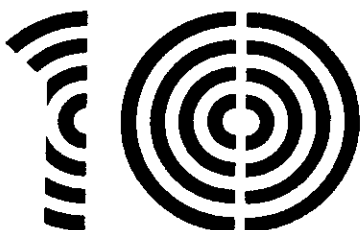




Acoustics Bulletin

January 1984 Volume 9 Number 1

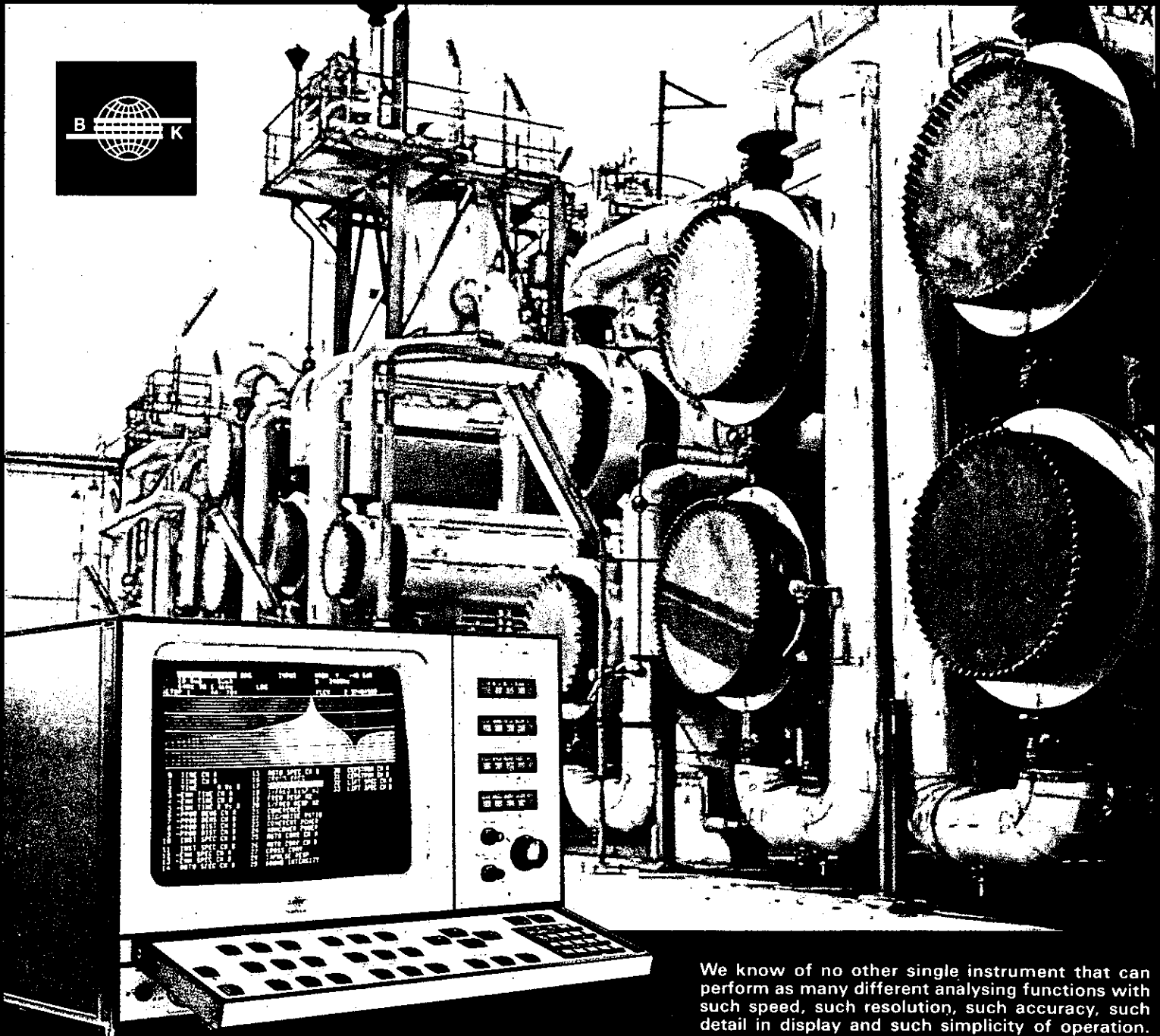


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January 1984

Volume 9

Number 1

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

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

Membership of The Institute of Acoustics

Membership of the Institute is generally open to all individuals concerned with the study or application of acoustics. There are two main categories of membership, Corporate and Non-corporate. Corporate Membership (Honorary Fellow, Fellow, Member) confers the right to attend and vote at all Institute General Meetings and to stand for election to Council; it also confers recognition of high professional standing. A brief outline of the various membership grades is given below.

Honorary Fellow (HonFIOA)

Honorary Fellowship of the Institute is conferred by Council on distinguished persons intimately connected with acoustics whom it specially desires to honour.

Fellow (FIOA)

Candidates for election to Fellow shall normally have attained the age of 35 years, have had at least seven years of responsible work in acoustics or its application, and have made a significant contribution to the science or profession of acoustics.

Member (MIOA)

Candidates for election to Member shall normally have attained the age of 25 years, must either (a) have obtained a degree or diploma acceptable to Council and have had experience of at least three years of responsible work in acoustics, or (b) possess an equivalent knowledge of

acoustics and cognate subjects, have had experience for not less than seven years of responsible work in acoustics or its application, and must have been a Non-corporate member of the Institute in the class of Associate for not less than three years.

Associate

Candidates for election to the class of Associate shall have attained the age of 18 years and (a) be a graduate in acoustics or a discipline approved by Council, or (b) be a technician in a branch of acoustics approved by Council, or (c) be engaged or interested in acoustics or a related discipline.

Student

Candidates for election to the class of Student shall have attained the age of 16 years and at the time of application be a bona-fide student in acoustics or in a related subject to which acoustics forms an integral part. Normally a student shall cease to be a Student at the end of the year in which he attains the age of 25 years or after five years in the class of Student, whichever is the earlier.

Full details and membership application form are available from: The Secretary,

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25 Chambers Street
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Presidents Letter

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Dear Member,

May I wish you all a happy and successful New Year?

In doing this I note that 1984, besides its significance for fans of Orwell, is the Year of the Tenth Anniversary of the founding of the Institute. Perhaps this makes it an appropriate time to point out that Council has recently been looking into the question of IOA involvement in registration of chartered engineer status. The decision on this will be an important one, not to be rushed into without identifying and weighing the advantages and disadvantages, but equally it is one on which we should not be too dilatory. Anyone with views on this subject is invited to write to me or to the Chairman of the Membership Committee.

The Institute started with a flourish in 1974 when it organised the Eighth International Congress on Acoustics, held in London. This was obviously a major undertaking, and in fact its timing helped in the decision to make 1974 the starting date for the Institute itself. Last year we were deeply involved with *Internoise '83*, an enterprise of similar magnitude. This year we return to our normal arrangements with both a Spring and an Autumn Conference, to be held respectively in Swansea and Windermere. I commend them to you as the only occasions on which the Institute Members as a whole can meet together, though I admit that in practice only a small fraction of the total membership find they can do so. The proceedings are made as attractive as possible, but unfortunately at any one meeting there cannot be a strong programme in every area and subarea of acoustics. In *Acoustics '84* at Swansea the presentations of wide interest should include, not one, but two Rayleigh Lectures. We are due to hear Eugen Skudrzyk's talk, postponed from *Internoise*, as well as the address by Shôn Ffowcs Williams. In addition we are pleased to have Edgar Shaw for the Stephens Lecture, and it is fitting that the only completely new Lecture Event inaugurated by the Institute should be given first in this Anniversary Year.

Yours sincerely,

David Weston

Letters to the Editor

Dear Madam,

Those of us who were fortunate enough to be able to attend the Eleventh International Congress on Acoustics in Paris last July cannot have failed to notice the point alluded to briefly by Stuart Flockton in his review on page 24 of the October Bulletin about the support given to the venture by the French Government. He mentioned that the Patron of the Congress was the President of France, there was a Comité d'Honneur made up of Ministers or Secretaries of State and five Ministries contributed to the costs. He didn't mention that the Minister of the Environment actually gave quite a long and relevant speech at the Opening Ceremony and that the Ministry had a stand in the exhibition which indicated a considerable commitment to furthering awareness of acoustics in the public at large.

I wonder if this excellent impression is maintained if one goes into the details of research support in that country. I have no personal experience of trying to get a Research Grant in France but my experience in this country is disheartening and I cannot but feel that it must be better in France. We all know how the subject of acoustics is viewed in this Country by Grant Giving Bodies: it is not a 'Pure Science' subject like Physics or Mathematics, nor is it 'Engineering' unless one can create a compelling economic argument, nor is it 'Humanities' unless the acoustic interest is minimal, etc. In other words whichever Committee or Body one sends a Research Proposal to is the wrong one; there is always a good reason for the Proposal to be sent back marked 'not for us'. Of course, I am exaggerating to make a point, but tales like that are widely known among researchers from all sorts of Institutions. It would not be difficult for me, were it not for the restraint of having regard for the feelings of those who have talked to me in confidence, to provide a list of projects covering a wide range of subjects which have been rejected (or, worse, not even considered) for apparently irrelevant reasons.

What I would like to know is: is it better in France? The indications are that it is. In my own field there was overwhelming evidence of widespread support and interest; people were able to tackle fundamental topics of a type which I have not been able to finance for years. They

also seemed to be able to form largish groups and thus benefit from the more rapid progress which always ensues when people are able to share and exchange views on a day-to-day basis. Are my observations shared by those working in other fields? Is there more general support for building acoustic research (to pick one at random) in France than in the UK?

I am sure that everyone would be interested to hear from those who have experience of obtaining Grants for research in both the UK and in France; could we have a small feature on this in the next issue of the Bulletin?

Yours faithfully,

J M Bowsher, FIOA

Editor's Note: Comments from other readers would be welcomed and should be sent to the address given on page 19.

Madam

The Branch structure of the Institute is now well established and providing a valuable local service to Members in most parts of the UK; the structure, however, can only thrive with the active support of the ordinary Members.

Branch Committees are currently reporting poor attendance at the regular technical meetings, a situation which if not reversed, could result in an eventual run-down of the Branch system.

I would like to use your column to ask all Members to support their local Branch whenever and as often as possible; I am sure that they, as well as the Branch, will benefit greatly by their involvement in this way.

Yours faithfully

T Smith

(Vice-president, Groups and Branches)

Dear Madam,

Background Noise Levels

May I through the columns of your journal question the value of these criteria.

As far as I know they originated in DES Building Bulletin 51 *Acoustics in Educational Buildings* (HMSO, 1975). They have now reappeared in DES Design Note 17 *Guidelines for*

Environmental Design and Fuel Conservation in Educational Buildings (HMSO, 1981). Since they are referred to in this latest publication it would appear that they have some sort of official backing. I question the use of these criteria for a number of reasons.

First it would seem to me that there are plenty of criteria already in existence such as A weighting, NR and PNC curves. Acoustics of school buildings are not that critical that they need their own set of criteria.

Secondly these criteria, as they stand, can be quite difficult to apply. The curves do not seem to follow any set formulae as in the case of NR curves, and no co-ordinates are given as for PNC curves.

In my work I am concerned with advising and teaching architects and architecture students. Technical matters are quite difficult enough already without needless complication and I suggest that the use of these criteria is discontinued.

Yours sincerely,

L W Bean, MIOA

INSTITUTE MEDALS 1985

Rayleigh Medal

The medal is awarded, without regard to age, to persons of undoubted acoustic renown for outstanding contributions to acoustics. The medal is normally awarded to a United Kingdom and to a foreign acoustician alternately. A suitable citation accompanies the presentation of the medal to the recipient. As a condition of the award, each recipient is required to give a presentation in a suitable form, to the Institute, of an acoustical topic of his interest. The 1985 Rayleigh Medal will be awarded to a foreign acoustician.

A B Wood Medal and Prize

Nominations for the 1985 A B Wood Medal and Prize will be made by the Acoustical Society of America.

Anyone wishing to put forward the name of a foreign acoustician for consideration by the Medals and Awards Committee as the recipient of the Rayleigh Medal should write in strict confidence to the President, enclosing a brief outline of achievements, etc, before the end of March 1984.

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Organisers

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Mr S S Kamath
Mr P Freeborn and
Mr S Turner
GLC Scientific Branch
The County Hall
London SE1 7PB

Remuneration Survey

EARLY LAST YEAR about 1,000 forms were sent to members with UK addresses requesting information for the Institute's first remuneration survey. The questionnaire was kept as simple as possible and the main objective of the data analysis was to investigate salary variations with age, grade of membership and type of employment. The current distribution of membership by grade is shown in Table 1.

GRADE	% OF INSTITUTE	% RETURNING FORMS
Fellows	17.5	41
Members	55.1	45
Associates	26.1	25
Students	1.3	64

Table 1 PERCENTAGE OF MEMBERSHIP BY GRADE

A total of 418 forms were returned, representing a significant 41% sample. Seven forms were unusable for various reasons, mainly due to missing answers. One university Fellow replied to all questions but omitted the salary! It was interesting to note that the percentage of Associates replying to the survey was much lower than for other grades of membership. The number of student replies was too low for the group to be considered significant although some results have been quoted. The range of salaries per annum for those in full time employment was £6,100 to £40,000. Following the practice of similar surveys, quartile and median values of salary distributions have been computed. For the purposes of this survey, net salaries are defined as those pertaining on 1 January 1983; the values are those calculated from the respondent's gross salary from his main employment only, less any area weighting that may have been included. Table 2 shows the quartiles of net salary for each grade of membership. These data have been further expanded in Figure 1 to show the variation of net salary by age group for Members and Fellows, while Figure 2 shows the same information for Associates. Student Members have been omitted from this particular analysis.

It is worth while noting the initial peak for Fellows in the 30 - 39 age group. As Table 3 shows, this may be due to the

	Lower Quartile	Median	Upper Quartile
Fellows	13000	15070	18000
Members	9500	11000	12850
Associates	7981	9471	11050
Students	6800	8000	8500

Table 2 QUARTILES OF NET SALARY BY GRADE

AGE YEARS	% FELLOWS	% MEMBERS	% ASSOCIATES	% STUDENTS
20 - 29	0	10	31	67
30 - 39	14	58	41	33
40 - 49	45	21	19	0
50 +	41	11	9	0

Table 3 PERCENTAGE OF SAMPLE BY AGE AND GRADE

uneven distribution of the sample within the age groups. Perhaps in a future survey the age groups should be divided into 5-year bands. This may slightly reduce the significance of the highest and lowest age groups but would provide more information on the main age groups.

The fields of employment analysis showed that the largest group, 29%, were employed by Public Authorities and that the groups covered by Education in Schools and Government, Architectural Practice and Students, in total, only amounted to 2% of the sample. As Table 4 shows, the highest paid group was in Education (University/Polytechnic), the lowest in Public

Authorities with Industry, Consultancy and Research and Development slightly higher. The highest individual salaries (in excess of £30,000) were mainly in architectural practice or consultancy.

The breakdown by qualifications for all members showed, as anticipated, that PhD's earned about 15% more than MSc's, who in turn earned about 5% more than those with BSc qualifications alone. There was a far wider spread of salaries for Associates than for Fellows and Members, but with PhD qualifications consistently ahead for each grade. The most common 'other' qualification was the Diploma in Environmental Health.

FIELD OF EMPLOY.	% OF TOTAL RESPONSE	LOWER QUARTILE	MEDIAN	UPPER QUARTILE
UNIV/POLY	16	11850	13220	15000
TECH. COLL	2	9634	11064	12475
IND/COMM	23	9450	11104	14000
PUB.AUTH	29	9200	10500	11679
R&D	14	9215	10984	14900
CONSULTS	13	9100	11500	13658

Table 4 QUARTILES OF NET SALARY FOR FIELD OF EMPLOYMENT (ALL GRADES)

IOA Annual Subscription

As detailed in a circular sent to all Members of the IOA, the following subscription rates will apply for 1984.

Fellow: £41

Member: £30

Associate (over 30): £27

Associate (under 30): £23

Student: £10

An area weighting was received by 15% of the sample ranging from £60 - £1300 with quartile levels of £454, £550 and £1,100. Of those receiving a weighting 52% were employed by Public Authorities.

A secondary income was received by 22% of the sample with quartile values of £200, £600 and £2,000 with two members having secondary incomes that could not be fitted into the four boxes available on the coding form! Of those receiving secondary income, 60% were in University/Polytechnic employment and 16% in Public Authorities. It was interesting to note that secondary incomes were received by 50% of Fellows, 18% of Members and 9% of Associates.

In comparison, 'benefits' were received by 25% of Fellows, 37% of Members and 34% of Associates. Quartile values were £290, £700 and £1,500 covering 34% of the sample. Many expressed the view that 'car allowance' within this area was not particularly a benefit - more of an unpleasant necessity. Of those receiving a benefit 90% were employed within Public Authorities, Industry and Consultancies.

The most commonly mentioned area of involvement in acoustics was clearly Environmental/Industrial Noise, followed by Building Acoustics then Vibration and Structural Dynamics. The area least mentioned was Musical Acoustics. The highest salaries were in the area of Speech and Hearing, closely followed by Physical Acoustics/Ultrasonics and Underwater Acoustics, with Musical Acoustics and Aerodynamic Noise at the bottom of the range.

Analysis was not carried out on the question referring to percentage of working week spent on acoustics. There was an obvious ambiguity between 'acoustics' meaning the entire field of the Institute's activities and meaning 'pure acoustics' as opposed to one of the applied or related disciplines. However, we have great sympathy with the member who claimed to be spending 150% of his time on acoustics — we can

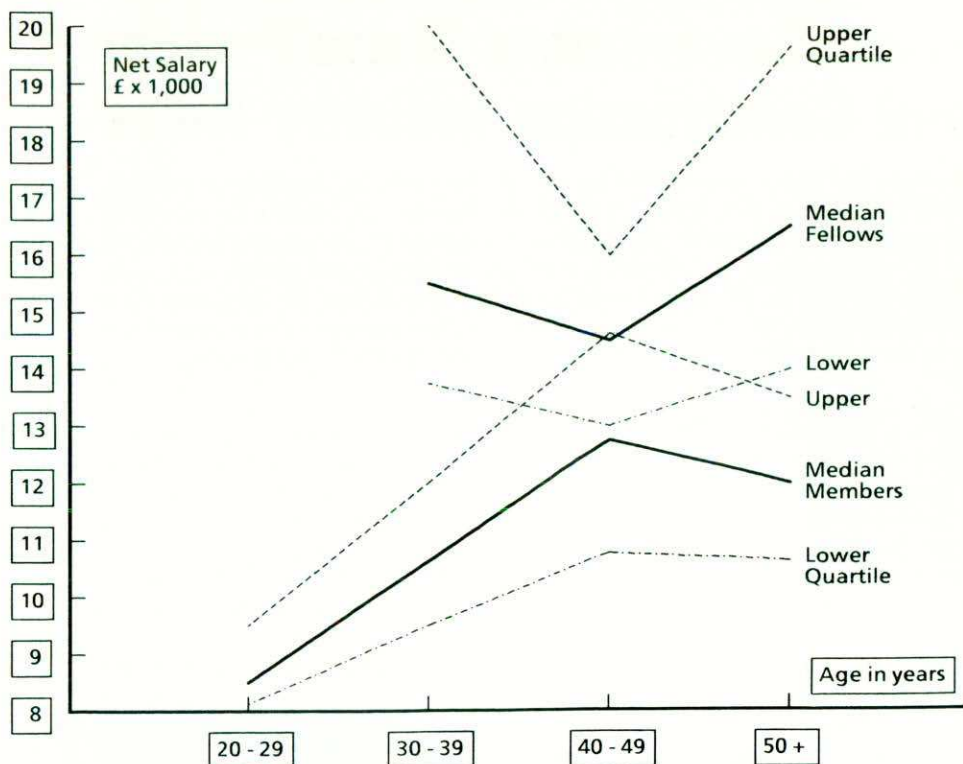


Fig 1 Net Salary by age for Corporate Grades

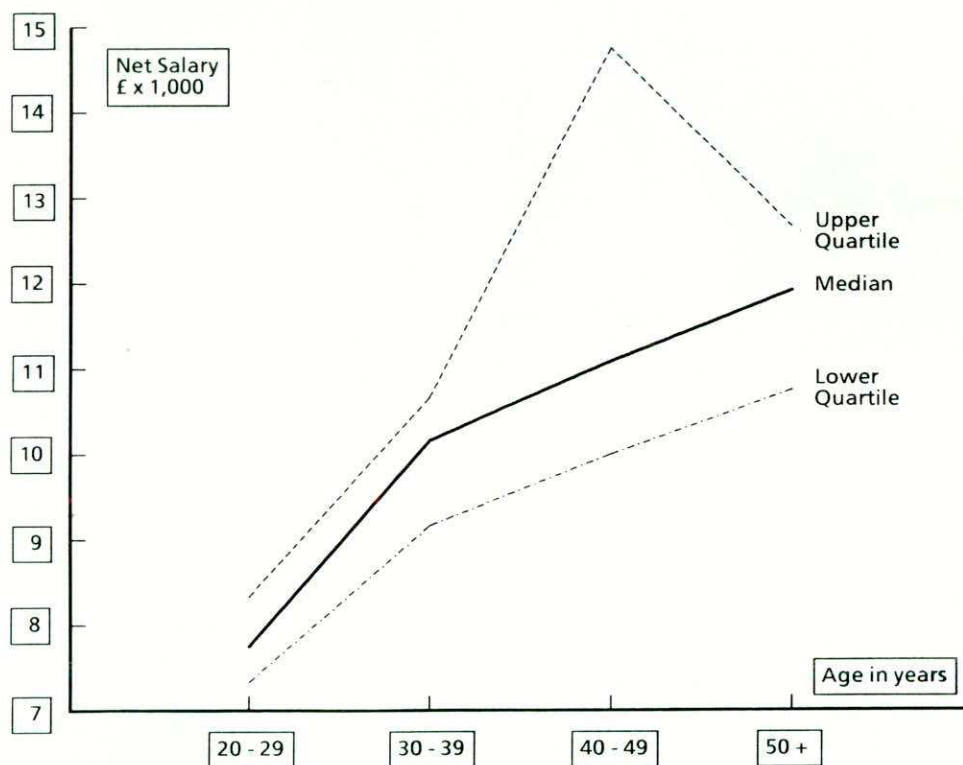


Fig 2 Net Salary by age for Associates

only assume that he is a very over-worked, underpaid consultant.

The survey has proved to be an enlightening insight not only to salaries, but also to the activities of the Institute's members. A great deal has been learned, particularly about the design of the questionnaire and with the software now written to perform the necessary analysis, the exercise could be repeated perhaps in alternate years. Comments

on any aspect of the survey would be welcomed but meanwhile we would like to thank the Council of the Institute for their help and guidance, the Greater London Council for permission to make use of suitable computer facilities, and especially, those members of the Institute who took the time and trouble to reply to the survey questionnaire. ☐

M Blackaller
J R Hyde

Local Government Noise Problems and Construction Industry Noise

Perhaps the most remarkable aspect of this one-day conference held at County Hall, London, on 3 October 1983, was the number of people who wanted to attend. Organisers Paul Freeborn and Stephen Turner had to disappoint those who phoned in the week before the conference to ask if they could attend, as numbers were limited to 100. In the end a total of 103 people turned up including 82 representatives from 66 local authorities, with smaller numbers from consultancies and government departments, and only five from academic institutions.

THE DELEGATES, who just fitted into the designated room at County Hall, were welcomed by the Chairman of the morning session, George Vulkan of the GLC, whose remarks were unintentionally illustrated by construction noise from workmen re-laying the tarmac outside the window. The first speaker was Lillian Birch

the Control of Pollution Act would have imposed conditions that were too stringent and inflexible to have coped with a large contract such as this. So, contrary to the title, he went on to describe how Greenwich had managed to control the noise emission without the help of Control of Pollution Act, by co-operation and discussion between in-



One sign of a successful conference — a full conference hall

from the DOE who gave a talk on the *Noise provisions of the Control of Pollution Act 1974*. Miss Birch gave a potted history of noise legislation starting, I think, in 1904 and then talked about how the present Act came about. She asked us to try to see it in the context of all other legislation such as common law and bye-laws. There were some fairly detailed questions both after the talk and later on in the afternoon, and although Miss Birch fielded the questions well (rather like a politician), I do not think she was able to give the type of information for which some of the local authority representatives were hoping.

Paul Cooney, from the London Borough of Greenwich, spoke on *Noise control and the use of the Control of Pollution Act 1974*. He described the Rochester Way relief road contract and methods of noise abatement and noise monitoring, but said fairly early on that

interested parties. Conclusions at the end were good, and I found especially interesting the following statement: '...public relations exercises and consultation with local residents associations are necessary adjuncts to noise control measures. I have found a public relations exercise to be a good

attenuator of noise, as subjectively up to 10 dB(A) can be achieved by a well worded letter;...' Makes you think.

Dr Michael Langley from the Sound Research Laboratories then gave a talk on *Vibration from piling — methods of assessment and case histories*. Dr Langley explained how the human body over-reacts to vibration, and people are often concerned about damage to property when vibration levels are still relatively low. There are many ways of measuring vibration and the parameters must be well defined. Piling is one of the major causes of vibration in the construction industry, but even so it rarely causes architectural damage, and structural damage is even more unlikely. It is important to make measurements of damage to buildings before piling takes place, and then monitoring can be carried out during piling. Little can be done to reduce the vibration from piling except by limiting the distance the hammer drops, or reducing the weight of the hammer.

The number of questions asked at the end of the talk showed that the measurement of vibration and interpretation of results are still a mystery to many people, and delegates seemed glad to discuss it.

Alan Beaman from Atkins Research and Development talked on *The new Code of Practice on Construction Noise*, and gave reasons for changing some of the old Code. Apparently the old Code gave rise to confusion in some situations, and in some cases was used for situations for which it was not designed. The noise limit of 75 dB(A) L_{eq} used in the old Code was widely interpreted as the standard, which was not intended. The new Code does not mention a figure (to the disappointment of some delegates) but sets standards of good practice instead. The proceedings give a list of topics covered by the new Code which will be out in its entirety fairly soon. Once again delegates asked



Speakers, surrounded by the usual conference paraphernalia of screens, projectors and maps (not to mention one or two delegates' heads). Left to right: John Hyde, Alan Beaman, Stephen Turner, Melvin Blackaller, John Simson, Lillian Birch, Michael Langley and P C Bird



Left to right: Speaker Alan Beaman with organisers Stephen Turner and Paul Freeborn

some fairly detailed questions, and once again, I think, were not totally satisfied with the answers.

John Hyde of the GLC explained how MWay, a software package for the prediction of traffic noise levels, had come about. He explained how 18-hour traffic noise measurements were first carried out for the Land Compensation Act. This led to difficulties, and the *Calculation of Road Traffic Noise* placed emphasis on calculating and predicting noise levels rather than on measuring them. However, this also led to difficulties, not least of which is lack of consistency in making calculations which are tedious and fiddly. He noted how a calculation of one point on a scheme, undertaken by several different people, gave a variation of 7 dB. (I remember being one of the extremes!). MWay was developed by Applied Research of Cambridge Ltd and consists of a set of programs written in FORTRAN. Maps must be prepared for digitisation, and input files prepared containing all the data, and then the noise calculation program is run. The limitations of the method were described and also the accuracy. One of the advantages is that once the basic data is input into the computer, odd parameters, such as traffic flows, can be changed and the noise calculations can be redone in a very short time.

Sound insulation of floors in conversions was the title of a talk by Stephen Turner (GLC) and Stuart Dryden (W S Atkins, formerly with the London Borough of Southwark). They explained that many local authorities are converting old houses into flats and have found that they have a large problem in

insulating one storey from another. Several methods of improving sound insulation were tested, so that the most effective could be recommended in future. The authors concluded that it is possible to achieve a good standard of insulation in all situations, and that if there are no restrictions, the best performance is likely to come from a combination of a floating floor and suspended ceiling. This was another talk which drew a lot of discussion and is obviously a problem which has been encountered by many of the delegates, and as the projector broke down, discussion could be prolonged!

The last paper of the afternoon was by Melvin Blackaller and Stephen Turner from the GLC and P C Bird of the London Borough of Hounslow on the *Sound insulation of a system built housing estate against aircraft noise, traffic noise and neighbours*. What can I say about this paper — it was written by my

section leader, my husband, and my colleague! The site in question was affected by aircraft and traffic noise and because of this several different standards had to be met for the GLC, for the London Borough of Hounslow and for the Building Regulations. Additional acoustic insulation had been required in the design of the estate and extensive measurements were made to check that the insulation reached the required standards. The housing did meet the prescribed standards in all but one case. One interesting fact that emerged from this is that significant differences were measured in sound level difference between sources of aircraft and road traffic noise.

There was a general discussion after all the papers, which went on for some time, and once again demonstrated that the delegates were pleased to have the opportunity to talk to the speakers and to each other about the papers given.

The GLC issued a press release on the morning of the meeting, which resulted in a representative from Radio London coming along in the afternoon to interview the Chairman of the afternoon session, John Simson. The resultant publicity was good for the Institute, for the Local Authorities generally, and in particular for the GLC which at the moment needs all the good publicity it can get.

It came to mind after the meeting that probably the biggest body of people in the country dealing with practical noise problems are local government officers, and it was obvious from the questions and discussion that they still need a lot more information about the job that they have to do. Anyone else who feels the urge to arrange this type of meeting would be sure of good support. □

Sue Bird

Professor Johns moves to Hong Kong

Professor David Johns who was President-Elect of the Institute left Loughborough University of Technology on 30 September 1983 to take up the post of Director (Designate) of the new City Polytechnic of Hong Kong.

Dr Johns has written to say that the Polytechnic Ordinance has now been passed and on 1 January 1984 the 'institution' was formally established.

Already some ten senior academic and administrative staff are in post and recruitment is progressing well towards

the complement of staff required to commence courses in October 1984 in transitional accommodation.

Planning is also continuing on the new campus development which it is hoped will be ready by October 1988. The target population for the first phase of development is approximately 8000 students.

Professor Johns hopes to retain a strong link with Acoustics and Vibration in particular as a member of the Editorial Boards of journals. □

Acoustics at Sandy Brown Associates

Alex Burd FIOA

Over the last five years or so the sequence of articles on 'Acoustics at...' has concentrated on major centres of acoustics research and teaching. In this issue of Acoustics Bulletin, as in the October 1983 issue, we look at the hard commercial world where the practitioners try to apply the lessons learned and the techniques developed in colleges, universities or research establishments.

Sandy Brown Associates was formed fifteen years ago by Sandy Brown in association with David Binns. Sandy at that time was the Acoustics Architect in the BBC Architects and Civil Engineers Department and, after a brief period with a foot in each camp, he left the BBC to concentrate entirely on consultancy.

In common with most comparable groups, SBA has had its ups and downs but these have been oscillations superimposed on a steady growth. The firm now has six partners, two of whom are architects, and five other acousticians. The number of architects varies according to the dictates of the work.

After several years in small (and noisy) offices around the West End, SBA have now moved into palatial premises in Swiss Cottage which will permit expansion as required into additional small units that are currently leased out as industrial units.

As most people will know, Sandy Brown is no longer alive; if there are acoustics in the after life he will be gathering together a group of specialists to study (and improve) them! Sandy will be remembered by all who attended the 1974 meeting on Architectural Acoustics in Edinburgh for his vivid descriptions of a few of his related (or largely non-related) lines of research. He is even more widely known as a jazz clarinettist and achieved pre-eminence in this field also.

Within the more normally defined range of acoustic consultancy our interests extend from architectural acoustics through environmental noise control to audio-visual systems. A brief summary of a few recent projects will illustrate this broad spectrum of experience.

STUDIOS

Recording

Having a foot in each camp — broadcasting and music — it was inevitable that the major emphasis in the early years should have been on studio

design. In fact, so firmly was the foot in each camp that part of the fees for some studio designs was taken as recording time. The list of commercial recording studios, in the design or improvement of which SBA had a hand, reads like a who's who of popular music. The period spans the progression of studios from the classical music studio in which an internal balance is maintained by the musicians to the multi-microphone studio in which the greatest possible degree of separation is required between individual groups of musicians.

Perhaps more critical even than the studio is the associated control room where the balance of the musical programme is finally adjusted by producer and engineer. The loudspeaker may well be the weakest link in the listening chain but all involved will blame the acoustics first — even for distortion! The control room is currently the haunt of the hard-sell (hype) merchants and a dangerous place for a mere acoustic consultant to venture.

Radio

Broadcasting is a highly specialised field and many of the currently active UK acoustic consultants gained their early experience in the Engineering Research Department of the BBC.

In radio, particularly, the absence of visual contact makes the sound channel, the only remaining channel of communication, of paramount importance. The presence of a level of background noise which would be unnoticeable in face-to-face discussion can seriously detract from intelligibility under broadcast conditions; intelligible sounds are even more disruptive than continuous broadband noise. Excessive reverberation can act in the same way to mask the desired programme. Thus, the standards of sound insulation to attenuate noises generated outside each studio and the permissible noise levels which can be generated by ventilation systems or other internal sources are extremely stringent.

Independent local radio represents a class of radio for which a tightly defined Code of Practice relating to the acoustic standards is laid down by the IBA. SBA has acted as architects and acoustic consultants for many of these stations — County Sound (Guildford), Red Rose Radio (Preston), Victory (Plymouth), Forth (Edinburgh), Trent (Nottingham), etc.

In addition, broadcasting centres as far apart as Abuja (Nigeria), Jeddah (Saudi Arabia), Amman (Jordan) and Brussels (Belgium) have been designed in these offices.

Television

The recent franchise changes in ITV and the advent of Breakfast TV and Channel 4 have led to major expansion in a field of work which had previously appeared to be fairly static. New stations have been designed for TVS (Maidstone), TV-am (Camden) and Limehouse (Dockland) together with extensions at many other sites.

New forms of construction and new types of acoustic treatment have been explored as dictated by each project and as described at a recent Building Acoustics Group Meeting.

In particular, the use of a resiliently suspended/supported, lightweight, inner skin which provides noise reduction and sound absorption has proved successful both acoustically and economically.

One of our more unusual ventures recently completed for Limehouse Studios has been to design a TV studio which will satisfy the demands of serious musicians as well as drama producers. An electroacoustic system has been installed which provides a gradual change in the amount of reverberant energy — at the touch of a button. Previous attempts to aid the musician (foldback, ambiophony and the like) have all failed to satisfy this critical band.

Overseas projects in recent years have included television theatres and studios in Brussels, Zagreb, Bahrain, Abuja and Lusaka.

AUDITORIA

Theatres, conference centres and concert halls have for long been the ultimate test of the acoustician's ability to withstand the pressures imposed by design incompatibilities and financial stringency in order to find the correct (for each case) balance of direct, early reflected and reverberant sound together with various other factors.

The use of acoustic models to predict certain of the characteristics of large studios or concert halls was inherited by SBA and has been continued in collaboration with university departments and others. The design of the Castle Terrace Theatre (Edinburgh Opera House) using a 1:8 model with Heriot Watt University was the first major application of the technique outside the BBC. Although this project foundered in the face of ever increasing costs, the BBC Northern Region Orchestra Studio was completed, the model study in this case being in collaboration with the BBC Research Department.

More recent work in collaboration with Mike Barron at Cambridge has included St David's Hall in Cardiff. For projects having a strictly limited design and construction programme (and usually a restricted budget as well) the 1:50 scale models, in which Mike specialises, represent the only practicable form of modelling. The answers provided by the model study undoubtedly contributed in St David's Hall to the successful achievement of an exciting new auditorium.

NOISE CONTROL

Building Services constitute the main source of noise within modern buildings; the services not only generate the noise (fans, motors, compressors, etc) but also provide efficient means of conduction from one point to another (ducts, shafts, ceiling voids, etc). Design work, approval of contractor's drawings and, occasionally, recommendations for remedial work form a hard core of the work carried out in this field.

Environmental noise nuisance frequently arises from poorly sited or inadequately silenced ventilation equipment. An even more frequent occurrence these days, however, is the late night discotheque in lightweight buildings — the village hall and local rugby club within a close-built community.

Vibration isolation is, of course, an essential part of the control of services noise; in addition, however, the vibration isolation of entire studios is usually necessary to achieve the high values of sound insulation between adjacent rooms. (Steel springs, rubber pads or glass fibre are normally specified for this type of application.) If a major source of ground vibration exists, such as an underground railway, it may occasionally be desirable to isolate an entire building and this is usually done by supporting the structure on elastomeric pads.

ELECTROACOUSTIC SYSTEMS

The trend to multiple use of large spaces which has been exacerbated by economic stringencies has led to compromise designs which satisfied nobody. Electroacoustic systems are now achieving a measure of respectability having demonstrated improved reliability and flexibility in recent years.

The adjustment of reverberation in order to enhance the musical responsiveness of an auditorium has been demonstrated to be acceptable by Assisted Resonance at the Royal Festival Hall; this system achieves stability and adequate power handling capability by dividing the spectrum to be covered into a number of narrow frequency bands, each of which is amplified separately.

The system which was mentioned above as having been installed at Limehouse — Multi-Channel-Reverberation by Philips — uses a like number of channels, each of which supplies only a fraction of the total power required.

An alternative approach has been used in some cases in which a reverberant

auditorium is utilised for speech and other applications by incorporating a highly directional reinforcement system to radiate sound into the acoustically absorbing audience.

COMPUTERS

With the advent of universal computers we have graduated from a terminal working into an agency computer to an in-house system. This is used for word processing and data storage as a matter of course and a wide range of interactive programmes have been developed to simplify the calculations which are frequently in use.

PROFESSIONAL ACTIVITIES

The partners and others in Sandy Brown Associates support a wide range of professional activities. In addition, the firm has been a Sponsor Member of the Institute of Acoustics since the inception of this class of membership and has supported various of the partners who have played an active part in the organisation of the Institute. □

It's your hearing. Protect it or lose it.  **Health & Safety Executive**

The Health and Safety Executive's campaign against deafness caused by noise at work was launched in London on 26 October 1983. In his speech Dr John Cullen, Chairman of the Health and Safety Commission, commented that many people still do not realise the damage that can be caused by high levels of noise at work. It is reckoned that a million or more people work in an environment noisy enough to damage their ears; a proportion of that million will go deaf. The aim of this campaign is to make people aware of the danger and persuade them that it can be tackled.

Features of the publicity campaign include stickers and posters for workplaces, available from the HSE Publications Division, St Hugh's House, Stanley Precinct, Bootle, Merseyside (Tel: 051 951 4000). The HSE book published in association with the campaign, *100 practical applications of noise reduction methods*, may be obtained from HM Stationery Office (price £7.50) or from booksellers. The book is a series of case studies showing methods that can be used to achieve lower noise levels in the workplace, and includes an industry index for quick reference to those case studies particularly relevant to certain industries. The HSE is to continue to collect details of effective solutions to noise problems and if the volume of information justifies it a further series of case studies may well be forthcoming.

The Health and Safety Commission propose over the next few years to try to stimulate action and ideas within industry and on design for new plant and perhaps methods of protection; and to see that this is backed by a firmer attitude all round. Dr Cullen pointed out: 'The Health and Safety Commission had intended this year to bring forward new regulations defining the standards to be reached; but the European Commission have stepped in and proposed a directive. We don't agree with everything they are proposing and we are going to have to discuss that with our partners in the Community. But we do see it as a step forward that there is international recognition that the problem has to be tackled... We shall get on top of industrial noise, as we have done with so many industrial hazards in the past.' □

Appreciation

Geoffrey M Coles

The name of Geoffrey M Coles was synonymous with the pioneering work in the field of gas turbine jet exhaust noise and his research in the early sixties is now considered, a quarter of a century later, to be a classic the world over.

Geoffrey, who died on 29 September 1983, will be remembered most for his paper *Estimating jet noise* published in 1964 for which the Royal Aeronautical Society awarded him the Orville Wright prize. The in flight to static correlation data which followed is still a yardstick for present day predictions.

As a very close colleague of mine in Rolls-Royce, he was particularly involved in the design and development of silencing systems for jet noise sources in our engines, and at least one silencer was patented in 1965.

Following his later service in Rolls-Royce (where he became Manager of Flight Test Data Systems), he moved on to the Hosiery and Allied Trade Research Association (HATRA) as Personal Assistant to the Director of Research embracing a whole range of topics, including the acoustics of Hosiery Machinery.

It was whilst he was at HATRA that we met again in a HMG Working Party chaired by the Health and Safety Executive on the subject of Machinery Noise relevant to Noise in the Workplace. His profound knowledge of the subject of acoustics generally was of immense benefit to this Working Party and the present HMG Legislative Document *Protection of Hearing at Work* (August 1981) owes much to his valuable guidance in this field.

In 1982 he moved into Local Government and joined the Mansfield D C as Head of Computer Systems Department where he remained until his death last month.

We remember his work with a deep sense of gratitude and those who live and work around major airports of the world can say thank you to Geoff Coles who did much to enable us to understand the noise generating processes in high speed gas streams.

We extend to his wife Anne and her children our sympathy at this time, and from the Members of the Institute of Acoustics we revere his name in the field of Gas Turbines. □

John L Flintoff, FIOA
Rolls-Royce Ltd

New Noise Council

The April '83 issue of *Acoustics Bulletin* contained a report on the setting up of a Steering Group, under the chairmanship of Professor G M Lilley, to formulate proposals for a new Noise Council. Because of its growing involvement with noise, the National Society for Clean Air had been invited to be represented at the early meetings of the Steering Group. It was hoped that the new Noise Council would be proposed jointly by the Institute and NSCA and the proposal was worded accordingly.

Professor Lilley attended a meeting of the Council of NSCA to introduce the draft joint proposal and NSCA set up its own Steering Group to consider the matter further. IOA was not invited to be represented or even to attend as an observer on the NSCA Steering Group. This group recommended rejection of the proposal for joint sponsorship and it is understood that NSCA is setting up a 'Technical Committee' of its own to deal with noise and it has been suggested that the Institute will be invited to become an affiliated member of NSCA so that IOA members will be able to serve on the NSCA's Technical Committee. To date no such invitation has been received formally but the IOA Steering Group has already made a recommendation to Council on how to deal with this invitation, if and when it arrives.

In the meantime the IOA Steering Group, now a Committee of the Institute, is renewing its investigation of ways and means to start up a viable and effective new Noise Council that will fill the gap left by the demise of the Noise Advisory Council in 1981. □

W E Scholes

NON-INSTITUTE MEETINGS

1984

21–23 March. *2nd International Symposium on the Performance of Computer-Communications Systems*. Zurich. Contact: I B M, Zurich Research Laboratory, Saumerstrasse 4, CH — 8803 RUSCHLIKON, Switzerland.

27–30 March. *75th AES Convention*. Paris. Contact: Ms T K S Bakker, c/o Polygram B V, PO Box 23, 3740 AA Baarn, Holland.

5–6 April. *SEECO 84 — Dynamics in Automotive Engineering*. Contact: SEE, Owles Hall, Buntingford, Herts SG9 9PL.

9–13 April. *2nd International Conference on Recent Advances in Structural Dynamics*. Southampton. Contact: Dr M Petyt, ISVR, The University, Southampton SO9 5NH.

13–17 June. *Principles of Sonar Systems Engineering*. Course presented by the Continuing Education Institute with Linköping Institute of Technology, Sweden. Zandvoort, The Netherlands. Contact: Course Registration Office, Continuing Education Institut-Europe, Anita Hull, Gustav Adolfsgatan 9, S-582 20 Linköping, Sweden.

18–22 June. *Waves in fluid-filled tubes*. (Euromech). Rimini, Italy. Contact: Professor F Mainardi, Università di Bologna, Piazza di Parta S Donato 5, 40127 Bologna, Italy.

4–6 July. *Turbulence Modelling for Incompressible Flows* (Euromech). Karlsruhe. Contact: Professor W Rodi, Institut für Hydromechanik, Universität Karlsruhe, 7500 Karlsruhe, Germany.

25–28 July. *10th International Symposium on Non-Linear Acoustics*. Kobe, Japan. Contact: Dr Akira Nakamura, The Institute of Scientific and Industrial Research, Osaka University, 8–1 Mihogaoka, Ibaraki, Osaka, 567, Japan.

21–24 August. *4th FASE Congress*. Sandefjord, Norway. Contact: FASE 84, ELAB, N-7034 Trondheim-NTH, Norway.

3–5 December. *Inter-Noise 84*. Honolulu, Hawaii. Contact: Inter-noise 84 Secretariat, PO Box 3469, Arlington Branch, Poughkeepsie, NY 12603, USA.

Notice of future non-Institute Meetings should reach the Editor at least four months before the date of the meeting. □

Proceedings of the Institute of Acoustics - Abstracts

Police Applications of Speech and Tape Recording Analysis

Joint meeting and exhibition with the Audio Engineering Society, 13-14 March 1984 at Birkbeck College, London

An Auditory Speaker Recognition Experiment

Marion Shirt
Department of Linguistics & Phonetics,
Leeds University

It has been suggested that phoneticians are better at auditory speaker recognition, by virtue of their phonetic training, than non-phoneticians. An attempt has been made to prove the truth or otherwise of this suggestion.

Twenty subjects from each category were asked to judge spontaneous speech samples of 4 sec duration in three types of listening-test:

- 1) Section A — Six closed *Identification Tests*
- 2) Section B — Two closed and two open *Pairing Tests*
- 3) Section C — Three *Discrimination Tests*

All tests but one used groups of speakers with similar English accents. Short speech samples were chosen to prevent listeners relying too heavily on segmental criteria for identification.

Preliminary results suggest that phoneticians perform only marginally better overall than non-phoneticians. The best individual score was the same for both categories of subject.

The Effects of Psychological Stress on Voice

T Shipp, M Brenner and P Morrissey

Speech Research Laboratory, VA Medical Center, San Francisco, USA

Two studies were conducted on normal subjects to determine whether selected acoustic and physiological measures differed between a stress and nonstress condition. The first study used a number-repeating task to induce stress. The results showed that, as compared with the low stress condition (repeating 2 and 4 digits), in the higher stress condition (repeating 7 digits) eye pupil size increased significantly as did voice fundamental frequency and there was also a strong tendency shown for voice 'jitter' (temporal variability in successive voice periods) to become more regular. Based upon these laboratory stress findings, acoustic analysis was performed on tape recordings of pilots saying the same words, first, in routine air-to-ground communications and, subsequently, in a dire emergency when a fatal crash was imminent. The results showed that speech in the high stress condition had a significantly higher fundamental frequency (one octave), the speech rate increased significantly, but no differences were found for voice jitter measures between the two stress conditions. The implications of these findings will be discussed relative to instrumental techniques developed and proposed for detecting psychological stress from voice signals.

The Case for Use of Natural Speech Vectors in Forensic Speaker Identification

H Hollien, L Oliver and J W Hicks, Jr

Institute for Advanced Study of the Communication Processes, University of Florida, USA

When speaker *verification* only is the issue of interest, it is quite legitimate to focus analysis on the signal irrespective of the speech related features it contains. Such approaches are appropriate because system distortions are minimal, noise is very low, talkers are co-operative and very sophisticated equipment is available. Not so in the forensic milieu. Here extensive system and speaker distortions (including noise) can be expected; speech is noncontemporary and speakers unco-operative. Hence, the signal is so distorted and/or masked, the usual identification techniques cannot be expected to be very useful. Our approach to speaker identification assumes that the signal contains speech features that are both robust (ie. insensitive to noise and distortion) and unique — as well as consistent — to the talker. These idiosyncrasies are based on speaker's anatomy, physiology and habitual communicative patterns. Further, it also is our position that, while there may be no single attribute within a person's speech/voice that would permit them to be differentiated from all other speakers under any condition, the simultaneous use of a large series of feature analyses may permit an identification profile to be developed. We have structured and tested just such a system; it is based on five natural speech vectors, each containing 20-40 parameters. These vectors, and the results of over 100 initial experiments, will be reviewed.

Philosophy of Speaker Identification

S R Lewis

Home Office, Scientific Research and Development Branch

Recordings of utterances made by the same speaker with the same content but not recorded simultaneously produce physical signals which differ, often very significantly. Does the 'identity of a speaker' refer to a statistical or non-statistical entity contained in the signal or a non-statistical entity of which one of the former is a part? Given only two recordings of utterances, which may differ in content, which may or may not have been made by the same speaker but which were definitely not made simultaneously.

(a) What comparison is being asked for when asked 'were they made by the same speaker' and

(b) What confidence is being referred to when, on replying to (a), we are further asked 'how confident are we of our answer'.

An attempt will be made to clarify or give some meaning to the above questions.

The Implementation of Speech Intelligibility Enhancement Algorithms on an Array Processor

N Curtis

Hatfield Polytechnic

Speech Intelligibility Enhancement Algorithms are generally digital filtering operations working sequentially on blocks of data moving through time. Exploiting the architecture of modern day Array Processors allows us to implement such algorithms with great efficiency and speed, and in some instances real time processing has been achieved. This throughput time is very important in police applications where many different parameters allied to auditory feedback must be tried in order to obtain the best results for a particular algorithm.

By way of example, the realisation of one such algorithm, an automatic adaptive filtering scheme, will be discussed together with other intelligibility enhancement algorithms that benefit from implementation on an array processor.

Audio Signal Examination using a Computer System

R Pape

To obtain the maximum information from a tape recording, a number of examination techniques is required. One possibility is to digitise the signal and examine it in various ways in the digital domain. Here, the development of a mini-computer system with suitable devices for interactive audio-visual examination of the digitised signal is discussed.

Real-time Digital Laboratory Enhancement of Degraded Law Enforcement Tape Recordings

J E Paul and J B Reames

The advent of digital signal processing has made a major impact upon the restoration of degraded law enforcement voice tape recordings. Perhaps the most widespread use of this technology has been at the FBI Laboratories in Washington DC, USA, where major application advances have been made.

The fundamental technology behind automatic, or better-stated adaptive, noise reduction is not new; however, its application to the forensic laboratory has made major strides in the past five years. The principal breakthroughs are due to the availability of very high speed digital electronic hardware. Heretofore, signal enhancement has been

carried out on general-purpose digital computers requiring hours of processing time to enhance each minute of recorded signal. New hardware, developed by Digital Audio Corporation, has made laboratory digital signal processing a practical reality by carrying out this voice enhancement in real-time, computing at rates of millions of digital operations per second.

This paper will discuss the manifold aspects of practical digital law enforcement tape restoration including that of a noise model, signal processing theory, hardware implementation, and laboratory application. Several recorded examples shall be presented and a demonstration of the hardware shall be made available to interested attendees.

Acoustic Signatures of Handgun Firings: A Case Study

H Hollien, J W Hicks, Jr, Nancy Aarts and N Thomas

Institute for Advanced Study of the Communication Processes, University of Florida, USA

During a recent trial of felony murder, the prosecution contended that handguns used in a shootout could be identified from their acoustic signatures. Specifically, a series of fourteen shots fired from three guns during a robbery were inadvertently tape recorded — and introduced into evidence. The Court upheld the objections made by the defense (re: the signatures) and requested that we determine which of the two positions was the more accurate. The experiment we

carried out involved 20 handguns of different makes/types/calibers, fired in four (physical) relationships and recorded via microphones placed 1) open range, 2) in an enclosed room and 3) in an enclosed room and damped. A variety of bullet weights and loads (handloads; several manufacturers) were tested; all shots were fired into a backstop consisting of ten bales of hay. Six wave front, spectrographic and related procedures were carried out on the resulting 1240 recorded shots. Included were FFT traces, t-f-a spectrograms, power spectrograms, level recordings (two types) and peak analysis. Basically, the data confirmed that each handgun can be expected to have its own signature but that this pattern can be altered by such factors as load, bullet weight and especially room acoustics. In short, it was demonstrated that none of the fourteen recorded shots could be identified — at least, unless they were replicated and studied under conditions identical to the first series.

An Update on Speech Decoding

Patricia A Hollien and H Hollien

Institute for Advanced Study of the Communication Processes, University of Florida and Forensic Communication Associates, Gainesville, Florida, USA

Tape recorded evidence can vary all the way from that obtained via body bugs, from wire taps, to FM transmissions/intercepts, to recorded interrogations or courtroom events. Indeed, the purposes for the recordings, the environmental conditions and the equipment used vary so greatly within the forensic

milieu, that it is quite difficult to generalise about them. Nonetheless, only a finite number of distortions/disruptions can operate to degrade a tape recording; these distortions are system based (for example, various types and levels of noise, frequency/harmonic distortion) and speaker based (for example, the results of stress/fear, drugs, health states of the talker, etc). Whether the tape recording to be enhanced and decoded supports investigation, interrogations or transcripts, a similar set of criteria can be applied relative to their enhancement. They include filtering, speed alterations, binaural listening and digital processing. Moreover, decoders can and should be trained in phonetics, the nature of distorted speech and the particular lexicon(s) utilised by law enforcement and intelligence agencies. Finally, it appears that blind and/or partially sighted individuals can be exceptionally good decoders. However, they require special training as well as specifically designed procedures that permit them to make permanent records of the materials they decode. Some of the more desirable characteristics for decoders will be discussed.

The Authentication of Tape Recordings: Further Considerations

B Klepper

Forensic Communication Associates (FCA) and Institute for Advanced Study of the Communication Processes, University of Florida, USA

Fundamental procedures of audio tape authentication have been carried out for several years by a number of individuals/agencies. As yet, however, there is no established consensus as to the types of procedures that should be routinely applied to this special class of investigation. An updated review of the standard procedures utilised by FCA personnel will be presented. In addition, there are some quasi-legal questions central to the authentication process which should be considered by the examiner. Specifically, two issues will be discussed: 1) If the integrity of a recording has been violated (via breaks, click signature, etc), should apparently intact portions of the same recording be judged inauthentic as well? 2) Does the inability to authenticate a recording (because of potentially fraudulent but unattributable signal patterns) necessarily imply that that recording has been manipulated? It is suggested that an expanded classification system be developed to deal with the ambiguities of the authentication process.

The Presentation of Tape Recorded Evidence

D J Dean

Home Office, Scientific Research and Development Branch

For several years the Home Office Tape Laboratory has provided an operational service in respect of audio tape recordings. Much of the work has been concerned with intelligibility enhancement and authentication of recordings as potential evidence for a court of law.

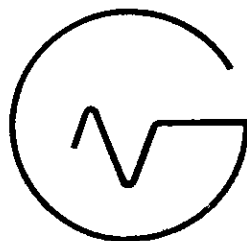
This paper examines some of the problems of preparing written transcripts and presenting tape recorded evidence in court.

Note: Additional papers will also be presented, for which Abstracts have not been received. □

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President
David Weston



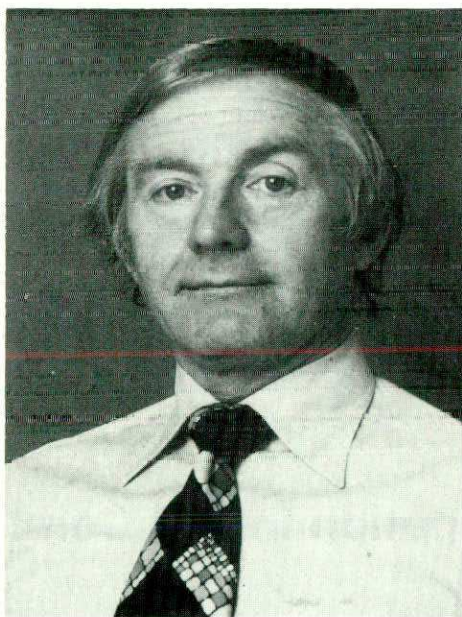
David Weston graduated in Physics at the Imperial College of Science and Technology, London. He is now a Deputy Chief Scientific Officer at Admiralty Underwater Weapons Establishment, and previously with Admiralty Research Laboratory. He joined the latter immediately on leaving the Imperial College of Science and Technology, but has also spent a year each at the Hudson Laboratories of Columbia University and the Applied Research Laboratories of the University of Texas at Austin. His principal professional interest has been in oceanographic acoustics, including sound propagation, underwater explosions as acoustic sources, the low frequency acoustic phenomena associated with fish having swim bladders, and sonar generally. Earlier he was connected with the Acoustics Group of the Institute of Physics, and received the Silver Medal from the British Acoustical Society. At the Institute of Acoustics Dr Weston has previously been Chairman of the Publications Committee, and Chairman of the Underwater Acoustics Group.

Vice-President
Michael Ankers

Michael Ankers joined Manchester City Council as a student Environmental

Health Officer in 1962, and has remained with the Council ever since. After qualifying at what is now the University of Salford (formerly RCAT) he subsequently moved into the field of pollution control in 1968. On Local Government reorganisation in 1974 he was appointed Principal Environmental Health Officer (Noise) in response to the specific demands in this single aspect of pollution control. A former member of the British Acoustical Society, he transferred membership on the formation of the Institute, since when he has been Chairman of the Industrial Noise Group, and a Council Member for two years. He serves on Membership, Awards and Meetings Committees, being currently Chairman of the latter and of the North West Branch.

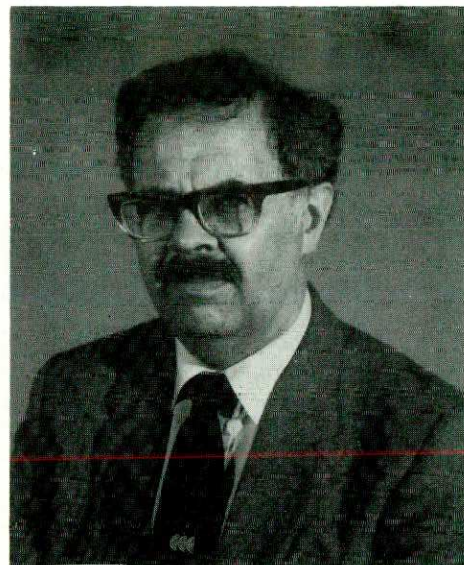
Vice-President
John Bickerdike



Educated at Leeds College of Technology as an Environmental Health Officer and subsequently at University of Salford, he served with the Leeds City Council until joining Leeds Polytechnic as the Course Tutor of the Environmental Health Officers Diploma Course. He is now Principal Lecturer in Environmental Health and Course Director for the BSc (Hons) in Environmental Health. His interest in

Acoustics developed in the early sixties from involvement with local authority problems and the training of officers for duties under the Noise Abatement Act and he is now heavily involved in teaching, research and consultancy. His particular interests are in the field of community noise problems and noise induced deafness from recreational activities. He has been a member of the Institute and its predecessor the British Acoustical Society since 1972 and a Member of Council since 1976. He is a Fellow and Vice-President of the Institute, Chairman of the Membership Committee and a member of the Noise Council and Education Committees.

Vice-President
Trevor Smith



Trevor Smith is a Senior Engineer at the British Gas Engineering Research Station, Killingworth where he has been involved since 1973 in developing specialised noise control hardware for the gas industry. Previous experience in the noise and vibration field was gained during periods spent as an Environmental Test Engineer at the Ferranti Guided Weapons Division, Manchester and subsequently as a Research Engineer and later Section Leader in the R and D Labs of C A Parsons, Newcastle upon Tyne. Although holding a BSc Tech in Physics and MSc in Acoustics, both from UMIST, Trevor considers himself to be an engineer rather than a scientist,

having spent over twenty years within engineering and achieved Chartered Engineer status.

In 1979 he became a Member of Council and was elected Vice-President in 1981 and again in 1983. He is responsible for looking after the interests of all Branches and Groups (particularly on Council) and for general liaison between the various parties involved. A confirmed supporter of the Branch and Group structure within the Institute, Trevor Smith is fully committed to the maintenance and wherever possible the expansion of these activities.

Honorary Treasurer Roy Lawrence



Roy Lawrence graduated in Physics from the University of Liverpool and was awarded a PhD by the same

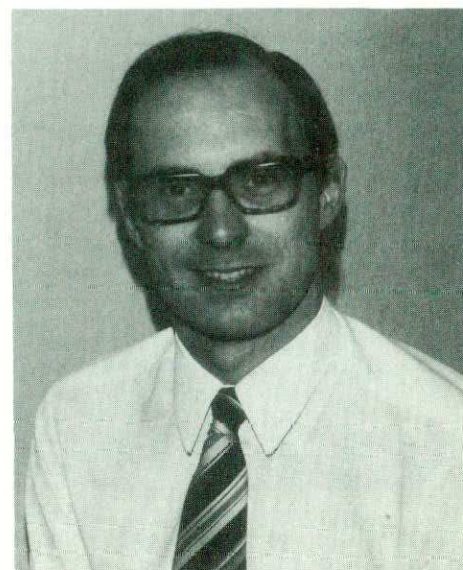
University for research into molecular sound absorption in polyatomic gases. There followed two years in industrial research with ICI General Chemicals Division at Widnes and three years teaching as Assistant Professor of Physics at the Haile Selassie I University, Addis Ababa. On return to the UK Dr Lawrence took up a post as a lecturer, later becoming principal lecturer at Liverpool Polytechnic where he established the Polytechnic's Acoustics Group in 1975. A former part-time member of the Nuffield supported Higher Education Learning Project, his present research interests include sound propagation in hot gases, the effect of turbulence on urban sound propagation and modelling in acoustics.

Sometime Chairman, Honorary Secretary and Member of various Institute of Physics Boards and Committees, Dr Lawrence was organiser of the Institute of Acoustics Spring Conference at Liverpool in 1975 and the Autumn Conferences at Windermere in 1979 and 1980 and played a large part in the organisation of the Internoise '83 Conference in Edinburgh.

Honorary Secretary Robert Hill

Rob Hill's introduction to acoustics was initially through a Bachelor's degree course in Architecture at the University of London, followed by a period as a university research assistant. Further experience in building acoustics and transportation noise was obtained through four years with a multi-disciplinary consultancy, followed by five years in the Environmental Sciences

Group of the Greater London Council. Rob returned to consultancy work in the private sector in 1979 by joining AIRO, where he is now a Senior Consultant. During his time with AIRO he has become involved in electro-acoustics, but the majority of his work has been concerned with noise and vibration in relation to planning and transportation, including the presentation of evidence in court or at Public Inquiries.



A former member of the British Acoustical Society, Rob has been an active Member of the Institute since its formation. He has been involved in the organisation of the London Evening Meetings virtually since their inception and was elected to Council in April 1980.

Participation in BSI Committees

The following additions should be made to the list of IOA Members participating in Standards Committees relating to Acoustics, published in Acoustics Bulletin in January 1983.

BSI Committee designation	Title	Name	Representing
BDB/51	Sound insulation	R H Clough	Con Soc
EEL/24	Electroacoustics	M E Delany	IOP/NPL
EEL/24/2	Measuring devices	M E Delany	NPL
EPC/1/1	Loudness and hearing thresholds	M S Shipton	NPL
EPC/1/6	Building acoustics	R H Clough	Con Soc
EPC/1/11	Acoustic testing of hearing protectors	M S Shipton	NPL
GEL/1/24	Acoustics and electroacoustics terminology	I R Summers	Univ of Exeter
PSM 25	Hearing protectors	M S Shipton	NPL



ACOUSTICS 84

1984 Spring Conference at the University College of Swansea, 10th to 12th April 1984

Technical Sessions will be held on: Building Acoustics, Musical Acoustics, Transportation Noise, Spectral Analysis and Speech Processing, Opto Acoustics, Biological Acoustics. A Poster Session will be organised on demand.

An **International Conference on Condition Monitoring** will be held at the same time. **Secretary of Organising Committee:**

Mr M A Jones
Department of Mechanical Engineering
University College of Swansea
SA2 8PP
Tel: 0792 205678

Exhibition

A joint exhibition will be held by the two conferences.

Chairman of Acoustics 84 Organising Committee

Professor B L Clarkson, FIOA
The Principal
University College of Swansea
Singleton Park
SWANSEA SA2 8PP
Tel: 0792 205678

SESSION ORGANISERS

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Opto Acoustics, Biological Acoustics

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Noise Emission from Industrial Fans

Industrial Noise Group Meeting

The Group held a highly successful meeting on *Noise emission from industrial fans* on 20 October at ICI, Welwyn Garden City. This was the first technical meeting organised by the newly constituted ING Committee and was well attended by 45 delegates, an indication that there is considerable interest in Industrial Noise within the Institute, despite the fact that this was the first ING Meeting for over 2½ years. A full programme of 'themed' one day seminars is being planned for subsequent years, with the emphasis on practical problems and problem solving.

The meeting opened with a lucid, yet non-mathematical, description of the various mechanisms of fan noise generation presented by Mr Norman Bolton of the National Engineering Laboratories, East Kilbride. This included interesting experimental data on the magnitudes of 'rotor/stator' type interaction tonal noise for different 'rotor'—'stator' spacings, and an analysis of how pulsations in the airflow caused by the action of the rotor could generate varying levels of broad-band noise due to non-uniformities in the pulse amplitudes and periodicity. Later discussions centred around the measurement and control of airflow turbulence, and the rather 'grey' area of establishing the fan impedance.

Ian Sharland talked on conventional (absorptive) silencing in air movement systems and a little on control of noise at source, particularly the elimination of poor airflows. He described the principal parameters governing the attenuation from absorptive silencers and stressed the importance of their correct positioning within the duct. One unconventional splitter silencer design was intended to improve low frequency performance, but with no additional pressure drop. Questions to the speaker included the role of pod silencers and the change in absorption properties of materials when wrapped in impervious membranes.

The ISVR trio of Tony Herbert, Steph Merry and Stuart Clegg presented the third talk, on laminar flow fans. This was introduced by Tony with considerable, although sometimes wayward, aerodynamic panache! The theory of laminar flow fans, describing

how the majority of the flow is through the boundary layer region, was briefly reviewed. It was emphasised that these fans do not obey the conventional fan laws of aerodynamic performance scaling and this was borne out by the results of model tests. A mathematical model for predicting the head/flow characteristics showed reasonably good correlation with the model results, particularly over the range of rotational speed and disc spacing of most interest. The fans were shown to be exceptionally quiet and to generate substantial

'pressure head', although necessarily they operate at low airflows. Nevertheless when compared to centrifugal fans of approximately the same duty they are in the region of at least 10 dB(A) quieter. The morning finished with Tony Herbert demonstrating a number of these model fans, including the first production model, and pointing out that one of his main difficulties in the past had been acquiring a drive motor which did not emit more noise than the fan!

Andrew Corkill of ICI Acoustics compared the capital and operating (electricity) costs of fitting splitter assemblies to fans. Reviewing the full range of fans from 2 m³/s to 250 m³/s capacity, he

IOA Diploma Examination 1983

Congratulations to the following candidates who have qualified for the award of the IOA Diploma in Acoustics and Noise Control.

North East Surrey College of Technology

T A Bradshaw	A E Eperson	S Roberts
C C Buxton	J E T Griffiths	G Salmon
W Campbell	D Haines	R D Saunders
K J Chamberlain	B G Hatton	P H A Smith
A C Conrad	G C Martin	J Staunton
Mrs A Eastbury	B Page	N C Tappin
S Ellis	N Purchase	

Liverpool Polytechnic

Y A M Balilah	C O Jones	M E Round
Miss E Flint	H C Jones	I P Smith
D R Hall	D Maynard	M J Taylor
P A James	Miss C A McGregor	

Newcastle Polytechnic

S Arnott	Mrs A K Hesselberth	H J E Robinson
M P Bowery	J Lawton	M Squirrel
S G Brown	P A MacLeod	J L Tweddle
J Davison	F R Miles	S Unwin
M D Dixon	G L Newcombe	J D Wildsmith

Cornwall Technical College

S P Dart	L Griffiths	R A Westlake
P G George	C D Harland	L C Willis
R G H Greenaway	H Morgan	

Leeds Polytechnic

Mrs J E Gingell	W P Lambert	N J Powell
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Bristol Polytechnic

M N W Austin	A M Higgins	R I Rogers
D B Dobbs	C S Johnson	M S Siblock
M Doran	S C Mountfield	A C Tanner
J A Gillard		

showed that in all cases the total cost over a 10-year period (assuming 24-hour operation) was less with good, aerodynamically designed silencers than with the rather rudimentary designs commonly used. This was despite the initial capital cost often being many times higher. The biggest savings were on the lower acoustic duty silencers commonly used on small industrial fans. The key design features of high performance splitter silencers were described.

The final talk, on active noise reduction, was given by Westwood Hong of Environmental Planning and Design Limited, who began by giving a brief historical review of the Active Noise systems that have been used, together with their limitations. He pointed out

that Active Noise control systems were ideal for many ducted fan applications since a large proportion of the noise was often in the low frequency part of the spectrum. Here, where plane waves are present, absorptive silencers are relatively ineffective, yet it is in the attenuation of plane waves that Active Systems are most efficient. His system had been used in ducts with airflow velocities up to 6 m/s with little reduction in cancellation performance. The talk was followed by a demonstration, unfortunately using a loudspeaker and not a fan as the noise source, but amply serving the purpose of showing what low frequency noise reduction could be achieved. □

Andrew Corkill

Institute of Acoustics Diploma 1983

The number of individual examination candidates was 204, from 12 Colleges, whilst the number of entrants from the Colleges ranged from 8 to 33. Over 500 module entries were received as follows, although the actual numbers sat were reduced through absences.

General Module	158
Law and Administration	124
Transportation Noise	45
Architectural Acoustics	81
Noise Control Engineering	83
Vibration Control	13

The number of failures and Merit awards was:

Failures Merits

General Module	24	20
Law and Administration	16	2
Transportation Noise	1	1
Architectural Acoustics	4	16
Noise Control Engineering	21	7
Vibration Control	3	1

Diplomas awarded in 1983 were as follows:

North-East Surrey College of Technology	20
Liverpool Polytechnic	11
Newcastle Polytechnic	15
Cornwall Technical College	8
Leeds Polytechnic	3
Bristol Polytechnic	10
Tottenham College of Technology	13
Derby Lonsdale College	6
Colchester Institute	10
Herriot-Watt University	5
North Staffordshire Polytechnic	5
Lanchester Polytechnic	4
Ulster Polytechnic	10

The total of 120 successful Diploma candidates in 1983 is a creditable number reflecting the hard work of candidates and Colleges. A further 12 candidates were successful in their written examinations but cannot be awarded Diplomas until their projects are completed. Candidates who failed one or more module papers (44 candidates) have 19 projects outstanding and it is expected that many of these candidates will complete the Diploma next year. □

Tottenham Technical College

P A Christopher	L D Hall	G W Jones
K R Fowler	A V Hawes	P D Jones
P Fox	J Howarth	C P Leftwich
J H Fricker	T E Johnson	J P Robinson
Mrs S M Green		

Derby Lonsdale College of Higher Education

C Daines	R Limb	A P Russell
Ms G M Holmes	G A Renton	Miss J H Urmson

Colchester Institute of Higher Education

M P Alston	G A Hearn	P Mason
D E Barke	Miss V A Hill	Miss S M Room
J A Cole	P Hunnaball	H F Ward
K Dakin		

Heriot-Watt University

H Behnam	D Carins	H A S Rahi
R P M Bonnington	C M Frier	

North Staffordshire Polytechnic

A J Bennett	P J Lycett	C G Ward
D J Lowe	J E Swistek	

Lanchester (Coventry) Polytechnic

N I Haverson	R Norton	I C Ward
M D Ironside		

Ulster Polytechnic

D L Bell	I J Gregg	J Slane
W J Briggs	J O Hetherington	R J Smyth
D Cuning	P J Mawdsley	D G Yarr
W A Francey		

The following candidates are to be congratulated on obtaining passes in additional Specialist Modules.

B G R Coley	P R Morgan	N C Rotheroe
A E Eperson	D R Morris	T G Talbot
J H Fricker	B G Olding	P J Turner
G P Goodwin	D R Poole	D C Walton
L K Head	J Reeve	C G Ward
G A Hearn	P Robinson	R G Whitehead
T E Johnson		

Material for the April issue of **Acoustics Bulletin** should reach Mrs F A Hill at 25 Elm Drive, St Albans, Herts AL4 0EJ, no later than Thursday 23 February.

Practical Uses of Active Noise and Vibration Control

THIS EXHIBITION AND SEMINAR at Sudbury House on 2nd November 1983, organised by the Power Industries Division of the Institution of Mechanical Engineers and co-sponsored by the Institute of Acoustics, was arguably the most successful one-day meeting on noise and vibration control for many years. Some two hundred delegates attended the event and witnessed the considerable achievements of British Technology in the development and practical use of active noise and vibration control systems.

THE OPENING SESSION was chaired by Mr B M Huggett of the British Gas Production and Supply Division. Mr Huggett outlined the programme for the day and reminded delegates that the main objective was to enhance communication between engineering end users and groups developing active control systems, so that new markets would be established and the areas requiring further development would be identified.

Main Papers

The first paper was presented by Dr H G Leventhall, Head of Acoustics at Atkins Research and Development and Visiting Senior Research Fellow at Chelsea College, University of London. Dr Leventhall gave a brief historical review and explained the principles of operation of active noise control. He illustrated the operation of active attenuators by referring to simple in-duct systems and, in order to answer the question 'Where does the energy go?', he identified three basic modes of action of active sources.

1. A reflector; in which a simple monopole acts as an impedance change, redistributing energy rather than providing much absorption.
2. Monopole to dipole conversion; in which if the noise source and the active source are sufficiently localised the components act as source and sink, thus limiting energy propagation.
3. An absorber; in which the sound field gives up energy in driving the (unidirectional) active source.

Dr M A Swinbanks, in his paper entitled *The active control of noise and vibration and its application in industry*, suggested that certain forms of 'active' control were already long established in Marine engineering and other large-scale industrial applications. He gave two separate examples from the 19th century in which vibrations from a reciprocating motor and in the

other case twin steam turbines were synchronised to suppress hull vibration. Dr Swinbanks pointed out that the synchronous cancellation of Yarrow's reciprocating masses, driven by crankshafts or cams, had a direct counterpart in Professor G B B Chaplin's synchronised method of vibration cancellation published in 1976. The important difference is that the electronic linkage gives flexibility to the modern technique. Further comparisons were drawn between the well-known dynamic absorber and modern asynchronous devices in which the electromagnetic drive is actuated by a processed feedback signal. Electronically controlled devices are simpler to adjust than their mechanical counterparts, but the range of application of the technique is currently limited by inadequate hydraulic or electromagnetic cancelling transducers.

Dr Swinbanks drew attention to the essential similarity of cancelling repetitive impulses and cancelling a series of simple pure tones. He went on to say that the problem of random or broad band noise suppression was not generally considered practical 10 years ago, however the prototype active silencer added to the gas turbine exhaust at the British Gas Compressor Station near Cambridge has now shown that suppression of broad band low frequency noise is possible on large-scale industrial plant. The time when active silencing is able to cope with higher frequencies should not be too far away. For gas turbine applications it will then be possible to reduce the length of the passive silencer and make significant fuel savings from lower pressure losses.

Finally, as a future application, Dr Swinbanks suggested that low frequency noise from combustion processes could be actively attenuated by controlling the fuel/air supply or by using secondary downstream burners to smooth out unsteady expansion processes.

The Exhibition

The main session of the day was a comprehensive exhibition of active noise and vibration cancellation systems which have been developed in the UK. The exhibition hall had been carefully arranged to allow the large number of delegates to view the exhibits and be served lunch during the same session.

Starting from the end next to the bar, the first display showed the adaptive system for noise cancellation developed by Dr Lietch and Mr Yang at Heriot-Watt University. The theoretical studies carried out by these co-workers were reported at Edinburgh in Internoise '83 and they are now moving towards practical applications.

The adjacent poster display by Cullum Detuners showed a comparison between passive and active remedial treatment of gas turbine exhaust noise. The predicted performance of Cullum's current standard exhaust silencer design combined with the active silencing system developed by Topexpress Ltd was also shown. Unfortunately the absence of cost information precluded any meaningful assessment of the practical value of these silencing systems.



Maria Heckl from Cambridge University explains her demonstration to Bert Penny of Pilkingtons

The next exhibit was Maria Heckl's work on active control of heat driven oscillations. Miss Heckl, of Cambridge University, demonstrated her technique on laboratory scale with a bunsen burner firing into an open ended tube containing a gauze mesh to stabilise the flame. A microphone at the top of the tube (corresponding to the flue stack exit) sends a signal, via the controller, to



Dr Madahar makes adjustments to the Topexpress transfer — adaptive multipoint vibration controller

a loudspeaker near the base of the tube (the combustion chamber) so that the input impedance is changed. In the demonstration, the simple closed feedback loop phase shifted the fundamental mode to give 45 dB attenuation at the original peak frequency.

Topexpress Ltd displayed two working active control systems: one for noise and one for vibration. Dr B K Madahar explained the operation of their transfer-adaptive active mounting, demonstrating the isolating capabilities of the system under minicomputer control. The demonstration used a four-point mounted small electronic motor but Dr Madahar saw the main applications of the system as being on marine diesels and large rotating plant. In the Topexpress system the transfer function between the vibrating source and the inertial mounts is initially computed after feeding pseudo white noise to the system. Thereafter the controller adapts by computing changes to the transfer function. For wide-scale practical application the software for this system would need to be implemented on a microprocessor. Dr Madahar hopes that this will be done within 6 months for fixed speed applications and within a few years for variable speeds.

Dr G White showed delegates a small-scale rig which Topexpress had built to demonstrate the implementation of active control of broad band noise in a duct. With a sampling rate of 6.4 kHz and a digital filter with 256 coefficients the single 4-inch cancelling loudspeaker was able to produce approximately 20 dB attenuation in the range 250 - 1500 Hz at the measuring point a few inches from the duct outlet.

A delegation from the Wolfson Unit (for the Electronic Cancellation of Noise and Vibration) of Essex University demonstrated their techniques for the suppression of repetitive noise and vibration. The Essex group listed immediate applications of their selective cancellation system as:-

- Engine noise up to 3000 hp or more
- Variable speed engines
- Compressor noise
- Military and commercial vehicle cabs
- Ships' accommodation
- Engine room noise
- Smaller loudspeaker enclosures
- Cordless selective ear defenders

The 'Free-Fall' active mount, also developed by the group, is highly compliant to repetitive vibrations but 'rigid' to motional or torque forces. Practical applications of the mount include engine vibration, cancellation of rotor-induced helicopter vibration, 'rigid' engine mounting and the reduction of engine and propeller-induced vibration in ships.

The Essex display comprised a working model of their 'free-fall' mount, a video showing how their trial and error algorithm adapts to repetitive sounds to generate the cancelling waveform, a stroboscopic demonstration of dipole cancellation using weatherproof high power ported loudspeakers and finally a walk-in booth for their selective ear defenders. These electronic open-backed ear muffs were demonstrated with a 100 Hz tone at 120 dB SPL and gave about 50 dB attenuation. The

current design is useful up to about 700 Hz for either repetitive noise or simply related tones. Applications may be in tractors and other mobile plant. Dr J Scott said that air-sea rescue operations exemplified the usefulness of the system in eliminating repetitive helicopter noise while allowing through warning shouts. Another possible application was for personnel operating rock drills. Essex also offer a 'random' system based on a self-adaptive control system driving a monopole cancelling source. This technique was not displayed at the exhibition but a number of commercial applications in ventilation systems were claimed.

Mr W Hong of Moniton Technic Ltd and Dr P F Chatterton of Environmental Planning & Design Ltd demonstrated a combined active/passive in-duct attenuator. The active part of the system is the tight-coupled monopole, a simple and low cost form of active attenuation developed and tested at Chelsea College under Dr Leventhall's supervision. Moniton Technic are in the process of constructing a plant room and office in Basingstoke incorporating the combined active/passive silencer in the air handling system. Dr Chatterton also anticipated a number of retrofit projects for the suppression of low frequency noise from HVAC systems.

A poster display of industrial applications for active attenuation was given by Dr Swinbanks' firm MAS Research Ltd. A model of the original in-duct active attenuation system was also exhibited.



Ian Brown tries out the Essex Selective Ear Defenders

Plessey Marine displayed the results achieved by their adaptive multivariable active noise control system. Dr A White explained that their research effort was at present very limited but significant reductions in the noise transmitted to the water through the hulls of submarines or ships could be anticipated. The Plessey system has similarities to the four-point vibration isolation techniques used by Topexpress, but in essence is more like the Essex system in that no prior knowledge of the control system transfer function is required but the adaptive controller recalculates from scratch. Initial results show reduction in fundamental noise levels by 10-30 dB at hydrophones in various locations around a test rig. Dr White points out that for submarine applications even a reduction of 6 dB in low frequency noise would allow a vessel to be undetected and hear over twice the range.

A poster display of practical applications of the Essex system to a turbocharged 17-litre 8-cylinder direct injection truck diesel engine and the exhaust of a similar 14-litre, 6-cylinder engine was presented by Dr M Croker of Ricardo Consulting Engineers plc. Dr Croker concluded that the active system gave a useful amount of attenuation but the algorithms in current use were not able to follow rapid changes of speed or load. He was also sceptical about the long-term use of current electromechanical acoustic transducers.

ISVR occupied the remaining exhibition space with their displays of the uses of active attenuation in Voice Communication Technology, Power Plant Noise Suppression, Multidimensional Noise Cancellation and Mechanical Impacts in Machinery. The Active Ear Defender for aircrew helmets, developed for the Royal Air Force, has been well publicised and delegates were shown the 'Tomorrow's World' video on the device. Mr P Wheeler suggested that the only snag holding up the widespread use of active ear defenders in strike aircraft is changing the number of connection sockets on standard ejector seats.

In the field of plant noise suppression ISVR have developed a Fast Transient Noise Cancellation algorithm designed for Generator Set start-up. Results were shown in which noise levels in the range 50 — 150 Hz from a Newton-Derby 16/24 kVA generator set were attenuated by about 10 dB throughout run-up. Work for this type of application is now concentrating on the reliability and durability of the transducers. Another project in progress is for cancelling discrete frequen-

cies in enclosed spaces. This type of multimodal cancellation in three dimensions has direct application to reducing cabin noise in propeller driven aircraft. Unfortunately the sponsors of this project refused permission for a working display to be included in the exhibition.

The suppression of the effects of mechanical impacts in machinery by cancellation of transients with a simulated reaction force is a recent development at ISVR and was later discussed by Professor E J Richards in a short paper. Gordon Stimpson demonstrated the technique with a laboratory-scale working model which produced up to 14 dB attenuation of the impulse noise.

Short Papers

The afternoon session was chaired by Dr C D Lyle, the technical adviser to the meeting organisers. Four forward-looking talks presented the viewpoints of an acoustic hardware supplier, a University Research Professor, a sponsor of active attenuation research and patent holder and, finally, a potential engineering end user.

The Technical Director of Sound Attenuators Ltd, Mr A T Fry, outlined the view of a hardware supplier. His firm, in collaboration with the Wolfson Unit at Essex University, have chosen six main areas where they intend to concentrate their efforts for commercial growth:

In-duct random noise for fan control
Out of duct to exterior for gas turbine noise control

Diesel engine exhaust noise control
Compressor inlet noise control
Repetitive noise control with headphones

The repetitive noise control electronics themselves

Mr Fry pointed out that active and passive systems naturally complement each other and gave an example of an integrated design of diesel exhaust silencer which is currently being marketed. The combined in-duct active/passive silencer was not so easy to implement from a commercial viewpoint, because reducing splitter size has only minor advantages since facing and handling are the most significant costs.

Professor E J Richards, Research Professor at ISVR followed with his paper *Problems of active cancellation of vibration*. He suggested that some 90% of noise arises from vibrating structures excited by impulsive or rapidly fluctuating sources. The impact may be metal on metal, fluid on metal or even fluid on fluid. The peak noise level is determined by the rate of change of

force so active control must concentrate on the quick drop in 'pulse level' immediately after impact. Professor Richards pointed out that if the cancelling force is not applied at the correct point then impact noise could be increased rather than reduced. On a laboratory scale the technique was very successful. Experiments with a ball hitting a plate showed that actively attenuated surface acceleration reduced the SPL at 1 metre from 79 to 65 dB. The peak frequency in this test occurred at 1600 Hz. Professor Richards considered the technique feasible for large machines and identified the difficulty of putting the cancellation force at the required point and the current limitations of hydraulic rams or other forcing mechanism as areas for further development.

Mr D R Easson from the British Technology Group of the National Development Corporation gave a short talk on *Consolidation of achievements to date*. He summarised NRDC's involvement in the prototype active silencer at Cambridge Compressor Station and pointed out that although the system had not been designed for longevity it remained fully operational after over 18 months. He suggested that active attenuation systems were inherently more reliable than, say, PA systems because precise control of the feedback path was essential. Later in the day the NRDC were praised for their funding of active attenuation research. Current interest in active attenuation, as exemplified by the success of the exhibition and seminar, was seen as a full vindication of NRDC's support.

The engineer's practical uses for active noise control were considered by Mr R A T Iredale of the CEBG. If saving space improved reliability, or lower cost could be demonstrated, then these were potential reasons for using active techniques. Items of CEBG plant where active attenuation might possibly be usefully applied were listed as:

Transformers; elimination or reduction of enclosures

Gas turbine exhausts; this is a challenging problem for oil-burning machines because the stack needs to be 70 metres high

Large diameter fans; employees can experience nausea from low frequency duct-radiated noise

Diesel engines; particularly saving space on mobile plant

Wind turbines; in which low frequency noise is not yet fully understood

Rotating plant; the possibility of active bearings

Mr Iredale concluded that reduction in noise at source is most important and, for rotating plant, active control of component alignment would have the additional benefit of reducing stress levels in machinery.

Panel of Experts

Mr C C J French, Vice-Chairman of Ricardo Consulting Engineers plc, chaired a panel of experts comprising Professor G B B Chaplin, Dr H G Leventhall, Dr C F Ross and Mr P D Wheeler. After a brief presentation on

Dr Swinbanks clarified certain points arising from his paper. He pointed out that the 'active' mounts which he had described had now been in service for 15 years and were fully accepted by the marine industry. He predicted that the Essex work on active vibration isolation will be put into large-scale marine applications within the next 5 years.

After a brief digression on reactive silencers the experts agreed that control is generally optimised by using combined active and passive systems. A

there are space or pressure drop constraints.

Dr Mugridge questioned whether active noise control could cope with turbulence. Dr Ross replied that a noise cone or multi-sensor systems could be used to discriminate against turbulence. He agreed that if coherence between the sensing microphone and the position at which suppression is required is not high then worthwhile attenuation is not possible. Professor Chaplin said that the Essex adaptive system would in any case find the best way to produce minimum noise levels. Dr Leitch pointed out that the Essex requirement for signal repetition was essentially the same as the coherence limitation which had been discussed.

Professor Grootenhuis of Imperial College asked for clarification on how the 'free-fall' Essex mount can produce a 'floating' engine which is at the same time a rigid structure. Professor Chaplin explained his experimental results but time did not permit further discussion of the practical implementation of the technique.

Conclusion

Delegates left the meeting after a very full and successful day's events in which groups developing active noise and vibration control systems met engineering end users. Not only was there a useful exchange of views and enhancement of communication within the active attenuation field, but also appetites were whetted for future events in which outstanding research and development effort comes to fruition in practical engineering applications. □

C D Lyle



Dr Walker from Leeds University illustrates his point to the Panel of Experts, chaired by Mr C C J French

active damping of structural vibration, given by Dr Walker of Leeds University, delegates' questions began in earnest.

Mr K Marsh of BP International suggested that a major future application will be on offshore platforms where space is at a premium. He asked whether more effort would be put into developing robust, 'boot-proof' transducers for practical applications. Professor Chaplin replied that research into actuator design was indeed required. He said that for vibration the transducers were the main factor limiting practical applications, but he considered that the Essex loudspeaker design had now proved itself entirely reliable. Dr Leventhall commented that the active system designer could use his ingenuity to locate loudspeakers away from the most hostile environments.

Mr Wheeler commented on the ridiculous current UK patent situation, illustrating his point by an example in which an 'inventor' had requested assistance for reducing aircraft noise around Heathrow. He required a large signal generator and a source of sound waves which would travel at twice the speed of sound. It is understood that this 'invention' has now been patented!

representative from Rolls Royce Industrial Marine said their dB(A) specifications were met by passive silencers and that they had no low frequency noise problems which could not be coped with by conventional means. He asked what use active attenuation was to him. Dr Ross replied that active control has advantages when

ISVR SHORT COURSES 1984

- 26—30 March Instrumentation and Measurement Techniques for Vibration Control
- 26—30 March Engine Noise and Vibration
- 2—6 April Clinical Audiology
- 2—6 April Environmental Health Officers' Course
- 9—13 April Second International Conference on Recent Advances in Structural Dynamics
- 5—7 June Vehicle Noise and Vibration Conference (to be held in London)
- 18-22 June Instrumentation and Measurement Techniques for Noise Control
- 2—5 July Applied Digital Signal Processing
- 10—14 September Industrial Audiology and Hearing Conservation
- 17—21 September Technical Audiology
- 17—21 September 13th Advanced Noise and Vibration Course

For further information please contact: Dr J G Walker, ISVR Short Course Organiser, or Mrs M Z Strickland, ISVR Conference Secretary, Institute of Sound and Vibration Research, The University, Southampton SO9 5NH. Tel: 0703 559122 exts 2310 and 532. □

Studio Design for Sound and Television

7 November 1983

Seven papers were presented at this Building Acoustics meeting at Birkbeck College.

In spite of improvements in the past decade in the characterisation of loudspeakers and listening rooms, recordings reproduced in different control rooms often sound noticeably very different. Equalisation is sometimes used as a remedy. In the first paper, Peter Mapp pointed out the deficiencies in current control room equalisation practice. He suggested that adaptive digital filtering would provide a far better solution to the problem of controlling listening conditions.

Bill Taylor described the acoustic design of outside broadcast vehicles with particular reference to the BBC's 'Digital Control Vehicle'. This incorporates hydraulically expanding sides to the control room and specially designed loudspeakers to provide improved listening conditions.

Chris Daubney described the IBA's Code of Practice and the philosophy underlying the rules which an indepen-

dent local radio station must follow. He also outlined new revisions to the code affecting the requirements for reverberation time and noise level.

David Lamberty introduced his paper on independent local radio design (co-author, Richard Galbraith) by complaining (perhaps with tongue in cheek) that, after spending many years learning how to satisfy the IBA Code, he was presented at the meeting with the change in the rules. He went on to describe Sandy Brown Associates' approach to independent local radio design and two recent case studies, Red Rose Radio (Preston) and County Sound (Guildford).

At very short notice, Roy Lawrence filled in a vacant slot by describing anomalous absorption associated with a particular carpet installed in a radio studio he had designed. The phenomenon remains puzzling as no-one in the audience appears either to have observed the anomaly or to be able to explain it.

Laurence Haslam and Richard Bussell described the acoustic design of four

recent television studio complexes, TVS (Maidstone), TSW (Plymouth), TV-am (Camden Town) and Limehouse (Docklands, London). Although each complex had a unique combination of acoustic problems and constraints, the trend has been towards the use of preformed, comparatively lightweight materials having a useful combination of acoustical properties and short assembly time. Studio 1 at Limehouse is unique in its possession of a Franssen-type artificial reverberation system.

Peter Dix presented an interesting account of the changes to the acoustics of EMI's Abbey Road studios and control rooms over the last fifty years. Nearly all the studios and control rooms have undergone several transformations, with the notable exception of Studio 2. This remains virtually unchanged since the Beatles first recorded there twenty years ago. Control room acoustics receive close attention. Experiments with a control room ceiling capable of being tilted at various angles suggest that listeners prefer it to be horizontal. One-third octave equalisation of control rooms has been abandoned.

Useful discussions followed the individual papers and, less formally, at the refreshment periods. □

N F Spring

BRANCH AND GROUP NEWS

Branch Development in Scotland

Following an encouraging response to a postal survey of Institute Members in Scotland, a meeting was held at Heriot-Watt University, Edinburgh on 26 October 1983 to discuss the formation of a Scottish Branch of the Institute.

About 30 Members attended the meeting which opened with a short introduction on Branches by Trevor Smith, Vice-President for Branches and Groups; this was followed by an intense general discussion on the proposed development.

By the end of the afternoon the meeting had agreed to development going ahead and had elected a Steering Committee with Howard Latham (YARD Ltd) as chairman to direct the development. The composition of the Steering Committee is representative of the local membership, both in geographical distribution and in subject interests.

The Steering Committee now has the task of organising local activities on a limited scale to show whether or not a Branch of the Institute is viable in their Region: first activities of the embryo

Scottish Branch can be expected in Spring 1984.

Offers of assistance or ideas on programme content, venues etc should be directed to the Secretary to the Steering Committee, Bill McTaggart, at 7 Riverside Road, Waterfoot by Eaglesham, Renfrewshire. Tel: 041-644 3442.

Trevor Smith

North West Branch

The Branch Committee has been giving a lot of thought recently as to how to make the Branch even more successful in the future and how to attract more Members and guests to attend visits and meetings arranged.

Most of us are well aware of the conflicting loyalties to family and professional life and somehow achieve some form of acceptable compromise which allows attendance at several if not many professional functions arranged. Distance separates many Members, causing added complications, but the Committee has also realised that for those

Members working alone in 'acoustically isolated places' or working among colleagues from totally different disciplines, this is not an insurmountable problem. It is often the chance of resolving 'that little problem' that bedevils many of us in practical situations, by talking to colleagues at a meeting, which will stimulate us to make the effort to attend.

As a direct result of all these thoughts an appeal for meeting ideas was placed on the autumn meeting notice circulated to all Members in the North West and similar verbal appeals have been made by Chairman Mike Ankers at the meetings.

In addition, the forthcoming December social meeting to be held at the Lord Daresbury Hotel in Warrington on December 7th is to be addressed by Ralph Harrison FIOA who will very professionally but tenuously link his chosen subject concerning transport to acoustics and vibration, so as not to frighten off Members' wives or husbands who will be present or those persons attending who might well become more regularly attending Members in the future.

Possible subjects for meetings to be held in 1984 and 1985 include at present: Musical Acoustics, Microprocessors in Acoustics (with an opportunity to see them assembled in equipment made by a large British manufacturer), Something New from a certain 'Danish Equipment Manufacturer', Active Noise, Hearing Defenders, Speech Recognition and Synthesis, an Aircraft Noise Monitoring System at a well-known International Airport and experience of Acoustics and Vibration by at least one of four large national concerns contacted about this particular subject.

However, for all those North West Members reading this report, who have not been able to attend recently, remember that it is your Branch and the Committee will arrange the type of meeting required if even more of you will attend and volunteer your ideas. We are successful and viable at present but there is no reason why the Branch should not flourish even more in the future.

On September 15th in the Bridge Room at Salford University the North West Branch were addressed by Robin Monk of Acoustic and Vibration Technology of Bramhall, Cheshire on his acoustical experiences and measurement techniques. The title of his presentation was loosely worded *The Role of the Acoustic Consultant*. It was also a light-hearted but professional opportunity to observe oscilloscopes and vibration monitoring equipment behaving and misbehaving where a rotating shaft was the centre of vibrational interest for the evening.

This kind of meeting may sound elementary to some readers but those of us involved in meeting organisation often take for granted many techniques learned years ago and may occasionally need reminding of the details of the mathematical principles concerned. In addition, we are grateful to Robin not only for his contribution but also for the educational opportunity which the presentation provided for new Members, or those of us not very often involved in his chosen sphere of Acoustics and Vibration Measurement, to learn something new.

On Thursday 17th November in the Bridge Room at Salford University Mike Russell of Lucas Industries Noise Centre addressed the North West Branch on *Noise and vibration control in Industry*.

Mike's initial point concerned the need to penetrate the psychological lack of awareness among managers and foremen of the hazards of excessive ex-

posure to noise and vibration and the method used by him was impressively demonstrated with the use of pre-recorded reel tape and a sophisticated amplification system provided by Geoff Kerry of Salford University, illustrating the effects of deafness utilising attenuating filters at 1, 2 and 3 kHz. The basic message of the effect of occupational deafness creating social isolation was the Company's first stage in effecting comprehensive and active noise and vibration control.

Other points covered in the address were ISO, BS and TC Standards, re-equipping of many factories in the Lucas Group in the 1970s, company noise standards for new equipment and the environment they are placed in, EEC proposals for noise regulations and practical methods of attenuating existing designs of manufacturing equipment. The Branch does not often have the opportunity of hearing such an experienced and humorous speaker and individuals who attended now know much more of the manufacture of the electrical components which are essential for the completion of most British manufactured vehicles, which they may already be driving daily whilst earning their living as acousticians.

John Dinsdale

Musical Acoustics Group Visit to Acoustical Manufacturing Co., Huntingdon

The Acoustical Manufacturing Co, makers of the world-famous QUAD range of amplifiers, tuners and loudspeakers were host to a small (unfortunately!) number of Group members for this most interesting and informative visit on 9 November 1983. Mr Peter Walker, founder and managing director of the firm, arranged a tour of the factory as well as several impressive demonstrations, not to mention an excellent free lunch!

The factory tour showed all aspects of the design and manufacture of the product range. A feeling of 'Good British Engineering', both acoustical and electrical, was apparent throughout. Mr Walker and his staff never tired of answering our questions, and were anxious for us to see everything that they did.

The working practices of this family firm encompassed a combination of sophisticated automation and craftsmanship. A computerised test station

was shown which is capable of testing and fault-finding a circuit board containing over 300 components in a few seconds, which reduces drudgery and much wasted time. Individual workers are entrusted with final assembly and quality control of a complete unit. The personal touch is conducive to a sense of 'job well done', individual job satisfaction, and surely contributes to the performance of these products. In particular, the skill exhibited by the women assembling the drive units of the ELS63 electrostatic loudspeaker was a pleasure to watch as they carefully manipulated films of diaphanous plastic only 3 microns thick.

This loudspeaker is remarkable in that it simulates a point source some 30 cm behind the plane of the diaphragm. This is achieved by means of a series of concentric annular electrodes fed by signals derived from a tapped delay line, each element 25 microseconds later than its inner neighbour.

This results in a source which practically as well as theoretically approaches a true doublet. A most impressive test of this was shown which is used routinely for checking production consistency. First of all, a measuring microphone showed that an electrical square wave was reproduced acoustically with little distortion of waveshape, no mean feat! When a second loudspeaker was driven in antiphase and the microphone was placed exactly equidistant from both diaphragms, near-perfect cancellation was achieved. Extremely good matching over the whole frequency range is required for this to occur and differences of less than 0.2 dB are commonly found on production models.

Mr Walker also showed the new compact disc player in conjunction with these loudspeakers, and gave a remarkable demonstration of the subjective effects of added reverberation on different programme material, one an orchestra recorded in a concert hall and the other a close-miked studio recording. The upshot of this was that a little extra reverberation is not apparent if the source material is recorded in a reverberant environment, but the same process applied to studio recordings reduces the quality to something Edison might well have rejected!

There is unfortunately not enough space to give more detail, but I would urge anyone with the opportunity to visit QUAD to see and hear the remarkable achievements of this innovative firm for themselves. □

John Goodwin

Standards Notes

Memorandum of Understanding

We have been asked by some of our readers to explain the new relationship which they have heard exists between the Government and the British Standards Institution. This, in fact, refers to the *Memorandum of Understanding* which was signed in November 1982 by the Secretary of State for Trade and the President of BSI.

The Memorandum records the joint commitment of Government and BSI to strengthen the voluntary national standards system in the UK in order to increase the efficiency and international competitiveness of British Industry. The Government is pledged, through the Memorandum, to lead by example in purchasing to standards whenever possible, and in recognising appropriate standards as a means of compliance with legislation, rather than detailing technical requirements in the law itself.

In an address to chairmen of Standards and Technical Committees the Presi-

dent noted, among others, some particular commitments on BSI, which were to:

- (1) take fully into account the public interest in standards by making available as required British Standards which are unambiguous statements of technical requirements, suitable for reference in Government regulations and/or in public purchasing contracts and for certification and quality assurance procedures;
- (2) amend, withdraw or withhold from publication any British Standard in conflict with technical regulations;
- (3) give priority to Government requests for standards work which Government considers to be in the national interest, agreed in consultation with the Standards Committee structure and in accordance with a mutually agreed timetable;
- (4) seek a fair and acceptable balance of all relevant interests in standards

work and encourage full participation in producing British Standards which reflect sound and modern technical practice and the commercial needs of both manufacturers and users;

(5) maintain efforts to achieve international harmonization of standards through international and European standards organizations in the interests of British industry and trade;

(6) promote the development of European Standards based as far as possible on wider international agreements in a form suitable for reference in Article 100 Directives; and, where these affect existing or proposed UK or EEC legislation, to ensure that the views presented by UK delegations in European standards committees are consistent with those of Government;

(7) with Government, encourage fuller participation by all interests, especially public purchasing authorities, in the preparation of British Standards and their use.'

Standards

Recent British Standards

BS 5108: 1983 Method for measurement of sound attenuation of hearing protectors (=ISO 4869). Determination of binaural free field threshold of hearing of subjects with and without hearing protectors. Requirements for test environment and sounds, selection of subjects, procedure for fitting protectors and presentation of results. Supersedes BS 5108: 1974.

BS 5942: High fidelity audio equipment and systems, minimum performance requirements

BS 5942: Part 5: 1983 Specification for microphones (=IEC 5815). Specification and methods of measurement for microphones intended for high quality sound reproducing systems for use in the home.

BS 6402: 1983 Specification for personal sound exposure meters. Specifies a device, usually worn on the person, which integrates a function of A-weighted sound pressure over time to produce a result called sound exposure that can be used to assess the risk of hearing damage to persons when in noisy environments.

BS Drafts for Comment

83/26236 DC BS 5942 High fidelity

audio equipment and systems: Minimum performance requirements. Part 8. Specification for combination equipment. (IEC 29B (Central Office) 114)

83/26271 DC Additions to BS 5428 Methods of specifying and measuring the characteristics of sound system equipment. Part 2: 1979 Amplifiers. Part 10: 1979 Preferred matching values for the interconnection of sound systems components. Part 11: 1979 Loudspeakers. Voltage and power rating of amplifiers with loudspeakers. (IEC 29B (Secretariat) 209)

83/26290 DC Supplement to BS 5428 Methods for specifying and measuring the characteristics of sound system equipment. Section 5.3: 1981 Circular connectors for broadcast and similar use (IEC 29B (Secretariat) 211)

83/54045 DC BS 4196: Part 7 Acoustics — Determination of sound power levels of noise sources — Survey method using a reference sound source (ISO/DIS 3747)

83/54046 DC BS 4196: Part 8 Acoustics — Determination of sound power levels of noise sources — Engineering method for small, nearly omnidirectional sources under free-field conditions over a reflecting plane (ISO/DIS 3748)

83/54417 DC Acoustics — Description and measurement of environmental noise. Part 2. Acquisition of data pertinent to land use. (ISO/DIS 1996/2)

83/54418 DC Acoustics — Description and measurement of environmental noise. Part 3. Application to noise limits. (ISO/DIS 1996/3)

83/54419 DC Acoustics — Measurement of noise emitted by passenger cars under conditions representative of urban driving. (ISO/DIS 7188)

83/76793 DC Airborne noise emitted by machine tools. Part 3. Operating conditions for woodworking machines. (ISO/DIS 7960/3)

British Standards proposed for withdrawal

BS 3489: 1962 Sound level meters (industrial grade). Superseded by BS 5969: 1981.

BS 4197: 1967 A precision sound level meter. Superseded by BS 5969: 1981.

Recent International Standards

ISO 389: Acoustics — Standard reference zero for the calibration of pure-tone audiometers

ISO 389: Addendum 1: 1983 (To be implemented in revising BS 2497).

ISO 1683: 1983 Acoustics — Preferred reference quantities for acoustic levels (No equivalent BS).

International new work started

ISO/DP 5347/DAD 5 Calibration by using earth's gravity Will provide a method for calibrating vibration and shock transducers using the earth gravity method. ISO/TC 108/SC 3 through MEE/158

ISO/DP 5347/DAD 6 Low frequency absolute calibration Will provide a method for the primary calibration of vibration and shock transducers at low frequencies. ISO/TC 108/SC 3 through MEE/158

ISO/DP 5347/DAD 7 Centrifuge calibration Will provide a method of calibrating accelerometers using centrifuge calibration. ISO/TC 108/SC 3 through MEE/158

ISO/DP 5347/DAD 8 Dual centrifuge calibration Will provide a method of calibrating accelerometers using dual centrifuge calibration. ISO/TC 108/SC 3 through MEE/158

ISO/DP 5347/DAD 9 Comparison phase angle variation calibration Will provide a method of comparison phase angle calibration of vibration and shock transducers. ISO/TC 108/SC 3 through MEE/158

ISO/DP 5347/DAD 10 High impact shock absolute calibration Will provide a method for primary high impact shock calibration of accelerometers. ISO/TC 108/SC 3 through MEE/158

ISO/DP 5347/DAD 11 Transverse vibration dependency testing Will provide details of instrumentation and procedure for transverse vibration dependency testing of transducers. ISO/TC 108/SC 3 through MEE/158

ISO/DP 5347/DAD 12 Transverse shock dependency testing Will provide details of instrumentation and procedure for transverse shock dependency testing of transducers. ISO/TC 108/SC 3 through MEE/158

ISO/DP 5347/DAD 13 Base strain dependency testing Will provide details of instrumentation and the method to be used for base strain dependency testing of transducers. ISO/TC 108/SC 3 through MEE/158

ISO/DP 5347/DAD 14 Resonance frequency testing on steel block Will provide details of instrumentation and the method to be used for resonance frequency testing of vibration and shock transducers. ISO/TC 108/SC 3 through MEE/158

ISO/DP 5347/DAD 15 Acoustic sensitivity testing Will provide details of in-

strumentation and a method to be used for acoustic sensitivity testing of vibration and shock transducers. ISO/TC 108/SC 3 through MEE/158

ISO/DP 5347/DAD 16 Mounting torque dependency testing Will provide details of instrumentation and a method to be used for mounting torque dependency testing of vibration and shock transducers. ISO/TC 108/SC 3 through MEE/158

ISO/DP 5347/DAD 17 Temperature dependency Will provide details of instrumentation and the method to be used for measuring temperature dependency of vibration and shock transducers. ISO/TC 108/SC 3 through MEE/158

ISO/DP 5347/DAD 18 Transient temperature dependency testing Will provide details of instrumentation and the method to be used for transient temperature dependency testing of vibration and shock transducers. ISO/TC 108/SC 3 through MEE/158

ISO/DP 5347/DAD 19 Magnetic field dependency testing Will provide details of instrumentation and the method to be used for magnetic field dependency testing of vibration and shock transducers. ISO/TC 108/SC 3 through MEE/158

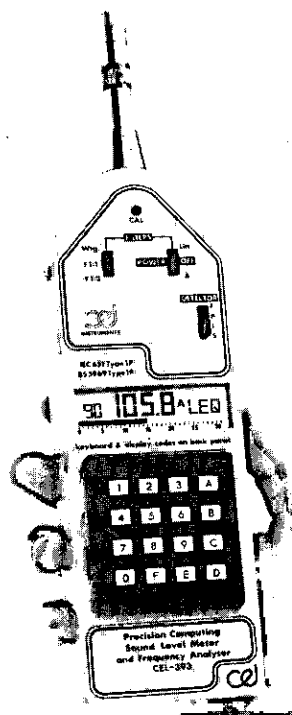
New Products

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

A Precision Computing Sound Level Meter

The CEL 393 performs all the functions of a full specification sound level meter and in addition its microprocessor provides a comprehensive time history analysis capability and automatic operation. The instrument calculates L10, L50, L90 and all the standard Leq based parameters. A memory facility is provided that operates in three modes:

- (1) Profile mode — 1 to 4 minute Leq based parameter to provide profiles for up to 750 periods.
- (2) Environmental Mode — Periods from 5 to 999 minutes may be selected and for each results of Leq, Ltm3, Ltm5, Lmax, L10, L50, and L90 will be calculated up to a maximum of 90 periods.



(3) Event Mode — The instrument detects noise events above a pre-selected level and retains in the memory the time of occurrence, duration, maximum level and SEL.

An optional digitally controlled filter unit provides octave or third octave frequency analysis.

The CEL 393 measures 285 by 75 by 25 mm and weighs 800 g.

A Portable Dynamic Accelerometer Calibrator

The CEL R11032 is a battery operated shaker that may be used to test and verify the performance of accelerometers and other vibration transducers which have a mass not exceeding 1 kg. It produces a reference acceleration of 1 g at a frequency of 79.6Hz with error limits better than 5%. The dimensions of the unit are 200 by 110 by 80 mm and it weighs 3 kg.

Further details from CEL Instruments, 35 Bury Mead Road, Hitchin, Herts, SG1 5RT. Tel: 0462 52731.

Noise Dosimeter for use in Hazardous Locations

GenRad's 1954 Noise Dosimeter has been approved by Factory Mutual Systems, an OSHA—recognised testing laboratory, as an intrinsically safe dosimeter for use in many hazardous areas of mines, chemical plants, grain silos, oil refineries and textile factories. It meets the standards for use in many locations where explosive concentrations of fumes, dust or fibres make it potentially hazardous to monitor workers' noise exposure. The 1954 monitor can be worn in a shirt pocket or clipped to a belt or other convenient location. A built in calibrator permits on-the-spot, 10-second calibration of the entire instrument, from microphone to the display.

Further details from GenRad Limited, Norreys Drive, Maidenhead, Berkshire. Tel: 0628 39181

A Multiplexer for Machine Vibration Monitoring

The Multiplexer Type 2514 has been designed by Brüel & Kjaer to comple-

ment their Type 2505 Vibration Monitor. It provides coverage of up to eight channels which it will continuously step through dwelling for a selectable period of between 1 second and 32 hours. Danger levels detected by the vibration monitor are indicated by an alarm and by a light flashing at the relevant channel of the multiplexer. The system can be expanded by connecting a number of multiplexers to one vibration monitor.

Further details from Brüel & Kjaer (UK) Ltd, Cross Lances Road, Hounslow, TW3 2AE. Tel: 01-570 7774.

E-A-R Plugs

Cabot Safety Ltd have introduced E-A-R foam earplugs in a plastic vial container fitted with a metal key chain. E-A-R foam earplugs expand slowly, once having been rolled down between finger and thumb, so that they completely seal each ear canal thus providing an effective means of hearing protection.

Further details from Cabot Safety Ltd, First Avenue, Poynton, Cheshire. SK12 1YJ. Tel: 0625 878320.

Plug-In Units

Cirrus Research announce the CRD 1.25 Leq and Exposure Plug-in unit for their CRL 2.35 Measuring System.

Three pre-set measuring times are provided for Leq computation. While set to Sound Exposure Level it can integrate over any period from 10 seconds to many hours. Readout is on the main frame or from a companion plug-in, the CRD 1.26 Digital Unit.

Cirrus Research have also produced for the CRL 2.35 Measuring System a vibration plug-in unit the CRP 1.21. This will measure jerk, acceleration, velocity and displacement. Direct dial-in calibration is provided.

Further details from Cirrus Research Ltd, 1-2 York Place, Scarborough, North Yorkshire YO11 2NP. Tel: 0723 71441. □

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Systems Engineers for "whole engineering" roles which can involve carrying out feasibility studies on new concepts, mathematical modelling, system simulation and dynamic studies, direct liaison with customers, proposal preparation, hardware design, and trials. In the case of very large projects there are specialist roles available in one or more of these tasks.

Software Engineers for design and development of software for microprocessor based control systems; the design and development of simulation software for one of the most advanced UK simulators; or in producing and developing software for a relational data base of information. Our client is particularly interested in candidates with a knowledge of CORAL 66. Vacancies also exist for **Systems and Software Product Assurance Engineers.**

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Institute of Acoustics

Meetings

1984

27 January	SG	Speech Telecommunication	Harlow
27 January	MAG	Music and Hearing (Joint meeting with British Society for Audiology)	London
22—24 February		Secure Communication Systems (joint with Institution of Electrical Engineers)	London
22 February	NEB	AGM and Bar Sports	Newcastle
23 February	EMB	AGM and talk at British Gypsum's R & D Department, East Leake	Loughborough
28 February	SWB	Seminar on the Control of Hearing Loss caused by Public Entertainment and Work	St Austell, Cornwall
13-14 March	M	Police Applications of Speech and Tape Recording Analysis (joint with Audio Engineering Society)	Birkbeck College, London
March	ING	Impact Noise	NCB Research Dept, Bretby
14 March	NEB	Education in Acoustics (joint with Institute of Physics)	Newcastle
10—12 April	M	Acoustics 84 — Spring Meeting and AGM	Swansea
11 April	NEB	Noise Forum	Carlisle
2 May	NEB	Noise at Work	Darlington
11 May	NEB	Social Evening	
5—7 June	M	Vehicle Noise and Vibration (joint with The Institution of Mechanical Engineers)	London
5—6 September	UAG	New Techniques in Sonar Transducers	Univ of Birmingham
4—6 November	M	Autumn Conference. Sessions on: Building Insulation and Privacy; Ship and Watercraft Noise, Speech	Windermere

1985

15—17 April	M	Acoustics 85 — Spring Meeting and AGM	Univ of York
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Key:

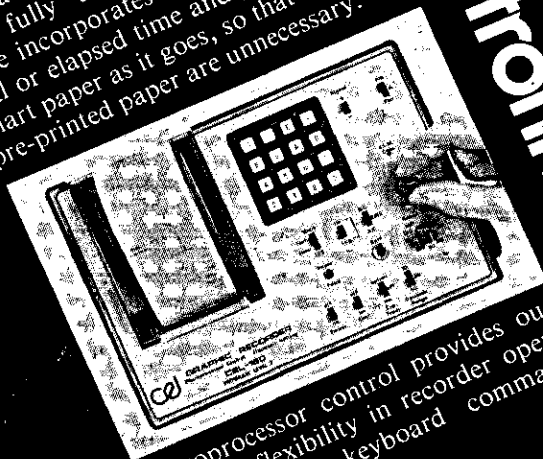
M = Meetings Committee Programme
SG = Speech Group
MAG = Musical Acoustics Group
NEB = North East Branch
EMB = East Midlands Branch
SWB = South West Branch
ING = Industrial Noise Group
UAG = Underwater Acoustics Group

Further details from:
Institute of Acoustics
25 Chambers Street
Edinburgh EH1 1HU

Microprocessor Control and Electronic Writing

Setting new standards that others will have to follow, the CEL-160 Graphic Recorder features many facilities never before obtainable in a single instrument.

The writing system is all-electronic and does not suffer the dynamic limitations of traditional pen recorders. Hence, it can accurately respond to full scale deflection for RMS levels with a writing speed of 10000 millimetres per second or write actual waveforms up to 10kHz. The fully annotated alpha-numeric trace incorporates digital recording of real or elapsed time and prints its own chart paper as it goes, so that stocks of pre-printed paper are unnecessary.



Microprocessor control provides outstanding flexibility in recorder operations. Simple keyboard commands

instruct program execution of AC or RMS amplitude versus time, automatic hard-copy frequency recording and automatic transient event capture. This revolutionary new battery powered instrument measures only 275mm x 195mm x 130mm and weighs just 3 kg making it ideal for on-site or laboratory applications. Full details of this exciting new development are available from:

Computer Engineering Limited
Wallace Way, Hitchin, Herts, SG4 0SE
Tel: Hitchin (0462) 52731/3.
Telex: 826615.

