i>
11.00	coffee
11.30	Doing the job - <i>Jeff Charles</i>
12.00	Working with design teams - <i>Duncan Templeton</i>
12.30	lunch
1.45	Writing the report - <i>Stephen Turner</i>
2.15	Quality issues - <i>Alan Saunders</i>
2.45	Rules of the Game - the ethics of consultancy - <i>Rupert Thornely-Taylor</i>
3.15	tea
3.30	Discussion
4.00	Close

Anyone interested is invited to contact Linda Canty at Head Office in St Albans

We will rock you - until the floor moves!

Hidden defects in the 150 year old floor of Leeds Town Hall auditorium may have caused the excessive movement which led to the abandonment of a rock concert.

The movement was so severe during the concert by rock group Black Rebel Motorcycle Club that temporary supports had to be installed beneath the hall's wooden floor while investigations were carried out. These revealed a second layer of floor planking, which was presumably laid over the original floor decades ago. It is believed that this newer floor conceals defects which would have caused a

completely unpredictable reaction to dynamic loading. Structural engineers, Symonds Group, were already carrying out a health and safety review for Leeds City Council, and the acoustics department had assessed the frequency of the floor through readings from monitoring equipment installed shortly before the concert. They had spotted a potential problem, so structural engineers were called in to monitor the floor during the performance. The 27m by 19m timber floor is supported on cast iron pillars with a maximum floor span of 3.9m. Accelerometers, a vibration

analyser and a sound monitor have been installed. The Town Hall was conceived as Leeds' response to plans by local rival Bradford to build St George's Hall. It was designed by a competition winner, Hull architect Cuthbert Brodick, although the tower and dome added in 1857 were not in the original concept.

The hall was opened by Queen Victoria in 1858 and throughout its history has been no stranger to controversy. The fine colonnaded front was intended to reflect civic pride and dignity; to this day the building remains the most immediately recognisable in the city.



WISE up to SET careers is video's message to pupils

Women Into Science and Engineering (WISE) has launched its new video, *Are You SET?*, which profiles five women in Wales who work in the science, engineering and technology (SET) sector. In showing the career opportunities available, the video demonstrates how exciting, worthwhile and vital working in SET can be, and how women can thrive in many different roles. Aimed at both boys and girls aged 11 to 14 it is designed for use in science, technology or careers lessons. In the video five young female engineers and scientists talk about their varied careers: Wendy, part of the Education Team at an interactive science discovery centre; Cheryl, investigating and testing

the properties of different materials; Sarah, involved in the design, production and testing of brakes using computers; Helen, working in a laboratory researching climate change; and Samantha, who is part of a team responsible for maintaining the equipment and machines in a paper-making factory.

The 14-minute video was produced by WISE in Wales with the support of the Welsh Assembly Government and the Welsh Development Agency.

WISE aims to attract more girls and women into SET, to support other organisations that enable women to advance their careers, and to help organisations trying to ensure that women are retained within the sector.

robustdetails

Robust Details Inspectorate

Robust Details Ltd is an organisation set up to develop, maintain and monitor the performance of construction details that are designed to provide better sound resistance qualities than are required by Building Regulations. With effect from the 1st July 2004 robust details can be used as an alternative to pre-completion testing to demonstrate compliance with Part E of the Building Regulations.

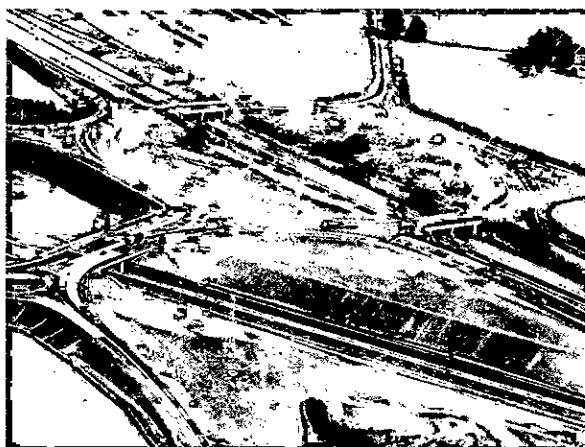
We wish to create a team of experts with extensive knowledge and experience of field sound insulation tests and are seeking to let contracts to consultants to fill the role of robust detail inspectors. These inspectors will be responsible for ensuring that robust details are continuing to comply with the Building Regulations. It is expected that the team of inspectors will be geographically spread across the UK, to limit the travelling required, and will be the leading experts in this field.

Candidates and their organisations should be able to demonstrate a substantial track record in field sound insulation testing and diagnostic work. You should have extensive experience in data analysis, and non-invasive as well as invasive diagnostic techniques. You should be a Corporate Member of the Institute of Acoustics, either ANC Registered or UKAS Accredited and able to undertake field sound insulation testing.

The robust details represent a significant raising of the standards of sound insulation in residential properties, and if you would like to be considered for these important contracts please send your CV and company details to: Mr PR Dunbavin, Inspectorate Chairman, C.O. David Panter, Robust Details Ltd, Buildmark House, Chiltern Avenue, Buckinghamshire HP6 5AP.

M6 Toll road

already the residents are complaining about increased traffic noise



It has only been open a few months but already homeowners close to the route of the new M6 Toll road are complaining about increased noise levels from road traffic. Although the construction consortium Cambba took steps in their design to ensure that traffic did not have adverse effects on local residents, there have been rumblings of discontent from communities affected since the motorway opened in November 2003. The M6 Toll web site claims that the route's alignment was carefully selected

to minimise the effect of noise on communities by following existing road corridors, and the adverse effect of noise would be reduced by earth mounding and fencing. A low-noise surface was used throughout.

The *Noise Insulation Regulations (1975)* set out the requirements for insulating residential property against traffic noise arising from new or altered roads. A survey was undertaken to assess properties eligible for noise insulation. Residents were contacted direct

and sound insulation works to those properties whose owners took up the offer were completed before the road opened.

However, Colas, the civil engineering contractor that built the road, has joined forces with the Ecole Polytechnique de Paris, a school of engineering, to devise a traffic noise barrier claimed to be a radical improvement over conventional designs.

Developed following research at the Polytechnique on the properties of irregularly shaped objects, the barrier uses frustra - truncated cones and pyramids - to absorb and reflect sound in different directions. The frustra (*sing: frustrum*) are the bodies remaining after the upper section of a cone or pyramid is sliced away. It appears that they are able to provide a dramatic increase in sound-reducing performance, according to a programme of reverberation chamber testing. The design team has applied for a patent on the devices, which are manufactured in 4-metre square panels from a wood-cement concrete composite. Apparently the new barrier devices are ideal for motorway tunnel entrances, but could easily be adapted for use near high-speed railway lines and airports as well as motorways.

Victorious birds celebrate with a song!

Sporting fans are not the only ones to celebrate their wins with a tune: researchers have discovered that an African bird does just the same thing. Pairs of the tropical boubou, or bell shrike, produce their victory song when they have repelled would-be invaders from their territory, say Ulmar Grafe and Johannes Bitz, University of Würzburg. The boubou (*Laniarius aethiopicus*) lives in sub-Saharan Africa, and is unusual in that both males and females sing. The birds live in monogamous pairs and sing duets with the male and female each having a distinct part. The duets are thought to have the principal purpose of defending territories and guarding mates, but the victory duet is particularly distinctive. The researchers found that the male notes of the victory display could be heard from two territories further away than notes of other duets. It was usually sung from a higher perch, thus making it more conspicuous and increasing its range.

When Grafe and Bitz played recordings of other boubou songs to 18 pairs of the species, nearly all stood their ground. Eleven of the pairs sang their victory duet within half an hour of the tape being switched off, and this was the first and only song the birds sang within half an hour of the confrontation.

In contrast, there were two pairs of 'losers' who were not seen or heard for 30 minutes after the playback ended. When these birds did eventually sing, it was not the victory tune.

The scientists admit that the discovery was made completely by accident. They were conducting investigations in Cote d'Ivoire, West Africa, of the birds' broader musical repertoire but noticed that whenever they packed up their equipment and left the birds' territories, a particular tune would always be heard. Grafe, a behavioural ecologist, deduced that there was a whole neighbourhood of birds 'listening in' to the conflicts, so that it was important to advertise a victory. This was not only to let the losers know they had lost, but to let other birds know that a pair had been victorious, thus making further conflicts over territory less likely.

Few animals vocally celebrate a win in this way, and the tropical boubou is the first documented to perform a duet. According to *New Scientist*, it is like a

After repelling invaders, the tropical boubou bursts into triumphant song



whole rugby team displaying at once. (Does that mean we can expect English birds to burst into *Swing Low, Sweet Chariot*? - Ed)

Techniques to reduce noise at work

case studies sought for HSE manual

The Health and Safety Executive (HSE) has retained PDA Acoustics to prepare a new version of the book *Sound Solutions*. The company is looking to identify potential case studies of practical techniques that have been adopted successfully to control noise at work in a variety of sectors. This will not only cover traditional heavy to light industry, but also many less obvious sectors such as leisure/entertainment, call

centres, construction, and so on.

If any member or a colleague knows of any noise control projects which have been successful in reducing work place noise exposure then PDA would like to hear about it. All you need to do is send a brief e-mail to :

andrewraymond@pdaltd.com

The organisation and/or clients involved will be acknowledged in the case study book.

RFH refurbishment plans under fire

modern electronic amplification or natural acoustic - which is most appropriate for this 50's iconic concert hall?

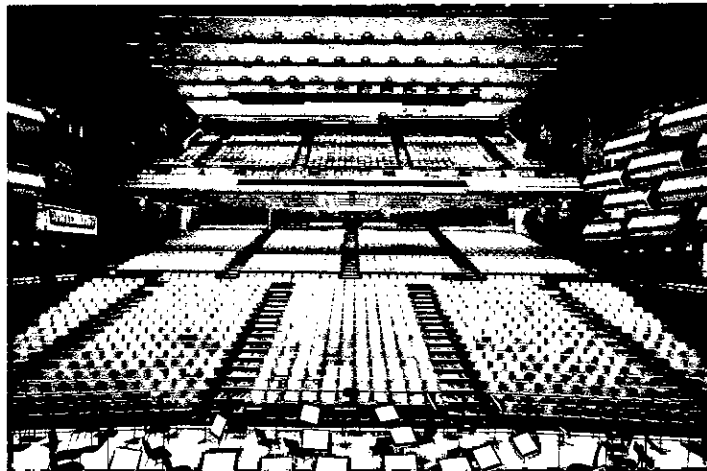
Plans to refurbish Leslie Martin and Robert Matthew's Grade 1 listed Royal Festival Hall have come under fire from a prominent acoustician. Derek Sugden has warned that the scheme would fail to achieve the acoustic improvements required by the brief, and would spoil the integrity of the original 1951 design.

Lambeth Council has been told that the designs, produced in collaboration with Kirkegaard, the American acoustical consultants, will not meet standards demanded by the South Bank Centre (SBC).

The conservationists are determined to persuade the SBC to leave the building intact and install a modern electric amplification system.

The developers, Allies and Morrison, admit that the new design would substantially change the auditorium. The proposed alterations include modifications to the canopy, the organ space and the interior decoration. Sugden, on the other hand, was convinced that the project was not worthwhile because the building was never going to be world class in the acoustical sense. In his view the RFH was a 1950s icon and should be left that way. Otherwise, millions of pounds would be spent on it and acoustically the result would not be particularly successful. It would be far better to leave it alone and put in an excellent modern amplification system.

Twentieth Century Society caseworker Claire Barrett has also written to Lambeth Council to express the society's views. The



letter says that enjoying a concert was not solely about an audio experience, but was equally about enjoying a space visually. The whole experience was important and it was problematic to divide them so starkly. The hall had always been used for the presentation of many different kinds of music and art forms: it was not worth altering a space so radically just so that it could fulfil one of its requirements.

Diane Haigh, Allies and Morrison associate, defended the project but admitted the auditorium would 'never be in the global top 10 for acoustics'. However, she dismissed the criticism, insisting that no electro-acoustic system would work. Apparently members of the project team did a lot of soul-searching, as they all admired the building, but found there was no way to make the improvements without introducing radical solutions. The fact was that the RFH had not remained untouched since 1951, as there were also changes in the 1960s.

David Whelton, managing director of London's Philharmonia Orchestra, countered the arguments with a view from the experience of a resident orchestra at the Royal Festival Hall (RFH). He profoundly disagreed with the case put forward in favour of electronic amplification. Conductors, soloists and orchestral musicians were, he claimed, unanimously in favour of a natural acoustic for a concert hall. It was acknowledged that the present acoustic in the RFH left much to be desired, particularly from the orchestra's perspective.

The Philharmonia Orchestra had taken part in mock-up tests for

Larry Kirkegaard's proposed changes to the configuration of the canopy, and its replacement with a more flexible alternative, and wholeheartedly supported the new scheme. The orchestra felt that it would make a significant improvement to the acoustics without compromising the architectural integrity of the building. Improving conditions for the orchestra would inevitably lead to a much better experience for the audience.

From his exposure to concert halls around the world, Whelton said he knew that halls with electric amplification systems always came second best to those with a natural acoustic. He had confidence in Kirkegaard's considerable experience and ability to make the improvement all musicians craved. The RFH was an inspirational building, but its acoustic aspirations were never fully achieved. Now at last the South Bank Centre was putting that right.

New sound system for Colchester's Mercury Theatre

A complete design and installation project for Colchester's Mercury Theatre was recently undertaken under the supervision of professional audio distributor, Autograph Sales, which has a well-established association with the theatre sector. Installed in conjunction with B & H Syscom, the joint venture reflects a new partnership approach the company is developing with installers across the country.

Following an approach from Marcus Christensen, the theatre's technical manager, Autograph Sales' Mike Mann visited the site and subsequently designed an intricate system which included loudspeakers, microphones and processors.

The theatre has a hexagonal auditorium and a compromise was needed for loudspeaker positioning due to sightline

restrictions, but detailed predictions were done to make sure the results were unaffected. The ability to use electronic predictions meant less time was needed on site, so minimising any disruption to the theatre's normal operation.

The system supplied includes two arrays of the Meyer Sound M1Ds, USW-1P subwoofers built into the stage and UPM-1Ps as front fills. For signal distribution a BSS FDS-336 minidrive was installed along with a range of microphones from AKG, Audio Technica and Shure. Further equipment consisted of Sony minidisc recorders and Lexicon and Yamaha effects. For the theatre, Marcus Christensen commented that, from the initial site visit through to the final fine-tuning of equipment, the installation team was



A better sound for performers and audience

extremely helpful and flexible, and proved able to work to the necessary tight schedules.

Further details tel: +44 (0)20 7485 3749 or visit www.autograph.co.uk

A dose of opera for the noisy element

Florida judge's poetic justice for car stereo nuisances

A judge in Miami, USA has come up with an innovative way of punishing those who play their car stereos too loudly - he sentences them to a night at the opera. Apparently, offenders who agree to sit in Judge Jeffrey Swartz's Miami chambers and listen to his favourite operas can have their cases dismissed, rather than paying a \$460 fine and being liable for court costs. The judge metes out his operatic punishment every Monday in his court room overlooking Washington Avenue, the location of many downtown nightclubs. He says his philosophy is simple: "You impose your music on me, so I impose my music on you."

Most of those accused of noise-related offences are young men with customised car stereos blasting out rap and hip-hop music from oversized and over amplified subwoofers. The judge decided how to deal with them after stopping at a red light next to a car from which the music was so loud that his car windows were rattling,



and he believed he could hear the bolts loosening in the engine.

In one particular week Judge Swartz had two volunteers for trial by opera. He told Gene Tary, 23: "You're a lucky man, you're going to be listening to *La traviata*."

Tary claimed never to have heard of it, but quickly added that it sounded good. Joseph Puerto, the other accused, said that he was no opera buff, but *La traviata* had to be better than a \$460 fine. The only time he had ever heard opera before was apparently about two seconds' worth in a James Bond film.

Apparently, the 54-year-old judge's musical tastes do not extend to Gilbert and Sullivan, for unlike the *Mikado* he does not specifically choose his opera to fit the crime. He seems to have resisted the temptation to play *Nessun Dorma* to punish those who keep their neighbours awake. Instead he bases his choice on what happens to be playing at the Florida Grand Opera.

Judge Swartz told the defendant: "You're a lucky man, you're going to be listening to *La traviata*."

According to the judge, it does not matter if offenders enjoy the punishment or not. "They either get to appreciate some culture, or it drives them up the wall - it's a win-win situation," he said. He makes some well-considered exceptions, and Verdi's *Macbeth* is not in the repertoire because the plot is too depressing. Bizet's *Carmen* is also excluded because listening to it could never be considered a punishment: it is far too easy-going!

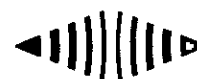
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dbioa@hotmail.com

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The Sharps Redmore Partnership was established in 1990 to provide a specialist acoustic consultancy service to the building and environmental sectors. Since then the Practice has been very successful and has steadily evolved to the present position whereby we have a team of 15 consultants working on a wide range of projects. Due to an ever increasing workload, opportunities now exist for consultants to join what has become one of the most experienced and successful group of consultants in the UK.

If you are interested in discussing these opportunities then please send details of your experience to:

Doug Sharps or Tim Redmore,
Sharps Redmore Partnership,
The White House,
London Road,
Copdock,
Ipswich.
IP8 3JH.

LMS International**Virtual.Lab, an end-to-end solution for full-vehicle NVH engineering**

PSA Peugeot Citroën has selected **LMS Virtual.Lab**, from **LMS International**, to support its full-vehicle NVH (noise, vibration and harshness) engineering. It is as an integrated process solution capable of accurately simulating the NVH performance at full-vehicle level, from the early development stages onwards. In allowing the combination of test models of components and subsystems with virtual models of the new vehicle design, it significantly accelerates the vehicle development process. Over the years, the second largest carmaker in Europe built up a strong experience in virtual prototyping and consistently invested in devising vehicle-development tools around generic CAE technologies. PSA Peugeot Citroën engineers have made great advances in virtual simulation, with a clear focus on key vehicle performance attributes such as NVH. **Virtual.Lab** will be used to support the engineering of ever-more-stringent NVH targets, which will further develop the distinctive Peugeot and Citroën brands. The system's tight integration with **CATIA V5** will be a particular benefit, as it will allow the design models to be connected with virtual simulation

models. The manufacturer will gain from the coherent and easily-traceable link between component and subsystem designs, and the design modifications needed to optimise full-vehicle NVH performance. Bruno Hazet, who heads the Vehicle Functional Performance Department within the group's Technical and Scientific Resources Division, explained that **Virtual.Lab** had been selected because it was

V5 would allow them to link vehicle design tightly to the simulation of key attributes such as NVH. Integration of **Virtual.Lab** with their testing systems from LMS would also allow the department to re-use test data and models, thus increasing the speed and accuracy of simulation. Jan Leuridan, corporate vice-president and chief technology officer, was confident that the car manufacturer would successfully set new standards for NVH, and get new vehicles on the market faster.

LMS International enables customers to engineer functional performance targets into their products, creating and maintaining distinctive brand values. Their understanding of the product development process is captured through a combination of products and services supporting physical and virtual product development, including test systems, CAE software products and engineering services. The company says that critical attributes such as noise

and vibration, ride, handling, motion, acoustics and fatigue can be turned from problems to competitive advantage. Further details: Bruno Massa, tel: +32 16 384 200 or e-mail: bruno.massa@lms.be



the only available commercial solution with a proven capacity to streamline the full-vehicle NVH development process, and provide in-depth NVH expertise and know-how. He added that the integration with **CATIA**

Audio Alliance**Skills demonstrated**

Corporate audio specialists **Audio Alliance** recently held a demonstration day. It was an opportunity for the Manchester based rental supplier to offer existing and new clients a chance to experience first hand the technology behind the shows. The event was organised by director Oliver Driver, who strongly believes that showing clients what is available and how it is used benefits all parties. During the day a

range of the company's rental stock was demonstrated, including digital systems, with **ProTools** providing surround sound playback, supported by a Sony **DMXR100** mixing desk and a Yamaha **DME32** processor.

An analogue system was also set up with an Allen & Heath **ML** series desk and **XTA** processing, while a smaller console, the **Midas Venice**, was demonstrated with **Shure DFR22** processors.

Loudspeakers on display included the latest Meyer Sound **UPJ-1P**, along with the Meyer Sound **UPM-1P**, d&b's **E3**, with **MAPP Online** software used to compare the

differences in loudspeaker placement. As Oliver Driver commented: "All our clients understand that we provide a very high quality service to the conference industry. New clients are surprised at the level of technology now available and, hopefully, these workshops made the equipment less daunting. Audio in this arena is no longer about a pair of Bose 802's or even d&b E3's, it is about system design and providing clear and intelligible sound from presenter to delegate."

Further details: tel +44 (0)161 273 5888 or visit www.audioalliance.net

**FX Cimple Solutions****Dedicated spares website launched**

The service and repair arm of the FX Group - **FX Cimple Solutions** - has launched a website dedicated solely to the sale of spare parts and equipment upgrades. As director Cliff Whitehead explained, **Cimple Spares** has been launched as an ongoing support for brands represented by the company. Visitors to the site will be able to purchase **JBL** parts, re-cone kits and diaphragms online, **Ensoniq** boards (for which **Cimple** is the only supplier), **AKG** **Akai** and **TC Electronics** spares and **Firewire** drives. There is also a section for the sale of selected second hand equipment. Depending on their trade status, visitors to the site can either purchase spares

online on account or by secure credit card transaction. Trade customers are entitled to discounts on most spares ranges.

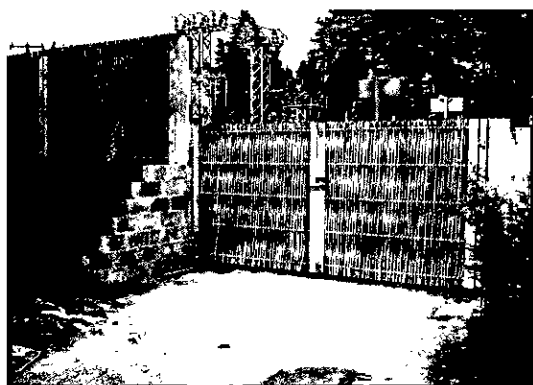
The website can be found at: www.cimplespares.com

FX Cimple Solutions can also be contacted on tel: 08707 60 7171, a dedicated line which connects callers to spares assistants and advice.

The company is part of the **FX Group**, which also includes **FX Rentals**, **FX Music Control** (sales of new and second hand equipment), **FX Technical Services** (installations), **FX Copyroom** and **FX Spain**. Further details: tel +44 (0) 20 8746 2121 or visit: www.fxgroup.net

ETS Ltd**Green barrier for Gleneagles**

What is believed to be the first ever natural-looking willow sound barrier in the UK has been installed at the luxury Gleneagles Hotel in Perthshire. It preserves the natural beauty of the hotel's surroundings whilst reducing the intrusive noise and visual impact of the electrical substation serving the complex.



Created and installed by **ETS Ltd**, the green barrier in woven willow offers a solution for screening any obstacle and reducing noise from sub-stations, factories and other unsightly or noisy objects.

George Graham, development director for Gleneagles, said he was delighted with the green barrier, and the natural look and unobtrusiveness of the structure was exactly what they were seeking. The smallest

detail of service, combined with a relaxing and natural environment, were intended to create a quality experience to keep their guests coming back, he added.

The green barrier is available in either woven or living willow, in specially selected varieties grown for their longevity and attractively coloured stems. This allows the creation of a unique stockade to whatever the height desired, suitable for most ground conditions and locations. The environmentally sustainable green barrier rapidly becomes home to birds, butterflies and other insects and if

it is the living version it changes with the seasons.

The *RockDelta* sound-resistant core, which is tested to international standards, reduces noise levels considerably and comes with a 25 year guarantee. The surrounding external structure is made from woven willow.

Environmentally friendly, it blends well with the natural landscape and provides an attractive acoustic and visual screen.

When asked why green barrier was different from other products on the market, the company's Dr Adrian Bowles explained that concrete, metal and sawn timber barriers did not look natural, and were often second-rate solutions to noise mitigation because they were largely acoustically reflective. He argued that, for anyone wanting to erect a noise barrier with a natural appearance, with the highest attenuation properties, there was nothing to match it on the market.

Further details:

tel: 01289 386664 fax: 01289 386750

e-mail: sales@etsluk.com

web: www.etsluk.com

British Gypsum**New acoustic stud even easier to use on site**

Gypframe 43mm AcouStud, which is designed specifically to help house builders and designers to meet the Approved Document E acoustic standards, is now being produced in standard lengths of 2395mm. This makes it even quicker and easier to fix on site.

The re-engineered stud has been designed to fit a standard 2400mm storey height without cutting, thus reducing handling and fitting time and minimising on-site wastage. The 5mm shorter stud makes all the difference.

Designed and developed in conjunction with **British Gypsum's** sister company in Scandinavia, the new AcouStud, with its sigma-shaped profile, was hailed as the most significant new development in stud design for more than a decade when it was introduced just 12 months ago. Its ability to absorb sound energy as it passes through the wall means the manufacturer can claim up to 6dB additional sound performance over standard GypWall metal stud partitions. Many of the UK's leading housebuilders now specify the stud.

The change in length has come as a direct result of discussions with house builders and contractors who are increasingly looking to cut site time and wastage.

Understanding speech clarity

Understanding issues that affect speech clarity in classrooms and how it can be improved is now a key requirement for all school designers, following the publication of updated guidelines from the Department for Education and Science.

To help designers find their way through what has previously been seen as something of a 'black art', British Gypsum has published a paper: *Improving speech clarity in classrooms*. This explains, in simple terms, how reverberation times are affected by room design, layout and internal finishes and how

speech clarity can be adjusted by careful specification of ceiling and room linings. For instance, by using the company's patented *Intel6* computer programme, together with its special sound absorbing and sound reflecting *Artego Casoprano* ceiling tiles, school designers can now predict levels of speech intelligibility in classrooms. By changing the relative locations of these two types of identical looking tiles, the performance can be manipulated to give near perfect levels of intelligibility.

This approach will help designers meet the requirements of *DfES Building Bulletin 93*,

as well as new acoustic requirements in *Building Regulations Approved Document E*. It has the added advantage of using the form of suspended ceiling construction common in many modern schools, and is therefore an economic solution to the increasingly important speech intelligibility issue.

For reference, the paper includes examples of a wide range of schools that have already achieved high levels of speech intelligibility using this package.

Copies of the paper are available free on request. Tel: 08705 456123 followed by #1 for literature, or e-mail: bgtechnical.enquires@bpb.com

Cirrus Research**Launches new series of sound level meters**

A new range of sound level meters for health and safety professionals has been introduced by **Cirrus Research plc**. The *CR:260* range is designed to comply with current noise at work regulations and with changes expected as a result of the Physical Agents (Noise) Directive. The range includes four different instruments covering the measurements most commonly required. All are robust hand-held meters: the *CR:261* and *CR:262* (type 1 or 2 respectively) offer L_{eq} , L_{Cpeak} , L_{max} and L_{min} . The *CR:263* and *CR:264* add octave band filters to the same basic meters.

These easy-to-use instruments were developed bearing in mind how little time customers have to make noise surveys and assessments. Therefore, only the essential features for such tasks are included. They can be upgraded at a later date, should a user find that extra information is needed, without the need to return them to the manufacturer or dealer.

The '+version' upgraded instruments can be connected to the company's *Deaf Defier* software, allowing measurements to be downloaded and reported. The *CR:263* and



CR:264 versions permit the software to be used for hearing protector selection.

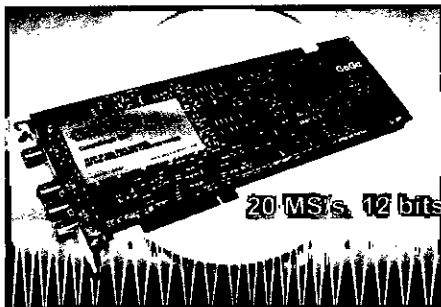
Further details: tel: James Tingay on 01723 891655 or visit www.cirrusresearch.co.uk

TTI

Versatile 12-bit, 20 MS/s digitiser for test and imaging systems

The new *GaGe CompuScope 1220*, now available exclusively in the UK from **TTI** (Thurlby Thandar Instruments), is a digitiser card designed to meet the requirements of scientists and engineers in the fields of ultrasonic testing, SONAR and LIDAR imaging systems.

The card combines the advantages of 12-bit resolution with the wide range of externally



clocked sampling rates required for the tightly integrated systems found in these areas. It provides two input channels, 12-bit vertical resolution, 20 MS/s (megsamples per second) simultaneous sampling rate, 10 MHz bandwidth on most input ranges, external triggering and external clocking.

Input ranges as low as ± 50 mV as well as AC/DC coupling and a choice of 50 ohms or one megohm impedances are all software-controlled for maximum versatility. DC accuracy is typically $\pm 0.5\%$ of full-scale input. The card can also be equipped with up to two gigasamples of on-board memory. Up to eight CompuScope 1220 cards can be combined in a master/slave system to provide up to 16 simultaneous input channels.

Unlike other digitisers on the market, the CompuScope 1220 features a wide external clock frequency range, from 20 MHz down to 1 kHz. This allows it to be used in applications where the clock frequency can vary based on external inputs.

Completely programming-free operation is possible using the established GageScope® oscilloscope software, which allows the user to easily set up the digitiser and acquire, view, archive and analyse signals. Gage also offers software development kits for C/C++, MATLAB® and the LabVIEW® environment, with support for Windows 95/98, NT, XP and Windows 2000.

Further details: tel: +44 (0) 1480 412451

fax: +44 (0) 1480 450409

e-mail: sales@tti-test.com or visit: www.tti-test.com

PEOPLE

**IAC appoints new group chief marketing officer**

Industrial Acoustics Company Group (IAC) has appointed Robert (Bob) Schmitt to the joint role of Group Chief Marketing Officer and Chief Technical Officer. Schmitt has been with IAC for 35 years and was formerly President, Americas Acoustic Division. Schmitt will work from the US headquarters in New York and his responsibilities will include the expansion of the US Sales Representative network and the global coordination of the Group's image and marketing strategy. This is a continuing focus for IAC following the company's recent acquisition of Boet Stopnon France. Schmitt will also oversee the group's global Research and Development strategy.

Brüel & Kjær**Hand-held, fourth generation noise analyser**

Introduction of the *type 2250* heralds a new presence in the field of environmental noise and vibration says **Brüel & Kjær**. Indeed, after 60 years in the business, the company claims that 'the innovative fourth generation of hand-held instruments is with us at last'. Indeed, this instrument is called a 'hand-held analyser', which strongly implies its enormous capabilities.

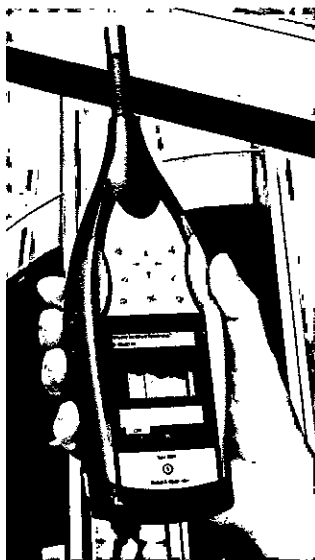
The design was inspired by feedback from sound level meter users around the world, enabling the instrument to cover a very wide range of applications across environmental noise measurement, problem solving, occupational health and safety, and quality control.

The software for all these functions is contained in an ergonomically designed casing, which although it still 'looks like' a sound level meter - the shape being largely dictated by physical constraints and international standards - is easy to handle and less likely to slip out of the hand, unlike some earlier meters. Each application software package can be separately licensed, so customers are able to obtain what they need, when they need it rather than being constrained to buy vast amounts of largely-redundant software.

The *type 2250* meter is designed and made for outdoor use and in difficult real-world conditions. It is claimed to be robust, light and easy to grip, hold and use with one hand even when the operator is wearing gloves. User-friendliness was an important design parameter.

Features built into the instrument include a high-resolution colour touch-screen display,

visible in sunlight and poorly-lit conditions alike; a separate built-in microphone (as opposed to the measurement microphone), so that personal comments and voice notes can be added while measuring; and they will be automatically attached to the measurement sequence. The measurement status is always displayed by means of a light - red, yellow or green - which can be seen from some distance away, and the various measurement tasks are arranged intuitively. The operator can choose whether to use the meter via the hard keys, or the touch screen. Each operator has a personal log-in and checklist, and can save particular measurement, data and display setups. The



validity of a measurement is documented by an on-board calibration history, and the quality and status of measurement parameters such as overloads are flagged up as icons on screen. Built-in electronic filters will detect and correct windscreen effects. On-line help is always available, and the data can be rapidly transferred to PC for storage, viewing and report preparation, using a USB connection, compact flash cards, or secure digital cards. The USB port can also be used to control the meter remotely, while project data is automatically synchronised between the user's PC and the instrument.

The 'big idea' behind the meter is that all measurement tasks become uncomplicated, because the instrument looks and feels the same whether it is used as a desktop analyser or in the field, in the palm of the hand. The company says this encourages familiarity and reduces the burden of learning new interfaces: the functionality of the system is changed simply by selecting the appropriate software for the task.

This comes in three flavours: the basic software included with every meter, which allows it to function as a class 1 sound level meter; frequency analysis software, providing real-time analysis in octave and third-octave frequency bands; and logging software, permitting the automatic storage of discrete measurements in a log file. In logging mode the L_{Aeq} or L_{AF} are logged ten times a second, and other broadband parameters and statistical data (also spectral information, if the frequency analysis software is present) can be logged at one second to 24 hour intervals.

More details are available at the dedicated web site www.type2250.com or tel: 01438 739000 for more details.

The 'Doppler effect' clarified

Thank you for your reply to my criticism of 'The Doppler effect explained' (*Acoustics Bulletin* vol.28 no.6).

The principal criticism was that an article purporting to explain the phenomenon disseminated a fundamental, and commonly made, error in relation to the effect of a moving medium. If the speed of propagation (relative to earth) of a tonal sound generated by a fixed source is increased by convection by a medium moving at speed v with respect to earth, the wavelength alters in proportion (wavelength = $(c+v)/f$). The time for one wavelength to pass a stationary point is equal to wavelength/ $(c+v)$ or $1/f$. Thus f is unchanged. Neither does uniform movement of the medium have any influence on the perceived tone of a moving source.

Other criticisms and comments are as follows:

1. Imprecision of expression at the beginning of the third paragraph could give the impression (to a non-expert) that sound waves are only produced at a constant frequency when it is stationary.
2. A wavefront is *any* surface of uniform phase, so a wavelength may not be defined as 'the distance between wavefronts'.
3. There is no 'wall' that needs to be penetrated. Concorde passengers and crew experience negligible disturbance when passing through $M = 1$. The only 'obstacle' is the rapid increase of wave

drag as the aircraft approaches $M = 1$, which must be overcome by the engine thrust. The buffeting experienced by aircraft in the 1940s in a dive, dramatised by the film *The Sound Barrier*, was partly due to the natural increase of turbulent pressures with speed, and partly because the aircraft were unable to overcome the drag rise and consequently remained in just-subsonic flight.

At Mach numbers just less than 1, shocks 'sit' on the wings and undergo unstable oscillatory to-and-fro movement. This flow regime also led to control reversal, which is why many pilots could not pull out of the dive. This does not happen on aircraft designed to fly supersonically. Concorde used to shift its fuel to compensate for the rearward shock movement as it went supersonic.

4. It is not the 'intense pressure front on the Mach cone' that causes the shock wave. The shock wave is caused, as correctly explained, by the coalescence of small acoustic disturbances. There is a finite step in the fluid pressure, temperature, density and velocity across a shock wave. It does not actually travel at the speed of sound, but this is a minor point.

Frank Fahy FIOA

Early London Noise survey - a major 'first'

I read the report of the 'Wilson 40 years on' meeting (*Acoustics Bulletin*, vol.29 no.1) with interest but was very surprised to see no mention of the early *London Noise*

Survey carried out by the London County Council in co-operation with the Building Research Station in 1961-63. This was the first major Noise Survey carried out anywhere, with 540 points on a grid pattern, each measured for 24 hours, and covering 36 square miles. The extensive factual data from the Survey as well as the social survey carried out at the same time provided a major input to the Wilson Report. The data was subsequently used by the Greater London Council in 1965 when noise guidelines based on L_{10} were officially adopted for London and a detailed report on noise planning was issued. The work of the Noise Section in the GLC Scientific Branch was widely recognised as contributing greatly to the early understanding of the noise problem and its alleviation.

George Vulkan HonFIOA

I am grateful for the opportunity to publish the above letter in order to plug a small but significant historical hole - Ed.

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27 May Publications St Albans	10 August Diploma Moderators Meeting St Albans	19 October Engineering Division St Albans
3 June Membership St Albans	14-15 September Underwater Acoustics Group Sonar Signal Processing Loughborough	21 October Bulletin Board of Management & Publications St Albans
8 June CCWPNA Examiners & Committee	16 September Underwater Acoustics Group Symposium on Bio-Sonar & Bioacoustics Systems Loughborough	26 October Research Co-ordination London
9 June Meetings St Albans	16 September Membership St Albans	28 October Membership St Albans
15 June CMOHAV Examiners & Committee	23 September Diploma Tutors & Examiners & Education St Albans	9 November CCENM Examiners & Committee
22 June Engineering Division St Albans	30 September Executive St Albans	11 November Meetings St Albans
22 June Research Co-ordination London	6-7 October Autumn Conference	25 November Medals & Awards & Executive St Albans
24 June Distance Learning Tutor WG & Education St Albans	8-9 October Reproduced Sound 20	7 December CCWPNA Examiners & Committee St Albans
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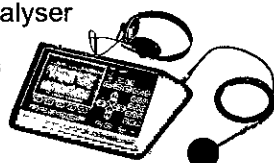


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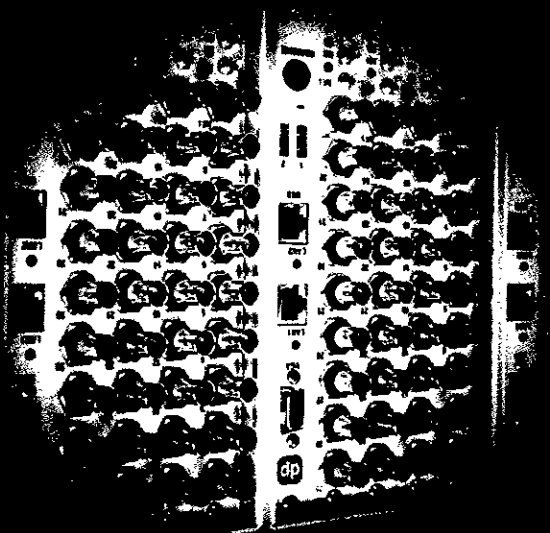
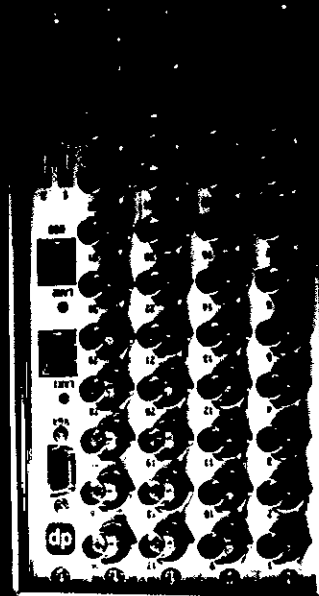
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